AUSTRALIAN MUSEUM.

NOTES FOR COLLECTORS:

CONTAINING

HINTS FOR THE PRESERVATION OF SPECIMENS OF NATURAL HISTORY.

By E. P. RAMSAY.

AND FOR COLLECTORS OF GEOLOGICAL AND MINERALOGICAL SPECIMENS.

By F. RATTE.

PRINTED BY ORDER OF THE TRUSTEES.
E. P. RAMSAY, Curator.

SYDNEY: CHARLES POTTER, GOVERNMENT PRINTER.

1887.

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E. PIERSON RAMSAY, Curator,
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CONTENTS.

GENERAL DIRECTIONS

FOR THE

PRESERVATION OF SPECIMENS OF NATURAL HISTORY.

The Human Race.

Skeletons of aborigines are much wanted, and for the benefit of collectors, annexed is a list of the *separate* bones of a complete human skeleton.

Bones in the Human Skeleton.

Vertebral Column.

Neck (cervicals)	7
Back (dorsals)	12
Loins (lumbra)	5
Sacrum and coccyx, 2 pieces (formed of 5 in the sacral and 4 in coccyx)	2
The twenty-two (8 in the cranium and 14 in the face) bones of the head are considered here as one piece (1), and the lower jaw as another (2). In the upper and lower jaws there should be thirty-two teeth in all	3

Molars	$\frac{3 - 3}{3 - 3}$	Three *on either side*, above and below.
Bicuspids	$\frac{2 - 2}{2 - 2}$	Two do. do.
Canines	$\frac{1 - 1}{1 - 1}$	One do. do.
Incisors	$\frac{2 - 2}{2 - 2}$	Two do. do.

The tongue or Hyoid bone is shaped something like the letter U	1
Breast Bones *(Sternum)*.—Two *large* and one *small* pieces *ossified with age*	3
Ribs—Twelve on each side	24
Collar bones—one on each side	2
Shoulder blades (*Scapulæ*)	2
Arm bones, 3 in each arm (*Humerus, ulna, and radius*)	6
Bones of the hand—*Wrist* or *carpal bones*, 8 in each wrist	16
Middle of the hand, or *Metacarpal bones*, 5 in each hand	10
Fingers, 3 each = 12; Thumb 2 } = 14 in each hand	28
Sesamoid bones, under the thumb joint	2
Pelvis or hips (in the young divided into 3 pieces)	2
Leg Bones, 4 in each leg (*Femurs, tibia, fibula, and knee-cap or patella*)	8
Bones of the Foot—Ankle bones, 7 in each foot	14
Metatarsus, 5 in each foot	10
Toes—Great toe 2; 4 other toes, 3 each = 12 } = 14 each foot	28
Sesamoid Bones under the joint of the great toe (these very small, and easily overlooked)	2

In cases where whole *skeletons* cannot be procured, the *skulls*, along with the lower jaw, will prove of great interest and value. Any apparent malformation or peculiarities in the formation of the cranium of the various tribes should be carefully noted; and all possible information obtained respecting such occurrences, and whether produced by artificial means or otherwise. Skulls of aborigines found suspended around native dwellings are of little value, but authentic skulls may be obtained from the graves of the natives of each tribe.

Mammalia.

Remove all blood stains if possible, and plug any shot holes or other bleeding wounds with tow, wadding, or rag; put a plug of moss or tow in the mouth to keep any blood or other matter from exuding. Note the *shape* and *colour* of the eyes and the fleshy parts, and the *sex*. Slit the skin open from about the centre of the belly downwards to the vent, but in the case of female marsupials, take care not to cut into the pouch; or this may be avoided, by cutting from *the chest* between *the fore arms, downwards*, and making an opening, in all cases large enough to extract the body; loosen the skin round it with the fingers, or handle of the knife, being careful not to use the blade more than is absolutely necessary; generally the skin will be easily separated; now sever the leg from the pelvis bones at the body, leaving the tail attached to the body, by which it may be more easily slipped out of the skin; turn the skin back, *outwards*, and slip the tail out entire, the skin will then draw off over the back with ease; sever the fore limbs from the body *with the shoulder blades attached to them*, and the neck close up to the back of the skull (at the atlas vertebra); skin the head as far as the tip of the nose, remove all the flesh from it, take out the eyes, and remove the brains by enlarging, *if necessary*, the opening at the back of the skull; anoint it well, inside and outside, with arsenical soap, and fill out the orbits with tow or wadding; clean the limbs, stripping the skin back as far as the paws; anoint all the bones with arsenical soap, and roll a little tow round them to make up for the amount of flesh removed; the tail often strips easily enough, but in some animals (as in the Platypus) it requires to be cut out by making an incision along one side of it. Anoint the skin on the inside well with arsenical soap,* and dust it with powdered burned alum; now turn the skin back, and pull the limbs and tail into their original position; open the palms of the hands and soles of the feet, remove the fleshy parts and rub in some soap and alum, remove the testes and fill up the skin to its natural size—if a female marsupial, fill out the pouch with a little tow. Allow the skin, after it has been prepared as directed, to remain for a few hours, or a day, if the time can be spared, and afterwards fill it out to about the natural size with tow, dry grass, or moss, cocoanut fibre, unravelled rope, or the refuse tow from the rope

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* For arsenical soap *see* page 16.

works, and sew up the opening; tie the mouth shut, pull up the wadding in the orbits, and adjust the eyelids, but do not distend them. Anoint the eyelids, face, ears, fleshy parts of the feet, pouch, &c., with a solution of mercuric chloride and camphor in spirits of wine. [Solution, see p. 17.] Hang up the animal in a dry airy situation, not in the sun, *until quite dry*, when, if required, to save space in packing the filling may be removed from the body, the feet and tail folded over the belly, and the skin doubled up.

The smaller mammals, such as mice, rats, bats, and even the smaller species of native cats and bandicoots, are best preserved entire, in *strong spirits of wine*, to which a little arsenic has been added, taking care to make an opening in the abdomen to allow the spirits to enter freely. The body should be well covered with the spirit, and care taken that the stopper or cork of the vessel be made air-tight. For small specimens the ordinary screw-topped preserving jars will do well, and for the larger ones a small cask; pack them tightly, when cured, in layers; put the head of the cask back in its place, and then fill up through the bung-hole with the preserving liquid.

The brains of many of our Australian animals are interesting and valuable to naturalists, and should therefore be collected whenever opportunities occur.

Having removed the head of the animal with at least two of the neck vertebræ attached, make a straight cut from the back of the head over the forehead and down to the nose, throw the skin back on either side as far as the upper row of teeth, remove the ears and any flesh that may be in the way, but not the eyes; take a small sharp dissecting saw, or a tenon saw, and cut carefully, *but not quite through*, the bone of the skull round the upper part and across behind the ears and orbits completing the circle; now with a sharp strong knife, *held as if to cut a pencil*, finish cutting through, being careful not to stick the point into the brain, prise up the piece from time to time as you cut along to ease the cap off the brain and skin, just under the bone. When the cap is removed either in one or more pieces, a membraneous covering called "*dura mater*" will be seen; cut this through carefully over the centre and sides of both hemispheres, so as to allow the spirit to enter freely, now immerse the whole in strong spirits of wine or other preserving fluid to harden it; after a few hours (ten) remove it again, take off the *dura mater* carefully, and slightly open the hemispheres, shake the brain a little forward from the base of the skull to allow the liquid to penetrate behind to the *very base where the cerebellum is situated;* as the brain will be a little shrunken and hardened you may remove the thin membrane called the "*pia mater*," which will be found immediately over and next the brain itself, being between it and the first covering called *dura mater;* replace the cap of bone, tie it in its place again, and keep the whole covered over with strong spirit.

The brains of aborigines so prepared would be of great value.

Marine Mammalia.

Whole skeletons or *the skulls and lower jaws* of all species of *whales* should be collected. These are frequently found washed up on the sea beaches.

Skeletons of *Porpoises* and *Seals*, &c., are also desiderata.

The smaller kinds can be skinned, and the skins salted and packed in *strong brine*, the skeletons cleaned and dried.

In the case of *Seals*, prepare in the same way as any other mammals, *and save the skeletons also.* Use plenty of *burnt alum*, and *paint the face, flippers, and feet well, several times while dying* with a strong solution of *corrosive sublimate* in spirits of wine.

Birds.

When first obtained, push a small piece of cotton wool, tow, or moss into the throat, to prevent any liquid from escaping, and remove any blood from the feathers. Pass a piece of string through the base of the bill and make it fast, leaving a long loop to hang the bird up by. Note the colour of the eyes, bill, legs, and feet. If the weather be hot and the bird cannot be skinned at once, it is advisable to brush the bill, eyelids (*being careful to note the colour of the eyes first*), inside of the mouth, and other fleshy parts, as well as the abdomen under the feathers, and the vent, with the solution of mercuric chloride and camphor (see page 17) ; this will prevent those parts being blown by flies, and, to a great extent, arrest putrefaction.

Before beginning to skin, for convenience sake, dislocate or break the *first bone* (the humerus) *of the wings* about the middle, and then, after separating the feathers on the abdomen, open the skin from the lower end of the breast-bone, or from a little above it, down to the vent, being careful not to cut into the intestines; if there is much moisture or fat, dust these parts well with powdered *lime*, or better, *plaster of Paris*, or fine, dry *sawdust* ; detach the skin from the flesh on either side until you come to the knee-joints, which push up inside the skin, and cut carefully through the exposed joints ; draw the legs back again, and detach the skin round on either side of the tail, cut through the vertebra at the tail, taking care not to injure the skin, which is very thin about this part ; draw the skin over the back, holding the feathers clear of the body, which may be powdered well with plaster of Paris to keep it from soiling them. The skin will now easily strip off as far as the wings, which must be cut through at the broken part or at *the first joint ;* carefully pull back the skin over the neck until you come to the skull, and ease it gently over the head with your nails ; detach the head, cutting the neck off with a *small portion* of the skull attached ; pinch up the skin over the ears and pull it *carefully* over them as far as the eyes, the tough skin round which cut through, when it has been eased over the orbit, taking care not to cut the eyelid ; detach the skin as far as the base of the bill, remove the eyes, the flesh from the head, the tongue, &c., and take out the brains through the opening enlarged at the back of the skull; anoint the head well with arsenical soap inside and out; fill up the orbits with a plugget of cotton wadding for eyes; roll up a piece of tow or wadding and plug the end of it tightly into the back of the skull, leaving out a piece of sufficient length to form the neck.* Now turn to the legs—remove the flesh from the bones, anoint them, and roll a little cotton wadding round them, leaving some of it over the end of the bone; clean the wing bones, *but put no wadding round them*, cut off the humerus, or the broken part of it, tie them a little apart by passing a string between the bones and drawing the wings together, but not too close, leaving a space of about one quarter of an inch in a bird as large as a thrush, and proportionately greater or less for other birds (in very small birds the wing bones may be tied close, just leaving room enough for them to play); clean the tail carefully, and remove the fat and oil glands, anoint it well with the soap, and turn it back into its place with a small piece of wadding over it; soap the legs and wings and adjacent skin, and turn them back as near as possible to their original position; soap the remainder of the skin well all over, especially the neck, ease it carefully back over the skull, pulling the head through, assisted by the string previously passed and left through the nostrils. In some birds, as the larger cockatoos and parrots, the stilts and avocets, &c., in which the neck being very small, the head cannot with safety be drawn through, it is advisable to open the skin at the back of the head, or along the throat, and turn out the head through the opening, which can be sewn up afterwards.

Having turned the skin back, and pulled the head, legs, and wings into their original position, arrange the feathers of the head and ears as neatly as possible, with the point of a long needle, by lifting up the skin here and there, and getting all smooth; pull up the wadding in the orbits to fill out the eyes, taking care not to distend or *bulge the eyelids out;* shorten the neck by pulling the false neck of wadding down a little inside; place a piece of wadding on either side near the wings, and thrust a small piece up from the breast as far as the throat, to fill it out, and close the bill on the end of it to hold it in position—by pulling the end of it the neck can be shortened at will; fill the body out to about its natural dimensions, or a very little more, to allow for the shrinking of the skin in drying, and arrange the wings *closed* on the sides, in the natural position; pull the legs down to their proper length, and take care not to elongate the neck; see that the bird is filled out enough, and sew up the opening—small birds need not be sewn up. Cross the legs, the tarsus of one over the tarsus of the other, and tie them; *the leg on the right hand side as the bird lies on its back*, should

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* Some taxidermists prefer to put the neck in after the skin is turned back; it is immaterial at what stage it be done, provided a good neck be formed.

be crossed over that on the left, if the bird is a male, and *vice versa* if a female. The legs and feet, margins of the wings, bill, orbits and nostrils, should be brushed over with the solution of mercuric chloride, which may be repeated two or three times as the skin dries, if the specimen be a large one. Having settled the feathers, and *affixed a ticket, with date, locality, sex, colour of eyes, bill, and legs,* and a number referring to the note book, in which particulars should be entered as to the contents of the stomach, &c., the skin should be carefully pushed head first into a *cylinder* of stiff paper (not funnel shaped) made just wide enough to contain it, and not small enough to cramp the bird—this keeps the wings together, and the feathers smooth whilst drying.

Carefully ascertain the sex of each specimen by dissection. On removing the intestines the ovaries (if a female), resembling a small cluster of round seeds or beads, may be plainly seen, situated on the inner surface against the back bone; if a male, two small (usually yellowish) oval bodies will be found near the same place. Large birds require to have the *last joint of the wings opened from without,* along the inner margin, and any flesh removed, and the bone and skin well anointed with the soap, after which the incision should be sewed up, and the margins and joints of the wings and legs well brushed with a solution of mercuric chloride; *should the legs* (tarsi) *of the birds be fleshy,* as in some of the larger ducks and geese, and some of the eagles, or puffed out by decomposition, it will be necessary to *slit them open along the under portion, down to the soles of the feet,* rub in arsenical soap or dry arsenic, and bind the legs round tightly with strips of rag or tow, to bring the skin into its original position, until quite dry. This is, however, seldom necessary with the Australian species, except when decomposition has set in, or in the case of emus and such like large birds.

Fishes.

These are best preserved in strong spirits of wine (methylated spirit will do). Care must always be taken to have close *air-tight* fitting stoppers to the vessels containing the spirits. The specimens may be plunged in whole, after *having first made a small opening in the abdomen,* to allow the preserving fluid to enter the intestines. If they can be put in alive, all the better. If spirits cannot be obtained, strong brine may be used, to which a little alum may be added with advantage, and after the specimens have been in soak for two or three days, they may be taken out, well salted inside, packed between layers of coarse salt, and fastened up tightly in a box or keg. In all cases where small specimens are placed among larger ones, or when they are packed for transit in fluid, each one should be rolled up separately in cloth or paper to prevent friction, without which precaution the fins and spines are likely to get broken, and the fish damaged.

Specimens too large to be conveniently preserved whole may be skinned, and the skin, with the head attached, placed in the preserving fluid, or salted, or they may be only partially skinned—an opening being made in the abdomen (the intestines pushed aside, but not removed), and as much as possible of the back bone and flesh taken out; this greatly reduces the bulk, and permits of a long fish being doubled up into a comparatively small compass. If time permits *skeletons* of important forms should be made and preserved as well as the skins.

Some of the larger fishes, rays, sharks, &c., may be preserved dry, after skinning. Make an opening in the skin below the pectoral fins, large enough to extract the body, remove the intestines, cut through the back bone and flesh all round, until the skin is reached; remove each portion of the body by cutting through the fin bones inside, and pulling the skin back, after the manner of skinning eels; when doing the head portion, the cleaning of the gills and removing of the brain, and all fleshy parts, must be carefully attended to, and the whole of the skin, skull, and any bones that may be left, well anointed inside with arsenical soap, and powdered with burned alum; the skin may then be sewed up, and the body filled out to its original proportions with *dry sand* or *dry sawdust*, which, when the skin is dry and ready for packing, may be shaken out to save room. Any parasites or intestinal worms, eggs or young found inside, should be preserved in spirits of wine.

The colour of the eyes and fins, and the general colouration of the specimens should always be noted; any information as to their capture, &c., or respecting their habits will be valuable.

Reptiles.

These animals, when not too large, are best preserved in strong spirits, a small incision being made in the abdomen to allow the spirit to enter. The larger specimens of lizards may be skinned in the manner described for mammals, but in filling out the tail, feet and limbs, the material should be cut up fine, to allow its being pushed into the small recesses, or dry sand or sawdust may be used. Care must be taken in skinning the tail, which cannot be stripped back, as in most cases with mammals. The skin of *the under side* must *be carefully slit up to the tip*, and the tail removed, it can then be replaced by an artificial one, made of tow, wound round two or three rushes. In skinning lizards, particularly the glossy species of *Tropidolepisma*, *Cyclodus*, &c., care should be taken not to break the tails, which are particularly brittle.

In preserving large specimens in spirits, the bodies can be skinned out through an incision made down the belly, the bones of the legs, arms, tail, and head being left attached to the skin, and the remainder of the bones preserved for examination.

Snakes are always best preserved in spirits, but if it be desirable to skin some of the large boas and pythons common in Northern Queensland, it may be done by making an opening in the skin just below the neck, a few inches in length along the belly, severing the vertebra through to the skin, and turning out the body after the manner of skinning eels; do the same with the head portion, *leaving the skull* *attached to the skin ;* remove as much of the flesh as possible, the eyes and the brains ; anoint the head and the whole of the skin on the inside with arsenical soap, and powder it with burned alum ; turn the skin back, and fold it up for transit. Perfect skeletons of all should also be obtained.

Tortoises and Turtles may be preserved dry, the breast-plate being more or less severed along the sides, laid back, and the head, limbs and tail skinned and cured as before described for animals ; the carapace (back) should be well cleaned, without breaking any of the attached bones, and anointed with soap and burned alum ; the breast-plate returned to its original position, may be sewn or wired on, and the specimen set out to dry on a board. Smaller specimens may be preserved whole in spirits.

In the case of large Alligators, Crocodiles, &c., the entire skeleton should be preserved, if possible. The flesh may be easily removed from the bones, and the head carefully cleaned ; and after drying a little, may be packed in *dry* sawdust, grass, or seaweed ; if the whole cannot be secured, obtain the head at least. In cleaning the skull and other bones, care must be taken not to cut or break any of them.

Insects.

Almost all insects, *except Moths* and *Butterflies* and some few *Coleoptera*, are best killed in spirits of wine. Procure a wide-mouthed bottle with tight-fitting cork or stopper, half filled with methylated spirits of wine, and plunge the insects in as soon as captured. For beetles hot water may be used, if no spirits can be obtained. Wasps, Hornets, and Flies may be killed in the same way. Some beetles with *powdery, hairy backs,* or *threadlike appendages on their wing-covers*, should *not* be put in spirits—they should be killed with chloroform, as advised in the case of Moths and Gnats.

Butterflies, Moths, and soft-winged insects in general, should be killed by chloroform ; some of the larger butterflies and moths may be disabled by squeezing them across the thorax and pinning them to the bottom of a cork-lined collecting box. Most of the Butterflies, however, are easily killed by a slight pressure under the wings with the finger and thumb. Fat-bodied Moths, &c., *should be stuffed ;* to do this make a longitudinal cut on the under side of the abdomen, remove the intestines carefully and replace them by a small piece of wadding, and bring the edges together again. Many insects may be taken by having a bright light burning in the tents at night, when they can be caught on the canvas, &c., or they may fly inside. Small Lepidoptera may be captured by suddenly inverting over them a box in which a little chloroform has been sprinkled, or a wide-mouthed bottle containing *cyanide of potassium;* the cyanide may be kept at the bottom of the bottle by a piece of gummed paper or wadding, or by plaster of Paris. Insects killed in this way must be pinned and "set out" as soon as possible, as they dry and become brittle very quickly after death. Insects, when killed, may be taken out of the bottles and dried on blotting paper or cloth, and then packed away in layers in boxes, with sawdust previously soaked in weak carbolic acid and well dried, or with a little crushed camphor sprinkled through the sawdust. The boxes should be fastened up tightly, and strips of strong paper pasted over the cracks. They will keep this way for months. Small packages thus prepared may be transmitted by parcel post. Moths, Butterflies, Gnats, &c., may be kept for transmission, folded with their wings together and the feelers between them, and laid in triangular-shaped pockets of paper made by doubling a suitably sized square of paper into a triangular form, and turning over and gumming together the edges.

If large caterpillars are found, they should be kept in a box with gauze over it and *fed* on the plant on which they are found, until they turn to the chrysalis; then pack them in wadding, sawdust, or bran, &c., for transit.

Shells.

Shells, or the calcareous coverings of molluscous animals, only require cleaning. Allow the animals to come partially out of the shell, then suddenly dash boiling water over them, and leave them in the water for a few minutes, or more according to the size of the specimen and thickness of the shell, after which they can easily be picked out with a bent pin or wire. The horny or calcareous *mouth pieces*, or *opercula*, which close the openings of certain shells, should always be preserved and gummed inside the shells to which they belong. *Bivalve shells* may be scalded with hot water and then cleaned. They may also be packed up in *dry sand* without removing the animal, which will dry up, and may afterwards, at a more convenient time, be softened in water and removed. In no case allow the animal to *rot* out, as in most instances during decomposition an acid is formed which corrodes and disfigures the pearly lining of the shell.

Land Shells are found most abundantly in the alluvial wooded regions, especially upon hill-sides, where during the day they are concealed under fragments of fallen trees, bits of bark, stones, &c., sometimes under leaves or in the tufts of rank growths of moss. Some are found on the trunks of standing trees, and on the under sides of the leaves.

Look on the leaves and stems of trees and large foliaged plants, *especially after a shower of rain*, under leaves by the sides of logs and fallen timber, in the rotten timber or in the ground beside it, where they are sometimes found burrowing in the soft earth several inches deep.

Fresh-water Shells are found along the banks of rivers and creeks sticking to logs, stones, leaves, and aquatic plants; also in small pools, swamps, and rivulets. All species or specimens must be killed by boiling water being poured over them, and the animal extracted with fine bent pin or wire. All bivalves must be tied together when cleaned and before they are quite dry, then put away in boxes with any soft packing, such as moss, so as to prevent them from getting broken.

Crustacea.

The larger kinds, such as lobsters, crabs, crayfish, &c., and some of the large swimming species, are usually obtained in deep water by means of *lobster pots* or *baskets*, and traps of various kinds, nets, &c., &c.; also by dredging and trawling, and in the seine and trammel nets. They should have an incision made under the carapace to allow the spirits to penetrate into their bodies.

Many may also be obtained in fresh water, in the streams, as fresh-water crayfish; or even *on land*, as the robber and hermit crabs.

Small crabs, prawns, shrimps, &c., are obtained both from shallow and deep water—in the former situation by wading and turning over stones at low tides on the reefs; in the latter by means of the dredge. Many small crustacea are found burrowing, or in the canals of sponges, &c.; others in the sand on the shore—under stones and masses of decaying seaweed or dead bodies; some burrow in mud, others live in seaweed on the rocks, or under it; others (Pinotheres) inhabit large shells (living), such as the large *Tridachna* or clam shells, and the *Pinna;* some few in the interior of large sea urchins; a few small forms inhabit dead medusæ; and amphipodous crustacea may be obtained in Ascidians. Small species inhabit stagnant pools, both in fresh and salt water, or are found sticking mantis-like to seaweeds.

All may be preserved by throwing them into strong spirits of wine. The smaller ones should be put into separate tubes or bottles. In every case attach a *label written with a black lead pencil on strong paper*, or a tin-stamped number. Enter in your note-book a corresponding number and as much information as possible about each species, the *nature* of the *locality*, and circumstances under which it is found. Also, its native name, if that can be ascertained. Some remarkable forms (*Proto Caprella*, &c.) like "*leaf-insects*" resemble the seaweeds on which they are found, and are difficult of detection. These may be obtained by washing the weeds in fresh water, when they easily come off.

Sponges.

On the contents of the dredge being emptied, if the sponges are mixed up with the mud, rinse them out in salt water, *slightly shaking*, but *not squeezing* them. Put them into strong spirits as soon as possible. *On no account let them get dry*, unless you want them for the skeleton only; when the *horny* kinds can be washed and squeezed out in fresh water, put in a shady, airy place to dry, and packed in boxes. Spirit specimens are always preferable.

Echinodermata.

All these, such as Sea eggs, Sea urchins, Sea stars, &c., may be thrown into spirits alive. If no spirits are to be had, wash them in *fresh water* to get the salt out, and let them soak an hour or so; dry them in the wind. Care must be taken to *get all the salt out of them*, otherwise they usually fall to pieces and become useless.

Sea eggs, in the absence of spirits, should have the "*lantern*" or mouthpiece containing the teeth, &c., cut round and taken out carefully; then the inside should be washed and the *contents shaken* out. Replace the "*lantern*" and set the specimen away to dry. In packing, *carefully protect the spines* with paper or shavings, *rubbed* grass or any soft substance; or roll them in paper and pack in *sawdust*.

Sea-worms, Ascidians, Sea-anemones, and all soft marine animals, should be washed out carefully if mixed with the mud or debris of the dredge, and placed for a few minutes—5 to 10—in a saturated solution of *corrosive sublimate in water* to harden*; then take them out, and wash them in weak spirits for a few minutes; afterwards put them in strong spirits and cork up tightly.

All marine specimens should have labels of *strong paper*, written on with *deep black lead pencil*, put in the bottle with the specimen—*do not use metal labels for them.*

Large specimens of Sea-stars, &c., which cannot conveniently be put in spirits, can easily be cured by *washing out the salt* and drying as above advised; pack up carefully and keep dry, in *rat*-proof boxes. (A little strong spirit poured over them will help to dry out the water.)

In dredging, respecting every haul, note the depth and locality, and the bottom and *surface* temperature of the water, *and the time of day;* also the nature of the bottom, whether sandy, muddy, or shells and sand, &c., &c., as the case may be; *and always keep* some of the fine shell sand and *debris* for future examination; this can be put in small boxes, bottles, or half-bushel bags, and allowed to dry before packing.

General Remarks.

Wounded birds and animals may be easily killed by pressing them tightly across the windpipe. In the case of smaller birds, place the thumb and second finger under the wings on either side and the forefinger in the hollow of the chest, just over the wind-pipe, press all tightly together, for a minute or so, until you find that respiration has ceased.

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* A saturated solution may be made by throwing some corrosive sublimate into an *enamelled pan* of boiling water, letting it boil for a few minutes, and then pouring off when quite cold.

The collector should always be careful to note down the *colour of the eyes and fleshy parts* as soon as possible after the specimen is captured; the locality and situation in which the animal is taken, with a few remarks as to the style of the country and the nature of the vegetation, geological characters, and elevation, &c.; also the vulgar, local or native name, and the rarity or commonness of the animal, and any information respecting its habits, &c., *being particular about the dates and season of the year.* The color and shape of Seals, Porpoises, Whales, Dugongs, &c., should be carefully noted, and a sketch made of their forms, whenever opportunity offers. In cases where the skins of these animals cannot be cured, the skeleton or at least the *skull* should always be preserved, being careful to note the sex—the females should be carefully opened in search of the fœtus, which should be preserved in spirits whole.

Should the collector obtain what he believes to be a scarce or rare animal the skull should not be cut nor the opening at the back part enlarged; with a little trouble the brains may be extracted through the natural opening.

In preparing skeletons of animals for transmission to the Museum, if you have a choice of the animals, select the largest and oldest, discarding those with fractured bones, if you can get better. The flesh should be carefully cut off, and the bones made as clean as possible. The head, arms, legs, and tail may be severed from the body, the back disjointed in convenient sized pieces, and the parts thrown into a tank or tub of cold water, with a few handfuls of salt, or about two or three ounces to the gallon, the salt and water renewed every second or third day for about a week or so; the remainder of the flesh can then be removed, and the brains extracted through the opening at the base of the skull, which must not be enlarged or cut in any way, and the bones when dried packed up.

Receipt for making Arsenical Soap.

White Arsenic	1 lb.
Common or Hard White Soap*	1 lb.
Salts of Tartar	4 oz.
Lime in Powder	3 oz.
Camphor	2 oz.

Cut the soap into thin slices, and melt it in a saucepan over a slow fire, when melted add the Salts of Tartar, which will reduce the mass into a creamy consistency, take it off the fire and put in the arsenic, stir it up well, add the lime, and then the camphor, either reduced to a fine powder, or dissolved in a small quantity of strong methylated spirits of wine, stir the whole up well, and pour out into earthenware jars to cool; if it is required very hard to pack up for travelling with, it may be poured out into *porous* vessels, when cold it may be cut out and pressed together into cakes like common soap, and when wanted for use, softened with a brush in a little water.

* Soft soap must not be used.

Solution.

Mercuric Chloride (corrosive sublimate)... ...	¾ oz.
Camphor	1 oz.
Spirits of Wine	1 pint

Dissolve the camphor in methylated spirits with the mercuric chloride, shaking it up occasionally until it is all dissolved. This must not be kept in a metallic vessel.

When none of the chemicals aforementioned can be obtained, the specimens may be skinned in the way described, the skin and the bones carefully cleaned, and the bodies filled out with fresh dry charcoal, or wood ashes, crushed into a coarse powder, to which may be added with advantage *grated or bruised* "*galls*," the excrescences found on the twigs and leaves of many of the gum trees (*Eucalypti*) ; they should then be hung up in a dry airy place till quite dry, when the stuffing should be shaken out, and the specimens packed up for transmission.

The following are among the Special Desiderata of the Australian Museum :—

Mammals.

Skins, skulls, and skeletons of *Aborigines*, males and females.

Authentic skulls of Aborigines from the *graves* of the natives of each tribe, also the *whole skeleton* if possible.

Skulls with the skin of the head and neck left on of *any mammals*, except the more common species.

Birds.

Nests and eggs of any species, *with the birds belonging to them.*

Cassowaries, their *eggs*, and their *skeletons.*

Nests and eggs of *Paradise* birds.

The bowers, nests, and eggs of the *Bower* birds, including the "*Regent*" or "*Cat-birds.*"

Eggs of *Hawks* and *Owls of all kinds.*

Great care must be taken to *thoroughly identify* the eggs in all cases, otherwise they are useless.

Fishes.

Particular attention should be paid to *fresh-water fishes*, such as are obtained from *Inland* water-holes, lakes, and lagoons. No matter how small, put a few of each kind in spirits.

AUSTRALIAN MUSEUM.

HINTS FOR COLLECTORS

OF

GEOLOGICAL AND MINERALOGICAL SPECIMENS.

By F. RATTE,

Mineralogist, Australian Museum.

SECOND EDITION—REVISED AND ENLARGED.

PRINTED BY ORDER OF THE TRUSTEES.
E. P. RAMSAY, CURATOR.

SYDNEY: CHARLES POTTER, GOVERNMENT PRINTER.

1887.

INTRODUCTION TO THE SECOND EDITION.

This edition of the "Hints for Collecting Geological and Mineralogical Specimens," has been greatly enlarged, more attention being directed to the geological formations in which minerals are found, than had been done in the first edition.

Fossiliferous localities have been quoted from catalogues of fossils, and from the late Rev. W. B. Clarke's "Remarks on the Sedimentary Formations," 4th edition; but, as many of these could not be found on recent maps, a great deal of pains has been taken by M. W. S. Clarke, Esq., the son of the eminent geologist, in pointing out their geographical position to the author.

This pamphlet is intended for distribution to any to whom it may be of interest, or who can spare time for directing attention to the subjects advocated, and the Trustees of the Museum hope by its means to obtain the contributions of people living in the interior, or travelling, and so to make a more complete display of the minerals and fossils of Australia, and especially of New South Wales; as hitherto these have been but poorly represented in the Museum, and some subjects which would afford much useful instruction to the public are entirely wanting. It is, therefore, hoped that these notes will cause further inquiries on mineralogical and geological questions, and promote among intelligent people the taste that these sciences deserve.

The limits of this pamphlet prevent our entering into details, or treating the matter from other than a general standpoint; but every assistance, in the shape of practical advice, will readily be given at the Museum, and those living in the interior can correspond with the Curator, who will answer questions as to what might be collected in their localities as far as existing information will permit.

CONTENTS.

HINTS FOR COLLECTING GEOLOGICAL AND MINERALOGICAL SPECIMENS.

PRELIMINARY REMARKS.

MINERALS, rocks, and fossils, in consequence of their weight and small commercial value, and because they are less known, are more apt to be neglected than other objects of Natural History, although contributions are often received at the Australian Museum from miners and others interested in science. To these the following directions may be useful in pointing out the methods and the best localities for collecting, and in enabling them to enrich our national museum to the great benefit of the public and the advancement of knowledge.

The mining centres have now and then contributed largely to the Museum, and it is there that the best opportunities for collecting occur. Besides rich specimens from the mines, there are others well worth procuring,—such as the adjacent rocks, dyke rocks, or eruptive rocks, and the minerals associated with the ores,—which are not only of scientific interest, but are necessary to enable observers to understand the conditions under which the ores have been deposited. Crystallized minerals found in the crevices of the dyke rocks and metalliferous veins, especially those of less common occurrence, are of great value to a Museum. It is not, however, necessary to pay much attention to minerals of wide distribution, unless they appear to be perfectly crystallized or occur in unusual conditions. For instance, quartz is the usual matrix of gold, and may therefore be neglected by the collector, while carbonate of lime or calcite, being rarely associated with it, is of great interest when gold is found in or near it. But in any case it is most desirable to obtain perfect crystals, and these chiefly occur in the cavities and fissures of the rocks.

If a collection is intended to illustrate the mode of occurrence ot a certain ore, specimens representing its common occurrence should be shown as well as those to which an interest of rarity is attached. For example, in a copper-mine copper pyrites in confused lumps, as well as blue and green carbonates, are likely to be plentiful; but in fissures and cavities, where there was room for the crystals to develop themselves, they will be found more or less perfect, and will constitute valuable specimens.

The Museum is rich in European and American minerals and ores, and possesses good representative specimens of the mineral wealth of New South Wales and other parts of Australia, but is poor in specimens illustrative of recent and valuable discoveries. As soon as a new mining field attracts the attention of the public, miners and speculators come to the Museum expecting to find specimens of the ores there. When such are wanting the Trustees would be glad to procure them for exhibition.

From districts near Sydney, or within easy carriage of a railway station, bulky specimens may be sent; but from the interior, where transit is difficult, smaller and rarer specimens will suffice. If a mineral or rock appear to be really interesting and of uncommon occurrence, a small specimen a cubic inch or so in size will be acceptable; the name of the locality, and, if possible, the nature of the country in which it is collected, should be stated. Even a small portion of a freshly broken rock or mineral *(not a weathered fragment)* will be useful for reference, and will be sufficient for identification when the localities have been *exactly* given, as larger specimens for exhibition may be obtained afterwards if considered of sufficient interest.

Frequently miners and people interested in mining pursuits bring specimens to the Museum for identification. It is, therefore, desirable that a portion of the rock in which the specimens have been found should accompany the ore in question, especially when it appears not to belong to any of the common forms of rocks.

It would be useless to give here any directions for the identification of minerals and rocks. These will be found in special books. But as a case of frequent occurrence, it is necessary to know the difference between limestone, silicious or quartz rock, and claystone or slate. The superior hardness will in most cases be a test for silica or quartz; while the effervescence produced by using muriatic acid or vinegar will detect a carbonate, which in most cases will be carbonate of lime.

The average miner is sufficiently acquainted by practice with the behaviour, degree of hardness, general appearance, and peculiar properties of the principal rocks and minerals, and if he brings anything for identification or otherwise, it is that he suspects there is a commercial or industrial value in the specimen, and, although this may not be the case, there will always be some interest attached to it if the peculiarities of its occurrence have been sufficiently described on a label or note accompanying it. If a dyke-rock is cut in a mine, or if a peculiar kind of mineral is found among the ores, specimens of which are forwarded, it is not quite sufficient to state from what place it comes; it is better to mention also the mine, the shaft, the depth, and other particulars if possible.

Sir Henry T. de la Beche, in a book entitled "How to Observe in Geology," which, although very old, might be useful to collectors, remarks that it is not necessary to have great knowledge of the sciences to make successful observations, and discover facts valuable to geology. This could be applied also to collecting ; but it must not be carried too far or induce one to gather every glittering, shining, bright stone, or to send valueless materials such as pyrites and quartz.

In collecting fossils it is necessary to be even more careful than with mineralogical specimens. There are some localities where fossils belonging only to one formation are found, and where people completely unacquainted with the simplest elements of geology might collect useful and valuable specimens. But there are also localities where they can be collected belonging to quite distinct formations or to different subdivisions of the same. It is especially in the latter that great care is necessary, and that sufficient knowledge should be obtained by the collector to enable him to distinguish the different beds in which fossils occur, so that if of widely distinct formations they may not be mixed together nor mistaken ; and if the beds are close to each other, or of little difference in age, it is the more necessary to be able to distinguish them, as the fossils found in them might present similar forms, or be identical, and it would not afterwards be possible to separate them. One should never venture to trust to memory when collecting in several places in a hasty travel, but keep careful notes, as in a few days the interest taken in the subject on the spot vanishes, and specimens from different places get mixed.

A geologist ought to be provided with a strong, pointed hammer, as fossils are not always found free. If such is the case in some instances, it will help him to find them *in situ*, and to get better specimens than those which have been separated, rubbed against the debris, or half destroyed by weathering. If, however, the material of which the fossil is formed has resisted these destructive influences, so much the better, and the collection can be made without using much of the hammer. This is the case when fossils have been transformed into silica, and occur in limestone, the limestone having weathered and left the shells and corals exposed in a perfect state of preservation on separated blocks often of a portable size (Wellington, Murrumbidgee). In other cases the formation in which the fossils are found is soft, sandy, or clayey, and they can be collected without more trouble than removing the earth carefully with a shovel (Some Tertiary fossils). In cases where fossils are found in slates that can be easily split up, the work becomes easy enough by using a chisel, or an old knife.

When collecting fossils in remote districts it will be advisable to select two or three small specimens of each form or species, rather than a single bulky one, unless it is considered a great rarity. These should be carefully packed in separate pieces of paper, and the *exact* locality, marked on each. Sometimes a single specimen, picked up in a hasty travel through an unexplored field, will throw light on the geological formation of a large tract of country.

In sending fossils, select only such as appear to be most perfect or least broken and rubbed. These remains having undergone changes through transport during the long period that elapsed since they died are liable to be deprived of the most delicate and important characteristics. For instance, a plant may show only a defaced outline, the very fine lines or nerves that cover its surface being lost. A shell may exhibit the test more or less damaged, and probably the remains only of the ornamentation, spines, tubercles, striæ, sculptures, &c. If the substance of the specimen has not been preserved itself, a cast of the outside or of the inside, or of the upper or under surface, will sometimes exhibit the markings and leading characteristics.

Lastly, it is necessary to bear in mind that from a new or distant locality, a small and varied collection is preferable to a few bulky specimens. Correspondence will be kept with collectors, so as to secure larger specimens of what might be found of scientific value. A long list could be drawn up of useless materials, which are mistaken for fossils by the unscientific, but are simply concretions, the form of which is accidental, and in conformity with the laws of molecular attraction, such as the so-called "petrified kangaroo tails," &c.

We are convinced that many who had not before paid attention to these matters will find it an agreeable pastime, and will seek for instruction and books, while some in whom a born taste for the sciences had not been previously suspected, may become most enthusiastic students of geology.

Packing and forwarding Specimens.

Minerals, fossils, &c., are very liable to be broken in transit, and lose a great part of their interest, so that packing must be carefully attended to. *Each must be separately rolled* in several folds of any soft paper (newspaper will do) so that they cannot be damaged by rubbing against one another. Small and brittle specimens must be carefully kept apart from heavy and large ones, and the whole packed tightly in a box with paper, sawdust, or broken straw. Fragile specimens, whether fossils or minerals, should be packed *in separate partitions*, or, better still, in *separate boxes* altogether.

Delicate crystals and slender stalactites, denticulations forming network like fine embroidery, such as occur in gossan-gold, and in silver mines, will not stand the ordinary mode of packing, even with cotton wool. Such specimens, presenting a strong base or part by which they were originally attached to the rock, should be fastened by that part alone, between pieces of wood or cushions of paper, to the sides or bottom of the box, in such a position that they cannot move or get loose when the box itself is held upside down. In this case there will be no need of any more packing, but only to nail or screw up the box as tightly as possible, care being taken not to shake the contents more than can be avoided.

It is *always* necessary to send particulars as to the locality in which the articles were collected.

Persons offering specimens for sale should, if possible, communicate with the Curator before forwarding them.

The address to be put on the box is—

Specimens. THIS SIDE UP. WITH CARE. Fragile.

Per Luggage Train.

THE CURATOR,

AUSTRALIAN MUSEUM,

SYDNEY.

From.....................................

A GLANCE AT THE GEOLOGICAL MAP OF NEW SOUTH WALES.

Some knowledge of the geology of New South Wales will explain the purposes for which mineral collections are displayed in the Australian Museum, and will enable collectors to judge for themselves of the suitability of specimens for exhibition.

A geological sketch map of New South Wales can be obtained at a trifling cost, or can be consulted at various Government offices in the Colony, and will be found very useful.

The variously coloured portions of the map form a band covering about one-third of the Colony, which extends westward to an average distance of 220 miles, parallel to the coast line, and is traversed from north to south by ranges which are most ramified and of greatest altitude in the south, where the highest peaks in Australia are situated. From this range the Darling, Lachlan, Murrumbidgee, and Murray flow westward through the driest part of the Colony, which appears on the map as being of a nearly uniform composition, and is coloured light green; nearly two-thirds of this part of the Colony are but little known geologically. The uniformity of the green tint is broken in some places by patches of a more complex composition, especially in the districts around Cobar, and in the western corners adjoining the South Australian and Queensland boundaries.

Granite protrudes on an extensive area in the mountainous regions, especially in the tin-bearing country of the north, and is represented by a bright red colour. When granite disappears from the surface it is generally overlaid by the Silurian, mostly composed of slates, which is coloured violet. The Carboniferous or Coal Measures of New South Wales are indicated by a darker shade of violet.

The light green colour above alluded to represents the tertiary, which covers more than a third of the Colony west of the coastal zone, and the dark green, or at least most of it, represents the basalts and other volcanic rocks of the tertiary age.

Sedimentary formations and intrusive rocks of less importance will be subsequently alluded to, but the five above-mentioned extend over the greater portion of the Colony.

Minerals of Primitive and Metamorphic Rocks.

Before reviewing all the formations marked on the map, we must notice the primitive and igneous rocks, crystallized or massive, in which minerals frequently occur. The earth's crust, as open to our direct investigations, is formed of layers of rock which have been deposited in the course of ages, mostly at the bottom of the ancient seas, and which have become solidified by pressure ; some of them, moreover, have undergone changes by water, pressure, and heat, so as to have become crystallized. The principal of these rocks are sandstones, conglomerates, slates, and lime-stones, which become respectively *Quartzites*, *Altered conglomerates* sometimes resembling eruptive rocks (Hill End, Ironbarks), *Crystalline schists*, and *Crystalline limestones*, commonly called marbles.

This change is called *metamorphism*,* and the transmuted rocks are called *metamorphic rocks*. It is mostly among the oldest formations that sedimentary rocks have been exposed to these changes ; but metamorphic rocks may be either Silurian, Devonian, or older, or still younger, and it is only by a careful study of their relative position and by the identification of any fossils which have not been totally destroyed that we can come to any conclusion respecting their true age.

There are also some crystalline rocks which, according to most geologists formed the primitive crust of the globe, and which began to solidify before the surface was fit for plant or animal life. (*See* A. Geikie, "Text-book of Geology," pp. 637-640.)

Australia being such an extensive country, its geology is but imperfectly known in detail, while the distinguishing between primitive and metamorphic rocks is attended with great difficulty. For the purpose of pointing out what minerals may be expected, we will briefly review the principal rocks forming the primitive or Archæan system, on the understanding that metamorphosed schists are often so completely crystallized that it is impossible to distinguish them from primitive rocks, the same crystals having developed in both.

* Contact-metamorphism is not meant here, but will be referred to hereafter, p. 16.

The *gneiss*, composed of quartz, felspar, and mica, the elements of granite, but with a schistose structure, contains the following minerals :—Garnet, sphene, tourmaline, epidote, apatite, oligiste (hematite or specular iron), graphite, &c.

The *mica-schists*, composed only of quartz and mica, contain : Garnet, felspar, tourmaline, amphibole, staurolite, cyanite, epidote, chlorite, talc, oligiste, magnetite, pyrites, graphite. This rock passes into *gneiss* by addition of felspar, and into *quartzite* by loss of mica. When they contain much amphibole, the two preceding rocks form amphibole schists, and amphibole gneiss. The green variety of amphibole, named actinolite, is frequent in these rocks, as well as large crystals of garnet. Magnetic iron and hematite or specular iron, are sometimes found in these formations as practically inexhaustible masses.

The *chlorite schists*, in which the whole or part of the mica is replaced by chlorite, contain generally the best garnets and also magnetic iron ores.

The *talcose schists*, in which talc replaces the mica, contain staurolite or cross-stone, cyanite, and other minerals of similar composition, namely, containing magnesia.

There are also some fine *slates*, the elements of which can only be detected by microscopic examination, which are said to belong to the primitive series; but some silurian slates, in which the mineral andalusite, or mascle, has been developed by metamorphism in contact with granite, present identical characteristics, and are only distinguished by their fossils, or by their position in the strata.

In some countries the so-called primitive rocks are traversed by valuable veins containing gold, silver, copper, lead, &c.

As to the presence of organic remains among these rocks, it has been contended by some geologists of great authority that altered plant remains accounted for the presence of graphite as well as in true metamorphic rocks, and that apatite (phosphate of lime) was due to the remains of animals. But apatite, for instance, is also found in igneous rocks, where it has evidently an internal origin.

The theory of the *Eozoon*, the first supposed organized being, is not accepted by many geologists, although sincerely accredited by some in America and elsewhere. (See Sir J. W. Dawson's books : "Chain of Life in Geological Times," "Life's Dawn on Earth," &c.)

There will always be great interest attached to anything that can be brought as proof of the early existence of life; but for the present it remains doubtful whether those primitive schists, wherever they are found in the world, should be called archæozoic or azoic. It will be wiser in the meantime to call them, as in the geological record given in Geikie's book, opposite page 136, primitive or archæan, a term that does not suppose either life or absence of life. The discovery in Australia of any trace (if possible) of these early rocks would be hailed with great interest.

Minerals of Eruptive or Igneous and Hydrothermal* Rocks.

The eruptive rocks, which, in common with mineral veins, have not been formed by sedimentary deposition, but have their origin at a certain depth, are not alluded to in detail, but are broadly marked on the geological sketch map, and, as their age is for the most part imperfectly known, it will be sufficient to say here but a few words about them. The most common, the fine or medium grained granites, and common porphyries, at least most of those of a light colour, often pink, light yellow, light grey, are not rich in minerals. Those of the granites that contain minerals other than felspar, quartz, and mica, form the variety called pegmatite, in which the crystals of the component minerals are very large, and where the mica exists in large white plates. This remarkable rock does not cover large areas like the common granites, but generally occurs in veins and dykes. There is also a kind of granite in which white mica is much developed; which often contains tin ore, and accompanies tin deposits, and in consequence has been named tin granite. The minerals which are mostly found in pegmatite and tin granite are tourmaline, emerald, zircon, topaz, sphene, amphibole (hornblend), garnet, apatite, magnetite, besides the different kinds of felspars.

Among the dark coloured eruptive rocks, attention should be given to those that are commonly known as greenstones, dyke-stones, diorites, serpentines, &c., as their study is of the greatest importance in consequence of their frequent association with metalliferous deposits. In case of doubt whether a rock of this class is likely to be a valuable contribution to science or not, as it is extremely difficult to name it by superficial examination, it will always be advisable to collect and send small samples, freshly broken and carefully packed, of the virgin, undecomposed rocks, in fragments sufficient to identify them by microscopic examination, provided always that with each sample is given the exact locality and place, depth from the surface, mode of occurrence, and other particulars. Among these rocks, some are remarkable for their porphyritic texture, namely, in being composed of a dark ground-mass, greenish, brown, or black, with large and well-defined crystals, of a white, red, pink, or green colour. This texture and the contrast of colours give them a special value for ornamental purposes, and they form attractive exhibits, besides their scientific interest. They are often connected with some more uniform rocks, of similar composition, the nature of which is consequently more difficult to determine with the naked eye. Intending collectors should take every opportunity of visiting the museums where these are displayed, in order to get a glance at what is interesting in this class.

We must not omit to state that some of the dark eruptive rocks (amygdaloid diabase and melaphyrs), as well as some of the common

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* The rocks termed *Hydrothermal* have been formed with the concourse of water and a certain temperature. Ex.: Granites, &c.

basalts, often contain round or almond-shaped cavities, which are sometimes empty, sometimes filled with calcite, zeolites, chalcedony, or even opal. Some of the valuable opals in Europe occur in diabase; but it does not seem to be the case with those that are found in South Queensland, or in New South Wales, near the Queensland border. Professor Liversidge, in his "Minerals of New South Wales," says that some opals of value are found in the Abercrombie Ranges, in a kind of trachyte, a volcanic rock, rough to the touch.

In order to show that the interest of the study of rocks in their relation to mineral deposits is not exaggerated, it may suffice to state that in Victoria rich quartz reefs have been frequently found to traverse some kind of eruptive rocks, called diorite porphyries, while quartz reefs found in certain other kinds of eruptive rocks have always been proved barren, and similar remarks have been made in New South Wales.

Lastly, attention must be called to the igneous rocks, the lavas, trachytes, and other volcanic products. In general, they have no necessary relation with ore deposits in veins. Although the dykes that accompany many of the auriferous quartz-veins of Sandhurst, Victoria, are called "lava-dykes," they are not products of true volcanoes.

Explorers who meet with craters of extinct volcanoes hitherto unrecorded will do service to science by making them known.

Volcanic lavas, and other volcanic products, which have been, at the time of their eruption, in the molten state, and at a red-heat, are the only rocks that illustrate the action of fire as a principal agent in their formation, and it is well to avoid some mistakes which take place daily. It is often said, by people who have not been trained in scientific matters, that fire has been acting in the formation of some products which, in the generality of cases, are merely rusty concretions, or iron ores, with a mammillated or honeycombed structure; this appearance is no more due to the action of fire than a piece of iron which has become covered with rust through being exposed to moisture or left in the water.

Beautifully crystallized white or light-coloured minerals are generally found in basalts and lavas. They are called zeolites, and melt very easily. Not only their beauty recommends them to collectors, but, in consequence of their easy fusibility and the alkalies they contain, industrial application may be found for them in the future. Thus, in seeking for minerals of scientific value, not unfrequently we come across products of industrial interest, while those most frequently engaged in prospecting for metal-bearing ores and raw materials for the manufacturers, should not disdain things that are only of scientific importance. If science and prospecting were to go hand in hand, many mistakes and much loss of time would be saved. For example, bitumen, found in permanent supply, is a valuable product, yet the washing of the dung of the rock-wallaby, often found impregnating such rocks as sandstones, has been mistaken for it; and again, some miners, prospecting for alluvial gold under basalt, have sunk a deep shaft through a decomposed rock, and, by doing so, have lost both time and money before they were made aware that what they were sinking through was neither basalt, nor lava, but a decomposed silurian rock.

Modified Rocks: Contact-Metamorphism.

At the contact of granites and other crystalline rocks in the formation of which a certain temperature has been necessary, other rocks are found to have undergone changes such as are produced by metamorphism, and the stratified rocks have thus assumed a crystalline structure. But this change is not shown by any sudden difference in their aspect: the modified rock, at its immediate contact with the igneous, often assumes characteristics so similar as to make it a matter of great difficulty, at a glance, to tell the difference. If, however, the outcrops are carefully examined from the eruptive centre, the changes will be noticed on a large scale, and will be found to form a succession of typical rocks shading into one another, from the pure igneous to the unchanged sedimentary rock, often containing fossils. In this case, carefully selected specimens of the most distinct types will be useful to illustrate the phenomena of *contact-metamorphism*. Let us take an example which is probably of common occurrence in this country and in Victoria, where the silurian slates have been altered at the contact of granites, and the granite is younger than the slates. The following succession is likely to be observed: Granite; faintly schistose granite; granitoid schist; gneiss; mica-schist; micaceous shales of a silky appearance; and, lastly, unaltered slates, in which fossils might be found.

Sometimes the shale at the contact of granites will be found to have been penetrated by infiltrations of silica, and thus changed into hornstones, or an impure flinty rock, very hard and resisting decomposition, but still retaining in many instances a slaty appearance.

In some cases silicates of magnesia such as the mineral chiastolite are found in the altered shales, when they contain a large amount of magnesia, and nearer to the granite the perfect crystals of this mineral are found, while at an intermediate stage the hardened shales will contain nodules or spots, due to the successive concentration of such matter as has not yet crystallized. (See Geikie, Text Book, pp. 578–582.) For an instance of contact metamorphism imparted to the surrounding rock on a small scale by basalt, see "Notes on some points of Basalt Eruption in New South Wales," by T. W. Edgeworth David, F.G.S., etc., read before the Geological Society of Australasia, where the author describes the basalt dyke at Bondi, near Sydney.

Minerals of Alluvial Deposits.

It will not be out of place to say something of the indications given by the minerals and rocks found in the alluvials, as their examination will be of service to the explorer. An example will make this better understood. When gold exists in creeks and gullies, in order to trace where it comes from, and, if possible, the quartz-reefs from which it is derived, the miner has to examine the products of the alluvials from the point where gold is known to exist, upwards, without neglecting any of the branches or tributaries of the main watercourse. The gold generally becomes coarser and less worn when approaching its original country, and also more quartz fragments are found adhering to it, and probably also more undecomposed sulphurets (mundic, &c.), which ordinarily accompany it in veins; and if, where these indications are met with, no more gold is found in the alluvials in ascending the creek or branch under prospection, it is evident that the reef or the original matrix cannot be very far off.

In examining from some high summits the geological features of a country, some of the rocks which compose the ranges, hills, plateaux, and peaks can, to a certain extent, be guessed from a distance by their shape, colour, and the form or absence of vegetation covering them; but this can be done only by those possessing a considerable experience of the local features of the country, as well as the geological formations of the world. On a smaller and closer scale, howover, some useful information can be obtained from the nature of the boulders, nodules, pebbles, and minerals found in the beds of rivers and creeks. Some of the rocks of volcanic or eruptive origin—such as basalts, porphyries, greenstones, granite, serpentines, &c.—will for long ages have resisted decomposition and disintegration, and therefore may be found in the alluvials sometimes at a considerable distance from their origin; and in the same way, any rock that it is judged useful to trace in consequence of its industrial value, or its probable association with metalliferous deposits, may, with more or less trouble, be found *in situ*.

The heavy or brightly shining minerals, which are found in the prospector's dish after the quartz pebbles and lighter debris have been removed, will also afford valuable information in pointing out some features of the mineral constitution of the upper basin, at the base of which they have been found. For instance, abundance of mica, thin sticks of black or green amphibole (hornblende or actinolite), garnets, &c., will indicate a gneiss and mica-schist country whether these rocks belong to the primitive or to the metamorphic series. Abundance of black sticks of tourmaline and white mica will enable the observer to suspect the presence of pegmatite granite and other minerals as topaz, zircons, &c. This will often be the case in a granite district where tin occurs (see *Mines and Minerals*, by J. H. Cox and F. Ratte, Sydney, 1885, pages 215 to 220). Some rare minerals and precious stones which are little known might be found in these alluvials, such as chrysoberyl, a stone remarkable for its bluish green wavy opaline colours, and its hardness between topaz and corundum (*l.c.* pages 296 and 307). Among the minerals of the tin family, rutile, octahedrite, and brookite, all composed of titanic acid, are sometimes found in alluvials, the first in red or grey-black prisms is rather common, the second in splendent crystals, often mistaken for diamonds, and the third in bright red striated plates. The two last species are found with the diamonds in New South Wales. But the diamonds themselves are found not only in alluvials, though they are generally more profitably worked there. At the Cape they occur in a dark greenish rock called *gabbro*, and in Borneo they have been found in association with serpentine, while in India they occur in conglomerates, and in Brazil in a metamorphic micaceous sandstone. Therefore, great interest is attached to the study of rocks found in alluvials in association with diamonds, as it might lead to the discovery of the matrix of this precious stone *in situ* in the upper part of the hydrographic basin.

Sedimentary and Fossiliferous Formations.

In the following pages we will follow the late Rev. W. B. Clarke and Mr. C. S. Wilkinson's reports on the geological formations known in New South Wales, so as to help the collector in search of fossils.

We have already alluded to the supposed lowest beds of the earth accessible to our observations, in which remains of plants and animals are considered doubtful.

In his "Remarks on the Sedimentary formations of New South Wales," the late Rev. W. B. Clarke alludes to them under the heading of so-called "Azoic" or "Metamorphic," and points out the following localities:—Cow Flat, Cooma Hill (Monaro), Wagga Wagga, flanks of Mount Kosciusko.

Lower Silurian.—The lower beds of the Silurian have a great thickness in Victoria, and it is in them that most of the widest quartz reefs of that Colony occur; but those series of the Silurian are scarcely known in New South Wales. They are characterized by fossils called *Graptolites*.

According to the Government Geologist (C. S. Wilkinson, Esq., F.G.S.), beds of altered sandstones and slates, which seem to be similar to the lower Silurian rocks of Victoria, occur in the Murrumbidgee district and near Moruya, but no fossils have yet been discovered in them. It would be an interesting novelty to find fossils in these New South Wales beds, and in order to attract attention to them we give in this guide a drawing of a characteristic Victorian species. (See Plate, fig. 1.) They are the organic remains of *Polypi*, allied to compound animals, such as the recent Hydrozoa, occupying cells distributed on a branched frame, and their remains appear as fine markings of various shapes, in which there is a denticulated outer margin, each denticulation corresponding to a cell. *Graptolites* are found in slates, and if these interesting fossils are sought for in the above-mentioned regions, it will be necessary for their discovery to split up pieces of the rock many times. It often happens in ancient slates that the easier cleavages do not correspond with the plans of stratification, and this circumstance causes greater difficulty in searching for graptolites.

UPPER SILURIAN.—The upper beds of the Silurian, which are extensively exposed in New South Wales, consist of conglomerates, sandstones, limestones, or slates; when altered by metamorphism they become crystalline and are respectively transmuted into rocks resembling diorite (Hill End, Ironbarks), quartzites, crystalline marbles, gneiss, mica-schists, and hornblende-schists. In these metamorphosed strata, fossils have often entirely disappeared, or when found are much altered and scarcely recognizable. In porous and friable rocks, like some conglomerates and sandstones, or in altered slates which have become crystalline schists, there is little chance of finding fossils in a good state of preservation unless in the compact marbles and quartzites. These fossils are not easily disengaged from the rocks, and, as a rule, it is better to leave them *in situ*, trimming the piece down to a portable size.

On the other hand it is in these metamorphosed crystalline rocks, and especially in their joints and cavities, that we should seek for crystallized minerals of scientific value. These rocks will not be found of a uniform composition, but will vary much according to the nature of the minerals of which they are formed. Moreover, the crystallized schists sometimes contain enclosed lenticular masses of quite a different composition, and all these metamorphosed rocks are occasionally traversed by veins and dykes, in and along the walls of which, rare minerals may be found; but when these beds are not strongly metamorphosed over large extents, crystallized minerals are not likely to be found in them except in the occasional vicinity of dykes or metalliferous veins.

Fissures, joints, and cavities, sometimes filled with clay, frequently occur in mines; these must not be lost sight of by mineral collectors, as they may contain crystals not attached to the walls, but which have become crystallized in the clay, or are completely detached.

In non-altered rocks minerals are rarer, but fossils are more likely to be found in a better state of preservation. In the Silurian beds, besides corals, sponges, and marine shells, the characteristic crustaceans called *Trilobites* are abundant. (*See* Plate, fig. 2.)

The principal localities for upper Silurian Trilobites are Yass; Bowning, Yarralumla Plains (Murrumbidgee); Boree Cavern, Boree (160 miles from Wellington, on the Lachlan Road, Belubula River); and Rock Flat Creek (Monaro). Other localities for upper Silurian fossils known are as follows:—Cavan (20 miles south of Yass, on the Murrumbidgee); Duntroon and Yarradong (Murrumbidgee); Dangalong (Monaro); Quedong (16 miles west of Bombala, on the Delegete River); Burrawang (West of Molong); Burrangong or Young; the

Murray district; Mudgee; Mount Canoblas (Orange); Limekilns (between Bathurst and Sofala); Bell River; Wellington; Wallerawang; Colalamine Plains (CoodradigbeeRiver); Colocolo (on the Paterson River); and other localities north of the coal measures area.

The limestones especially occur at Gulgong, Wilbertree (near Mudgee), Brombie, Belubula, Canowindra, Forbes, Cow Flat, Rockley, Tuena, Binda, Bowning, Murrumbidgee, Yarrangobilly (22 miles south of Tumut). With the exception of the Tertiary, the Silurian forms the largest aggregate area. This formation is traversed by gold-bearing reefs, copper lodes, &c.,

Devonian.—Next comes the Devonian, which is patchy. It is composed of a series of stratified rocks, similar in nature to those of the Silurian. The same may be said as to the occurrence of its metamorphic strata, as well as with respect to the occurrence of minerals, with the exception that metamorphism is not so frequently observed in these rocks as in the earlier formation. The Devonian strata in New South Wales are traversed by valuable gold-bearing reefs, &c.

The fossils to be collected in the Devonian are numerous; they include marine shells, corals, &c., and also a few plant impressions, namely, some of the Lepidodendrons. *Lepidodendron nothum* is a common species found also in the lower carboniferous; it is usually met with in the shape of impressions of branches adorned with scale-like or lozenge-shaped figures, as in the sketch (fig. 3).

Localities known for Devonian fossils are as follows:—Moruya River; Quedong; Yarralumla. Yarradong, Cavan, already mentioned for the Silurian; Bowenfels, Sofala, Mullamuddy (on the Cudgegong); Upper Colo River (Cudgegong); Brucedale (Bathurst); Mount Lambie; Cope's Gully (near Hanging Rock); Moara Creek (near Tamworth); Pallal (near Bingera); Allyn River (a branch of the Paterson River); Kempsey; the Macleay River; Mount Frome (county Phillip); Collins Flat (between Marulan and Bungonia, county Argyle); between Wellington and Molong; the head of the Murray River.

An important point in observing the fossiliferous strata is to find, as far as possible, where the beds which form the passage from one formation to another are situated. These passage-beds might afford the instructive evidence of a mixed fauna; while the upper beds of one formation will show with the lower beds of the next a marked difference.

As a "geological horizon," which might, in several localities, serve as a guide between the Silurian and the Devonian, the late Rev. W. B. Clarke mentions (page 21, Remarks, &c.) that some conglomerates, which form ranges of considerable extent and prominent features, overlie the Marine Upper Silurian strata, and contain remains of some of the plants already alluded to as belonging to the genus Lepidodendron.

Coal Measures.—The Coal Measures of New South Wales are deserving of much attention by collectors, whom we will try to direct to the localities where fossil plants, marine shells, &c., can be found. According to Mr. C. S. Wilkinson, F.G.S., they may be divided as follows, in descending order :—

Upper Coal Measures	...	*Permian.*
Upper Marine Beds		
Lower Coal Measures		
Lower Marine Beds		*Carboniferous.*
Lepidodendron Beds		

The inferior beds in the Hunter District are composed of conglomerates, sandstones, shales, and limestones, and have not been found to contain any payable seams of coal. The fossil plants found in them are chiefly Lepidodendrons and other carboniferous plants, and have, in consequence, been referred to as "Lepidodendron Beds" in Mr. Wilkinson's report, published in "Mines and Mineral Statistics," 1875, pp. 128, 132, 135. They contain also marine fossils such as shells, crinoids, &c. J. Mackenzie, Esq., Examiner of Coal-fields, made, on behalf of the Australian Agricultural Company, at Smith Creek, near Stroud, a section across these lower beds, which will be found at page 247, section 20, in the above-mentioned book.

East of Stroud is a belt of porphyry, marked on the geological map, and striking north and south. Where the section begins there is a dyke of porphyry over 50 feet in width. From there eastwards, and for 2,500 to 3,000 feet, a dozen beds of fossil plants are found, and at the lower part of the section the marine strata are found accompanied with beds of limestone full of debris of crinoids, and resting on the Silurian slates. "These fossiliferous strata range from near Port Stephens, in the county of Gloucester, through the north-easterly parts of the counties of Durham and Brisbane, including the sources of the Hunter River; thence over the dividing range to Nundle and Goonoo Goonoo, on the Peel River, and again further north to the Manilla and Horton Rivers." (p. 133.) They are also found in the ranges near Canowindra.

The Lower Marine Beds come next, containing carboniferous fossils such as shells, crinoids, &c. Fossils from these beds were obtained at Stony Creek, Harper's Hill, Ravensfield, Singleton, &c.

The Lower Coal Measures come above it, and their plant seams contain Glossopteris (fig. 4), Phyllotheca, &c. Fossils have also been obtained from West Maitland, Greta, and Anvil Creek.

In these localities, above the coal seams, the upper series of marine beds (350 feet above the Anvil Creek coal seam) occur with marine shells and other fossils. These beds have supplied fossils also in the Western District, Bowenfels, and Wallerawang, where they occur in coarse conglomerates about 100 feet below the 10-feet coal seam of Lithgow Valley.

The Upper Marine Beds are also to be found at Wollongong, Kiama, and Jervis Bay

The Upper Coal Measures worked at Newcastle, Lake Macquarie, Catherine Hill Bay, Wollongong, and in the Western District contain at least sixteen seams of coal each more than 3 feet thick, besides the oil-shale beds. Glossopteris, Phyllotheca, and other fossil plants are found in them. According to the state of our knowledge, the Upper Coal Measures should provisionally be referred to the Permian ; and Mr. Wilkinson, in the special report published in 1882, even questions (page 51) whether they should not be included as a division of the great Carboniferous series.

Fossil plants cannot at all times be collected in a coal-mine ; one must be well informed of the progress of the works, for plant-seams are not often accessible, and it is chiefly when new shafts are being sunk that opportunities are afforded of inspecting them. As a rule marine fossils are found in beds far distant from the plant beds. The plant beds in these series are generally very thin seams of shale separated by thick strata of sandstones and conglomerates in which the fossil plants have not been preserved, although some are occasionally found in such strata. The opening of a drive or an "adit" in the solid rock will afford less opportunity for collecting, as few fossiliferous seams are likely to be intersected ; but if any of these are rich in fossils, the opportunity ought to be taken advantage of at once, as specimens of great interest may be unearthed, and otherwise lost. Moreover, every foundation work, every quarry, every road cutting ought to be examined, and visited by intending collectors.

At the collieries, fossils can often be obtained from the roof and from the side of the worked seams, as is the case near Newcastle. At Stony Creek, Maitland, Anvil Creek, Greta, where the lower coal measures are worked, marine fossils are found in the roof and sometimes also in the sill of the worked seams.

Plants, when they are in a good state of preservation, should always be collected, and if they can be obtained in large slabs so much the better ; but in any case, more interest must be attached to those which show flower spikes, seeds, or organs of fructification, of which we give a few sketches (*Lepidostrobus*, a spike of Lepidodendron, and *Cardiocarpon*, a fossil fruit, figs. 5 and 7).

Casts of shells are very common in some carboniferous sandstones, and a judicious choice should be made so as not to collect too many of the common kind. Crinoids (sea-lilies, *Echinodermata*), which in consequence of their delicate and brittle appendages are very rarely complete, constitute some of the most remarkable of the early marine forms. They should be specially sought for and carefully collected ; in limestone, their tests and articulations will generally be found transformed into crystallized carbonate of lime, whilst in sandstone their substance has generally been completely destroyed and only the inner casts in the shape of round balls a few inches in diameter, which give but a very incomplete idea of the fossil, are found; what ought to be sought for and carefully collected are the pieces of stone which envelope these balls, and represent the hollow casts of the outer surface where all the ornamentation of the tests may be seen in reverse. To give some idea of these beautiful representatives of life in the early seas, we have given a sketch of this portion of a new species of crinoid from the carboniferous sandstone of New South Wales (figs. 6, 6a).

In the Coal Measures some few specimens of a species of fossil fish have been found, whose remains would be extremely valuable to the Museum, and would form important additions to our geological records, so that they should be diligently searched for even among apparently valueless debris. The localities for the Lepidodendron beds especially are Back Creek (Barrington diggings), Manning River, Goonoo Goonoo Creek (near Tamworth), Rouchel River, Canowindra (Belubula River), Cowra. Localities for the Lower Coal Measures: Arowa (Paterson River), Greta Creek, Anvil Creek, Stony Creek, Wingen. Localities for the Upper Coal Measures (Permian), especially, are as follows:—Jerry's Plain (Hunter River), Mulubimba (Newcastle), Arowa, Raymond Terrace, Blackman Swamp, Bowenfels, Guntawang (County Phillip), Illawarra. Localities for the carboniferous generally:—Dunvegan or Burragood (Paterson River), Booral (between Stroud and Gloucester), Ichthyodorulite Range (near Stroud), Stroud, Lewin's Brook (Paterson River), Tilligherry (Karuah River, Port Stephens), Dungog, Glen William (5 miles from Clarence Town), Williams River, Branxton and Carrow Creek (County Durham), Piper's Creek (County Macquarie), and many other localities on or near the Hunter River, namely: Raymond Terrace, Muree (near Raymond Terrace), Morpeth, Glendon, Singleton, Darlington, Osterley, Harper's Hill (Maitland), Bell's Creek (Upper Hunter River), Arthur's Hill or Mount Arthur (County Durham), Oaky Creek, near Cobbadah (County Murchison), and in the south, Bombaderry (County Camden), Blackhead (between Illawarra and Shoalhaven), Cambewarra Mountains, Jamberoo, &c.

The limestones in some localities (as mentioned for Silurian fossils), such as Wellington, and the Murrumbidgee near Yass, are completely studded with fossils. In some of these limestone beds the corals and other fossils, especially gasteropods, are permeated with quartz, which has penetrated the limestone and taken the place of the substance of the shells or corals, so that they stand in relief in the weathered surfaces of the limestone. These beds contain some fossils which give them a Silurian aspect, while some others have undoubtedly been referred to the Devonian and some to the carboniferous. There is consequently, resulting from their study an interesting question to solve, and it would be of great interest for the Australian Museum to receive specimens from various localities, special attention being paid to position in the different beds from which they are collected. The most valuable and interesting fossils in the limestones are *Trilobites*, some rare forms of *Gasteropods* resembling the marine genus *Turbo*, and the remains of fishes. The Silurian and Devonian fishes were covered with plated armour, the remains of which are often found broken and disseminated; it will be, therefore, necessary to collect carefully those fragments found in the same spot, especially if they seem to belong to the same piece, or to the same fossil. Great results are expected from these researches, as what is known of the numerous and strange animals that lived in earlier times is comparatively trifling.

These observations, being of a general character, are applicable to all other formations, in searching for and collecting fossils.

TRIAS.—In both divisions of the Hawkesbury Sandstones, in the Wianamatta Shales occurring around Sydney, and in the Blue Mountains, are found fossil ferns, shells, and fishes. Fossils are reported from Clarke's Hill (Cobbity, near Camden), Cockatoo Island, Chapel Hill (Campbelltown), and Parsonage Hill, near Parramatta.

In the first edition of these notes, according to the opinion generally accredited, Trias was accompanied with a query (?) But, recently, in September last, Mr. Maiden, the Curator of the Technological Museum, discovered, among the debris raised from the excavations at Cockatoo Island, some remains of a Labyrinthodon, one of the gigantic animals which belong to the Triassic period of Europe. (*See* Professor W. J. Stephens on the subject in "Proceedings Linnean Society of New South Wales, 1886.") It is, therefore, probable, after that important discovery, that the above beds will be definitively referred to the Trias.

JURASSIC.—The Clarence series (Jurassic), which extend in the Clarence River district, are composed of coal-bearing strata, conglomerates, sandstones, and shales, but more recent than other Coal Measures of this Colony. They contain fossil ferns, among which is *Tæniopteris daintreei*, and are considered as the equivalent of the Ipswich (Queensland) and Victoria coal-bearing series. The Rev. J. E. Tenison-Woods (*See* Proc. Linnean Society, vol. VIII, part I) mentions as lower Lias localities: Talbragar River, Ballimore near Dubbo, Clifton, Darling Downs. (Plate, fig. 8.)

CRETACEOUS.—The Lower Cretaceous makes its appearance in the north-western part of New South Wales from whence it extends up to Northern Queensland. It is composed of conglomerates, calcareous greensand, and clay. Hitherto the fossils found in these beds have been procured chiefly in boring for water; they are marine shells, among which *Ammonites* is characteristic. In Central Queensland, fossil shells allied to *Ammonites* attain an immense size; but it is especially in the Jurassic and Cretaceous formations that the remains of the extraordinary large marine animals (*Ichthyosaurus* and *Plesiosaurus*), which inhabited the ancient seas are found, and three species already discovered have been described by Professor McCoy.

The vertebræ and fragments of the ribs of these Saurians are most commonly met with. They are of more value if they come from localities in which they have not previously been found. All the bones ought to be carefully collected, with the view of obtaining as far as possible a perfect skeleton of the same animal; but the head is the principal part to be sought for, and should be removed with the greatest care.

TERTIARY.—This formation includes in Australia the Eocene, Miocene, Pliocene, and recent deposits. In the great Dividing Range, at various altitudes ranging up to 4,000 feet, are found conglomerates, silicious sandstones, clays, and ironstones, with impressions of leaves representing the extinct vegetation of a tropical climate (*Eocene* and *Lower Miocene*); in Victoria the marine deposits representing the Middle and Upper Miocene contain rich beds of fossil shells, consisting mostly of extinct species, and partly of species actually living in warm seas. Corresponding strata in New South Wales are found on the banks of the Murray, in the south-western part of the Colony.

In the river drifts of the Middle Pliocene, most of which are covered with basalt, and form the "deep leads," remains of the ancient fauna and flora of Australia are found, some of which belonged to gigantic animals.

In these "deep leads" are also found immense trunks of trees, fossil fruits (Gulgong; Lumpy Swamp, near Orange; Carcoar; Bentree) leaves, and insects (Sydney Flat, near Uralla).

The fossil bones found in the caves, sometimes imbedded under a great thickness of calcareous tufa, belong in great part to the extinct marsupials of various families, and among them are found remains allied to animals now living in Tasmania (*Thylacinus*, *Sarcophilus*), and in a few instances identical with the present living species of *Phalangista*, *Macropus*, *Bettongia*, *Mastacomys*, *Mus*, *and Hapalotis* (Wellington, Mandoona).

CONCLUDING REMARKS.

After perusing this little pamphlet, amateurs and collectors who understand its usefulness, and are able to send specimens, will understand not to send things of very common occurrence. The importance of separate packing is noticed on page 11, and particulars as to locality, place, &c., should be supplied as completely as possible.

A very simple way of avoiding any mistake is to write before-hand suggesting what the collector can do in his particular district, and asking for advice.

The following books, in the meantime, can be recommended:—

Catalogue of a Collection of Fossils in the Australian Museum, with introductory Notes (the Notes by F. Ratte).

Descriptive Catalogue, with Notes of the General Collection of Minerals in the Australian Museum, by F. Ratte.

(Both Catalogues to be had at the Museum or from the Government Printer).

Minerals of New South Wales, by Professor A. Liversidge. (Government Printer.)

Catalogue of Works on the Geology, etc., of Australia, by R. L. Jack and R. Etheridge. (Government Printer.)

Mines and Minerals: A Guide to the Australian Miner, including Geology, Mineralogy, and Determination of Minerals, by Professor Herbert Cox and Felix Ratte. (Booksellers in Sydney.)

Reports of the Department of Mines, by C. S. Wilkinson, Government Geologist, E. F. Pittman, Inspector of Mines, E. David, Assistant Geologist, and other officers of the Department. (Government Printer.)

Remarks on the Sedimentary Formations of New South Wales, by the Rev. W. B. Clarke. Fourth edition. (Government Printer.) It is necessary to ask for the fourth edition which contains lists of fossils, and localities, map and sections.

Catalogue of Australian Fossils, by Robert Etheridge. (To be found in the Public Library, Sydney.)

Text Book of Geology by Archibald Geikie. (Booksellers.)

EXPLANATION OF PLATE.

Fig. 1.—*Graptolites caduceus (Salter).* Lower Silurian slates; Canada and Victoria.

Fig. 2.—*Sphærexochus mirus. (Beyrich),* a trilobite. Upper Silurian; Bohemia and Bowning, near Yass, New South Wales.

Fig. 3.—*Lepidodendron nothum (Unger).* Fragment of stem. Devonian, Mount Lambie, New South Wales.

Fig. 4.—*Glossopteris browniana (Brongniart).* A fern. Carboniferous (Lower Coal Measures) and Upper Coal Measures, New South Wales.

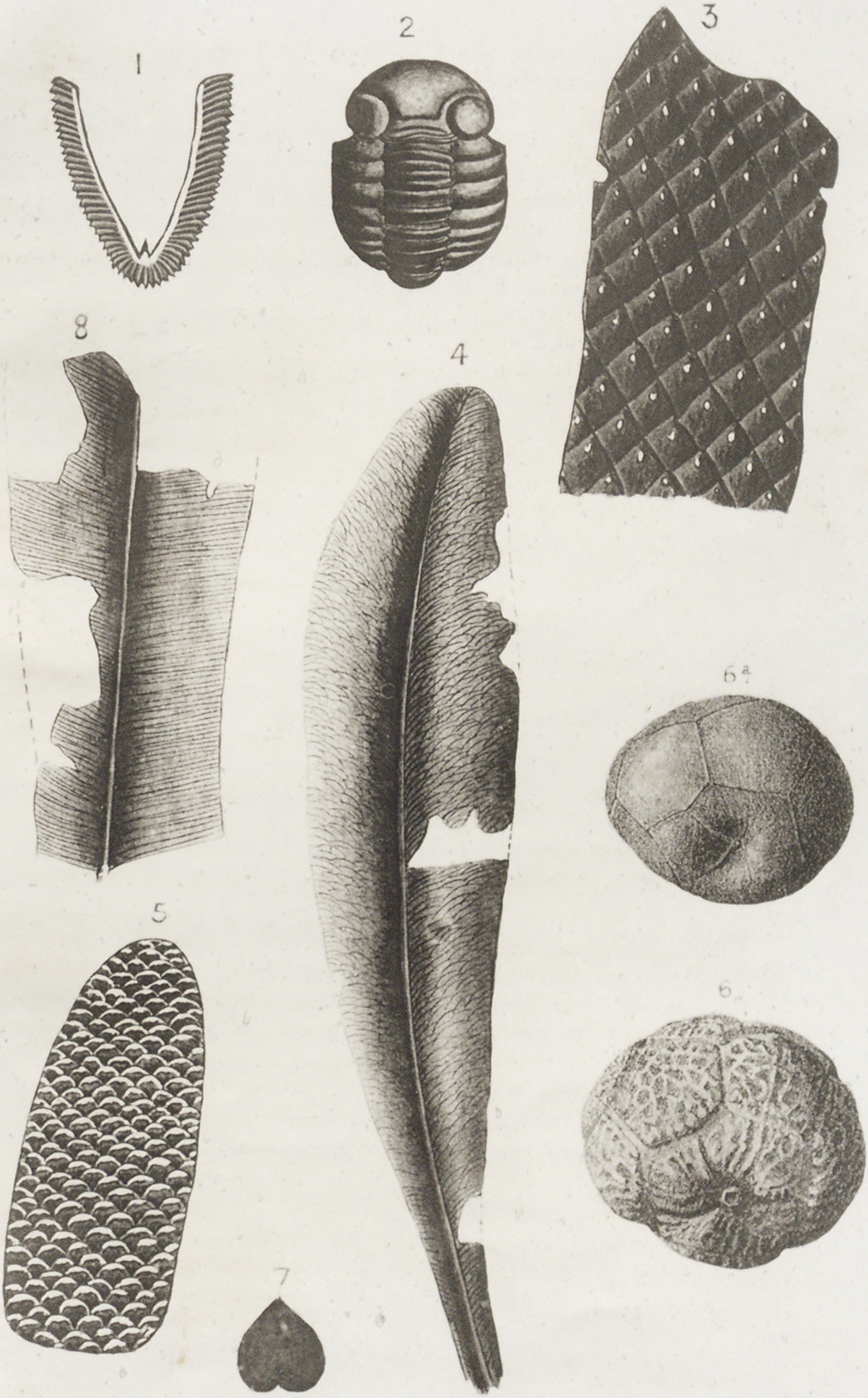
Fig. 5.—*Lepidostrobus,* a spike of *Lepidodendron.* Carboniferous. Specimen from Durham, England, in the Australian Museum.

Fig. 6—6*a*. — *Tribrachiocrinus corrugatus (Ratte).* A crinoid (sea-lily), from the carboniferous sandstone of Jamberoo, New South Wales. Fig. 6 represents the calyx without the arms and stem; *s* is the place where the stem is attached; and Fig. 6*a* represents a cast of the inside.

Fig. 7.—*Cardiocarpon australe (Carruthers).* Probably the fruit of a coniferous tree. Tivoli Coal Mine, Queensland.

Fig. 8.—*Tæniopteris daintreei (McCoy).* A fern. Tivoli Coal Mine, Queensland, and Cape Patterson, Victoria.

Sydney: Charles Potter, Government Printer.—1887.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PUBLICATIONS OF THE AUSTRALIAN MUSEUM.

Catalogue of the Specimens of Natural History and Miscellaneous Curiosities in the Australian Museum, by J. Roach. 1837. 8vo, pp. 71. (Out of print.)

History and Description of the Skeleton of a new Sperm Whale in the Australian Museum, by W. S. Wall. 1851. 8vo, pp. 66, with 2 plates. (Out of print, but to be reprinted.)

Catalogue of Mammalia in the Collection of the Australian Museum, by G. Krefft. 1864. 12mo, pp. 133. (Out of print.)

Guide to the Australian Fossil Remains in the Australian Museum. 1870. 8vo. (Out of print.)

Catalogue of the Minerals and Rocks in the Collection of the Australian Museum, by G. Krefft. 1873. 8vo, pp. xvii.–115. (Out of print.)

Catalogue of the Australian Birds in the Australian Museum, by E. P. Ramsay. Part I, Accipitres. 1876. 8vo, pp. viii.–64. Boards, 2s.; cloth, 3s.

Catalogue of the Australian Stalk and Sessile-eyed Crustacea, by W. A. Haswell. 1882. 8vo, pp. xxiv.–324, with 4 plates. Wrapper, 10s. 6d.

Guide to the Contents of the Australian Museum. 1883. 8vo, pp. iv.–56. Wrapper, 3d.

Catalogue of the Library of the Australian Museum. 1883. 8vo, pp. 178. Wrapper, 1s. 6d., with two supplements.

Catalogue of a Collection of Fossils in the Australian Museum, with Introductory Notes, by F. Ratte. 1883. 8vo, pp. xxviii.–160. Wrapper, 2s 6d.

Catalogue of the Australian Hydroid Zoophytes, by W. M. Bale. 1884. 8vo, pp. 198, with 19 plates. Wrapper, 3s. 6d.

List of Old Documents and Relics in the Australian Museum. 1884. 8vo, pp. 4.

Descriptive Catalogue of the General Collection of Minerals in the Australian Museum, by F. Ratte. 1885. 8vo, pp. 221, with a plate. Boards, 2s. 6d.; cloth, 3s. 6d.

Catalogue of the Echinodermata in the Australian Museum, by E. P. Ramsay. Part I, Echini. 1885. 8vo, pp. iii. ii.–54. 5 plates. Wrapper, 2s. 6d.; cloth, 3s. 6d.

Descriptive list of Aboriginal Weapons, Implements, &c., from the Darling and Lachlan Rivers. 1887. 8vo, pp. 8.

Notes for Collectors. 1887. 8vo, 1s. Containing
- Hints for the Preservation of Specimens of Natural History, by E. P. Ramsay. pp. 17.
- Hints for Collectors of Geological and Mineralogical Specimens, by F. Ratte. pp. 26, with a plate. (The two parts may be obtained separately. Price, 6d. each.)

In course of preparation:—

Catalogue of the Library. Revised and corrected.
Guide to the Museum. New edition.
Descriptive Catalogue of the Eggs of Australian Birds, by A. J. North.

In the press:—

Catalogue of Sponges, by R. von Lendenfeld.
Catalogues of Medusæ (two), by do.
Cheque List of Australian Birds, showing the distribution of all the known species, with notes, by E. P. Ramsay.
Catalogue of Shells. Hargraves, and General Collections, by J. Brazier.