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1856.

Dr. J. R. Jones

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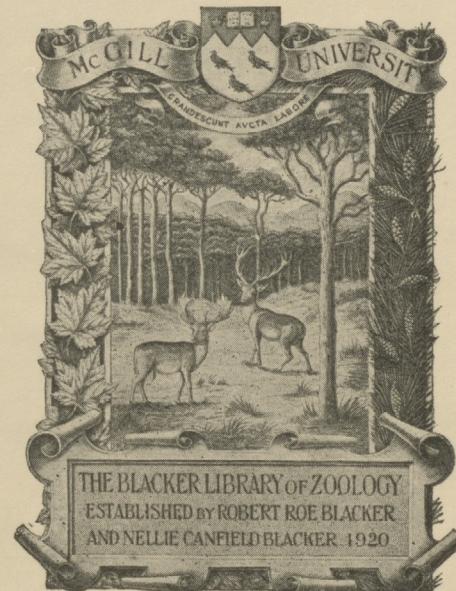
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Radiata & Mollusca

For more correct account
see page 24 & following

1 Radiata

This subkingdom was so named by Cuvier, because many of the animals included in it are more or less radiated in plan; that is exhibit rays or branches. Of all animals they exhibit the lowest degree of organization. They are wholly confined to a watery medium or sphere of existence. On account of the obscure form, which the nervous system takes in them, some naturalists have proposed for them the name *A'vita* (undiscernible). A number of them, apparently hovering in character between plants & animals, or externally resembling plants, are called *Zoophytes* (plant-animals). The Radiata is divided into five classes - 1 Infusoria - 2 Polypi; - 3 Acalephae 4 Entozoa - 5 Echinodermata. (Each of these are divided into orders.)

The Infusoria - ~~into~~ are microscopic animalcules; that is animals so small that they cannot be seen without the aid of a microscope. In all stagnant water, where vegetable or animal matter, has been infused or allowed to decay, these minute animals are found, being it is supposed, developed from ova, or germs conveyed thither by obscure means. Besides the orders here enumerated there is one order Dictyomaceae which are not yet for certainty referred to the Animal Kingdom. They consist of single cells, in cases of silex or flint, of numerless forms, found living & moving in all water which has been exposed to the air, and dead in the mud of rivers, in guano, and in many alluvial deposits.

2 The class - Infusoria - is divided into 2 orders -

- 1 Polygastrica -
2 Rotifera

1 Polygastrica. These are the most minute
of the ascertained infusory animals.

While some species are naked others are clothed in silken robes even;
and it has so happened in the history of the world, that thick strata
have been composed of the hard exuviae of these humble creatures.

Though individually invisible to the naked eye, these animals, by their
immense numbers, impart a distinct colour to the water in which they swarm,
and they are one of the causes of the phosphorescence of the sea.
This order includes 2 families. - Urcularia - Beracea. -

2 Rotifera - These have a gelatinous body, of an oval shape with
a mouth and a stomach. About the head there is a very singular organ,
variously divided into tubes, with toothed edges, which vibrate
in various ways, and when viewed under the microscope, have the
appearance of one or more toothed wheels revolving with greater
or less rapidity. This organ from which the ~~organ~~ order derives
its name, is supposed to be in some way connected with the function
of respiration. The rotifera are so exceedingly minute, that a drop of water
is to them as a lake in which they may deposit themselves. We give
short descriptions of these small animal, to hang on to those more worthy
of our study,

Class Phylozoa. i. 5 orders -

3

- | |
|--------------------|
| 1 Order Hydroidea |
| 2 do Helianthoidea |
| 3 do Asteroida |
| 4 do Actinoida |
| 5 do Peripera |

The Phylozoa are so named from their external resemblance to plants: they are otherwise called Zoophytes (animal plants) & Polyperas. The general character is that of a small animal or polyp, consisting of a stomach and a mouth surrounded by tentacula (organ for holding);

but this character is found in many special forms, and in various connection, constituting great difference.

1 Order Hydroidea have for their fundamental type the Hydra, a single polyp, usually seen enjoying an independent existence, attached by a stalk to some twig or other object in stagnant water.

The Hydra seldom exceeds an inch in length, but is sometimes as long as 6 inches. The body is wholly gelatinous, consisting only of a kind of bag which serves as a stomach, with a circle of long arms or tentacula round the mouth and not other outlet for the upulse of the food. Small larvæ, worms, and entomostrophic insects seem to be their favourite food; and to entrap them the expand their tentacula to the utmost, and spread them in every direction, moving them gently in the water to increase their chances. No sooner is their prey laid hold upon, than it evinces every symptom of painful suffering; but its violent contortions are momentary, and a certain death suddenly follows its capture. How this is produced is a mere matter of conjecture, as not even a wound can be perceived on the dead animal.

In another family *Tubularidae* we find a tendency ^{to} of the consolidation of the exterior, into a kind of horny tube or sheath; and when a number of polyps are associated together a compound structure is produced. Instead of the foot of the ^{the} hydra, we have here a horny tube, in which the lower part of the animal is placed, and which being connected with its organization, has an independent vitality. In a third family *Sertularidae* the polyps reside in small horny cases, which are connected with each other in much the same manner as the branches of a plate. But they go a little more minutely into the structure of the hydra. It consists principally simply of a tender tube like sack attached at one end to some solid object in the water, such as a stone, twig, or floating piece of wood, and having at the other extremity a small opening surrounded with several thread like tentacles. These parts constitute the whole animal. There are no viscera of any kind, heart lungs, blood vessels or nerves within. The animal is simply an empty sack with a mouth. Into this mouth is drawn by the tentacular, various microscopic animalculae, which happen unlucky to venture within their reach. Once within they are soon digested into a liquefied, which is absorbed into the walls of the sack, and contribute to the nourishment and growth of the hydra. The sprouts seem to grow of their own accord out of the sides of the parent. They appear at first as knoblike protuberances from the body of the hydra, they gradually increase in size, and come to present

something of the form of the parent, an aperture is then run at⁵
the free extremity, and around this tentacula begin to sprout.
The young during their growth, are like so many buds upon
the sides of the original stock, and the hollow part of
each communicates with the internal cavity of the old one,
from which they are fed. Even after the tentacula of the bud are
sufficiently developed to enable it to obtain food for itself, the
communication remains open for a time, as appears from the
fact that either of the stomachs is distended when the other
is fed. As the bud, however, advances toward completion, the
aperture contracts, and is at last obliterated; the stock itself
gradually becomes more slender, and is at last broken by the
highest effort of either the old or young Hydra, and the latter
is then set free and after swimming through the water for a time
attaches itself to a twig or stone and commences life and the
nursing of a family on its own account. There is no distinction
of sexes, and what is more astonishing, the Hydra may
be cut into pieces, and each minute fragment will grow
into a new and perfect Hydra, and produce young.

6. Order Heliánthoiada

So named from their resemblance to the popular picture of the sun and his rays - consists of a variety of fleshy polypes, which have the power of fixing themselves by the base, though many of them also crawl, and allow themselves to be moved along by the current of the water. The family Actiniidae (άκτις - ray and εἰδος form) have the body of a soft gelatinous texture, and often brilliantly coloured. Their tentacula are arranged in several rows around the mouth, having the appearance of full blown many petalled flowers, whence they are called the sea anemones and sea sunflowers. They are among the most highly organized of the class, and few on shell rock, and other marine animals, which they draw into the mouth, with their tentacula, disengaging shortly afterwards the shells and indigestible parts. They are very sensitive to light, and expand or close their tentacula according to the feelings of the day. When the palps are drawn in, the aperture from which they proceed closes like the mouth of a purse, and the animal appears like a simple fleshy tubercle adhering to the rock. The species most common in Europe is the *Actinia semipellucens*. It is about three inches wide with a bluthey envelope of an orange colour, and it has two circular rows of tentacula of moderate length. The structure of the *Actinia* is much superior to that of other polypes; the ^{animal} body has a cylindrical, fleshy simple & very contractile body. They rarely exert any locomotive power, though they possess the power of moving from one place to another.

Their mouth which is the only opening to the body, is terminal
and furnished with teeth, surrounded by one or more ranges
of tubular radiated tentacula, disappearing when the animal
contracts its orifice, in which state it is not unlike a ripe pig or a
loosely drawn purse. The eviaceous skin which covers the Octopus,
enables them to assume various forms, they are sometimes flattened, conical
or cylindrical. They feed on small molluscous insects, shell fish,
shrimps, &c., but principally small sea crabs, which they draw into their
mouths, with their tentacula, and as we have before said disgorge them
shortly afterwards, by the same opening; these tentacula appear to attack
themselves, by creating a partial vacuum in each of them, as no viscous
fluid, is absolutely perceptible on touching them, but a gentle suction is
distinctly experienced. The whole interior of the body ~~is~~, but one cavity
or sack, and from the great expensibility of the mouth, large shell fish
may be swallowed without injury; but when the shell is so situated
as not to be readily discharged by the mouth, it is said to be forced
through the body, making a wound near the base, which readily
heals, without occasioning any apparent uneasiness to the animal.
As we have said they rarely use any locomotion, but when they do, they
detach their base, ~~and~~ and move their body, and use their tentacula
as legs, these being probably furnished, with a viscous exudation, and
a roughness well calculated to effect the office. The young of these animals
are produced from eggs, which are in clusters, on a membrane of a ribbed -
like form, in the respiratory chambers. They bring forth the young alive out
of their mouth, which are generally from eight to twelve in number.
Though at this age some of them were nearly imperceptible, they immediate-

8. attached themselves to the nearest object, and expanded their tentacula in search of food. These animals though destituted of eyes, seem evidently affected by light. For when a candle was one time placed near a sand which contained some of them, they closed up immediately and did not again open until the light was removed. These animals like the polypii have great powers of reproduction; they may be separated transversely or vertically, and each foliated tube, becomes a distinct animal; and some time after perfectly formed & small ^{true to be} actinia issue from the mouth. When forcibly detached from the rock to which they are attached, by thin sucker like base, they forcibly contract themselves, into a firm round mass, with a shining surface, and are not easily removed without injury. But even when torn of the rock so that portions of their base remain on the rock, the remainder continues to live and what is more wonderful still, the form swells; its mouth stomach and tentacula become developed, and a perfect actinia is reproduced. These again produce from the latter part of their base globules, buds or shoots, which are detached by themselves, and fixing in their turn, to the neighbouring ^{rocks}, produce fresh colonies. The tentacula of this animal as above noticed are tubular, with a minute orifice at their extremity; and their interior, communicates with a compartment, between the stomach & the external tissue, a wall of the body; a compartment not single however, but divided into longitudinal membranous partitions, into numerous chambers.

between which there is a free communication. This chambered, or divided cavity, of the aerating receptacles, and is filled with the sea water taken in through the tubular tentacula, and expelled, when the animal contracts, through the same tubes, a fresh supply being absorbed on the dilatation of the body. The respiratory apparatus appears to be thus under the creature's volition; and it has been observed, of examples kept in vessels, that as the fluid, in which they are confined, becomes deficient of air, and consequently, less fitted for the purpose of aquatic respiration, they fill themselves with it almost till they burst resembling an inflated bladder; and this evidently because 't is only in a great volume of such liquid, that the quantum of air necessary for the support of life, (and which a much smaller volume of unexhausted water would supply,) is now contained. In these respiratory compartments are the eggs, arranged in clusters on a delicate convoluted membrane; and it appears, that on the detachment of the eggs from this membrane they either pass by means of a minute orifice into the bottom of the stomach, whence they escape, or are transmitted through the tentacula. Some traces of the nervous system appears to have been seen in the Actinia; but nothing certain can be proved.

10 Another family, the *Sucernaria* (*sucerna* a lamp) resemble the former family, but their substance is softer. They have a long slender pedestal supporting a radiated disc, which expands like a parasol, and is surrounded by numerous tentacles, united in bundles. Their name is derived from the phosphorescent light they emit.

Order Asteroidea

This order shows us, the individual polypus sinking, as it were, under the compound form. One noted family, the *Aleyronidae* are of a spongy character. They are well known on our coasts under the name of dead-men-fingers, and others, referring to their fleshy character & the forms they present. What seems a disgusting fleshy mass in the fisherman's net, proves to be, when placed at ease in its proper element, a structure of wonderful beauty. The mass is traversed by a multitude of minute canals, terminating in prominences, from which the polyps protrude.

For a fuller & more correct account see
Radiata see Page 26~~7~~ & following.

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Mollusca

29

I have now come from the Radiata, and enter upon the lower Molluscs, as we are going from the lowest to the highest. I have now come in to a class of animals quite different from my hitherto mentioned. The animals of the mollusca are of soft body, destitute of any skeleton, but covered with, what is called a mantle, from which comes the shell; we commence with the lowest class. The Mollusca are divided into three classes.

namely -

- | | | |
|---|-------------|------------------------------|
| 1 | Cephalopoda | for example the cuttle fish. |
| 2 | Gastropoda | do do - Snail (land). |
| 3 | A cephalo | do do oyster. |

We will commence with the lowest and go upward. First - the A cephalo - is divided into 3 orders; we will take the first. "Tunicata" & "Brachiopoda" & "Gymnibranchiate". We will take

"Tunicata" first, they consist of a white tough sac, of an oval form; no organs of any kind can be discerned on the exterior surface except the small openings which are placed on two little protrusions of the sac. In each of these holes there is a small tube running into the sac, one of which draws in the sea water the other expels it. It is destitute of any motion except the slight contractions & expansion of its sac. Into one of these small openings, the animal is enabled to keep a continual current of water, so that it may find means of support from the small animalculae which the current brings in. Its true mouth is at the bottom of the sac (inside of course) to which

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it directs the current which enters the opening, from the mouth there is a canal leading into the stomach, from thence ~~all the~~ a canal runs to the opening which ejects the water which circulates through the body. From the opening where the sea water is taken in is what ~~was~~ answers the purposes of a heart; the blood circulates all round the sack of the animal, and from thence to all parts of the body. The way in which the blood circulates is rather curious. The heart commences its palpitation very rapid, so rapid ~~as~~ that the blood is propell'd back for a while, but the palpitations become less & less until ~~the~~ you think the animal would expire, but the heart commences to palpitate again, and if you were to look, you would see the blood flowing in a different direction again, thus the blood is continually changing, backwards & forwards. The animal is destitute of any locomotion, and the expansion of the sack is ~~so~~ so slight that it is hardly perceptible. The contraction of the animal's sac is said to be muscular, but the expansion only its elasticity. These animals are solitary & simple, but also exist in chains side by side with their heads one way, we have been lecturing on the simple ones. I forgot to mention that they are filled with sea water. About the base of the opening that takes in water there are feelings on the tops of the openings are the eyes of the animal to prevent any injurious thing from passing in with the current. Leaf like expansions for gills. The young are hatched within the parent, and then when they appear ~~they~~ are perfectly per quate independant, of their parent who is fixed, these are aided in their locomotion by their tails, which act as a rudder they resemble the tadpole. The ovum they ~~are~~ are of a great number; which when hatched are in chains ~~of~~ all sailing with their heads one way.

The ovum which they produce is single, and out of it is hatched one 3⁷
solitary animal, &c like. This kind again produces a chain, and then
such one in the chain produce one again. Thus each animal resembles
not its parent but its grand parent. We now come to the - Brachiopoda
(which means arm footed) so called from their possessing two long ciliated
arms, supposed to be used for creating currents, by which food may be
brought to the mouth. These animals are very rare, there being only a
few existing now in seas. They are contained in a Bivalve Shell, but this
shell has not its valves connected by a hinge as in the higher cephalans,
but by means of certain muscles of the animals body by which they are brought
together like the boards of a book. The Brachiopoda are dwellers in deep
water, are widely diffused over the earth and make a conspicuous appearance
in the earliest fossiliferous strata. The genera Lingula and Terebratula are
fixed by means of a fleshy footstilk to submarine bodies. In Orbicula
the pedicle is wanting and the lower valve of the shell becomes itself the means
by which the attachment of the animal to the rock is effected. This animal
secures its prey partly by current partly by the ~~two arms~~ which it ~~sends forth~~
There is another respect in which the Brachiopoda differ from the others
animals we have been describing, it has only two arms and those
when not in use are always kept coiled up within the body. The greater
part of these animals are attached by a fleshy stem to rocks or the bottom or
sunken logs. The mantle may be described as two fleshy plates the animal
between them and open all round, in these there is a calcareous shells which
when put together form a bivalve shell. The mouth in this animal is tow-
ards the base of the arms. The mouth of this animal leads into a stomach
~~fitted~~ surrounded with masses of living the intestinal canal

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thin runs along and goes out at the side. Very near to the mouth is the heart, it is divided into two compartments, and it circulates the blood around the animal, & backwards and forwards like the Tunicata. These animals have numerous muscles some for shutting some for opening its shell. A great many of these creatures live at a great depth in the sea & others swim on the surface; but to speak of the ones at the great depth, first it appears very strange that the animal should chose such a place where one would think no animal could exist under such a pressure of water, it is also a great deal cooler at such a depth than elsewhere, & also it is a wonder what the animal gets to live on down in such regions. But to describe them. They have a great deal stronger muscles than the others, for they need to change the water they have in them much often, besides such a pressure of water is upon them, that they would need to have very strong muscles to contend against it. That is why they are so rare (down at such a depth) it is not often that they are seen in collections, only now and then are they washed ashore, & sometimes when they are dredging some deep place, the live in countless numbers become in their depth from the hand of man. Occasionally they are found in the stomach of bad fishes, but not often. There is a great no distinct hair in these creatures. Of these 1 order there is a great many ~~some~~ families ~~all~~ some of which will be given on the next page.

This order is divided into the following.—

On each of these we have not time to enter but we will just notice that— the Brachia are fixed onto the rock themselves by the lower plate while they raise the upper by their muscles. The Ostracules are slightly different, for instead of adhering to the rock themselves they have a hole ~~where~~ at the bottom of the shell through which comes a ligament and fastens it to the rock. (These genera can be found out separately in the Encyclopedia).

1	Terebratulas	33
2	Spirifers	Bivalve
3	Rhynchonellas	
4	Ostracodes	
5	Productores	No hinge line
6	Brachia	plate laid on top
7	Ostracules	raised & pulled down
8	Singula	by muscles

The Lamellibranchiata

This class ~~differs from the rest~~ includes all Bivalves; as the vestiges, muscles, cockles &c. Let us look at the arrangement of the dweller in some of these shells. Thin mantle is all closed up except at two openings towards the posterior part of the shell; thus the animal may be said to be closed up from the world but by these two openings, one of them like the Tunicata, is for the entrance of water, the other for the exit. The mouth at the ~~anterior~~ back of the shell, with four tentacula, the tentacula do not ~~but~~ appear on the outside of the shell at all, they are used for the capture of small animalculæ. The stomach is (as is the case in all molluscs) surrounded by a mass of liver, the same as in the Tunicata. The opening in the animal through which it takes in the water, leads to the branchial, or breathing apparatus, forming a double fringe, to each lobe of the mantle, and neatly arranged within the margin of the shell.

These gills also determine the current of water to the mouth of animal, through which, the animal gets the greater part of its food. The heart is not far from the mouth of the animal. It is (as in most molluscs) divided into three or two cavities, though most generally, the circulation is the same as in the tunicates. The intestinal canal is short, and comes down to the opening where the stream passes out. The stomach of the animal is supplied with hard stony bodies for teeth. We will now say something of the nervous system; which has been wanting almost in the former classes. The nervous system commences from a band round the gutlet to the base of the leg, from there to the opening, through which the current passes in. Round the mouths there is quite a number of muscles. These animals require the nervous, more than the ones we have hitherto been looking at. These bivalves have certain large muscles, take for example the oyster, that blue spot nearly in the center is the mark of the muscle which decided the opening or shutting of the shells. In some others the *Natica* for instance, has two muscles one at each end, being a different sort of bivalve from the oyster, the one near the beaks of the shell is called the anterior muscle, the other one the posterior. Those which have only one muscle, that muscle is placed in the middle. The foot of these bivalves are partly for locomotion, but as much as for an organ for attaching itself to rocks or other things. It is like the anchor of a ship, to the muscle, to enable it to attach itself when it likes.

The foot of the Oyster is very deficient so much so as hardly to be perceptible, it is generally attached to the sea bottom where it resides by the shell alone. In some shells we have little dots on the sides, these are supposed to answer the purpose of eyes. The spawn are hatched in the body of the parent, like the tunicata, they then find their way into the gills, and after staying a small time there are passed up by the current and out of the mouth, we will say more of the young afterwards. The mantle is the organ in which is the shell, the mantle has small cells containing carbonate of lime; the animal extends the mantle to the border of the shell, deposits then a pearly layer of cells, containing calcareous matter, thus layer after layer, it extends its living mansion, in just proportion to its own growth. After this has been formed the animal thickens it by an interior lining, forms a matter secreted from a different portion of the mantle, and names (mother-of-pearl) in its character. If a cross piece of a shell be examined with a microscope, you will be able to see the calcareous cells, and the lining of the mother of pearl, or if one so as to expose the top of the shells, they will appear the form of a honey comb. In these bivalves we have male and female. The mantle of the oyster is open all round nearly, mouth same as muscle or stomach enclosed in liver. Eye told by the ~~lance~~ round shells. The pectoral called from the resemblance to a certain kind of stone comb, forms the tyke of a pearly intimately connected with the oyster, but of higher organisation, being provided with a well developed foot and having eye-spots.

The foot of the muscle is provided with a collection of hair-like filaments (the byssus) by which it attaches itself to solid objects. Belonging to this family, ^(murex) are some remarkable boring mollusks, which have the power of penetrating hard rocks, and making deep holes which are enlarged as they advance, in accordance with the growth of the animals, and which, therefore, they cannot quit.

The Clam or Spiny Oyster family (Spondylidae) are inhabitants of the Mediterranean and the warmer seas, and are found at various depths attached to coral rocks, and dead shells. The upper valve of their shells are covered with spines.

The Cockle family Cardiaceae (cardium a cockle) are of numerous species, and the shells of many of them are very beautiful. The animal is characterised by having the mantle open anteriorly for the foot, and the shell by having at the hinge irregular primary teeth, generally accompanied with two lateral ones. Cockles are enabled by a large development of the foot to burrow in the sand of the sea shore.

Ayadæ) - The shell in this family usually approaches the cylindrical form, having a strong hinge and open at the two ends, through one of which the foot is projected while the other affords exit for the respiratory tubes or ciphons. They are remarkable for their power of boring and burrowing, so as to form for themselves a habitat. The razor shell (stolen) can thus sink a way in itself into the sand with surprising celerity. Some species of the genus *Pholas* are equally noted for their power of boring into wood. Fixing themselves by the foot, they cause their shell to revolve and then with its edge cut a way in & if the shell gets much worn it is supplied with a new formation.

Under this order we therefore have the following families.
of course only a few out of the many. the chief are -

1 In regard to the Ostriadae (or oyster family),
we have already made some general remarks.
And I will only add, ~~that~~ a few remarks.

The edible oyster *Ostrea Edulis*, has, as Puff-

- 1 The Ostriadae 83
- 2 " Anomiae
- 3 " Pecten
- 4 " Mytilaceae
- 5 " Spondylidae
- 6 " Cardiaceae
- 7 " Myadæ

Forbes remarks, its capital in Britain; for though found elsewhere
on the coasts of Europe, both northwards & southwards, nowhere
does it attain such perfection, as in our seas, through which it
is generally distributed - sparingly in some places, abundantly
and in gregarious assemblages in others. The oyster as we
have before mentioned, deficient in a foot, and is fixed to the sea-
bottom, when it resides by the shell alone. It employs its branchiae, and
the minute cilia with which these are covered, in making currents of water
to the mouth, to bring animalculæ, for its prey. The mouth is situated
near the hinge under a kind of hood formed by the edges of the mantle.
The ancient Romans valued our native oysters even as we do now,
and must have held them in higher estimation than those of the
Italian shores, or they would not have brought them so far for their lux-
urious feasts. In the month of May the oysters cast their spawners which
the dredgers call the spot. It cleaves to stones, old oyster shells, and
pieces of wood, at the bottom of the sea. It is conjectured that the
spot in twenty four hours begin to have a shell. The oyster is considered
full grown for market when from four to seven years old.

38 Until the third or fourth year the growth of each animal is easily observed; but after their maturity it is difficult to count the layers. Old oysters become very thick in the shell.

The next family is the - *Anomiae* - We have not as yet said anything about it. - This genus of shells belongs to the class Cephalopoda, order Lamellibranchiata and family Ostreaceae. The animal inhabiting this shell, is very much compressed, edges of mantle thin, not adhering, & furnished on the out side with a row of tentacular filaments; the abductor muscle is thick, divided into three portions, of which of which the largest passes partially through a notch, on the lower valve, adhering to marine bodies by a small calcareous piece at its extremity, which in some species is wanting. The shell is adhaerent, angular, inequivalve, inequilateral, and much resembling an oyster; the inferior valve flatter than the upper one, divided ~~into~~ at the summit into two branches, forming a notch or aperture of an oval form; one of them, large & thick forms the ~~aperture~~ part to which the ligament is attached; the superior valve is much larger and more convex, with an oval excavation beneath the the summit, for the other attachment, of the short & thick ligament; a subcentral muscular impression, divided into three parts,

Like the oyster, the anomia, possesses no locomotion, they ^{lay} ~~lay~~
& die on the spot they were born; the small osseous portion
which they are affixed to marine bodies, has sometimes been
mistaken for a third valve, but it is in fact no more, than the
thickened extremity of the tendon, or interior muscle of the
animal, by means of which it becomes attached to the object
on which the egg was hatched. It is so constructed as to
close up the hole or notch, at the summit of the upper valve,
when the muscle of the animal is contracted. In this genus the
smaller perforated valve is the lower one, being always placed in contact
with, and conforming to the shape of the substance upon which it
lies; in the oyster on the contrary, the larger and most unscarred valve
is the lower one. Bolt describes the animal of this shell as being
very similarly organized, with that of the oyster, and its habits
appear perfectly congenial. De Blainville has made two
divisions, those which have the small osseous appendage to the
muscle and those which have not. The first is exemplified in
any *Anomia epithymum*. The other is the *A. squamata* which
is fixed by the valve itself —

Pecten — The Pecten
so called from the resemblance of the shell to a certain kind
of comb, forms the type of a family intimately connected with
the Oyster, but of higher organization, being provided with a
well developed foot & having the operculum ^{con} for the most part.
and can propel themselves in the sea & ^{can} jump out again
in the air, by means of shutting the shell quickly.

Hence they are called, Sea Butterflies. Their shell is irregular.

Mytilaceæ or Muscle

This family we have said something about before, but we will now look a little more minutely into it. This family is well represented by the Common muscle (*Mytilus Edulis*) which is found in great abundance on our shores, usually near the mouths of rivers. Some species are inhabitants of fresh water; and one of these the Olio is noted for producing small pearls. This pearl is made in the following way. Sometimes a foreign substance, such as a bit of wood, sand, stone, or perhaps small animalculæ, forces its way through the shell of the muscle, when the muscle feels it coming through, it piles upon this spot small layers of pearly matter, which makes a small ball when finished; this is what is taken from the shell, and sometimes is a very good kind. The foot of the muscle is provided with a collection of hair-like filaments (the ligament) by which it attaches itself to solid objects. This curious arrangement, and the other principal parts of the organization of the muscle, are depicted in the drawing which I have made. Belonging to this family are some remarkable boring mollusks, which have the power of penetrating hard rocks, and making deep holes, which are enlarged as they

advance, in accordance with the growth of the animal, and
which therefore the cannot quit. The way it bores into rocks
has been a matter of much discussion, but the prevailing idea
is that it effects it by chemical means, we have said that this
animal has two openings at the lower end, one for taking in
the water which then passes through the gills and into
the mouth, then round and down the intestinal canal and
out at the other orifice, we have recapitulated it to show
the animal borrows; now when the animal wants an habitation
it seeks some cliff in the rocks where it can lay, then it commences
its burrow, by instead of allowing the sea water to pass round its body
and out at the other opening it opens its shell and pours this acid
against the place where it wants to burrow, this acid 6 degrees
dissolves the stone, and the animal works it way back into the
hole.

~~This~~ — The Clam or Spiny oyster family

(Spondylidae)

A great many splendid ~~are~~ species are found within the ~~family~~
This family does not need further ~~or~~ remarks.

This genus of Molluscs have their valves always equal, and the shell is never affixed, by its lower valve to other bodies.

The shell is equivalved, regular, and inequilateral, the greater number of species appearing longitudinal, from the great elongation of the anterior side. The hinge has two unequal teeth, one short, straight, and placed beneath the umbo, the other oblique, marginal, and prolonged, being inserted into a corresponding fossula. The valves are more or less strongly ribbed, smooth or imbricated; the internal margin, crenulated or plaited. The cockle family are of numerous species, & the shells of many of them are very beautiful. The animal is characterized by having the mantle open anteriorly for the foot, and the shell by having at the hinge irregular primary teeth, generally accompanied by two lateral ones. Cockles are enabled, by a large development of the foot, to burrow in the sand of the sea shore.

Miyadai - The shell in this family usually approaches the cylindrical form, having a strong hinge, and open at the two ends through one of which the foot is projected, while the other affords

out for the ctenophores (or respiratory tubes). They are unarmed for their power of boring & burrowing, so as to form for themselves a habitat. The way in which they do this I have before described. The razor shell (Solen) can thus sink a way for itself into the sand with surprising rapidity. The way in which they perform this is; they attach their lysus to the bottom of their burrow and extract it so as to be enabled to put out their chitinous pipe for respiration and when, the ~~feet~~ feel the sand move around them in the least, they contract their lysus and draw themselves back into their burrow. Hence it is difficult to get a living specimen.

Some species of the genus Pholas are equally noted for their power of boring into wood. Fixing themselves by the lysus, they cause their shell to revolve, & thus with its edges cut a way in, the wearing of the instrument being constantly replaced by a new formation. The Torpedo is a great creature for burrowing into ships bottoms & all timber, hardly a piece of timber can be taken up at sea but you will find some of the creatures. They subsist on the animalculæ which are brought in by the currents which they make into the pores of the wood. They line their burrow with shell. So that no matter how many of them there are in one piece of wood, yet their burrows will not unite for whenever they come to their neighbour's shell they turn in another direction.

Univalve Shells

The Univalve shells are for the most part divided into the following
1 class - Gastropoda is divided into ten ~~orders~~^{orders} & their families.
we will name the orders now, but we will enumerate some of their
families after in their order. Orders 1 Cyclo Branchiata 6 Pectibranchiata.

There are three orders under which
most of these class - they are -
1 Branchiopoda - 2 Pulmonata
3 Pteropoda

2 Scutic	do	7 Infero	do
3 Tubuli	do	8 Sudic	do
4 Pectini	do	9 Pulmonata	
5 Heteropoda		10 Pteropoda	

- 1 Branchiopoda - The aquatic which breath water.
2 Pulmonata - The land snail, which breath air.
3 Pteropoda - Those which have wing like appendages about the
head, for swimming.

We will commence with the lowest in the scale & go up & give
a short description of some of its families - Pteropoda -

All the creatures of this order move rapidly, most of them have shells,
but some have not. They have wing like appendages, which they
always keep flapping and so move in the water. If you suppose
the foot of the animals we have just left, to the flattened or out & thinned,
you have an idea of the wing like appendages of the Pteropoda. The body
is symmetrical, and hence the better adapted for swimming.

The *Bllopoedes* are found in enormous multitudes; one of them the *Bllo Borealis*, which abounds both in the Arctic & Antarctic seas, forms a very important article of food, to the whale, which swallows thousand, at at a mouthful. This little animal is itself equally carnivorous, and well fitted to seize the minute animals, which form its prey. These animals are distinguished by their great number of prehensile organs. Its six tentacles are provided each with about 3000 invisible filaments, each of ~~which~~ is furnished with about 20 suckers; thus each *Bllo* is computed to possess 360,000 ~~of~~ examples of that form of pneumatic apparatus, for the purpose of ~~prehension~~ or seizing - a complexity of structure considered, a perhaps without example in the animal creation. When the prey is drawn to the mouth, it is then reduced by a series of sharp strong teeth, not like those of a comb upon a pair of ivory jaws; and it is then drawn in to the gullet by the tongue, which is covered ~~with~~ regular rows of sharp hooklets all directed backwards, and evidently intended to assist in the act of swallowing.

46 Before going on to the next order, I will explain the few characteristics of the Gasteropods -

This class is an extensive class of molluscs and perhaps the most typical of their province, since they have its general characteristics, of a well developed nutritive system, and sluggishness of habits, in the highest perfection. They derive their name Gasteropoda, (~~from~~ the Greek words, one meaning the Belly the other, the Foot), from their organ of locomotion which is a muscular disk projecting from the abdomen, & capable of progress by alternate dilatations & contractions.

In the more ~~simple~~ ^{perfect} forms, there is a distinct head, with the rudiments of eyes, which generally appear as a couple of black spots, either at the tip of the horns, or at their base.

Most of the Gasteropods are marine; but some dwell in fresh water, and a considerable number, unlike the Mollusca in general, are inhabitants of the land, though usually found of ~~dry~~ and moist situations. Excepting in a few species the Gasteropoda are provided with shells. The shell is in all except a few, of one piece (univalve); besides which, the animal, has, in some instances a small (operculum) or lid of calcareous matter or horny, which it draws down upon the mouth of its shell, so as to close it up in.

The simplest form of shell, is when it is composed of a low cone, without any spiral; such is the case in the limpet. In an allied genus the *Pileopsis*, we find the ^{cone} pointed prolonged and somewhat rolled upon itself; and by gradual links of this kind, we are brought to ^{regular} the spiral of the snail. That spiral winds round a kind of central column, the *columella*, ascending in a direction from left to right, and sometimes prolonged in a lengthy canal, by which the animal may communicate with the circumambient fluid, without protruding its head from the shell. Cuvier has arranged the *Gasteropoda* in nine orders, according to their organs of respiration.

Order Pulmonata

We now go on to this order the *Pulmonata*. (*Pulmo*, a lung) Snails & Slugs the most advanced of *Gasteropods*, are provided instead of branchiae, with a vascular network of pulmonary vessels, fitting them to breathe the atmospheric air. Most of them accordingly, are land animals; and those which are aquatic - living chiefly in fresh waters and brackish pools - are obliged like the whales & seals, to come occasionally to the surface to breath. All the breathing *Gasteropods* feed chiefly on vegetables, and many of them exclusively so; but some are extremely voracious, & will devour almost any organised matter that falls in their way (see P. 40).

They further observe these nurses to be the produce of another intestinal worm in the Symnacea, one longer & more slender, and to which they give the name of the grand-nurse. Supposing these grand nurses to be the immediate progeny of the distoma, as is probable, we have thus a quadruple series of generations, each presenting an animal more or less peculiar in its form.

The family of Helicinæ (Land Snails) are among the most familiarly known of all animals. They possess a shell, generally much thinner than that of the marine gastropods, & into which they withdraw themselves under apprehension of danger or when at rest. They feed exclusively on vegetables by biting off pieces of the leaves by means of a horny plate attached to the upper lip; and their destruction is so great, in gardens, that man considers them as his enemy.

The common Garden Snail of this country (*Helix Hortensis*) is much exceeded in bulk by the Great Vine Snail (*Helix Pomatia*) of France & Italy which has also ^{been} occasionally found in Britain. More striking examples of the family are to be found in tropical climates, where some species of the genus *Bulimus* attain to such a size, that their eggs are as large as a pigeon's. In some species

the direction of the whorls of the shell are reversed. Another large
snail of tropical climates is the *Itchatina*, which feeds on
trees & shrubs & is generally distinguished by the beautiful colours
of its shell. - The family of *Limacinae* (Slugs) are naked
or unshelled snails, noted as the pests of gardens on account
of their great destructiveness amongst vegetables. The
slug has a prominent head, with four tentacula, and
at the end of the longer pair the eyes are situated.
These tentacula (usually called the horns) can be drawn in
by a process resembling the inversion of a finger of a
glove. On the back there is a kind of shield or disc, which
sometimes encloses a small shell, and under which is
placed the pulmonary sac or breathing apparatus.

~~REMARKS~~
for next order see Page 52

50 They are diffused through all climates, particular species being attributed to each. The aquatic Pulmonata have only two tentacula. The family of Lymnaeidae (Pool Snails) reside in stagnant water, feeding upon plants & seeds, and having, for the digestion of the latter kind of food, a very muscular gizzard. These well known molluscs are abundantly found in our own rivers & ponds, particularly the latter, as they seem to prefer the stagnant water to the running stream. It is not unrequently 2 inches in length. The form of the shell is oval, turreted, or conical; substance thin, smooth, and the spine pointed, an oval aperture extending widely from the front to the back; the edges disunited, the right side always sharp, the left with a very oblique plait or fold, at the point of junction, between the columnella and the remaining portion of the edge. The uniform characters of this genus, render it difficult to distinguish the species, but 17 or 18 have been described as inhabiting Europe & America; two have been mentioned as natives of India. Africa & S. America possess counter species, which remain unknown, from being too common to excite the attention of the traveller. This genus is so nearly allied to the Physa as to induce formerly to unite them; the only difference is that they their whorls turn left instead of right.

Another noted family - *Planorbis* (Marsh Snails) - are distinguished by having the coil of their shells upon one plane. They are very common in England. This genus may be divided into species, such as are keeled or carinated and those not so; *Planorbis cornutus* is a specimen of the latter, & *Planorbis barinatus* of the former. The species of this genus inhabit the lakes & ditches of Europe. Some are known in a fossil state.

The *Symnæa* is remarkable from its connection with a very curious phenomenon, in the reproduction of entosa, lately brought to light. The cercaria is a small parasitic animal, a little like a tadpole in form, which by means of a sucker, attaches itself to the body of the *Symnæa*, on which it lives. By & by, while in this condition, it is transformed into a kind of worm, with a double sucker, and is recognised as the distoma. We thus become aware, that the cercaria is a transient or immature form the distoma, as the caterpillar is of the insect. The question arises, What is the origin of the cercaria? It appears that, at a certain season of the year, the viscera of the *Symnæa* contain a quantity of little worms, of elongated form, with a well marked head, & in each of which are clearly to be observed a number of young cercariae. When these have reached a certain size, they leave the body of the worm, and escape also from that of the *Symnæa*, to fasten upon its exterior, there to pass on to the subsequent condition of distoma. Naturalists call the worm the nurse of the cercaria. ~~They further observe~~ (P. 48) (see page 48)

Bran chifra

We now go on to the Bran chifra which are divided into the following orders - 1 Cyclobranchiata - 2 Scutibranchiata

- | | |
|--------------------------------|---------------|
| 3 Tubuli do | 4 Pictini' do |
| 5 Heteropoda | 6 Tecti' do |
| 7 Infero Branchiata | 8 Nudi do |

We will commence with the Nudibranchiata and ascend.

The Nudi - (nudus, naked, branchiae gills); This order of gasteropods, which might be denominated sea slugs, have the gills exposed on some part of the back, in the form of a wreath, so as to exactly resemble, a bunch of vine leaves, whose stalks form a common centre. It includes all the naked marine gasteropods, as Triton, Doris, & Tethys. They are generally ornamented with beautifull colours. Besides moving about like other gasteropods, by means of their foot, or crevicle under side of their bell, in the depths of the ocean, some species - as the Tritons & Doris - have the power of swimming & crawling on the surface of the sea, with the foot uppermost. In swimming they are propelled, both by their branchiae & the sides of their body, which act in the manner of fins -

The Infra—Cirriferous, lower, & branchiae) have the gills situated beneath the extended margin of the mantle, and consisting of two long series of leaf-shaped organs. They are incapable of swimming, & are confined to the shore. Their food consists of seaweed. This order in the system of Cuvier comprehends only two genera—
Phyllidia & Diphilidia of which little is known

The Tectibranchiata (tector, concealed & branchiae, gills) comprehends those species in which the gills are folliculated on the right side or on the back. These animals are generally covered by a small bubble shaped shell, concealed in the folds of the mantle. They are all marine living chiefly on the shore, or on floating seaweed. They may be further described as thick, fleshy, soft molluscs, generally possessing a distinct head, furnished with a pair of ear shaped tentacles, and with the mantle usually dilated into two lobes resembling pens, with which they can both swim & crawl. Many of the species are very large, and when taken out of the water appear like great oval masses of flesh. This order consists of two families. The Bullidae (bulla a bubble) have the shell composed of so perfect ~~that~~ as sometimes to be capable of receiving the greater part of the animal & it is always more or less convolute. The genus *Bimastilla*, is a large genus established by Dr Seach, & it inhabits the Indian seas.

54 There is no trace of shell & the animal is thus described: - the body sub globular, the lower part offering an oval formed space, circumscribed by thick lips, indicating the foot, the upper part with a thick edged oval slot, symmetrical & formed by a complete union of the swimming appendages of the mantle, communicating with a cavity in which are found a very large pair branchia & annus, four divided & branched tentacles, besides two buccal appendages. The *B. Leachi* here figured is the only species known; it is classed by de Blainville, in the *Paracephalophora* third order *Monoplanobranchiata* second family *Aplysiacea*. The *Aplysiaceae* possess a mere rudimentary shell, resembling one half of a bivalve. The upper tentacula probably suggested the idea of the ears of the hare whence the common name sea hares given to these animals by the fishermen in most countries.

Order Heteropoda — This order comprehends those gastraeopods ⁵⁷⁵ which have the foot compressed, & in the form of a thin vertical fin. The branchiae which are ~~fin-like~~, are situated on the hinder part of the back, directed forwards; and immediately behind them are the heart & liver & viscera. The body is gelatinous & transparent, with a muscular covering elongated & generally terminating in a compressed tail. The genus *Barnardia* (earinae a Bell) are characterised by having the heart, the liver & the gills protruding from the body, and increased in an extremely fragile & beautiful shell, the convexity of which is terminated by a single keel whilst the tail is furnished with a sort of fin which performs the part of a rudder. We will give a short description of the *barnardia* from the British Cyclopaedia.— *Barnardia*.— This singularly elegant mollusc has been considered by many authors a species of the genus *Argonauta*, from which it essentially differs, as the following description clearly points out. The shell is symmetrical, extremely thin, a little compressed, without a regular spine, but its summit slightly recurved backwards; the aperture oval & very retired; the substance of the shell is semi-transparent, and of a glowy appearance, and may be at once distinguished from the *Argonauta*, by having a single keel, and the apex or spine, never entering the aperture. It only partially protects the body of the animal which is lengthened

156 backwards from the nucleus to into a true tail, furnished with a vertical fin at its extremity; the head is very distinct, with two long conical tentacula; it has two visible eyes, the respiratory organ & the nucleus entirely enveloped by a mantle, with lobed edges.

~~In the plain~~ Three species are known the *C. vitrea* so called from its glass like texture; the *C. Fragilis*, from its extreme delicacy; and the *C. cymbium*, or boat shaped carinaria, which is not larger than a grain of sand, & can only be seen by the aid of a magnifying power; one inhabiting the African seas, another the Mediterranean and the third, considerably larger, is found in the Eastem Ocean. At one time this molluse was ~~comparatively~~ incomparably rare, & large prices given for it, but one of its species has latterly been more frequently met with. Many specimens are now existing at the Ville and its inhabitants, & are beautifully displayed in spirits, maybe seen in the splendid museum of the Royal College of Surgeons.

The genus *Fivolis* in general resemble the carinariae but no shell has been observed. Their snout is prolonged into a recurved proboscis. They are common in the seas of the warm or temperate latitudes.



57

Order Pectini— (pecten a comb & branchiae, gills).— This is the most extensive order of the class, since it includes almost all the spiral univalve shells, as well as several which are merely conical. The order is thus characterized by ~~curves~~: the branchiae composed of numerous leaflets or fringes, ~~hunged~~ parallel, like the teeth of a comb, are applied ~~to~~ in two or three lines, according to the genera, to the floor of the respiratory cavity which occupies the last whorl of the shell, and which communicates outwards by a wide ~~aperturum~~, between the margin of the cloak & the body. They have two puls., & two eyes, raised sometimes on pedicles with a mouth in the form of a proboscis more or less lengthened. Under this order, the species of which are mostly carnivorous are placed eight Families.

1 The Trochus family, Trochidae (τροχός, a whorl or top), are so called from the pyramidal shape of their shell, which resembles a top. The whorl for the body is flattened, and the aperture is closed by a horny operculum, or some analogous part. The species are all marine. Some of our most elegant British univalves, and many of the most ornamental exotic shells, belong to this family. They are remarkable for boring with their proboscis into the shells of other molluscs. The Buckle is perhaps the best known example.

55
The marine snail family (Turbinidae) are characterized by having a shell of a regular turbinated form generally much elongated, and a mouth entirely circular. With respect to their habits, it would appear that they frequent submarine banks covered with sea weed, and are all vegetable feeders. A few are natives of fresh water, and a limited number ~~are~~ ^{are} marine. They are found in great abundance in the Indian seas, and are used as food, many being of large size. The winkle is a form of the family, with which all are familiar. Another genus the *Scalaria*, is remarkable for the beautiful & striking form of its shell, one example of which, has been valued at a hundred pounds. We will give a short account of this shell taken from the Cyclopaedia (British). - *Scalaria* -

This mollusc has been commonly called the winkle-trap, a corruption from the German word Wendle-trappe, a winding staircase. At one period large sized examples of it were very rare, and no shell ever produced a higher price, the enormous sum of one hundred guineas having been given for a specimen, which at the present time would find no purchaser at as many shillings. This shell is now by no means rare or an

ordinary size; it seldom exceeds more than $2\frac{1}{2}$ inches, but when it reaches $8\frac{1}{2}$, it is of very rare occurrence, and still bears a size of out of all proportion to the smaller specimens. —

The *S. scalaria* are marine shells, their spiral is more or less elongated in the different species, but in all, the succeeding whorl is always larger than the preceding, which occasions the twisted form of these shells to differ from the cylindrical shape of the *Nassa*, to which in some other respects they may be said to possess a resemblance, particularly in having numerous ribs on the whorls. The aperture of the *S. scalaria* is round or nearly so, sometimes a little more depressed on the inner than the outer side; the edge of it is thickened, sharp, and outwardly reflected at right angles, and then appears a very slight indication of a groove or canal on the columella side not mentioned by Fauvel or other writers; they possess an operculum, but it is extremely uncommon to meet with it, as the animal is rarely imported with its shell. The *S. scalaria Pretiosa*, which, from its name, implies its estimation, is very singular for its umbilicus, and the separation of its spiral whorls, which appear like an attenuated tube spirally enrobed round a cone. The whorls are drawn out, and some examples have been met with, in which the whorls do not touch each other in any sense.

They are however, ordinarily, touching or connected together, by the longitudinal ribs, formed of the previous termination of the aperture. The family Capulidae have a shell with an expanded opening, and but slightly turbinated, without operculum notch siphon. They do not appear to remove from the spot to which they are first attached, a cavity more or less deep being formed in the surface to which they adhere, either by the chemical agency of some salient fluid, or by the long-continued operation of currents of water.

The volute family, Volutidae (voluta, a spiral wreath), form an extensive and interesting group, having beautiful shells, but all of them decidedly carnivorous. In the majority the eyes are sessile placed at the base of two short tentacles; & the mouth is of a trunk form & extensile; while the foot in the typical species is of enormous size. They are almost confined to warm latitudes.

The cowry family (Cypracidae). - From the polish of their surface, & the beauty of their markings, the shells of the cowries are in considerable request, as mantle-piece ornaments, and have been in demand in most countries from time immemorial. The shell of ~~one~~ ^{one} species of Cowry, *C. Moneta*, is commonly used by the natives of certain parts of Africa, and other semi-barbarous regions, as money. It is yellow, or white with a yellow ring, the margin & base, being tubercular.

The Whelk family (Buccinidae) comprehends all the shells at the columella or lip, but a notch or short inflected ~~the~~ canal, towards the left. The mollusc is of a spiral form, with the foot shorter than the shell. The head is furnished with two tentacles, and the mouth is armed with a proboscis. The common whelk abounds everywhere on our coasts, where it creeps about in search of prey, boring holes, with its trunk through the shells of other molluscs, and sucking their juices. This species is eaten, but is coarse and indigestible. (The British Except) The general characters of this mollusc are its being slightly covered with an epidermis, oval shaped, lengthened, and the spire moderately elevated; an oblong oval aperture, notched, and sometimes anteriorly subcanal inflated, the right lip thickened, not turned over, the columella plain, & nearly all seen. They are found in every part of the globe, and are used as an article of food, particularly in the northern countries. These molluscs are not remarkable for their bright colours, being for the most part of sombre tints, and inhabitants of cold climates; but their great diversity of form, delicacy of sculpture, & pencilled markings, render them highly interesting, to the mere collector of natural history, without a reference to their more scientific examination.

To this family (Whelks) belongs several other shells as the Buccinum, Cenithium, Melanopsis, Planaxis, Subula, Terebra, Eburna, Harpa Dolium, Cassidaria, Basis, Ricinula, Callianaria Purpurea & lastly Concholepas, all of which have notches or inflected canals.

We have not time to say any thing about most of them, but as the Harpa is such an elegant shell we will say something about it. There has been a little discussion as to whether Linnaeus was right in placing these molluscs under this genus (Buccinidae) for although there is a notch on most of these molluscs, yet they are ~~somewhat~~ ^{somewhat} different in the structure of their animal. Yet we will put them all together as all having notches and ribs along the shell. These ribs in the Harpa's are longitudinal parallel ribs, which are compressed sinuous, & sharp; the upper extremity of each armed with one or more projecting detached points, giving the spine a coronated appearance; the form of the shell is oval, more or less inflated; the aperture with a notch at the lower end of the canal; the columella is smooth, flat and pointed at the base, the last whorl larger than all the others united, the right side deeply excavated.

Another family belonging to this order is the Spindle shell family Muricidae (more, the purple fish) have a univalve aporal shell, with

a small oval aperture, ending in a straight or slightly ascending canal. The splendid shell of the *M. Regius*, which is found along the western shores of South America, is one of the ornaments of the cabinet of the conchologist. The Muricidae, together with the Buccinidae, appear to be destined to keep in check the superfluous numbers of the bivalve molluscs, and herbivorous gastropods, by dulling their shells & draining their juices. In the Murix & other molluscs, we see regularly formed spines, or protuberances, at given intervals around the ~~the~~ spiral form of the shell. Each of these it is quite clear, formed previous to termination, & became successively closed, as the increased size of the animal required more room. These additions go on with the greatest regularity and correspond accurately, in all the species, with the exception of some few, which may be considered sports of nature and not generic distinctions. By counting these Periodical ~~are~~ additions, we come to the same conclusion regarding their age as with the Wintletrap. In the Strombidae, the aperture of the shell, is much dilated; the lips expanding, and extended into a groove leaning to the left. The Strombidae are carnivorous in their habits, and are tenants of the seas of hot latitudes.

The number of species is considerable, and many attain to enormous dimensions. In several of them pearls have occasionally been found.

The Corallidae form an extra genus or family comprising many species, one of which, the common lime, possesses a shell of uncommon elegance of form, & rendered additionally attractive by fine colouring.

Order Tubuli - (tubular, a small tube, & branchial, gills) are so called from having long tubular shale like shells, more or less irregular, in which the branchial or gills are lodged.

These animals are permanently attached to other bodies, and have no power of shifting their station. In the genus Magilas the young animal takes up its station ~~in~~ in the hollow part of a madrepore, and increases its shell in length as the madrepore increases around it; keeping the aperture even with the outer surface of the coral, and thus securing free admission to the water (British Ecol) - Magilas.

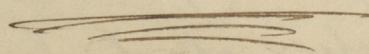
Order Scutæ — (Scutum, a shield, & banchæ, gills) derive their name from having the gills covered with a shell in the form of a shield. The Fissurellidae (fissus divided) have a shell shaped like that of a limpet, but with a fissure at the apex of the cone, and this opening is associated with a different form & arrangement of the breathing organs. (B. Ceph.) *Fissurella*. This shell exhibits a very striking illustration of the wisdom of the present system of Classification, since it differs in many important respects from the patella, with which Linnaeus had confounded it; taking in this as well as in every other instance, the form of the shell, without any reference to its parent architect. Shells of this genus are in the form of a very depressed cone, truncated, cone, oblong or elliptical, & perforated at the summit, vertically towards the anterior part; the ~~anterior~~ surface is in connection with the animal's mantle, & never quite circular, but more frequently long, & oval shaped, & sometimes resembling a key hole, whence they are familiarly called key hole limpets. The margin of the shell is thickened and sometimes excavated, and the exterior surface longitudinally ribbed, and sometimes striated transversely. The ear shell family, of which *Holotis* is the type are furnished with a handsome ear shaped shell.

its thin shell is to be met with in my collection, a minute description of it in scientific language would here be useless; we will nevertheless give its general characters. The substance of the shell is internally brilliantly nacreous; it is extremely depressed, more or less of an oval shape, with a very small apical termination, and very flat. The aperture is the full size of the shell; its edges continuous, the right one thin & blunt, the left flattened, enlarged, and sharp, parallel to the left side; a series of holes exist, which serve for the passage of the two pointed lobes of the animal's mantle. There is only one great muscular depression. The animal is entirely covered by its shell. As the increase of the animal's size requires, an extension of its protecting covering, a new hole is commenced, appearing at first only a notch, on the margin, afterwards completed as the growth of the shell continues, and others are formed in succession while the peristome nearest the spine, is carefully closed in the same succession, leaving however, in almost every instance six holes at the same time open. When the animal is at rest it adheres to a rock like the limpet, and can only be detached by a sudden effort. So perfect is the vacuum formed by the animal

that it would again at least a ton weight to force these shells from their resting place, could the substance of them withstand of them notwithstanding the application of the necessary mechanism. Its body is of a very depressed oval shape, slightly turned backward; it is provided with a large foot, doubly fringed round its circumference; the head flattened, tentacula conic at the base, and a little flattened; the eyes are placed at the ^{inner} ~~summit~~ of prismatic peduncles, situated on the external edge of the tentacula; the mantle is ~~very~~ very thin, deeply divided on the left side, and in closing two very long, unequal, bronchial combs. See (B. Cyc.) Their range is south of Britain as far as the Canaries. They are cooked for food, but a more important use of them is in making those mother of pearl ornaments which constitute so much of the beauty of works of paper-mâché.

Order Cyclobranchiata ($\kappa\omega\lambda\delta\sigma$, a circle, & $\pi\alpha\gamma\pi\alpha$ gills) - In these gasteropods the gills consist of little tufts or pyramids, attached in a circular arrangement to the inner surface of the margin of the mantle - The limpet family (Patellidae). Among them we find the power of locomotion at its lowest ebb, for they seldom move far from the spot on which they were produced.

and many of them from the shape of the shell corresponding to the surface of the rocks, appear never to have left it. The common limpet (*Patella Vulgaris*) is universally distributed around our coasts. It subsists on sea-weeds of different kinds, living on the surface of rocks and stones between tide-marks. It is sometimes used for food, though much too tough to become a delicacy — The Chiton family, *Chitonidae* (xivwv), a garmmetae characterized by a series of testaceous symmetrical plates, implanted in the back part of the mantle. Guilding says these animals live on rocks and stones of the sea coast, and are distributed nearly over the whole globe. Many species are constantly under water, while others ascend above high water mark, spending the day exposed to the hottest sun, or resting in spots occasionally moistened by the ebb and setting surf. They seem to feed entirely by night. Though they remain stationary during the day, yet when disturbed they will often creep away with a slow and equal pace; sometimes sliding sideways, and creeping under rocks & stones for concealment. If accidentally, they soon recover their position by violent contortions & undulations. They sometimes roll themselves up for defence. — (See B. Ceph) —



Class Cephalopoda

This class is so named from the way in which their limbs are arranged round their heads of the animals it contains. These limbs in some eight, in others ten in number, perform all the offices of feet, arms, and fingers, and in many genera they are used also as fins. The head, from the arrangement of the limbs, is in the centre, like that of the radiata. They are, nevertheless, the most highly organised of invertebrate animals, presenting rudiments of an internal skeleton, developed for the purpose of protecting a brain and lodging organs of sight, and in most of the existing species, organs of hearing. They possess distinct hearts for the systemic and pulmonary circulations, and highly complicated digestive, secretory, and respiratory organs. Their head is large and conspicuous. All the species are marine and carnivorous.

Order Dibranchiata (Sis, two-fold, and Belexia, gills). This order includes those species which have two gills, and are characterised by having three distinct hearts, an apparatus for secreting & emitting an inky fluid, and cephalic arms, never above ten in number, solid, and supporting suckers — The most typical form of this order is the cuttlefish Sepiadae (Sepia, a cuttlefish). These animals have monocular arms, which are also used as legs; by these they crawl with the greater facility

on the bottom of the sea, swim quickly, in the water, and retain a forcible hold ~~of~~ the animals upon which they prey. Their eyes are large, and fully developed, like those of the vertebrated animals. In size, cuttle fish far exceed all the testaceous molluscs, and may be termed ~~as~~ the giants of the Invertebrata. If the accounts of the old Indian voyagers be true, there are some of such enormous dimensions, that they seize upon the divers, entangle them in the folds of their ~~the~~ serpent-like arms, and finally devour them. These stories are greatly exaggerated; but it is well known that many have been caught of such a size, that two of them would be a good cart load. The flesh was prized by the ~~natives~~ Indians, and in many countries, though not in Britain, it is still used as an article of food. The common species forms the bait, with which one half of the cod fish taken at Newfoundland ^{are} caught. All the varieties of the Sepiae yield a dark-coloured juice; and the typical species *S. officinalis*, is chiefly sought after for the preparation of bluc'd which it affords. This juice forms a beautiful brown colour, with a fine grain, and has given name to a species of drawing, now very much cultivated for landscapes, and other branches of the fine arts. Sepic drawing was first practised at Rome many a century ago. From the rudiment of their calcareous shell imbedded in the back of the mantle, the material called prouuce is made - a powder used to prevent ink from spreading.

on paper after ovaries. The eggs of the cuttle fish are attached together in clusters, and are commonly called sea grapes.

Order Tetrabranchiata (four-gilled) consists of only one family, Nautilidae (naus), a subfamily of which the genus *Nautilus* is the type. Its form is spiral, discoid, the whorls contiguous the last enveloping the others; numerous cells, separated by a thin pearly partition, or transverse septum concave on one side, and prepared by a siphon running through them all. Some species are umbilicated, but none are known to be mammillated. In the fossil species the divisions of the shells form external ribs, and assume a great variety of sculpture; but in the recent species these divisions are but slightly visible; and when the shell is deprived of its exterior coating, and the pearly substance displayed no trace of these separations can be discovered. The animal inhabiting this molluse, only occupies the last open division of its shell, being attached to it by means of a tendinous or muscular appendage, which passes into the siphon; the mantle is obliquely opened, and prolonged into a kind of hood above the head, which is provided with tentacular appendages, as if digitated, and surrounding the

aperture of the mouth. In the fossil genera of the Nautilaceæ two syphons, are found to penetrate the cells, but we do not know of any living species presenting more than one. Much speculating of opinion exists as to the habits of this mollusc, which is described as sailing before the wind like a vessel; and it is by some conjectured that the empty cells contain air or water, which the animal can voluntarily expel, so as to render its habitation sufficiently buoyant to rise to the surface of the waters. Other naturalists are of opinion that the shell is nearly enveloped in the mantle, and the animal carries it on its back, in the manner of the snail, crawling habitually at the bottom of the sea, which it only quits, from peculiar circumstances of necessity or convenience.

The late ~~beneath~~ Mr. Bennet captured one of these animals attached to the shell; and Professor Owen has published a most elaborate and interesting description of its structure, which we will not mutilate by partial extracts. A singular part of its formation is what has been termed the beak, that is a hard portion resembling the parrot's beak, by means of which this mollusc possesses the faculty of crushing smaller shells, cuttages, &c indicating its being carnivorous. —

The cephalopodous molluscs bore a conspicuous part in the earliest ages of creation, of which we have any record - what geologists term the Palaeozoic period. In the absence of fish, they were the chief destructives, and some of them attained a size truly monstrous. Of their fossil shells the Ammonite is a well known example having a spiral coil; though supposed to have been an internal shell, occasionally measures four feet in diameter. It is a discoid shell, more or less compressed, the spiral turns more or less evident, & convex, the aperture more or less expanded, the partitions or septa constantly sinuous with a dorsal siphon. They are variously sculptured, but the greater portion of them resemble the marks of progressive growth or rings observable on the ram's horn, from which circumstance they have probably derived their trivial name, of Cornua Ammonis, a ram's horn. Another well-known fossil relic of this class is the Belemnite, which is believed to have been likewise ~~an~~ internal structure, forming the rudiment of a vertebral column. This fossil is found in great abundance, in most of the formations from the sea upwards. The origin of these singular productions, has at all times, been involved in great obscurity, as nothing analogous to them in form has been observed among living animals.

and it is curious to observe the different opinions which mankind
in various ages have held respecting their production. They were
known to the ancients. They were known by the name of Idæus
Dactylus. Among the northern nations it was a common opinion
that these stones were petrified fingers, fabricated by demons,
in order to be used in those mysterious rites, of supernatural
agency of which their fierce & gloomy superstition postured the
belief. By them they were designated by terms referring
to such agency, their common names being those of
"Devil's Fingers" "Spectrum Candela" &c. As fossils came
to be better understood, the belemnite was supposed, on account
of its conical cavity, either to be the remains of the tooth
of some unknown animal, or as it was usually found as-
sociated with marine productions, a spine similar to
that of the echinus. When at length, with the advance
of science, it came to be considered as the remains of a
terrestrial animal, new theories & conjectures arose. It was
first supposed to be a dentalium then a limpet; but further
observations at last, proved it to be the remains of a
univalve shell, divided into chambers, pierced by a tube, and
similar in their construction to those of the Nautilus, which

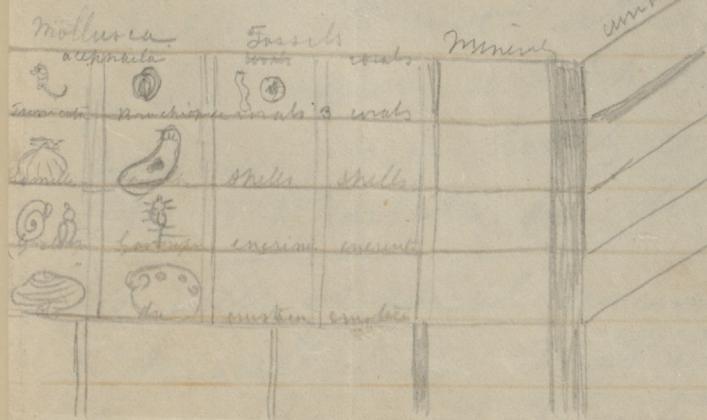
was inclosed in an outer case or sheath, having a sparing mineral structure, radiating from an axis, passing perpendicular through the fossil, which in its most perfect state is formed of carbonate of lime. When perfect, it presents the appearance of two conical shells, the apex of the one being inserted into the base of the other. Its general appearance is that of a straight ~~bent~~ elongated, conical shell, formed of two distinct and separate parts. The external being a solid sheath, having a conical cavity cavity in the upper part, which contains an internal, conical nucleus, which is pointed and chambered transversely through its whole length. The chambers are slightly concave on the one side, & convex on the other, perforated by a lateral siphuncle.

The outer case is most commonly found without the nucleus, being merely the ^{sheath} of the internal conical mass; its form is that of a long cone more or less pointed; and it often has a lateral groove; it becomes solid as we approach the apex, whilst the base is perforated by the conical cavity, before mentioned, for the reception of the multilocular nucleus. The cavity is not always placed in the center of the cone, numerous instances ^{are} known of its being placed ~~on~~ at one side, and a division passes from its point, to the apex of the cone. (see B. *bypa*) for particulars.

Articulata

The Articulata (*articulus*, small joint), or jointed animals, rank much on a general level with the Mollusca; but being allowed to have a superiority in the nobler parts of the animal structure, they may be arranged as third, instead of second, in the ascending scale. They are characterised by having, in segments and by the greater number of them possessing an external skeleton of some, adapted to the segments of their bodies, and to which muscles are attached. While the vegetative portion of the frame - namely, the organs of nutrition & circulation, are more largely developed in the Mollusca, the organs of the animal powers, the nervous apparatus, & arrangements for locomotion, are more largely seen in the Articulata. They have a symmetrical double nervous cord extending along the whole body, studded with knots or ganglia, from which proceed branches to the various segments, and terminating anteriorly in a kind of brain, in the form of a ring surrounding the gullet. The articulata are consequently distinguished, by comparative activity of movement, one large class - the Insects - possessing generally the power of rapid flight in the air.

This department of the Animal Kingdom, is also noted
 for many curious forms. Some of its orders
 consist of distinct species. Some are
 mankind; but a large proportion
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 divided into the following classes -



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 - 1. Trachinida - 2. Insecta - 3. Crustacea - 4. Tubicola -

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This department of the Animal Kingdom, is also noted for the immense variety of its forms, some of its orders presenting many thousands of distinct species. Some are strictly beneficial to mankind; but a large proportion chiefly attract attention by their great powers of tormenting, & the injury which they can inflict. These noxious qualities, however, are chiefly experienced in warm climates.

The Articulata are divided into the following classes -

We will as usual ascend the scale -

1 Anellata - This is decidedly the lowest form of the articulata. The body consists of a long series of segments, without any hard casing, and without any limbs. The first segment forming the head, usually differs little from the rest, except by the presence of the mouth, and the principal organ of sense. The blood is coloured, but though often of a reddish hue, (when salts of iron are present) it is found on microscopic examination, to be differently constituted from the red blood, of the vertebrated animals, not possessing ^{red} globules. ~~of red~~. The Anellata are divided into four orders -

1 Suctoria - 2 Tenuicola - 3 Acoelaria - 4 Tubicolae -

- | | |
|---|------------|
| 1 | Trachinida |
| 2 | Insecta |
| 3 | Braustacea |
| 4 | Biripedia |
| 5 | Copezoa |
| 6 | Anellata |

~~1~~ Suctoria - Leeches - This order is destitute of all ~~regular~~ external organs of respiration, but they breath from the surface of the skin, or as some suppose, by interior cavities. These ~~molluscs~~ animals live for the most part at the bottom of the sea, or in fresh water; but a few live reside in humid ground. This order contains one family the (Hirudinidae) or Leech family. They are destitute of all limbs, they have an oblong body, sometimes depressed & wrinkled transversely; both ends are provided with suckers, by means of which they move when out of water. When in their native element they swim with facility. The alimentary canal in these animals adheres to their skin. The mouth is in the center of the anterior sucker, it contains three rows, ~~of teeth~~ each armed with a double range of very fine sharp set teeth, which enable it to pierce the skin without inflicting a dangerous wound. The leech has a sack or stomach in each section, the last one being larger than any of the former. Along side of the stomachs, small openings, each leading to one of the stomachs, they are supposed to be for the purpose of secreting the fluid of the leech, also for the protection of the ova. Circulation performed by canals, ~~is~~ running around lengthways & across. The blood circulates from the head to tail;

(Earth worms) This order comprising
the ~~annelids~~, & the Earth worms, are remarkable
as provided with ~~having~~ silky bristles. The common earthworms
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the one that runs along the animal lengthways is called the, dorsal, the one which communicates with the sides of the animal, lateral. The animal is provided with eyes. The nervous system goes from them round the gullet, along the back in a double string, and then branching out, to the head running along the sides, each eye has a distinct nerve to it. The food of the leach is, aquatic animals, they feed by fastening on their prey and sucking out their juices. The trade in leeches is carried on to a great extent, it has been related to good authority to be in England 7000,000 per annum. The name of the medicinal leach that is exported is (*Hirudo Medicinalis*). In summer leeches retire into deep water, and are taken by nets made of twigs and rushes. They are very common in the South of France. —

2 Order *Terracola*. (Earth worms) This order comprehending the aquatic genus *Nereides*, & the Earth worms, are remarkable as provided with ~~having~~ silky bristles. The common earthworms are of marked importance in the economy of nature. But before taking up ~~either~~ any example, we must give the chief distinctions of this Order.

The animals of this Order are distinguished by having rings provided with bristles, and no suckers. It is by means of these bristles that the worm walks, as the leech does, with suckers. They also use these bristles for passing themselves into the ground throw out the ground, as they work in, with their bristles. Internal organs like the leech, very large stomach, but not eyes, as the leech has. These Earth-worms are of great importance to us, for they turn up the ground ~~by what~~ and bring up the finest soil to the top, the small mounts of a ~~size~~ ^{slimy} character, that are seen at the mouth of their holes, is of the finest soil brought from below, above; and they loosen the earth, rendering it previous to air & water, as well as to the fine fibres, of the roots of plants; they also ~~are~~ ^{are} great instruments for adding to ~~the~~ depth of the soil. For example it is a fact well known, that lime or marl, put on pasture land, is in a few years, buried to the depth of some inches below the turf. This is not as many suppose, that the particles have worked themselves down, but is owing to the digestive process, by which the common earth worms ~~are~~ are supported.

Therefore it is easily seen how a stony ground can be turned into ~~useless~~
good ground. They subsist on decayed animal, & vegetable
matter, which they find at a considerable distance below the surface
of the ground; and after having separated, the serviceable
portion, from the rest they come to the mouth of their holes,
and eat the remainder, in little intestine shaped ~~shades~~ ^{shades}.
In one instance it was ascertained that in the course of
80 years they had covered a field, with a bed of earth 13
inches in thickness. They also supply food to Birds &
other animals.

Sea-antepeds-sea-mice
Order Brantia ^(Wandering Seaworm) - The animal of this
order have their gills or breathing organs projecting from the
middle parts of the back or sides of the body, where they
assume the forms of little ramifications, tufts, plates or
tubercles. The greater number of these species of this order
live in the mud, or freely swim in the ocean; but a few, like
the next order live in tubes. Some are confined in their movement.
In this ~~organ~~ Order we have a greater development of locomotive
organs; they have strong lateral jaws, working from side to side
as in all the Articulates. Each joint has a foot, with bunch
of bristles attached to it; bristles are pointed and provide with a claw
for seizing upon their prey. They use these ~~long~~ bristles for swimming,

and for walking. They are found under stones and logs lying in damp places. They are the chief food of fishes. Certain of them are used for fishing (*Lumbricus Marinus*) are found in sand, on our coasts, are about a foot in length, and of a reddish colour, & emit, when touched a quantity of yellow fluid, has three pair of gills.

One of the most interesting families of this order is the Nereidae or sea centipedes, many specimens of which occur on our own coasts. Some of the Nereids exhibit a singular peculiarity in their mode of propagation. The hinder part of the body, being gradually transformed into a additional animal, is cast off by spontaneous division. Able to repair injuries, the Head can be cut off many times. Although these animals divide, yet for the most part reproduction is by ovula very like worm.—

4. Tubicolae—(tuber, a tube, & colo inhabit) are so called because they generally occupy tubular sheaths, consisting either of calcareous matter, secreted from their own bodies, or of particles of clay, or of very fine gravel, agglutinated together to serve has a habitation. They are further characterised by thin branchiae or gills being attached

to the head or anterior portion of the body. These are in the form of a plume of feathers, and generally vividly colored. The most common tubicules on our coast are those which belong to the genus *Serpula*. They are found incrusting the surface of stones & shells which have been dredged up from the bottom of the sea. Professor Jones remarks: If, while the contained animals are alive, they be placed in a vessel of sea water, few spectacles are more pleasing than that which they exhibit. The mouth of the tube is first seen to open by the raising of an exquisitely constructed door, and then the creature cautiously protrudes the anterior part of its body, spreading out at the same time two gorgeous fanlike expansions of a rich scarlet or purple colour, which float elegantly in the surrounding water, and serve as branchial or breathing organs. But of two kinds, hooked & elongated claws which help it to push itself out of the shell, and has muscles to draw it back, so that you may easily imagine that it goes out slower than it goes in, these claws have saw-like teeth.

Class Episoa

The Episoa are small ~~free~~ animals found about the gills of fishes & their skin, especially on the salmon, cod fish. The peculiarity of these animals is that when young they are free moving animals but when adult fixed & deprived of all their limbs, even their eyes, which they had before. They are very numerous animals, their general structures are similar, all are put in one order. Their general length is about $\frac{1}{2}$ inch long including theirova sacks. Here for the first we approach near to insects, for these animals have heads, thorax & abdomen, theova after it is kept for a short time in the body of parent is sent forth into ovaries. There is others again oval wth an inch similar to the last we have been mentioning nearly, but it has, anterior of the head ~~stomach~~; horny jaws; heart bottom thorax ovaries of this one at side, instead of behind as in the other. The male (for this is the female we have been describing) is much smaller; free; born on ~~other~~ fishes, when it attaches itself to a fish it generally stays their all its life. Eggs large, young something like spider, 8 legs with bristles; eye spine, mouth lower part of animal, all oval, bigger as oars. 2 stage (*at the end ~~of~~ of each stage casts skin) small, oval abdomen, at the end of this

stage it buries its skin and a different animal (different form)
breaks forth, swims by rapid jerks, when this animal
has seized upon the fish it is going to settle on it seizes
it with its claws, when it has once fastened upon a fish
from that moment it ~~no~~ ceases to be a free animal
the time to drop off one by one, till it is destitute of every
thing, it then increases in size.

Gloss Brachopoda

(Cirrus, a lindtli, & No. 3, a goat.) These are a family of
crustacea, of such peculiar & dubious form that till lately
they were classed as molluscs. However we will take them
as a class by themselves. We will take the Barnacles
first, belonging to the first order - 2 Lepididae - Lepas
Order Balanidae - We will take as example of this,
the genus *Balanus*. These animals are attached to shells, stones,
it has a sort of plate for a base, by which it attaches itself
to rocks &c, ~~so~~ it has overlapping edges, thickly giving to the
shell ~~a~~ strength. Surface of the shell has 6 prominent
areas, 6 depressed; the depressed are thin, prominent thick.
The edges overlapping in that manner, make it more easily increased
in size, without adding like the ichneus to the plates.

Carina piece at side; Postum broad piece. At the top
of these shells is the accessory or beak, which opens to let
out the beautiful feathered antennae. Though parts are
thick it is not solid, but it is very strong, the sea
shore is covered with these animals. The arms which come
out of the beak are for determining currents of water to the
animal. 2 Order Lepadios - genus Sepas - a calcareous shell,
attached by stalk, differing from the Balanus in this respect.
The Sepas Antipera - literally, the goose-producing; a name
records one of the most remarkable delusions of the early observers
of animalia nature. This shell is found attached to ships
bottoms & stones, drift wood &c. Five plates grow from center
to circumference, carina along back, 2 scutia or shield,
2 Terga back plates. The stalk of this animal is flexible & possess
the power of fixing itself by a glutinous secretion, head bottom of
cell, animal doubled up is still so that when it hangs down
the mouth may hang in its proper place, palis, horny jaws,
working sideways, ciliated feet, intestine doubled up in shell
6 pair of jointed ciliated feet, small plates are at the bottom
of feet supposed to be gills. Stalk muscular, nervous system

runing, form ring round gutlet, down back double strings,
then branching out. Eyes, small, no eyes, sensible to light
Mode of reproduction curious. The young are free like the
crustaceans, oval, flat expansions for swimming, limb used
as ears, 2 ~~other~~ appendages, hirsute, a advance of mouth
is the eye. Second pupa stage, bilateral, sort of bivalve
shell, 2 eyes, 6 hair feet, tail condensed to two short
appendages, suckers for attacking itself, swim by motion
of feet. When the animal fixes itself the feet are
used for making currents, throws out glutinous matter
which in process of time forms sort of shell. 3 stage
throws off limbs becomes fixed animal, casts skin. We have
now gone through the different processes.

Glass crustacea

The crustacea are very numerous and include all soft shell
fish as they are called, such as Crabs, Lobsters, Shrimps &c.
They have articulated body & limbs, large buckles, we now
come to those animals which have for the most part a
buckle over their anterior portion instead of shell, abdomen
& kind of pointed buckle. These animals are never fixed,
the head is provided with antennae, large eyes on pedestals.

they have a fin for swimming, place for spawn under tail;
This class is divided into two groups.

- 1 Entomostraca - This group includes a good many orders.
2 Malacostraca do do do do do do
-

2 Malacostraca - There ~~for~~ are small insect shells
for example the shrimp. All the Malacostraca have 14 seg -
1 Entomostraca have ~~always~~ mostly more than 14 seg - They have
a coat, eyes sessile. This group can always be determined
by either more or less than 14 seg - The Entomostraca,
resemble the young Barnacle, but never as it becomes
fixed. 1 genus - *Hypphonura* - or sword fish - (*Simulus*)
The tail of the Simulus differs from the lobster & shrimp &c
in being of one piece, the buckler is of 3 pieces - covering
the whole body, an exceptional form - compound eyes, this is
the first we have had compound eyes, but when we come
to the insects we will se lots. Let us look into the eye of
the Simulus, first when we look at the top of it, we see
that it is quite hard, and part a continuation of the shell of
the animal, but much thinner than at any other part.

We see now that this is provided for the defence of the eye.
If we look into the horny covering of the eye of the stimulus
we will notice it is divided into a number of little plates,
and if we remove this covering we will see hair like tubes
from them to a common centre. Back of these tubes
are like so many small telescopes. Between each of these
of these tubes there lies a colouring pigment (black)
so that no ray of light may go from one tube to another.
These compound eyes are the side eyes, which out of
which it can see along its sides and all around about
its side, but out of these it can neither see directly in front,
nor directly behind. But then for the front it has two smaller
eyes, simple, on points, for front vision. Anteriorly this
animal has two nippers, 6 pair of feet, posterior feet for
retaining spawn, mouth, but has no real jaws, the mouth
is at the base of the feet in the centre, and it is very curious
to it grinds its food, the parts of the legs, which are in the
body of the animal have saw like teeth, which work one against
another and so grind the food. Stomach part of mouth.
So that you see this animal is something like the Barnacle

doubled up in its shell. The posterior feet also swimming organs. The tail can be erected by muscles when danger approaches, and it is rather a formidable weapon.

There is an allied genus to this found fossilized namely (Trilobites) they have three lobed bodies, but there is not much known of them being extinct years & years ago, there are some fossil tracks, however, supposed to be those of Trilobites.

2 Genus *Phylopoda* - body composed of segments, flat limbs, branchial & fitted for swimming, one eye. In the last genus we had respiration & mastication combined, now we have respiration & locomotion. Branchiopoda (includes fresh water animals) these are so called because the locomotive extremities fulfil the functions of gills. The majority of the animals of this order swim with the back downwards, darting about with great agility, & moving backwards and forwards with the greatest ease. Many exhibit only one eye as in the family Monoculidae or byclops. The type of this family is the byclops quadricornis. It is very common in the ponds and ditches of this country. It has all the antennae single, & not dividing the body oval, on the tail six jointed.

It is about one fifth of an inch in length. The female has an oval sack on each side of the tail, in which the eggs are carried. By calculation, it appears that, at the end of one year, a female, which gives birth to 40 young at a time, may become the progenitor of 4,442,189,120 young.

3 Gladio-cera - Poliphemus - huge eye-body doubled up large antennae for locomotion as well as touch & smell.

Swims by rapid jerks, reproduction - 2 kinds of eggs - Summer & Winter, cast skin in autumn, & one egg along with it, remains unhatched all winter, but hatches early in Spring.

4 Ostro-poda - 6 legs from shell, moves by these legs.

Bivalve shell - respiration & locomotion, size small abdomen is enormous. The shells of these animal are in abundance forming fossil shoals, adult from the first no change.

5 Copepoda - Byclops (one eyed) great antennae for locomotion & sense, feet for threefold purpose, locomotion, respiration & touch (fresh water). reproduce quick, millions in year. Sacks for protecting young, young state different from adult - one set little hairs, food for fishes. —

Malacostacea - is divided into 5 orders -

1 Laemodipoda - sessile eyes - Genus Caprella
which differ from the rest of the family, in
having their body, of a very narrow & linear
form, the composite eyes placed behind,

the upper antennae & ocelli wanting, and the legs long & slender,
& variable in number, the ^{end} of the second pair, being often
~~noticed~~ walked on the ^{under} other side. These curiosities
are of comparatively small size, seldom exceeding an inch in
length. They are generally found among marine plants,
creeping along, according to Otto Fabricius (*Fauna Greenlandica*)
in manner similar to the looper caterpillars, throwing the
head backwards in various directions, & vibrating their antennae,
when swimming they bend the extremity of their body.
This family comprises three genera: - 1 Septomera (Fabricius)
Proto (Beach) having the legs fourteen in number, placed in
a regular series. 2 Naupredia, having the legs, only ten in
number, placed similarly, the second, third & fourth pairs, being
furnished with a basal vesicle. 3 Caprella, having ten legs
but placed at ~~intervals~~ irregular distances, the second & third

- 1 Decapod
- 2 Spinopoda
- 3 Amphipoda
- 4 Isopoda
- 5 Laemodipoda

segments being destitute of legs. To the latter genus belongs
the bancer *Phasma* of Montague, (*Lanaria sinensis*) described
by Mr Montague in the seventh volume of the Linnaean
Transactions, by whom the following observations were made
— the female differs in possessing several plates or valves
beneath the body situated between the two pairs of pins, the
use of which is to carry & protect its eggs or young, at which
time they expand very considerably, and form a kind of
pouch, distended with ova, fifteen or twenty of which are
easily distinguished between the transparent plates. In this
part a very strong pulsation is visible; whilst examining a
female under a water microscope, this author was surprised
to observe not less than ten young ones crawl out from the
abdominal pouch of the parent, all perfectly formed, and
moving with considerable agility over the body of the
mother, holding fast by their hind claws, and exerting their
head & arms.

Order Isopoda — It is distinguished by the hard envelope of the
body, the eyes not raised upon footstools, the body divided into
a series of nearly equal sized and generally flattened segments,
and the legs of nearly equal size, and 14 in number, the anterior
pairs not being cheliferous, or armed with large claws.

These characters will readily distinguish them from the leaping shrimps (Gammaride or Amphiopoda), and from the order Saemodipoda, as well as from the great division of Podophthalmous crustacea. The legs are terminated by a short curved hook or nail; the under surface of the abdominal portion of the body, is furnished with flattened appendages, or plates, having the edges fringed with fine hairs, serving as is supposed, for respiratory organs, and covered by a larger hair. The body is generally flattened, and of an oval form, being broader than it is thick. The internal pair of antennae, are almost obsolete in some of the most aberrant species, of the order which are not aquatic. The females carry their eggs, for a considerable period in a membranous bag, under the heart or between the pectoral scales. The young when hatched are very similar in form to their parents, and undergo scarcely any other change than that of an increase of size, produced by the occasional shedding of the outer envelope of the body. The greater number of species inhabit the water, some of them being parasitic upon fishes. The terrestrial species also require a certain degree

of moisture, in order to preserve their gills in a fit state for respiration. Belonging to this order there are a great many genera we will give two 1 Armidillo 2 Oniscidae 1 Armidilla — These two genera are so unlike in their structure that we will say little upon the Armidilla and dwell a little more fully on the Oniscidae or Slates. 1 Armidillo — These are for the most part oval, and possessed of a very great number of legs; body composed of an extensive series of segments, of equal size, and bearing, with the exception of the anterior, two pairs of legs. The antennae are two in number, the eyes are composed of an union of ocelli, ~~and if in some species~~, The number of the legs as well as the segments, of the body, increase with the age of the animal. These animals walk but slowly, and with an undulating motion, produced by the ~~successive~~ progressive action of the numerous legs; the majority of them when disturbed roll themselves up into a ball. They feed upon animal & vegetable substances in a state of decay, and lay a very considerable number of eggs in the earth. From these eggs the young are produced, at first,

without any appendages to the body; 18 days afterwards, however the skin is cast, when they appear with 22 segments, and 26 pairs of legs, of which the first is used for locomotion; at the 2 moultings the animal has acquired 36 legs, and at the 343; the body being then composed of 30 seg., and in the adult state the male has 37, and the female 64. These are always found in moist places.

2 Briscidae - or Slates. These have the body of a crustaceous texture, & of an oval-oblong form, without pencil-shaped appendages, and capable of being contracted into a ball; the under side of the body being concave. The number of legs is 32 in the males, & 34 in the females. The Gomerae Marginatus are found under stones, especially in mountainous & woody districts. This group is highly interesting to the naturalist, from the remarkable analogy which it presents to some of the crustaceous animals to which the name of wood lice, has been given. They are always in moist

places, for the heat of the sun would dry up, their gills.

3 border Amphipoda - The bodies of these animals, are generally compressed and curved upon the sides; the eyes are sessile & immovable, mandibles furnished with a palpus, & many of them have vesicular bursae either between their feet or at their external bases, the use of which is unknown. The first pair of feet, or that which corresponds to the second foot-gaws, are always annexed to a particular segment, the first after the head. The antennae, which, with the exception of the phasmidæ, are four in number, projecting & gradually tapering to a point; the tail is articulated & styliform. Many species of the amphipodes inhabit springs & rivulets, others are met with in the salt waters; they are always found swimming on one side, & in this position they swim & leap about with activity. These animals are all comprised under the genus (*Gammareus*), among the most interesting species is the *Pennys*, which is found on the coast at Rochelle, where it wages continual war against the nemids, and other marine annulata, which inhabit the same locality.

When the tide is coming in, these crustacea present a curious spectacle; myriads of them may then be seen moving in every direction, beating the mud with their arms, & diluting it so as to discover their prey; when they do discover it, larger than themselves they unite ~~and~~^{to} attack & devour it, which they never fail to do.

4 Order Stomatopoda (σ to jia, a mouth 11-ovs, a foot) commonly called Sea Mantles, comprehends crustaceans possessing maxillary feet. Their gills are naked, and are not affixed at the sides of the thorax, and placed in a particular cavity prepared for them, as in the crabs & lobsters, but where there exists particular organs of respiration, they are found under the form of membranous ciliae, attached to the sub-abdominal appendages. These animals have the teguments slender & transparent, and not of that firm consistency which is found in the lobster. The carapace or shell is often divided into parts, one bearing the eyes & antennae, the other the appendages of the mouth, and the thoracic legs; in other groups it is formed of a single piece, and exposes a certain number of the terminal thoracic segments; the

abdomen in general is very much developed, and always composed of seven joints; the eyes are affixed upon movable foot stalks. The internal antennae are always terminated by two or three filaments, the organs of the mouth are formed nearly as in the Decapods (lobsters &c) but the foot jaws have the form of large claw like legs, those of the second pair (or first pair of leg like organs) very often much larger than the other legs, and used in prehension; the two legs of the first pair have the same form as the foot jaws; the others are either filiform & furnished with a lateral appendage or rudimentary; each of the five basal abdominal segments is provided with a false pair of swimming-legs, like those of the Macrura, the sixth segment having on each an appendage terminated by two plates, forming, with the seventh abdominal segment, an apparatus for swimming. The habits of the Stomopods are not well known. It is however beyond a doubt, that those species with powerful claws, use them for the purpose of seizing their prey, in the same manner as those Orthoptera which are named Mantes; and it is on this account that these Stomopods are called Sea Mantises.

The Cancer Hantis is the type of the order; it is about 7 inches in length. Its great claws, have at the base three movable spines, and the terminal joint has 6 long & very sharp spines, of which the terminal is the strongest. This species is common in the Mediterranean.

5 Order Decapoda (ten feet) — 3 Suborders —

1 Brachyura — We will first say a few words about the Order.
2 Anomura
3 Macroura It is an order, which, comprises all the largest species of the class, & well characterised by having ten legs; the head intimately united with the thorax, & covered by a large shell or shield; a mouth consisting of numerous pairs of organs, of which the outer pairs, in some of the species are elongated; but the most characteristic trait consists in the existence of gills or branchiae, more or less numerous, fixed in a peculiar cavity beneath the sides of the shell.

1 Sub-division - Macroura - Long tails - & suborder of ten-legged crustaceous animals, having the eyes placed at the extremity of footstalks & the abdomen elongated, equalling in size the remainder of the body, & not concealed, but simply bent under the breast, & terminated by a fan like apparatus or swimmeret, having also on its under side, 5 pairs of small appendages or false legs, with two filaments at the extremity of each. The abdomen is always 7 jointed, the antennae generally long & exerted, very often 2 as long as the body, the outer foot jaws long, and not entirely covering the

inner parts of the mouth. The shell is longer & narrower than in the Brachyura or crabs, & generally terminated in front by a spine. These crustaceans are marine, & do not quit the water like some of the land crabs.

The Lobster, Shrimp, Prawn, &c, are examples of this suborder.

These animals by means of their tails can run backward very quickly, with their claws dragging ~~afterwards~~ then ready for defence. Change their shell once a year, ~~but when we come~~ When at the end of the spring these crustaceans, having previously obtained such an increased supply of food, as to make their shells too confined for the increased size of their internal organs, they cast their entire skeleton as we may term it. Previous to doing this, they appear sick, languid & restless, seeking some secluded place, in which they may securely remain until their new covering shall have attained a sufficient consistence. In casting their shells it is difficult, at first sight, to conceive how it is possible that the enclosed claw, for instance, can be so completely drawn out of the old covering, through the narrow part by which it is attached to the body, so as to leave the shell of the claw entire, & attached to the exuvia of the body, in which state they are constantly found. It is to Beaumir, that we are indebted for our knowledge of the precise circumstances

connected with this curious phenomenon, he placed several cray fish about to moult, in pots pierced with holes in running water, and thus watched the ~~of~~ moulting. (It can easily be told when they are about to moult, by pressing the backs of the animals, when the shells yields readily to the pressure of the finger, not offering that resistance which is common to them) The animals then beat their legs with violence against each other, the body is in a complete agitation, the membranes between the segments being greatly distended, so that the shell is raised considerably from the abdomen, the membrane bursting which connects them. By degrees the entire shell & external covering is shed, & in the course of 2 or 3 days, or even 24 hours, the new skin has acquired its proper consistence. The stomach of the lobster is a round muscular bag, it has 3 calcareous for crushing its food after it has been already ground in the mouth. It devours its old shell. The Lobster is remarkable for its reproduction of limbs; in some species the limbs are so slightly fixed on, that the least touch causes them to shed them. It is also said that the lobsters fear thunder, and will cast their claws in a great clap, and they will do the same on the firing of cannon.

If a limb be broken off, in the course of a day or two the naked skin exposed by the wound, is found to be covered with a reddish pulliche, which soon assumes a convex surface, grows longer becomes unicel, increases in size, & splitting, exposes to view a soft body, composed of the same number of parts as had been lost. This soon gains the consistence of the ~~body~~ remainder of the body, but never acquires the size of the limb lost although at every subsequent moulting up of the skin, its size increases more rapidly than that of the rest of the limbs. The young from the first are like parent. Heart of sober condensed; intestinal organs, the organs of respiration along the sides.

2. Anomura - Hermit Crabs - This family has the abdomen prolonged, but destitute of a shell so that the tail is soft. The tail being soft is well adapted for the dwellings these animals always chose. They are remarkable for their habit in living in the deserted shells of mollusca exchanging a less for a larger as they increase in size, & fixing themselves to their strange habitation by peculiar processes which seem developed for the purpose. It is here that the soft tail comes into use, for it winds it round

the spiral coils of the shell it has taken for its abode.
At the end of this flexible tail there is a hook by means
of which the animal holds itself in. They have locomo-
tive feet. When first one of these shells ~~are~~ with the crab
in it, is taken up it looks like a large spider. One of their
claws is larger than the other, and it always closes up the
mouth of the shell, like operculum. ~~This~~ The land crabs
also inhabit shells (snail shells) and go down annually to
the sea shore to change their shells, for larger ones. It is
a very curious sight to see a herd of these creatures going
back with all varieties of shells upon their backs.

I suborder Brachyura — Short tails or Crabs —
This is the chief division of the class, crustacea. They
have the tail short & folded beneath the trunk, under
which it keeps its spawn. The C-dible crab (*Canen Pagurus*)
is the type. It has the carapace or shield, which covers
the thorax & head broad & arched for a considerable distance
along the sides, each side having 8 pectenos, & the middle
in front armed with 3 ~~short~~ teeth. They have no means
of moving rapidly like the lobster in the water,

a bray fish, but it has stronger limbs for defence; buries
in sand; great fighters; they are the highest of all the crustacea.
Their canal is short; they have one large claw, which they
keep at the mouth of their burrow, like the Hermit crab
keeps its at the mouth of its shell. The adults can live in the
air, but the young are always born in the water. ~~These also~~
land brays also annually resort to the sea for reproduction,
whose habitations are generally in the mountains, away
from sea & water, where they reside in cavities or burrows
of the earth & rocks or in hollow trees. They feed variously.
It is said when they are on their way to the sea side
they beat their legs together, to frighten any thing that
might do them injury. They resort to the sea side for the
purpose of depositing their eggs. They possess a cavity
in the vicinity of their gills, which serves as a reservoir
for the water requisite to keep these organs constantly ~~moistened~~
moistened, but their vitality is soon suspended by immersing
in water. These animals can move in every way, backward,
forward, sideways &c. One genus the Pinnotheridae, inhabit the
bivalve shells, but not like the Hermit crab, for it only takes those
shells which are already deserted, but this little creature does not.

for it goes into the shell whether the ~~animal~~ occupant is dead or not, and they seem to live a very good time, for there is hardly a Pinna to be taken up, but you see one of these little animals; they are also found in the mussle. And some suppose that it helps the bivalve to catch its prey, by giving it a jolt when any prey is near. The young of the fish is a very curious animal; it has eyes, locomotive feet, they keep hold of their parent for a considerable time.

Class-Insecta - These outnumber the Crustacea. Their structure differs - coat consisting of chitin - no calcareous matter - external organs - Head large eyes occupying the two sides of the head - compound eye, most perfect in the insects - some have only, as the ants, 50 lenses, house fly 4000 - Butterfly 17000, Dragon fly 25000 - All have antennae, organs of touch, communication, organs of hearing, organs of sound with inlets of air at base, smelling not certain, form of body delinquent (except Crustaceans) head like crustacean. Thorax 3 rings; 3 pairs of feet. Head one pair of feet; thorax one pair feet one on wings, abdomen ~~some~~, No carapace. Nine segments in abdomen, no abdominal tibias.

Organs of mastication not so complicated as in Crustacea.
Upper lip or labrum; next mandibles; next maxillæ ~~not~~ with organs of touch; next labium or lower lip with organs of touch; last of all chin or mentum. Food various. Senses of insects something like those of the Lobster having joints. They consist of a series of tubular joints, formed of a similar substance, with the remainder of the external parts of the body, and are provided with internal muscles & nerves. The joints have received a series of names analogous to those of the legs of the higher animals. They are the coxa, trochanter, femur, tibia, & tarsus. The coxa is the basal joint, articulating with the sternum, & very variable in form. The trochanter is a very small piece connecting the ~~piece~~ ^{joint} with the thigh or femur, which in general is the thickest part of the leg, and in leaping insects greatly thickened, & sometimes toothed beneath. The next piece is the shank or tibia a piece generally somewhat shorter, & more slender than the femur, and often gradually thickened towards the tip, where it is armed with one or two spines or spurs varying in their number & size in adjacent groups. The terminal part of the leg is called the tarsus, divided into

several joints never exceeding five in number, which is always found in the majority of insects with membranous wings, undivided by wing cases. In many beetles the number is variable, & the same is the case in the Neuroptera &c. The under surface of these joints (tarsal) is generally clothed with short hair or downy often forming a kind of cushion or brush; the penultimate joint is also often divided into two lobes, & the terminal joint is also generally terminated by two hooks, between which, in many insects,

there are one, two, or three, small, often membranaceous, appendages, termed *pulvilli*. The wings - the wing consists of ~~the~~ two layers of membrane, ~~without any visible air-tubes,~~ ~~so narrow~~ penetrated by air-tubes, made of Batine, the wings are not instead of gills of the crustaceum. Nervous system different in the different changes; digestive organs the same. Openings in each segment, penetrating the body of the insect in every direction, giving it a ~~like~~ lightness in structure. The most remarkable change of insects is their Metamorphosis.

The three great ~~changes~~ ^{states} are, 1 Egg 2 Larva 3 Pupa 4 Imago or perfect insect. 1 The egg has a hard external coat over it; of worm shape. The produce of this egg is a worm & a worm in way sense of the worm, which is called the larva. 2. The larva

grows rapidly, very carnivorous. The insect has now arrived at an active state of existence; it is not that it is destined, in a more special manner, to grow and to eat. It is to this state that the ordinary terms caterpillar, grub, & maggot are generally applied in a manner so indefinitely, that it is impossible, with any pretension to correctness, to assign these terms to any precise divisions of insects. Appearance, a fleshy worm, provided generally with a distinct head, and six scaly legs attached to the anterior part of the body. (for full account see B. Blyth). Before however it goes into the pupa state, if you were to look you would find arrangements beginning to be formed for the mosquito. The 3 Pupa is quiescent like egg, except that the animal is already formed in the pupa.

The period passed by insects in the pupa state is very variable, the variations extending from a few days to as many years. It next passes into the Imago. (for further particulars see B. Blyth - on the Insecta as I am only giving the principal features). ~~Some~~^{We will} adopt the structure of the wings, as affording the characters of the orders, which we do as follows. First however there are the two ~~great~~^{sub-} classes.

- 1 Myriapoda - many legs - as the centipedes or millipedes.
- 2 Hexapoda - 6 limbs - or the insects proper.

1 Myriapoda - 2 divisions - 1 Chilognatha 2 Chilopoda
of these we have no time to say anything.

2 Hexapoda - Insects ~~properly~~ -

Orders

1 Coleoptera - Wings four, the upper pair crustaceous with a
straight suture (beetles & earwigs) -

2 Hemiptera - Wings four, the upper pair semi crustaceous & in cam-
heit (bugs, locusts, tree-hoppers, plant-hoppers 8c) -

3 Lepidoptera - Wings four, irriticated with scales (butterflies moths)
hemi met

4 Neuroptera - Wings four, membranaceous, anus unarmed,
(dragon flies) 8c. met -

5 Hymenoptera - do - do - anus armed with sting
(Bees, wasps, ants, saw flies 8c) - met -

6 Diptera - Wings two, halteres two in the place of the posterior
wings (flies, gnats 8c) - met -

7 Aptera - Wings none - (lice 8c) - no met -

* The Brachoptera we have left out here because some unite it with the Coleoptera
but properly it is an order by itself, we have put in on the next page however.

The Aptera, Diptera, Lepidoptera, Hymenoptera, Homoptera
are called Hemisulcate or sucking insects.

The Thysiptera, little known parasitic - Neuroptera, Orthoptera
Coleoptera, are called mandibulates from from their mandibles.

Mesioapodes - more than six feet - no wings, each segment one or two
pairs of legs, groups of ~~two~~ simple eyes, beginning of compound
mode of growth different from the insects (Proper). There is 2 divisions -

1 Chilognatha - as example of this division we will take the Gally-
worm (*Tolus terrestris*); we find a long cylindrical body of about
fifty hard rings, each giving origin to 2 pairs of legs (small).
There is a distinct head, with eyes, antennae or feelers & a pair of
stout horny jaws; ~~the other order~~, a pair of strong sharp claws,
formed by an enlargement of the second pair of legs, in addition
& the horny jaws of the gally-worms. (This order we will come to just now
namely the Chilopoda) These horny jaws of the gally-worms are
provided with sharp toothed edges, for cutting the ^{vegetable} ~~assimilate~~ food
on which the animal mainly lives.

2 Chilopoda - (Centipedes) (sometimes called Millipedes) This division
has fewer rings & therefore may be considered as superior to the

last division. They are eminently carnivorous, and, in order to seize the insects, on which they prey, possess, as we have before mentioned, a sharp pair of claws, very strong, formed by an enlargement of the second pair of legs, which are perforated at the tip, with a minute aperture, through which a venomous fluid is probably instilled into the wounds made by them. They live under stones, & in chinks of timber, and often lie in wait for their prey in the ripe fruit to which insects are so apt to resort. Some species attain to the length of 15 inches, but rarely.

2 Hexapoda - 1 Order Aptera - or wingless - It includes a variety of creatures which are not very pleasant to look upon. The family Pulicidae (named from the pulix, or common flea) have the rudiments of wings, but, in point of fact, depend for locomotion on the extraordinary elasticity of their legs, enabling them to make an enormous spring. The power of the flea to penetrate the human skin, and to feed on the blood, is very well known. The creature lays from 8 to 12 eggs, which are hatched in about 5 days, coming forth in the larva form, in which state the parent feeds them on particles of dried blood. A West Indian flea, of minute size, named the Chigoe, is a dreadful pest to humanity, from its ~~inhabitancy~~ habit of depositing its eggs beneath the skin, where the

larvae come out & create seven sores, insomuch as often to cause the death of the nobler animal. Family, Parasita are typified by the common louse, a creature justly regarded with loathing, because it never exists unless in connection with dirty habits. Man, the dog, sheep, & other animals have each an appropriate parasite of this order. The Parasita are almost entirely destitute of eyes. Family Thysanoura (or Spring-tails) are small insects possessing a forked tail for leaping. The Podura willow is an example. Another is well known under the name of the sugar-louse. — The flea has the mouth provided with three lancets for sucking.

2 Order Diptera - (The House Fly) These are a large tribe; they have, as their name indicates, two wings, but in the place of the other two which other insects have, they have two small projections, which are for the purpose of the other wings resting upon them, they are called balancers, & seem to be the rudiments of the posterior pair of wings, in other orders. Their mouth is formed for sucking in some but in other species sharp lancets for penetrating the skin. The lancets are a modification of the jaws, upper lip modified to proboscis, labium to lancets. Larva footless worms, found about the ground. This order is divided into numerous families, some of which we will give on the next page. Before however we give the families, we

will make some general remarks on the Diptera. Many species of this order are useful in devouring obnoxious insects & consuming dead carcasses, & other decaying animal matter, which would otherwise pollute the atmosphere. Some however, are a source of great annoyance & damage. The bite of the mosquito, for instance, renders that insect the plague of every country in which it is found. Many species deposit their eggs upon the bodies of our domestic animals, so that their larvae may there obtain nourishment. Others infest our viands or cereal plants for the same purpose. The first family is,

Family - Culicidae - (Gnats) are the most highly organised of all the Diptera; and the perfection of their suctorial apparatus, which is furnished with six lancets, many of us can attest from our individual experience of what is called the sting of a gnat. Their larvae are aquatic, being those singular little red worms, thick at one extremity, which we frequently observe in stagnaneous waters. They move by a sort of rumba, & are seen frequently resorting to the surface to inhale a fresh supply of air. In their perfect state they abound in the neighbourhood of marshes. In the generality of insects which fly by night, we perceive a general inclination to fly towards the light, and be bewildered by it; but this is not the case with the gnat. We will ~~say~~ ^{stay} some time at the gnat, and describe its ~~bitter~~ part of the structure of its lancets, & then its young.

When we notice the beautiful organisation of the proboscis. That
fearful organ which causes us so much pain, we immediately
perceive its superiority, or rather ~~its complete~~ the more complete
development, which it exhibits over the mouths of other diptera,
except the Tabanidae. This apparatus, although it appears
to the naked eye like a long slender simple & single organ,
consists, in fact, of a considerable number of fine lunatiform
pines, enclosed in a fleshy gutter, forming an instrument
admirably fitted for suction, & provided with a poisonous liquid,
which it instills into the wound it makes, & which is supposed
to have the effect of causing the blood to flow more freely.
The thirst for blood is very exhibited by the female; she makes
entire themselves with the honey of flowers. This insect seldom
appear by day, except in dark woods, seemingly effected by the
sun's rays. But at twilight they sally forth to pursue their
blood thirsty operations, and it is at this period they assemble
in swarms in the air for the purpose of ~~coppling~~. Shortly after-
wards the female deposits their eggs in a very remarkable manner.
The larva are destined to live ⁱⁿ ~~on~~ the water. The gnat is an aerial
being. Taking its station at the extremity of some floating leaf,
the female deposits her eggs one by one, attaching them together
& forming them, with the assistance of her hind legs, into a
curiously formed boat like mass, which floats upon the surface of
the water. These eggs hatch in the course of a couple of days.

The body of the larva is long, and furnished at the sides with long hairs; the head distinct & rounded, with two long ciliated jaws, which are kept in constant motion, serving for producing a current of water, for supplying itself with food; the mouth is also furnished with two long palpi, covered with hair, and besides these the animal possesses no other organs ~~for~~ locomotion; the last joint of the body is elongated, and furnished on one side with a long tube, placed at an angle and enclosing a breathing apparatus. These larva are small semi-transparent animals which may be seen throughout the summer in ditches, or other standing water darting about with much rapidity. They are transformed into pupae in about 15-days; the front or thoracic part of the body is now thickened, and exhibits beneath the rudiments of legs & wings, enclosed in a general covering, and the hind part of the body curved towards the heart; instead of the posterior tube of the larva its external breathing apparatus now consists of two anterior small horns. It jerks about the water with much agility by the assistance of the small swimmers, or little oars, at the ex-

limits of the body, & two long hairs. The pupa rising to the surface, at the period when it wishes to cast off its pupa skin, elevates the front part of the thorax, above the level of the water, when instantly, by swelling the exposed part, the skin bursts, and the head of the gnat appears, followed by the thorax, which from its increased size, enlarges the slit, so as to allow the rest of the body to follow with greater ease. At this critical period the old skin of the pupa, which is of course now hollow in some places, serves as a support; in fact, it becomes in very sure a life boat to the little animal. The observer, who sees how the little boat gradually sinks, and how its margin approaches the water, forgets the mischievous insect it contains, which at another time he would crush without remorse, and becomes interested for its fate, especially should wind agitate the water. If it should upset it would be all over with it, and numbers do thus perish. The gnat after having fixed itself thus perpendicularly, draws first its two anterior legs out of their case, and moves them forward, and next the two intermediate ones; then inclining its elp towards the water, it rests itself upon it; for water is to them a soil sufficiently firm & solid for support - although charged with the weight of the insects; for as soon as it is thus upon the water it is in safety, its wings unfold themselves, and are dried at it flies away. We have dwelt rather long upon this, but it is a very interesting, when well known. This will be very short with the other family.

The Mosquitoes are another species of the same family which in many parts of the world interfere so much with our ease & comfort, as to become one of the worst of pests, & a real misery of human life. The mosquitoes & also the gnats warn you of their approach by their humming noise, which is caused by the rapid vibration of their wings. They are very common about all hot & marshy places. The Midge so well known for its aerial dances, is the smallest species of the family. It is a small yellow winged two winged fly, very much resembling the last species in form, but much smaller in size. It is stated to have been first seen in America about the year 1828, in the northern part of Vermont & on the borders of Lower Canada. The female fly deposits her eggs in the beginning of July, in the opening flowers of the grain, or when the wheat is still in the milky state. The eggs hatch in about eight days, when the little yellow maggots or worms may be found within the chaffy scales of the grain. The sedges & grass also sometimes serve as a shelter for these depredators. The worms do not exceed an $\frac{1}{2}$ of an inch, in length, and are often much smaller. Towards the last of July or beginning of August, the full grown maggots cease eating, & become sluggish & torpid, preparing to shedding their skins, which takes place in the following manner: the body of the maggot gradually shrinks in length within its skin, and becomes more flattened & less pointed or ready

may be seen by its delicate transparent parancy. This torpid state lasts only a few days, after which the insect casts its skin, leaving the latter entire, except a little rent at one end of it. After ~~sudden~~
shedding this skin, it recovers its activity, & writhes about as at first, but takes no food. It is shorter somewhat flattened & more oblique than before, and is of a deeper yellow colour, with an oblong greenish spot in the middle of the body. Within two or three days the maggots descend either of their own accord or are shaken out of the ears, by the wind, & fall to the ground. They do not let themselves down by a thread, as has been supposed by some, for they are not able to spin. Having reached the ground, the maggots soon burrow under the surface, sometimes to the depth of an inch, those which have not moulted casting their skins before entering the earth. Here they remain without further change through the following winter. It is not usually before I am ~~that~~ ^{sure} they are transformed to pupae, this change being effected without another moulting of the skin. This pupa state lasts but a short time, a week or two at most, but in more cases only a few days. The pupa then works its way up to the ~~surface~~ surface of the ground, before liberating the included fly, & when the insect has taken wing, the empty pupa, still in skin, will be seen protruding from the ground. I have been much longer at this than I intended however we must part with it at the other.

Family Tipulidae (or Water spinners). — The most familiar species of the family is the hairy long legs. These insect when in full growth are harmless, but their larvae are very injurious, to the roots of grass &c; others to the wheat-crops, by depositing their eggs in the centre of the corolla. They form a large tribe subdivided by structure, but named from the places or substances they frequent: thus we have Buliciform tipulæ, Terricole tipulæ, Gallicole tipulæ, & Floral tipulæ. The larva live in ground. Another species Hessian Fly
(see Naturalist)

Family Tabanidae (or Gadflies) have highly organised mouths, the sucker being provided with six lancets. They are also called horseflies. Many of them feed upon the blood of mammalia, & even of man himself. In the woods, in summer they alight upon our face & hands & put us to considerable pain. It is related that Messrs Kirby & Spence were present in an entomological excursion, of the prevalence of these insects, against the seven punctures of which, they could find no protection. The Cleg (*T. Pulvialis*) is the most common insect of the family. The larva of the Gadfly also burrows in the ground. (For further remarks see B. Byhl).

Family Oestridæ (or Bot flies) are all parasitic in some part of the body of the mammalia. Most of them lay their eggs in the skin of animals, which they pierce ~~with~~ purpose. This of course causes considerable pain, & the animal resorts to many manoeuvres to evade their tormentors. There are

Others, however, that deposit their eggs among the hair in situation when they can be licked off. Then are swallowed, & hatched in the stomach or some place inside the horse, if in the stomach it attaches itself to the membrane & produces the disease termed the bots in horses; it then passes out with the horses excrement. (A fuller account of the young will be found in B. Lyell under Bot).

Next family is a large one namely, Family Muscidae, Flies (Musca aff.) - The most familiar species are the House-fly (*M. domestica*) and the Meat-fly (*M. vomitoria*). The first of these are great torments not that they bite, sting or hurt, but that they buzz, tear, & swarm on every thing eatable. The larvae are bred in manure & carrion, & undergo their change in a very few days. The larvae are white worms, ~~they can~~ The house fly can walk on any surface, but we will say more about this last now. Let us look for a while at the larvae of the Muscidae. They are thick, fleshy, cylindrical, attenuated towards the head & truncated at the other extremity of the body; the head is soft, with two or three horny points, which serve to pierce the matter on which they feed; they are destitute of legs, and their progression is effected by hooks at the mouth, whichs they affix in the surface of the substance upon which they are placed; ~~their motion is by~~ having first extended the body as far as possible they then draw up their hinder part contracting the front as much as possible, and so on in this way.

In passing to the pupa state these larvae employ two principal modes. In the greater number there is no shedding of the skin; the skin of the larvae hardens, contracts, and becomes an oval cocoon, within which the pupa is disengaged, appearing at first merely as a gelatinous mass, but afterwards in some degree exhibiting the different parts of the perfect insect, the eyes & wings being unfolded upon the breast. In the others the metamorphosis is effected by the larva shedding its skin, and the insect then appearing, in the form of an inactive incomplete pupa, like that of the former, but not inclosed in a cocoon. In some of the latter, as in the aquatic species, the pupa retains its activity, jerking about with much agility in the water, whilst many are quite inactive. It has long been a question, how flies walk in & vibrations when they have to contend against gravity. The legs are terminated by a tarsus consisting of five joints, the last of which is armed with two small claws, & very often with two or three membranous lobes or pulvilli. It has been generally considered that it was effected by the formation of a vacuum, but Mr Blackwell has since shown this to be incorrect. These lobes or pulvilli, that we have above mentioned are covered with hair, & are thought to contain a fluid, which enables it to adhere to the surface of anything no matter in what position. They generally fly in the same manner as a bird, with the back upwards.

They have, however, the wonderful faculty of reversing their position, & of flying backwards, as when starting from a window, & alighting on the ceiling. How the buzzing sound is produced by the fly, has given rise to various conjectures. Bemmix ascribes it to the action of the air on the edges of the wings, at their origin, as an ~~oblique~~ Harp String, or to the friction of some internal organ, on the roots of the wing nerves. The sole instrument which the fly possesses for eating or drinking is the trunk or sucker, an instrument convenient enough for liquid food. It dissolves its food to a liquid passing through the sucker, & converting the sugar into a syrup. Few flies withstand the severity of winter; but such as do, remain in a dormant state, frequently in haystacks.

The next family Blow-flies are well known. They deposit their eggs in meat; but when the larvae which are produced from them, are about to change into the pupa state they penetrate into the earth. These flies are the pests of the larder. They are of a black colour, with four longitudinal grey lines in the thorax; the abdomen is chequered with black & grey, & the legs are black. It is as large as, but more slender than the blue-bottle fly. Their insects are of very great service, in the economy of nature, thus providing the consumption of dead & decaying animal matter, young hatched in their own body.

Family Hippoboscidae (or Horn-flies). - These like the last also hatch their young in their bodies. The Horse-fly (*H. equina*), the type of the family, infests the horse; Streblus, the bat; ornithobia & ornithomya are found upon a variety of birds; leptotarsus which has only rudimentary wings, inhabits the deer; and the mallophagi, which are destitute of wings, the sheep.

3 Order Sepidoptera - Scale wings. There are a very beautiful order of found winged insects, known by the English names of butterflies & moths, & distinguished by having the wings composed of a double transparent membrane, clothed on the upper & under sides, with minute colored scales, resembling dust or farina. The eyes are large & lateral, the antennae generally long & multi-articulate, & very variable in form; the mouth is composed apparently of a long and spirally coiled organ, which when examined, is found to consist of two pieces, representing the maxillæ, sometimes being provided with a small jointed appendage or palpus at its base. This very slender & delicate proboscis, is employed by the insect, in sipping the sweets from the flowers, upon which alone it subsists, and which by its peculiar construction, is admirably adapted for penetrating the narrowest blossoms. When at rest it is rolled up in a coil, and supported by two large & compressed pulpi, composed of three points, inserted upon a lip fixed to the front of the head. A more minute examination of the head, however, proves, that the rudiments of the

other parts of the mouth, namely an upper lip & a pair of mandibles,
also exist, but in a very minute state, & as it would seem, impoties
for any service in feeding - a peculiarity, the more remarkable,
because in the preparatory state of the larva the mandibles are very
robust & horny, & constantly employed, in biting the leaves, which
at that time serve for the support of the insect. The colours which
render the wings so beautiful, reside in these scales, of which as many
as 400,000 are reckoned to exist in a single silk-fly. The Lep-
idoptera subsist exclusively upon fluid nutriment, for obtaining
which the maxillæ are so fashioned that they lock together
with teeth into a single tube. All of this order are either males
or females; neutrals, which are so common among the Hymenoptera,
are not found in the Lepidoptera. They go through a perfect Met-
amorphosis deposited on the leaves of plants, proceed in due
time the larvae or caterpillars, each species being generally placed
on the kind of plant which it is fitted or inclined to eat.
When it has attained its full size, it spins round its body
a cocoon or case of silk, in which to spend its life, as a pupa
or chrysalis. The threads are formed by a glutinous secretion from
glands, which seem analogous to the salivary glands of other animals,
forced out through a small opening at the end of the body, it hardens
as it dries in the air. Some Lepidoptera form no cocoon, but hang in
the pupa state by a thread from some lofty place - At the proper time the perfect
insect bursts from its case, to stand a brief gay existence in the air, to lay its

eggs and then pupa. The Lepidoptera is divided into 3 divisions—
1 Diurna-they are the Papilionidae (or Butterflies) daily.
2 crepuscularia - the Sphingidae (or Hawk-moths) evening.
3 Nocturnae - the (moths Prokter) fly only by night.

1 Diurna - Papilionidae (or Butterflies) are distinguished by the extraordinary beauty & variety of the colours which adorn their wings; & the number of species, each having some marked peculiarity, is enormous great. It is believed that not less than 2000 species exist in Britain alone. Beautiful as are many of these, there are still more splendid examples in other countries. Some of the foreign species exhibit an expanse of wings not less than nine inches; some display a metallic brilliancy of hue absolutely dazzling. (In this see end of suborders)
(next page) X

2 Crepuscularia - Sphingidae (or Hawk moths - twilight) - from their general habit of flying abroad in the twilight, live in much the same manner as butterflies. Fly on of a duller colour, & in flying make a loud humming noise. One species, noted for a skull-like patch of colouring on the back of the thorax, & then called the Death's Head moth, emits a squeaking kind of sound. In consequence of the peculiar aspect of its body, the sudden appearance of this insect has been popularly regarded as ominous of evil. It has a very formidable character towards bees, whose hives it enters boldly, scattering the inhabitants in alarm, & then preying upon the honey. (In this see end of suborders next page)

3 Nocturna (or moths proper) fly only by night and are of a dull style of colouring. The most important tribe is that of the Bombycidae, comprising the silk worm & allied species. The silk worm (*Bombyx mori*) is a native of China, where it has been domesticated for at least 3000 years. It was imported into Europe in the reign of the Emperor Justinian 550 A.D. It is said that two Persian monks who had long resided in China & had made themselves acquainted with the mode of rearing the silk worm, succeeded in bringing some of their eggs to Constantinople. These were hatched, & a sufficient number of the butterflies saved, to propagate the race. Thus a new & importance branch of industry was established in Europe. The caterpillar of the silk-worm when it has attained its full growth (about 8 inches in length) proceeds, to enclose itself in an oval shaped cocoon, preparing to assume the state of the chrysalis or moth. The cocoon is formed by an exceedingly slender & long filament of fine yellow silk, emitted from the stomach of the insect. After emancipating itself from its silk prison, it seeks its mate. In two or three days afterwards, the female having deposited her eggs, from 300 to 400 in number, both insects terminate their existence. We will now give a few of the tribes which come under these suborders.

4 Hymenoptera - 1 Diurnal day fliers - (*Papilio*) - 1 & quits & Heliconii
3 Danai & Nymphalids, & Plebeii -
we have not time to go into each of these, but will just take their distinguishing characters.

1 *Cyntis* - Posterior margin of the wings longer than the anal margin divided into Trojans, having red spots on the breast, & Greeks having no spots.

2 *Hecimii* - Wings narrow, entire, often almost naked.

3 *Danai* - Wings entire, divided into the Bandicid or white, and festivæ or variegated.

4 *Symphalis* - Wings dentated, divided into the Ocellata, or those with eye like spots, & the Phalerata or those with simple spots.

5 *Phebi* - Caterpillars, short, thick, divided into the Purpureæ or those with dark spots, and the Ultra-coloræ with transparent spots.

2 *Sphinx* or *Buprestularia* (evening) - The caterpillar is generally of a green colour, with a hook of its back towards its tail placed upon leaves. Warm moths. The caterpillars live in stalks, pass into pupa state in ground, (the larva).

3 *Nocturna* (moth proper) all have dull colours, fly by day more than we suppose, for they fly very high up & are not seen. But many hide in dark shady places, in cracks & holes. ~~fall~~ When they sleep their silk is of

The same character as the silk-worm; some spin their hair with the silk in thin cocoon. Their silk is contained in spinnerets.
Nocturna divided into numerous families.

- 1 Attaci - Wings somewhat extended & inclined at rest.
- 2 Bombyces - Wings crossed upon the body, antennae pectinated
- 3 Noctuas - Wings crossed upon the body, antennae setaceous.
- 4 Geometriae - Wings horizontal. (another name) (loopers).
- 5 Tortrices - Wings very obtuse, front margin curved.
- 6 Pyralis - Wings forming with the body a furcate delta.
- 7 Tineas - Wings rolled into a cylinder.
- 8 Alucitae - Wings digitated.

The Tortricidae ~~bin~~ (or weavers) bind leaves into rolls for nest.
The Tineae (or clothes moth), wing not so flat as others, long narrow, feed upon hair wool feathers.

4 Order Hymenoptera - 4 wings, membranous, furnished with various veins, forming cells, but not assuming the appearance of net work, the posterior hair being smaller than the anterior. The mouth composed of a pair of upper & lower jaws, & two lips the lower of which is elongated, & forms together with the lower jaws,

a kind of tongue or sucker, capable of being extended a considerable length, & employed in collecting honey from flowers; the females are furnished with a horny apparatus, at the extremity of the body, which in some species is transformed into a pair of jaws, adapted for making slits in the twigs of plants, for the reception of the eggs, & in others consisting of a powerful sting; this sting is composed of five pieces, first a pair of elongated flattened organs, between which, the extremity of the sting is lodged whenever employed; second the instrument itself which is so often seen protruded from the tail of the bee, & which, upon a close examination, is found to consist of a canal having a gutter along its upper edge, within which, two darts of the most exquisite construction play backwards & forwards, & which are armed with fine teeth set backwards; the sting by means of strong muscles at its base, is thrust forward, and, from its strength, forms a support for the interior situated darts, which are plunged still farther into the wound, whence, from their structure, it is impossible to draw them out without force; the poison is conveyed through the hollow canal ⁱⁿ the sting, from a reservoir near the dilated base of the apparatus, in others again this horny apparatus, is elongated into an ovipositor, adapted for depositing the eggs, in the bodies of caterpillars, &c. The head is

furnished, also, with a pair of anteriores, which in the typical division, consists of 13 joints in the males, & 12 in the females. This order is divided into 2 grand sections - 1 *Tribantia* & *Aculata*, 1 *Tribantia*; abdomen of the females furnished with saw or borer Subsections - 1 *Scutigerous*; (saw flies) abdomen sessile furnished with saw; larva with pret. Family *Tenthredinidae* (saw flies, Sciuicidae) —

Tenthredinidae (saw flies) These insects deposit their eggs by the means of two saws attached to the extremities of their abdomen.

The eggs of these creatures are deposited in the bark of trees the twigs of various plants, or within the epidermis of the leaves, in which a slit is first formed, into which the eggs are successively introduced. The dorsal segments of the abdomen are displaced at the sides in these insects, the terminal ~~sext~~ segment being produced at the base beneath, towards the base of the abdomen, forming a groove on the under side, within which the saws play, being, moreover, protected by two distinct scaly plates. When the insect, therefore, is disposed to make use of its saws, it widens the groove & extends what at first ~~at right~~ appears to be a single membranous area, but which is very soon perceived to consist of two plates, each formed of two distinct portions, constantly applied against each other when at rest; the lower half of each of these instruments, that is, from base to tip, is the saw & the upper half of each constitutes the supports of the saws, being formed with a groove, somewhat like the structure of a slant knife; in each of these grooves, therefore, one of the saws plays backwards & forwards, the muscles

at its base, acting as the moving power, & when these four pieces are brought into contact, a central space is produced which serves for the passage of the egg. At first sight the saw appears to be composed of simple teeth, but the application of high powered lenses proves that one of the edges of each tooth is itself furnished with very minute teeth, thus combining the property of a rath or file, in their lateral action, with that of a saw in their vertical movements. These highly magnified powers, also, show that even the exsertious sides of the saws are furnished with an infinite number of minute points, which in all probability, serve to irritate still more forcibly the edges of the wounded part of the plant, causing it to produce a greater supply of extravasation fluids, which is serviceable for the development of the egg. After the groove is undercut sufficiently deep, the saws are made to conduct an egg into the place prepared for its reception, immediately after which a drop of frothy fluid is introduced into the hole over the egg, of which the probable use is to close the wound. Each groove contains but a single egg. In some species the wounded parts of the leaves wounded by the saw fly, produce galls (as in *Nematus interior*) similar to those formed by the true gall fly. Another species *Tenthredovariabilis* (see B. England).

2 Subsection - Pupivora or Ichneumonidae - abdomen per-
dunculated, furnished with a barb; larva without feet

Families 1 Encyrtidae, 2 Ichneumonidae, 3 Gynopidae, 4 Chal-
cididae, 5 Proctotrupidae, 6 Chrysidae.

Long antennae & ovipositor,卵 deposited in other animals,
which are hatched while the ~~other~~ animal is living.

(For further particulars see these families in British Entomol.)

Gallivora - (gall insects) small animals - (Gynopidae)
(B. E. glana)

2 Section Stenolepta - abdomen of the females (& neuters) armed with a
sting -

Subsection 1 Heterogyna - females or neuter wingless - Families

Formicidae, (social) Mutilidae, (solitary). - Formicidae or ants,
males & females both winged, but the females only for a short time
soon dropping their wings. They make galleries under ground &
in decayed wood, to find small insects & grubs for their food.

Sub - 2 Fossores - (mason wasps) female winged, when not ^{Formicidae} golden
basal joint of posterior tarsi simple. Families - 1 Scoliidae
2 Sapygidae. 3 Sphecidae. 4 Bembecidae 5 Tornidae 6 Nyssonidae
7 Crabronidae. - (See British Encyclopedia for three different families)

Sub 3 Dicloptera - (wasps proper) females (& neuters) winged, wings
~~represented~~ they are, however, very soft, & it seems not improbable

folded; Families Masiidae Vespidae. In this sub-section the wasps build paper nests (see B = Cylind. Wasp), these are made from decayed wood.

Apiformes Sub-section - Mellifera - (the proper) females (♂ neuter) winged, wings not folded, posterior tarsi with ^{the} basal joint large, & compressed into a ballinaceous organ. Families Andrenidae, Apidae - we will say a few words about this interesting family. In this family we have included all those insects which have the lower parts of the mouth formed into a trunk, & bent downwards, the antennae elbowed in the middle, the wings smooth, & body generally hairy. It includes therefore not only the honey bee, humble bees, mason bees, leafcutters, carpenter bees &c, but also a great number of other species, whose habits are still unknown. The trunk is very short in some, whilst on the others it often attains a very considerable length, being sometimes as long as the whole body.

Hemiptera - These insects are characterised by having the wing-covers of a consistency intermediate between the scales covering of the beetles, & the membranous wings of the flies, being semicrustaceous,

not meeting together when at rest by a straight slanture,
but having some portion of the inner margin of one
wing-cover folded over the other. As an example of this order
we may take the water-simmers, that may be seen
about all stagnant water, long legs - This order is divided
into three - 1 Hydrometra - (to which belong these water bugs)
2 by cicadæ a cicada - there are not locusts. The noise
which they make is produced by a sort of drum, it is
of the males which sing. From hence the poet has said
Happy the cicada lives
since they all have voiceless wives.

Which is quite true as far as matter goes, but had grammae
eggs deposited in bark of trees, that is the reason they are
mostly found upon trees, look being then looking for a hole
or crack to deposit them in. The larvae feed on bark, & where
there are a good number of them injurious to trees.

3 Cicopidæ (or frog spitter insects) - the larva & pupæ of this
insect have the power of emitting a frothy secretion, somewhat
resembling saliva, which has, from a vulgar error, been
termed frog or cuckoo-spit, because it appears at the season
when the bird visits us. The larva & pupæ resemble the
perfect insect in form, the former, however, is entirely destitute
& the latter has only the rudiments of wing covers & wings; ^{as} represented
they are, however, very soft, it seems not improbable

that the froth, which we perceive on almost all kinds of plants,
is discharged by the insect for the purpose of forming a
covering against the overpowering effects of the sun. In certain
seasons, this insect is so multiplied, that persons walking
beneath willow trees are wetted with the continual dropping of the
fluid. Another nearly allied species (*Aphrophora goudotii* &
Bennett), has recently been found in very great quantities
upon the trees in the island of Madagascar, the larva of which
has the power of discharging a considerable quantities of
clear water, especially in the middle of the day when the
heat is greatest. Family *Aphidæ* - plant lice - This family
has the tarsi two-jointed, the first joint very short; prothorax in
both sexes; antennæ with six, seven, or eight joints; females
generally apterous; tarsi with the last joint vesiculous; upper
wings in the males larger than the lower; head transverse.

This family contains the genus *Aphis*, of Linnaeus. Antennæ
setaceous or filiform, seven jointed; clypeus larger than the wings,
elongate, triangulate; abdomen toward the apex generally horned;
eyes entire. Other genera. The minute animals of this genus, live
entirely on vegetables, & the loftiest tree is as liable to their attacks
as the most humble plant. They prefer the young shoots, on account
of their tenderness, & frequently insinuate themselves, into the very heart
& the plants, doing irreparable mischief before they are discovered.

But for the most part they burst the foliage, & are always found on the under side of the leaf. Sometimes however the root is preferred. There are rarely, except one species (*Aphis salicis*) which is larger and much stronger than the others, to be found on the bark of trees. Sometimes winged sometimes not, produce young alive in spring; in autumn deposit their eggs, (see British Entomology for Aphidæ).

4 Boccidae - The species of this family, which are generally called scale insects, are of small size, having, in the winged individuals short legs, with only two joints to the tarsi, and a single hook at the extremity of each. The male is destitute of a mouth but is furnished with two large wings, and a pair of small appendages behind the wings the wings, resembling the hoovers of the diptera; the abdomen also in this sex is terminated by two or more slender filaments. The antennæ are moderately long & piliform the number of joints not exceeding eleven. The females on the contrary, in their perfect state, are amongst the less perfectly organised of insects, appearing only as an inert scale-like mass, destitute of legs or antennæ, & applied to the bark of various trees & plants, which consequently appears, from the number of individuals collected together, to be covered by a vast number of galls of an oval shape or rounded form; there are, however, several coccæ affixed to the plant. In their earlier stages, however, these insects are smaller & more active, having much the appearance of tiny small red tortoises, and feeding

like their parents upon the stems or leaves, which they pierce by means of a ~~sharp~~ long & sharp rostrum, which goes to the very center of the shoot, causing the sap to flow in abundance, or bleeding the plants as it is termed, & by which means great injury is done, especially to the vines, which are liable to be much infested with them, and which are thereby sometimes rendered barren. In this state the continue growing is size for some time, but the period soon arrives when the sexes undergo a very singular difference in their transformations. All the insects now affix themselves to the surface of the plants or stems, the little activity which they had previously possessed entirely ceasing. The males discontinue to increase in size, and if one of them be opened carefully, a small & elegant chrysalis will be found within the old skin of the larva; the females, however, continue to increase in size, until they are many times larger than the other sex, the margins of the body being glued down to the plant, the body being by degrees distended by a very great number of eggs, until nothing more than the upper & lower skins of the insect remains. Soon afterwards the male fly, of a very elegant form makes his appearance, and being unprovided with any means of taking food, is adapted only for continuing the species. See British Encyclopedia.

6 Order Stictoptera - These insects are rarely seen, being parasitic upon wasps. The name of the order is derived from the Greek, and is in allusion to various appendages of small size, which at first were regarded as attached to the fore legs, and consequently, as their legs are prothoracic & true fore wings are mesothoracic, it was considered by Latreille, that the former could not be analogous to wings, & accordingly that Mr Kirby's name of the order was in appropriate, in him of which the name Rhopiptera was proposed in allusion to the fan like form of the real wings, which are very large; in shape like the quadrant of a circle, and furnished with a few longitudinal nerves arranged like the ribs of a fan. (for further particulars see British Encyclopedia).

7 Order Neuroptera - (nerved wings) The mouth is formed with mandibles for mastication, ^{& this order} chiefly distinguished by the structure of the wings in the ^{in the} Pterygidae, which are naked; they are four in number & of equal size, & furnished with a great number of nerves, which give the wings the appearance, & under the microscope of the most beautiful net-work; the membrane enclosed between these nerves is very fine & transparent, often exhibiting a reflection of the prismatic tints, or marked with spots or bands of various colours. The situation of these organs during repose is various; in some they are horizontally extended at right angles from the body, as in the larger Leptilidae; in others as in the smaller species of the same family, their inner surfaces are applied against each other; whilst in the Pterygidae they lie flat upon the back, & are deflected at the sides like the roof of a house, as in Hemerobius.

Psocidae. In many species the wings are of equal size, as we have seen in the dragon flies, *Pauropidae*; in others the posterior pair are considerably smaller than the others, especially in the *Exthemeridae*; in which, indeed, the posterior wings occasionally are entirely wanting. In *Nimoptera* the posterior pair are much longer than the anterior, & very slender. Some of the nerve-winged insects pass through a semi-metamorphosis merely, the rest undergo a complete transformation. The majority of them are carnivorous in the larva state as well as when they are perfect insects. Larvae is worm like, 6 legs.

Fabius - 1. *Oryganiidae* - caddie worms. larvae form case of stones & shells which they always carry with them. These insects resemble the lepidoptera in the distribution of the nerves of the wings, and the hairy covering with which the wings & bodies are beset. These insects are found in the neighborhood of water, & are called caddie-flies or water mussels, & their larva caddie-worms, in which latter state they reside in the water in cases of sand, shell &c. These insects are well known to the fisherman as an excellent bait for several kinds of fish. Thus Braude Walton tells us in his chapter on baits, "There be divers kind of caddie worms, that are to be found in this nation, in several distinct countries, & in several little brooks;" he then proceeds to describe ~~three~~ several species of them, as first, that which is called a "Gipper" w hose bush or case is a piece of Reed about an inch long. "And there be a choice bait for the chub or chavender, a indeed, a great fish, for it is a large bait then there is the "cock spin, being in fashion like the spine of a cock, sharp at one end, & the case or house in which this dwells, is made of

small bushes & gravel & stones." He then goes on to state in his curious way how some of the cases of the other species are made, but we will just run over the rest taking the particulars. Another is called a shaw worm & by some a fur coat, whose house is made of little pieces of straw, weeds, rushes; other again house themselves in two or more sticks laid parallel to one another; others with a small bundle of reeds or rushes, duck weeds, sticks & glued together, by which they float on the top, & can row themselves about the water with the help of their feet.

From this quotation a general idea may be obtained of the cases of these insects, but it is also worth of notice, that it not infrequently happens, that small shells are applied to the cases; and it appears that the caddice-worm does not hesitate to seize upon them for its own purpose, even although they enclose living snails. Some species likewise are incased in a tube formed of a slender & narrow bit of grass, which they are enabled to roll in a beautiful spiral direction, the edges being so nicely fitted as to have the appearance of one continuous piece. In some modern popular works on insects, the various kinds of caddice-worms, are spoken of as constituting but one species, not at all choice in the ornaments, with which it decorates its coat. These worms are of the greatest service to the larvae, the latter being very tender & soft, with the exception of the head, & two first segments of the body, which are the only portion

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Mineralogy

Our earth has sometimes been defined as a "huge mineral," but the discoveries in modern chemistry, show that it is composed of a vast number of compound bodies continually acted upon by changes of temperature, & the solvent character of the fluids which percolate through the interstices which it contains. The character of these bodies differ most materially both in their external appearance & in their effects on the human frame. Thus we find in the same neighbourhood poisons of the most deadly character assuming forms of the most exquisite symmetry, whilst metals which are of the greatest service in domestic economy & the useful arts are apparently worthless if not repulsive in their appearance. All unorganised matter is mineral in the strict sense of the word. Water when in man follows the same laws; no organisation in minerals. First it recognises all the compounds which occur in nature. Second it's they exist in nature itself. It gives you a knowledge of the formation earth, and by it you can more easily follow up geology; it is nearly allied to chemistry. There are very few species in minerals, differing in this respect from zoology. The minerals are the same for the most part in all countries. The composition of minerals. There is a few chosen to form the great part of the earth; some again are very rare, only ocean being found only in the very great depth of the earth. - Formation - 1 Oxygen
2 Silicon 3 Carbon 4 Aluminium 5 Calcium 6 Magnesium
Iron 8 Potassium 9 Sodium 10 Sulphur. Some of these are

161. in the pure state, as simple substances, others again are compound, as carbon isolated in an isolated state & oxygen pure, iron & sulphur; all the rest are combined; they are nearly all combined with oxygen as Iron with oxygen. The earth's crust as we may say is oxygenised.

1 We have just been looking at the composition of mineral, we will now look at, ~~the~~ the question 'How made up'?

Some we have seen are simple as the diamond metallic gold

2 Binary or composed of two minerals; compound of Silica & iron ore.

3 Haloids, salts - 4 minerals - gypsum (or sulphate of lime) calc spar. Gypsum is ~~an~~ a compound of Sulphur + oxygen

+ oxygen

Calc spar the same only that carbon instead of Sulphur -

4 Complex composed of two minerals of the 2 order joined, as common gypsum, another example is a mineral called stilbite which is ~~an~~ a compound of Silicium or Aluminium

— of Silicium

— of Soda

— of Potash

& certain quantity of water

3 Forms - ~~as well as~~ Every mineral left to itself & allowed to pass into solid state, assumes a geometrical solid. Amorphous is an exception (shapeless). Crystals differ in size. They have 3 divisions

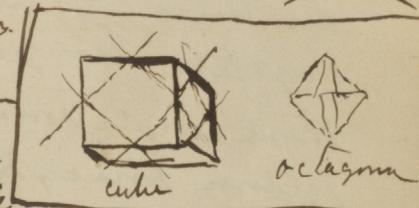
1 Distinctly crystals. 2 Compact or ~~so~~ very minute. 3 Decomposed & crushed to an irregular form. Form Their forms are we have before mentioned geometrical solids. The axis are the lines through the center originating from a point, shows direction of growth. as the following figures — Fig 1 some times however ~~these~~ axes are projected without being filled up as in this figure — Fig 2 others are



— These axes are divided into two parts
1 Principal
2 Subsidiary axes — 1 Principal axis as in Fig 3 — such as in Fig 1 —

4 Arrangement of crystalline forms in nature, System of 6 —
1 Tessel 2 Tetragonal Hexagonal, Rombic Monoclinical Triclinic Reduc.

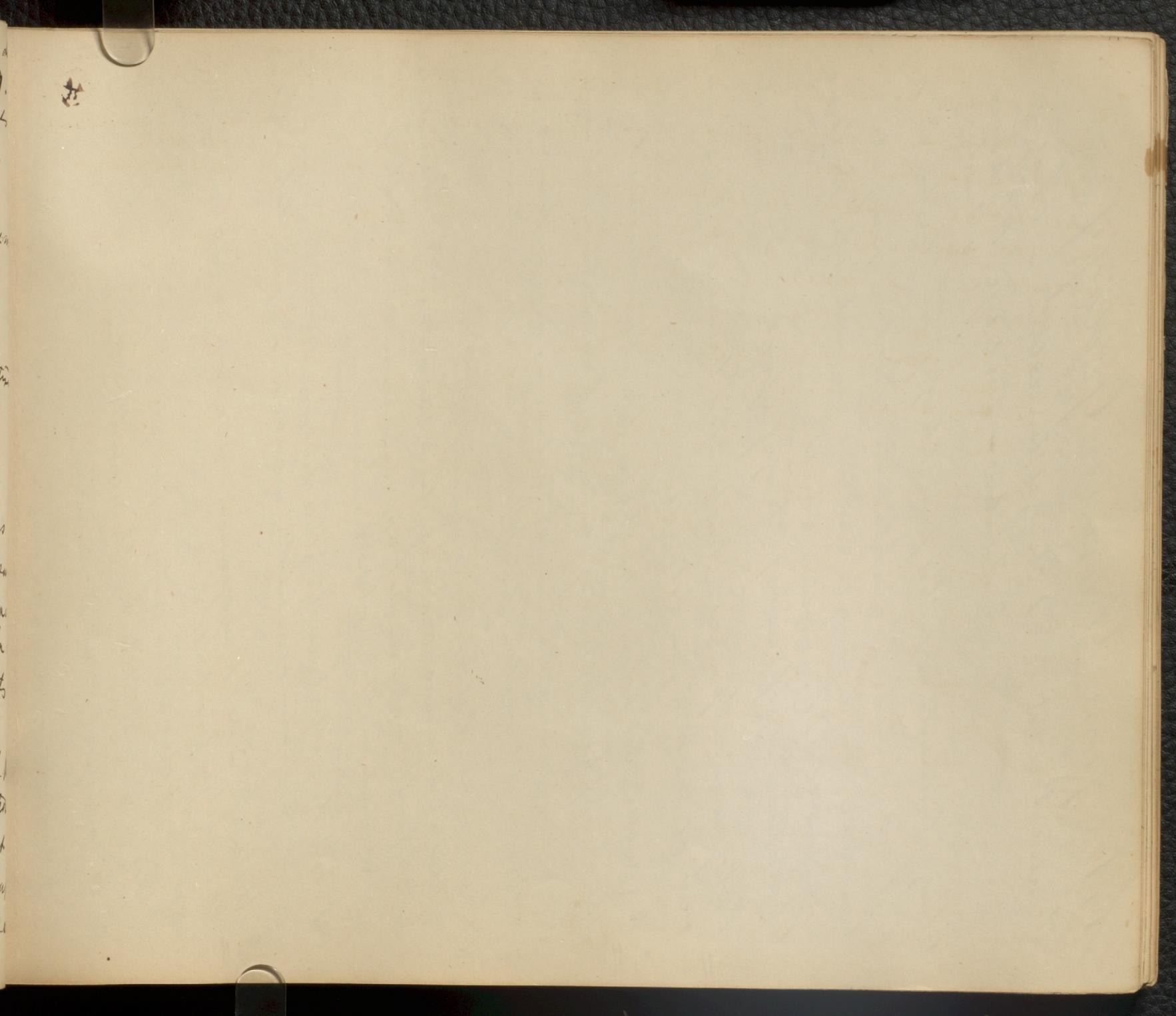
First Tessel consists of octadecim + equilateral triangles, cube 6 squares, some however 24 sided others 48 sided as some garnets — axes equal + angles right angles (cube \square octagonal \diamond) — it very important thing in minerals in cleavage; if you take a cube + take a hammer + strike a smart strong blow on each corner edge, they will off fall & leave quite a smooth edge, so that an expert person can make a octagonal out of a cube for instance, in this rude drawing.



Sometimes in crystal forms may be met with that even a considerably pruned ~~they may~~ not determine, & yet belong to this division — These are called Hemi Reduc for instance half cube or half octagonal —) but to return to our old subject, some again are more complex than the cube & octagonal, for instance the garnet 48 sides, others 24 sides, not very often. Any octagonal or cube may crystallize in any of these forms. Different minerals often have naturally a different form.

- 2 Tetragonal - 4 sides, double 4 sided figure, there are no cube in they divided elongated 4 sided prisms; angles more or less acute, the form like this
- 3 Hexagonal - regular Hexagons; there are a great number of minerals crystalline in this form; 3 transverse axes inclined to one another.
- Hemihedral form - for example we have Beryl-quartz, Tourmaline. the determination of angle very important.
- 4 Rombic - 8 axes all unequal & of indefinite length. Numerous substances crystalline in this form do so.
- 5 Monoclinic - axes inclined two kinds of faces
- 6 Triclinic - they all have rhomboical base, but few crystallise in this way.
- We will now briefly notice some of the imperfections of crystals - ~~Formation~~
Imperfections of crystals

In the foregoing description of crystals, the planes have been always supposed smooth & even, the faces equal & uniform, or at the same distance from the centre or point of intersection of the axes, & each crystal also perfect or fully formed, & complete on every side. In no these conditions are rarely if ever realised, & the edges of crystals are seldom straight, nor the faces mathematical plane surfaces.
 It very interesting variety of these irregularities which pervades all the systems except the tesselar, is named nemimorphism by most authors. In this the crystals are bounded on the opposite ends of their short axes by faces belonging to wholly distinct forms & hence only the upper or under half of each form is produced, or the crystal as the name implies half formed. Tourmaline is an example of this. &



Notes from Davis' Geology of -

Senton Period - 1 Chazy limestone - chazy.
2 Number & Bird eye, Black over & Trenton -

Chazy limestone so called from Chazy on Clinton Co. N.Y.
west side of Lake Champlain. Rock a grayish
limestone, & the fossils seen are remarkable for being
with few exceptions, much smaller.
Characteristics species of Chazy Epoch -

1 Protovans - sponges - Cospongia Palmeri & S. Vassano S.
occur at the Michigan Islands -

2 Radiolaria - (a) Polyps - No species have been described -
(b) Scalaphs - Species of Chaetetes & Columnaria (Billings) -
(c) Echinoderms - The Crinoids include as many known
aspects as Crinoids - The following are a few of these

(1) Crinoids - Palaeocrinus striatus (B)

Blastoides criniferus oacharensis (B) a genus of Rhynchonelliform
This family makes its next appearance in the middle Devonian
& abounds in the Subcarboniferous -

(2) Cyathids - Etallacyctis oliverchi scri. B.

Actinocrinus tenuirostratus - genus Salacocyctis -

3 tabulariids - (a) Bestoyans - Petalopora in cesta
stilocrysta pectinata -

(b) Brachiopods - Orthocerasites (H) Leptena planiceps H
Leptaena incrassata H Myorachilla plana H -

(c) St. Conchifera - none described -

(d) Gastropods - Melacera magna - M. logani - Scalops angulatus
Bellistrom naticinum

44 The Cephalopods - Orthoceras secti - annulation
O - trinoseptum

Articulates - (a) Z. trilobites - Illinoian Anterior &
Illinoian Cassiania - Aaphus atlanticus - A zigzag -
Ganada rocks -

(b) Ostacoceras, or Bivalve Crustaceous - Depositional Canadian

The Trenton limestone derives its name from the well-known locality of the rock along the gorge at Linton in color. The dark rock is gray to black & the grayish colors predominating on the west ridge of Trenton Creek -

1 Protocoens - Specie 2 Black - river species -

near Ottawa city - Dolyceraspis spongia parvula - occurs
2 Radiates - (a) Radiolaria - true coral polypos occurs here
Petraea conicolum - Columnaria Alveolata occurs here
New York, but occurs only in the Black - river limestone
Chonetes - Dry coprolite
Mylaspis subulosa - Trenton fossil -
The chain Coral (genus Heliopsis) -

seen in the Trenton limestone & in Galena limestone of the Trenton Epoch

(b) Acalyphs - Graptolites annulus (canaliculatus) -
Agassiz refers also to the Acalyphes Trentonian, Ganada, Illinoian, Cassiania & the related corals found by horizontal banks over

Notes on Trenton & the Lower Epochs continued -

(C) *Sphaeridium* - The star-fish & valve shells most common at
of the Trenton - *Tamiasites spinosus* B - The Crinids
Leptocrinus elegans (Bell) - The 2-armed cystid shells -
- *Cystisphaera amara* B - Of the Trenton in Ottawa Canada -
Cystids described by E. Bellamy as from the Lower Silurian
of Canada is 21, making 22 species so far as known
in North America for this era - The numbers of these
done over amount to 50 species - & the Star-fishes to
11 - Thirteen of the Crinids & 8 of the Star-fishes are
Trenton species -

3 *Ostrea* ts - (a) *Bryozoa* - *Pectenora* & *Ptilobrachys* are common -

(B) Brachiopods - *Ostrea dysoni* - *O. occidentalis* -

O. tenuicostata - *O. tricostata* - *Lepanomia sericea* -
Strophomena rugosa (formerly *Lepanomia depressa*) *S. alluvialis*
Rhyynchonella incrassata H - *Rhyynchonella? hispida* H
(C) Conchiflers - *Arcicula tentaculata* - *Anthonyshia*
bellistriata - *Gastropoda* *Conocardium nasuta*; also
Conocardium from autumn - of the Black river
lime-tree on the Ottawa, Canada, & species of
Umbonium -

(d) Gastropods - *Planorbis lenticularis* - common in
the Trenton - *Obliquissima bicincta* - *ob. bellistriata*
often from lime-tree - *Helicostoma planulata* from
Canada - *Bellerophon striatulus* very common -
Cyrtolites compressus - *Cyrtolites* sp. *gasteriferus* -
Melania cyrtolites is like a partly uncoiled *Bellerophon*,
& is not chambered - Also several species of
Patella - like species of *Urticula* -

(c) *Aphalopods* - *O. orthoceras fuscum* - a small
turbid species - *O. vertebrae* also found - *Osmoceras*
tenuifilum - this last species is very common in the
Black river limestone, & is sometimes over two feet long.
The genus *Osmoceras* is peculiar in the head of form
of the siphuncle - *Endoceras proteiforme* is
& *Gonioceras uncus* - &c. The endoceras is the
most singular known, having attained a length
in some cases of 15 feet; & a diameter of nearly one foot.
(d) There are also curved species - *Cyrtoceras annulatum*
cryptoceras as undatum - abundant in the Black river
also the genus *Spirifer* - *Ammonites* of the Hunter -
This genus the species *P. immitatum* &
in the Black river limestone B - occurs
Conularia gracilis supposed to be the shell of a
Cephalopod -

4 Articulates - (a) *Terebratula* - *Asaphus gigas* as
small specimens - sometimes the shells of a great
Calymene amaria - *Lischas dentatus* - *Terebratulus*
concentricus - *Agonotus bivalvis* -

(b) *Ostracoids* - *Lepidodictya tabulata*
In the State of New York the Black river limestone is
especially remarkable for its great abundance of
the Orthoceras family, among which are the species
Osmoceras tenuifilum & *O. vertebrae*
& *Gonioceras uncus* - which do not occur in the over-
lying Trilobite limestone; In Canada, however & other
parts of the West, there is a mingling of B.R. - Black & Yellow
shells, which proves that the rocks make but one group.

Notes on Hunter & Chapman's Epochs Continued -

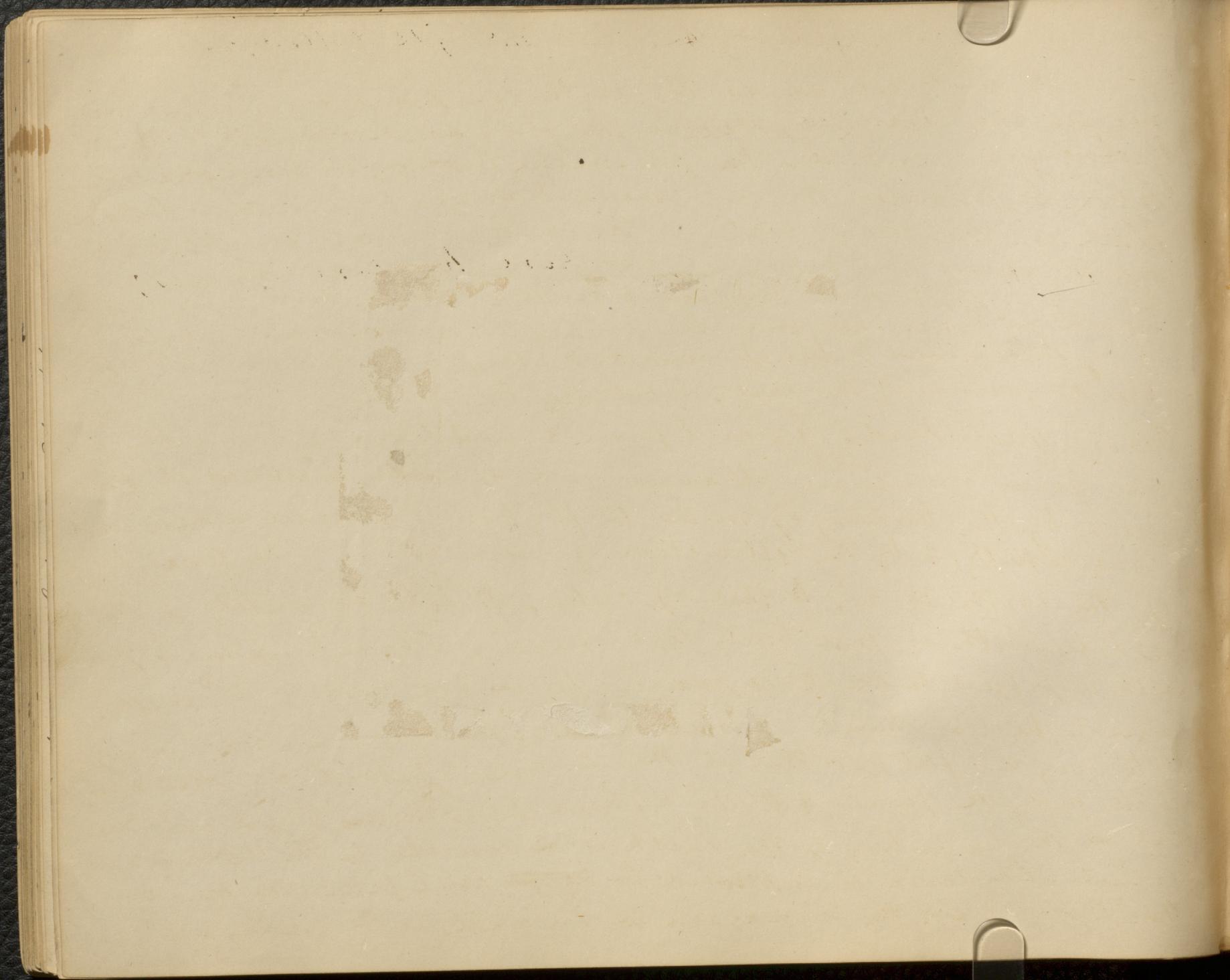
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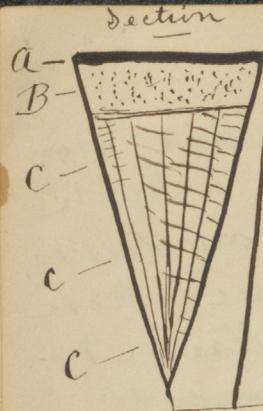
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geology — Mc Gile College

Of what materials ~~are~~ is the earth composed, & in what manner are they arranged, these are the first inquiries with which Geology is occupied. In pursuing Geology we find ourselves led on to consider the successive changes which have taken place in the former state of the earth's surface & interior & the the causes which have given rise to these changes, & what is still more singular & unexpected we soon become engrossed in researches into the history of the animate creation or of the various tribes of animals & plants which have, at different periods of the past, inhabited the globe.

First great head, General form & conditions of the earth, The form as we are all aware is a spheroid, flattened at the poles, by the tendency of matter to fly from the centre when revolving rapidly, & by the attraction of gravitation. The density of the earth is $2\frac{1}{2}$ * that of water, while the density of the whole earth is five times that of water. The interior mass of the earth is subject to great expansive forces. The crust of the earth cannot be less than 300 miles thick, the temperature also increases 10 to even 25 feet, so that at the distance of about 25 miles any rock may be fused, & at the distance of 1,20 miles turned into vapour. But at the temperature of the earth is ~~so~~ variable to the depth of 60 or 70 feet. The earth is supposed to ~~be to~~ have bring the crust then ^a molten mass the solid again to the centre, as the drawing will show



Suppose this to be a section of the earth towards the centre - a is the crust which we walk upon - B is the molten mass, ~~in~~ which is the height of the temperature for after that it decrease as it gets nearer the centre. c - c - c is the solid portion to the circumference.

The earth consists speaking generally of ocean basins fully ridges or mountain masses plains raised out of the sea.

The second great head is the structure of earth's crust.

(a) In large scale -

1. Stratified ~~or~~ which are the prevailing order of rocks. This is generally the ~~order of~~ ^{way with} the bottoms of lakes, estuaries, & rivers, which they have their bottoms composed of layers of sand gravel & clay alternately.

General condition of the earth's crust -

* The first thing which a geologist does to look at under this head, is the kind of rock.

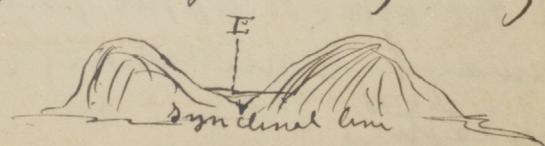
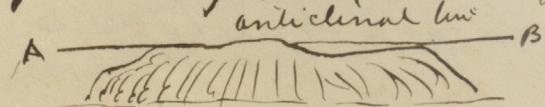
2 Whether Horizontal or inclined.

To decide the ~~inclination~~ of angle of inclination, however, a very simple instrument is ~~used~~ called a clinometer, ~~which~~ however we have not time to describe, but it can generally be decided without any instrument.

Rocks are also said to dip & strike. If a stratum or bed of rock instead of being quite level, be inclined to one side, it is said to dip; the point of the compass to which it is inclined is called the point of dip; & the degree of deviation from a level or horizontal line is called the amount of dip of the angle of dip. Thus in this drawing (fig 2) a series of strata are inclined, & they dip to the North at an angle of 45° . The strike or line of bearing is the prolongation or extension of the strata, in the a direction at right angles to the dip; & hence it is sometimes called the direction of the strata. Thus in the above instance of strata dipping to the north, their strike must necessarily be east & west. Dip & strike may be aptly illustrated by a row of houses running east & west, the long ridge of the roof representing the strike of the stratum of slate which dips on side to the north, & on the other to the south.

A stratum which is horizontal, or quite level in all directions has neither dip nor strike.

An anticlinal line is a line running along the summit of a ridge, & one following the bottom of the adjoining valley a synclinal line.



Mina Beds - These beds are all twisted & distorted in every direction. An example of this sort of curved structure in which the beds are twisted in this way, has been well described by Sir James Hall. It occurs on the east coast of Scotland, near St. Abbs Head ^{where}. The rocks consist principally of a bluish slate, showing frequently a ripple-marked surface. The undulations of the beds reach from the top to the bottom of cliffs from 200 to 300 feet in height, & there are 16 distinct bendings in the course of about 6 miles, the curvatures being alternately concave & convex upwards. An experiment was made by Sir James Hall with a view of illustrating the manner in which such strata, assuming them to have been originally horizontal, may have been forced into their present position. A set of layers of clay were placed under a weight & their opposite end placed towards each other, with such force as to cause them to approach more nearly together. On the removal of the weight, the layers of clay were found to be curved & folded so as to bear a minute resemblance to the state in the cliffs. We must however bear in mind that in the natural section or sea cliff we only see the foldings imperfectly, one part being invisible beneath the sea, & the other or upper portion, being supposed to have been carried away by denudation, or that action of water which will be explained hereafter.

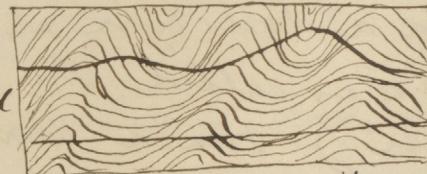
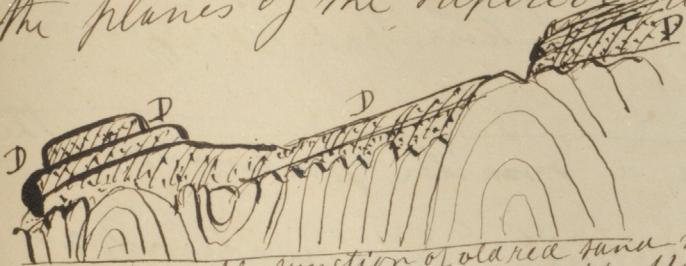


fig 3

We next notice unconformable stratification - Strata are said to be unconformable when one series is so placed over another, that the planes of the superior ~~repose~~ on the edges of the inferior. (fig 4)

D is the unconformable strata. -



Unconformable junction of Old red sand-stone & Silurian schist
at the Scar Point near St Abbs Head, Berwickshire.

In this case it is evident that a period had elapsed between the production of the two sets of strata, & that, during this interval, the older series had been tilted & disturbed.

Afterwards the upper series was thrown down in horizontal strata upon it. If these superior beds, as D D, are also inclined it is plain that the lower strata a a, have been twice displaced; first, before the deposition of the newer beds, d, d, & a second time when these same strata were thrown out of the horizontal position. (see Syll.)
Fractures of the strata & faults. - Numerous rents may often be seen in rocks which appear to have been simply broken the separated parts remaining in the same places; but we often find a fissure, several inches or yards wide, intervening between the disunited portions. These fissures are usually filled with fine earth & sand or with angular fragments of stone evidently derived from the fracture of the contiguous rocks. (For particulars see Syll.) It is not uncommon to find the mass of rock, on one side of a fissure thrown up above or down below the mass with which it was once in contact, on the other side. This mode of displacement is called a shift, slip or fault. (see Syll.)

Denudation - is the removal of solid matter, by water in motion, whether of rivers or of the waves & currents of the sea, & the consequent laying bare of some inferior rock. It affects stratified rocks, a point to which till hitherto very little attention had been given, (see Lyell Page 66) -

2 Unstratified rocks - ~~are~~ there are a smaller portion of the earth's crust.

B On small scale - { slab structure - laminations ^{shaly}
of strata } Unstratified columnar globular Cuboidal.

* Columnar - always at right angles 
C minute structure ~~either to rock from earth to~~ ^{Rock grain} ~~or~~ ^{wire} pebbles
porous rock - vesicular - compact - fine grained crystalline
Rock, coarse granite Rock.

3 Chemical natures of Rocks (divided according to the minerals that compose the rocks)

1 a great many substances may be denominated simple minerals for example Sandstone - quartz Rock - compact felspar - hornblend - mica slate - talc slate - chloritic slate - serpentine.

2 mixed Minerals - granites - quartz hornblend felspar
sinter - green stone - Basalt - with compound felspar Porphyry

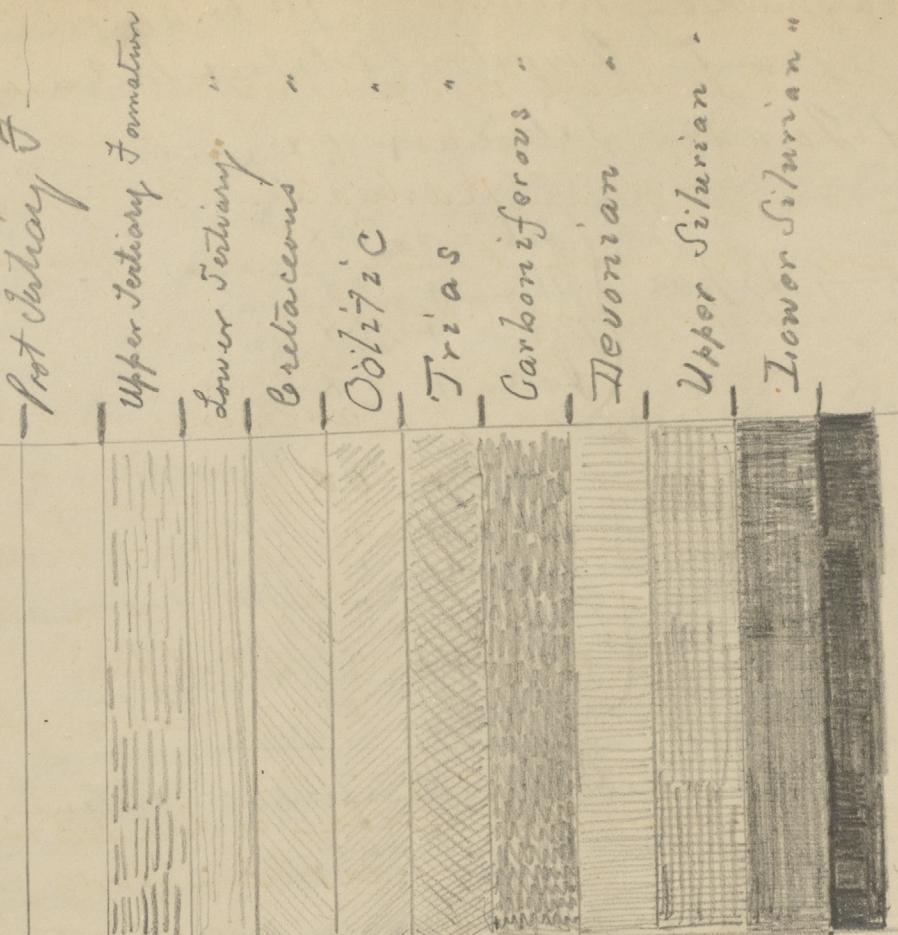
3 Those composed of fragmentary minerals - for example - grit-sand-stone - shale - clays - Quartz - Felspar & Mica are composed of the following - 1 Quartz Silica + oxygen

2 Felspar { Sil + ox
Alu + ox
Pot + ox
Sod + ox

3 Mica { Sil + ox
Mag + "
Pot + "
Cal + "
Zel + "

4 Origin of Rocks - 1 Igneous (unstratified crystalline).
2 Aqueous (stratified)
3 Metamorphic (mica) Gneiss,
Gneiss same as granite only laid in layers.

IV Modern Age



II Secondary Age

I Palaeozoic Age

Metamorphic Rocks

Lower Silurian rock in N. America - 8 slates
 Potsdam Sandstone - Calcareous Sandstone -
 Chazy Limestone - Bird-eye limestone - Black River L.
 Clinton L - Utica slate - Hudson River Group -

all found in west of U.S. states

Radiata

Taken from notes on lectures by Prof. Bailey

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All the animals of this class ^{are} of a small size, & nearly all inhabit the waters. They are divided into two great divisions - 1 called the Typical Radiates & 2 the aberrant Radiates. The Typical Radiates are divided into 5 classes - 1. Protosoa (animalculæ, sponges).
2. Hydrosoa (polyps).
3. Acalephæ (jelly fishes).
4. Anthozoa (sea anemones, coral animals.)
5. Echinodermata (sea urchins, starfishes).

The Aberrant Radiates are divided into 3 classes - 1 tending to Mollusks

Class 1 Bryosoa - sea mats

tending to articulate, { 2. Rotifera - wheel animals
3. Enterosa - Intestinal worms

First - The Typical Radiates. Class 1 - Protosoa is divided into 3 orders.

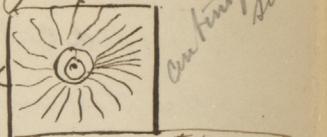
Order 1 Reticulopoda

This order is so called from the root footed character of the animals. It is divided into three groups 1. Without shells (Amoebæ)

2. Chambered perforated shells (Foraminifera)
3. Siliceous shells (Poly cystina)

Group 1. Without shells (Amoebæ). The creatures of this group are microscopic, abounding in stagnant water. Structure a mass of loose cells. They have no outward thick coat nor any determined form.

These creatures have no mouth, but what they take simply passes through the gelatinous mass with which they are surrounded & do nourishes them. They reproduce by spontaneous division. One species of this group of which ~~this~~ I have drawn a figure, by the aid of the long branching tender threads by which it is surrounded catches hold of its prey & presses it against its body, till it passes through into its body, & thus nourishes itself. Its food is small microscopic plants. These are fresh water animals, yet in the sea there are some which are very similar to them, the only known difference being the sea ones, have cells with a ~~red~~ sort of case thrown around.



*name not known
to me at present*

Group 2 Chambered, foraminated shells. Foraminifera - There are a vast number of these creatures now existing. Their form is globular as in figure, they have a shelly outer covering, perforated by small holes. Through these orifices they protrude kind of feet, with which they move & seize their prey. Mode of reproduction not known. Some of these shells of this species group are very beautiful, they increase in size by adding ~~and~~ new cells to their edges as in the following figure.



rotalia
testicamerata

The shells of the Foraminifera differ in dimensions. Some of them are perfectly microscopic, & others again the size & shape of a dollar & from their resemblance to a coin have received the name Nummulites fossil money. Fan shaped animalcule. Another is the

Testularia or entwined animalcule, it has the figure of a cluster of globes rising in the form of a pyramid, & when a section is made in the direction of its length, it displays the different cells into which the cavity of the shell is divided.



Group-3 - Silicious shells - *Poly cystina* - They differ from the *Fusulinidae* in having their shells silicious - not made of carbonate of lime. They are larger than the last group. They have a thin shell of silica, openings from which they send out long arms - some are quite cylindrical others flattened discs. *The Prodycystis*, *Silicocystis*, *Hyalostoma* are examples of this group.

2 Order - *Poifera* - (Sponges) placed by some among plants but are now proved to be animals - This order might be generally described as compound polypes, the individuals being connected by a membrane extended over an internal massive structure, calcareous or horny in its character. In one large family this internal structure is the substance called coral; in others, it is that no less familiarly known as sponge.

Group 1 - *Spongia* - Sponges - On carefully examining the sponge, it is seen to contain a number of minute orifices or pores, extending in channels through the substance. In a living state, when enveloped in membrane, the only



vital action that can be traced, is a continual passage of water into & out of these channels, being probably for the purpose of supplying the animal with nourishment. Modes of reproduction various. when young they move about, but when old are stationary.

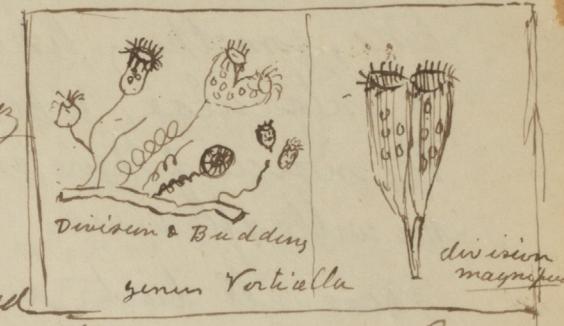
Order Infusoria - Form cell-like, all the animals of this order have some definite form, not all shapes as in the last order. Some have both proper mouths & stomachs, & this is the first ^{place where} mention we have anything like inside organs. A small intestinal cavity answers for the stomach. They have circulation, Reproduction, Generation; They have 3 ways of Reproduction, 1 Spontaneous Division
2 Budding
3 From eggs (like sponges)

The Leucophrys is an example of this order, (see the figure). In figures 1. 2. 3 are represented the different states of spontaneous division, Fig-1 when the first line appears across the body of the animalcile Fig 2 where the division has made some progress. It is almost separated. It is seen that each half take a $\frac{1}{2}$ of the cells or stomachs. Another species is the *Saxodes* which is considered the giant of the order-
Fig 4

Rem-(top of page)
X Besides the Spongia. There are 3 other species. *Halicion dia* *Tethia* (found ^{found} in the clay round Montreal & the last *Spongilla* a fresh water sponge.

genus *Loxodes* has a distinct stomach connected with the mouth by the intestinal canal. The young of this genus are produced ~~from~~ through the side of the parent. (See Fig 4). These creatures ^{are} quick moving & very predaceous.

Genus *Vorticella* — These animalcules are stationary. Their form is a sack open at top, from which openings project cilia for causing currents of water. This sack or cup is attached to the end of a long slender stem, very contractile, for when alarmed in the least it contracts & pulls down the bell flower. They reproduce in the two ~~ways~~ following ways 1 by Division 2 by Budding. The self division is as follows — The bell first begins to expand in breadth, & then a separation commences, extending in the direction of its length, double rows of cilia being meanwhile formed. At length the two parts being perfectly developed, the bell divides into two animalcules & fringes of cilia next appear fringing the base of each. Soon the young animalcules, twist off from the stem which speedily decays, & after swimming about for some time, at last put forth a new stem from the end of each bell; then affixing themselves to some object, they multiply by self division, & become in their turn the progenitors of a numerous race. The Budding is the same as in other species (it may be seen in the figure).



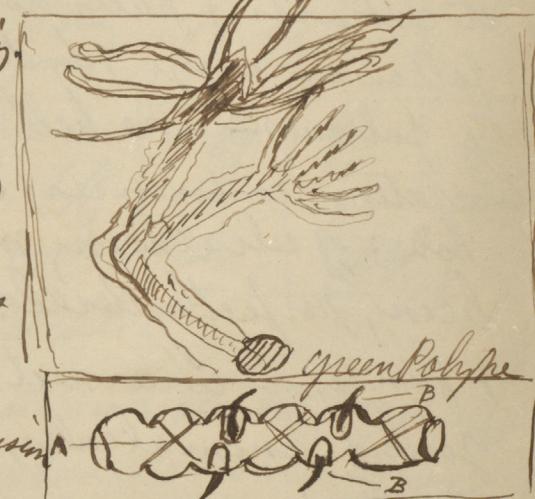
Class - 2 - Hydrosoa

Here we rise another step in nature. The bodies of this class are sack-like, something like the Vorticella. They have a distinct stomach & tentaculae, which ~~are~~ are organs of touch mentioned, on the the inside of their tentaculae, they have what is called cell darts, which we will afterwards find is quite common among this class of animals. These cell darts are kind of claws, which they make use of, to hold their prey more securely. In the figure there is a portion of their tentaculae magnified to show the cell darts, & also the muscles for contraction & strengthening.

This class is divided into 3 groups

1 Group Naked Polyps as Hydra. (fresh water)
These interesting little creatures may be obtained in any pond, on pieces of wood or mud shells etc. We will take for example the yellow

Hydra - You will notice in the figure the expansion at the base of the stalk, this is called the foot & enables the animal to adhere to any substance. It sometimes floats about, using its long arms for oars & thus swimming. At other times it elevates a part of its body above the water, & this look like a little bladder, it then floats along with the wind.



magnified view of tentacula
(portion)

A: MUSCLES -
B: CELL-DARTS

as we have before mentioned the tentaculae are muscular & also hollow, containing every here & there small dark cells. If the prey that they swallow is at all coloured, the Hydra's body partake of that colour, the nutritive fluid being absorbed in the Hydra's body. If any substance which it does not prey upon comes by chance into its mouth, it is at once rejected. When it has once seized its prey it is the victim is suddenly paralysed, & it is thought that this is due to the darts, through which poison passes.

It is then enabled to catch prey much stronger than itself.

Sometimes when it has two enormous worms the tentaculae can hardly be seen, but it hardly ever fails to secure them.

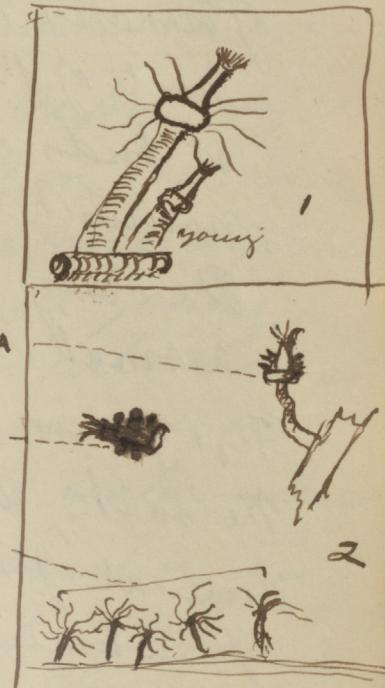
The stomach of the polypus consists of the whole internal cavity of the creature, & when its prey has been devoured the body & feelers are no longer extended, but contract. While the process of digestion is advancing, they are very sluggish, & the whole nutritive fluid (as has been mentioned) is disseminated throughout the whole internal surface, both of the body & feelers, imparting to them a coloured appearance; thus when a red worm has been devoured, the juice of the prey tinges the entire surface of the Polypus. The Polypus multiplies by buds & shoots. If it is kept in a vessel of water & well fed, 2 or 3 shoots are seen when the weather is warm

growing out of its body at the same time, & from them again, while still attached to the parent shoot out others. When a young polypus is about to come into existence, that part of the body from which it will grow swells beyond its natural size. This continues gradually to increase, & when a sufficient enlargement is attained, the head of the young polypus appears, & its arms are protruded, & by the aid of the latter it now supplies itself with food, in the manner of the parent. Until nearly the time when it separates from the parent, the young polypus possesses, an internal communication with the latter, & also a common sensation; for if one is disturbed & contracts, the other directly does the same. (It has also taste or a). Its power of producing any organ of which it has been deprived is also very great.

We have not time to enter into this suffice to say, that though they should be cut to 10 pieces, or even turned inside out (which has been tried) each piece will become a new animal, & it will continue to live digest & reproduce them turned inside out. The Hydria is the type of multitudes of both in salt & fresh water.

Group 2 Polyps in tubular cells. Tubularidae - Tubularia & Eudendrium.

Tubularia - Marine - These animals are fixed, they have two sets of tentaculae, large round the base of the head, & small round the mouth. These tubes are never seen alone they are always together in groups, for this reason that the young are also stationary, & consequently grow round the body of the parent, & do these again produce young & so on. Here is a figure of one of the Tubularidae genus Tubularia They reproduce by gemmation & rva. The following is the strange manner in which it reproduces. If you look at Fig 2 you will see the different processes. The first, letter A is the Tubularia sending out little buds at the base of the sort of head, by & by the tentaculae diminish & the top part of the animal shrinks, as these cells grow larger, at length as is seen in letter B the head falls off the body altogether, carrying the cells with it. And when it reaches the bottom, the little cellular work themselves off, & the ~~head of the parent~~ shrinks & dies. Then the cellular attack themselves to a piece of wood or stone, & commence their growth as is seen in C like ~~for~~ Hydri. They soon grow to their full height & commence in their turn to reproduce.



Another genus *The Gudendium*, differ from the *Tubularia* in having only one set of lenticulae.

Division 3 - Compound Polyps. This division is divided into two other divisions 1 Campanulariidae & 2 Sertulariidae.

1 Campanulariidae - wine glass form - ~~having~~ branching cell at the end of each stalk, the interior of branches filled with a dark coloured marrow, part of the animal - extensible mouth. When it buds out the ~~are~~ young are not separate, but help to nourish the parent. Reproduction something like *Tubularia*. The ovary cell as seen in the figure bursts & a little creature like a small Medusa comes forth.

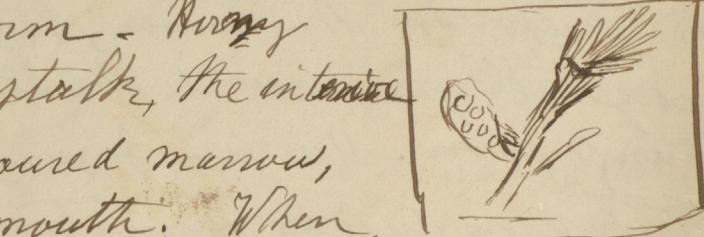


Fig 1 you can see plainly the ovat in the sack, what shape they are. Fig 2 represents the young after it come out of the sack, the dark spots seen in the body are ova, which after a time come forth again, & assume the appearance of Fig 3 which sometimes are taken for some kind of animaculæ. These after a time settle down on some substance as Fig 4. They then grow in length & height & at last a wine glass shaped cell appears on them after which they shoot out other buds. The first appearance of the cell is in Fig 5. In Fig 6 the completed figure is.

another genus grows zigzag with a cell at each corner. Thus
These appear like Hydra from the first.



2 Sertulariidae - cells opposite each other - We have 3 genera

1 Antenularia =

2 Plumularia =

3 Sertularia =

Highly magnified

In further particular see the work in the
Library on the microscope construction. Page 202 -

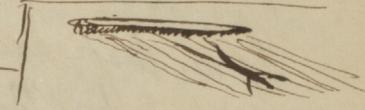
3 Class Aculephae - sea nettles - so called from the property
many of them possess of irritatin & inflaming the skin, the cause
of this property we will explain hereafter. These are never attached
to any thing in their adult state, they may be while young
but nothing of their young state is yet truly ascertained.
They are all jelly like some of them in fact so much
so that they can not be distinguished from the water which
surrounds them. Most of these creatures are possessed of
with long thread like filaments, ~~which~~ which if touched
produce a sort of numbing ~~pain~~ sensation. This is caused
by rows of cell which are along these threads filled with a sort
of irritating fluid which is ejected when it seizes any thing.
They are not unlike the cell darts of the Polyps. There are male &
female forms.

Orders - Siphonophora or Physozzades - We take for our first example the Physaliae or Portuguese men of war. Physaliae The animals of this family have an oblique & wrinkled salient crest on the upper surface & one furnished below, near one of the ends, with a number of cylindrical appendages. In this crest they have a number of air cells which keeps them afloat & the wind wafts them along the surface. Their cylindrical appendages are extensible tubes. It seizes its prey by these arms, & if the prey be larger than themselves they enclose it & soon paralyse it with their arms, but if it be small they suck it up through these tubes & there digest it. The stomach is at the base of the tubes. The stomach it may be observed, is a cavity of considerable size in the centre of the inferior surface of the disc, at its union with the peduncle, & it is either really or apparently divided into 4 compartments by means of a fleshy membrane; it is usually found to contain a yellowish & almost fluid pulpy matter, which is regarded as the digested element, destined to supply the demands of the system (this description serves for all the medusae) through which it passes circulates, traversing certain large tubes & vessels which radiate from the stomach towards the circumference of the disc.



Physalia

subdividing into smaller branches, & forming numerous junctions with each other, so that upon the margin a complete mesh of tubes is established. Another root has a flat plate containing air cells, it is something like the last one only flattened out



2 Order Dis-cophora or Pulmo-grades.

(a) Bare-eyed - *Madeiria sarcia* &c

(b) Clothed eyed - *Rhisostoma cyanea* &c.

(a) Bare-eyed - all the bare eyed medusae are developed from Polyps & reproduce by gemmation not by ova as in the clothed eyed. We will take for example the *Madeiria*. Top thick & round ~~dist~~ thin. Eye spots round sides as seen in figure - mouth at end of stalk. This animal opens & shuts like an *Alberella* when swimming. The mouth leads to a stomach & from thence by a series of canals circulated through the body. Organs of sensation placed round the extremity of the body. The follow is the way these reproduce - The extremity of the mouth ~~like~~ turns towards the animal, gets covered with small cells (see fig) on each of these is a young animal which soon breaks forth & away -



cell magnified Perfect animal

(b) Clothed eyed - *Rhizostoma* (coat mouthed) - These attain a great size, but contain very little matter, one weighing 5 or 6 lbs, will when dried not weigh more than 7 or 8 grains. If we look around the disc we will see in little sacks pigment discs, for this reason they are called clothed eyed. The tentacles of these creatures (unlike the last mentioned) instead of having a distinct mouth, have the extremities all split out or like root fibers, through which the sea water is filtered & all substances which the animal feeds upon are ~~has~~ drawn up into these tubes, but whatever is not fit for digestion is again thrown out. The esophagus first splits up into four then each of these again become split at the ends into several tubes. The following is a short account of its water foot form - Notes on the mouth -

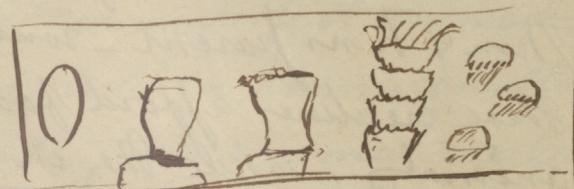
In the *Rhizostoma*, there is placed beneath the disc a pendent peduncle, or foot stalk.

which is divided into 8 foliated laminæ, or processes, & each of these again ~~are~~ is found to contain numerous canals, opening on the external surface, by minute absorbing orifices; these canals ultimately merge into 4 large canals, communicating with a central cavity.

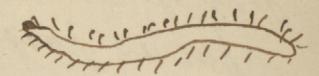


The disc of the *Phisostoma* & of other medusae, is an organ of locomotion, an apparatus for enabling the animal to float & readily in the surface. Gelatinous as is its structure, texture, it is never-the-less capable of certain contractile movements; & are essential ~~for~~
the swimming of the animal in the surface, from suspending them it at once sinks. Look like clear yellow transparent jelly.

Genus *Cyanea* - The tentacular are prehensile organs, for they seize the prey & carry it to the mouth. Their food consists of crabs & fish &c &c. These creatures are some times 4 feet in diameter. Tentaculae very long. Colour red & purple. These creatures are phosphorescent. The following is the mode of their growth as far as possible to be ascertained. In the ova, it is oval, from it comes a creature very like except that it is attached at one end to something (see figs) next it changes to what is seen in the fig - having small tentaculae, after this it grows by each a new cup like, being added till it attains a great height & each having tentaculae, these lastly come off separately & inventing themselves (see fig) swim off, till the come to the last one which remains from & then goes on adding again.



3 Order - Ctenophora or Ciliogrades. Gydippe, Berse, Cestum &c
 (Larval Polyp forms of Acalephae).
 Long extensible arms - sexes not distinct. ~~We will take for~~
 example the Berse it is has transparent body, banded, with fingers
 of cilia on each band & by which they move. They have long extensible
 arms, which are covered with a multitude of smaller filaments
 each of these can be contracted to the main arms & the arms
 again to the body. Organs of circulation
 placed round the animal's sides in shape of cavities
 cavities. Nervous system doubled. Eyes in posterior
 part of animal's body. Granular - There
 is another creature of this kind, only lamelliform,
 thin & transparent - rows of cilia round animal.
 These creatures afford food to a great number of fish & other
 animals, while they in their turn are very voracious.



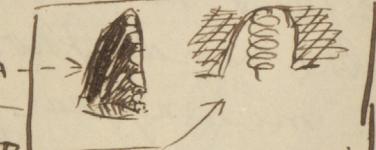
4 Glass Anthozoa (flower like) These creatures bring us back to
 forms something like Polyps or Hydrois - The creatures of this class
 however are larger than & higher than Polyps - large tentacular which
 are hollow, & are provided with ~~cell dots~~ - thread cells - They are
 much more complicated in their structure than the Polyps - having
 internal organs - 1 family Actiniadæ or sea flowers - Cylindrical

soft but firm, are of fine colours - These creatures have the power of secreting some adhesive substance at their base, by which they affix themselves to rocks & other objects - but can release their bodies when necessary & either by creeping on their feelers, or filling their bodies with sea water, & gliding along change their location. In their appetites they are voracious & seize the little shelled inhabitants of the sandy shores. Actiniae bring forth their young alive; one or more appear first on the tentacles, from whence they can be withdrawn & transmitted to others by the parent, & are at last produced by the mouth. In the course of 6 years, one specimen was found to produce above 276 young - The actinia like the Byssus may be cut up & dismembered ~~but~~ without injury - the parts becoming perfect animals or the members rebudding - It is said an actinia having swallowed an Pecten, the shell stuck across its body, & the animal could not get rid of it at all; instead of dying however a new mouth & two rows of tentaculae were formed at the base, becoming a double animal - There are various sorts of anemones which we have not time to mention. (see work in library Microscopic its structure) - One sort that we will mention, is rather different in shape, being a long slender ~~that~~ green stalk supporting the tentaculae -



When alarmed these creatures at once contract - They are generally seen on the European coasts not often on the American. The tentaculae are ejected by a stream of sea water being allowed to enter into them. The tentaculae are muscular. They can hold very large creatures, such as fish, crabs &c. The thread cells (see fig) are the chief means employed in killing their prey.

A Point on tentacula magnified - showing cells
B Cell magnified showing thread like filament



Tentaculae all around the mouth which is central.^B
The mouth leads to an extensile stomach large & muscular.
They throw out of their mouths the bits of shells of crabs or bones &c
which they have taken in with the flesh - or sometimes pushes
the foreign substance through its body. The body is chambered
round the stomach, part of the chambers are full of sea water
the sea water connects with all the chambers by
means of openings - & also in these chambers
are openings for letting in the sea water - The



tentacula as above noticed are hollow with a minute orifice
at their extremities; & their interior communicates with a compartment
between the stomach & the external tissue, a wall of the body's.
a compartment not single however, but divided by longitudinal
membranous partitions into numerous chambers, between which
there is a free communication. This chambered, or divided cavity

is the aëration receptacle, & is filled with sea water, taken in through
the tubular tentacula, & expelled when the animal contracts, through
the same tubes, a fresh supply being absorbed on the dilatation of the
body. In these compartments are the eggs arranged in clusters
on a delicate membrane; & it appears that on the detachment
of the eggs from this membrane, they either pass, by means
of a minute orifice, into the bottom of the stomach & are
swallowed away, or are transmitted through the tentacula.
This point however remains unsettled. These creatures sometimes
live for a great number of years - There are some ~~go~~ again that have
but few tentacula, but a number of small sprouts on the end
of each stalk. 

2 family - Xeniidae ex Zoanthidae - These differ from the last, in
being always attached to some sub rock or to each other,
very similar in other respects to last family.

3 family Alcyoniidae ex Alcyonium - Fixed, horny skeleton, covered
with a ~~loose~~ ^{dark} calcareous spicules. The polyps are distinct - each has
a separate cell - but each cell is connected with the others, so that all
are alike nourished - One species is Alcyonium digitatum - Its name
is derived from its fingered appearance. The French call it
Main de Mer, or "sea hand". The Germans Fingerspund, or "fingers
hand". Sometimes they are very small; but when larger are named
by the fishermen Cow's humps & others, differing a little in form,

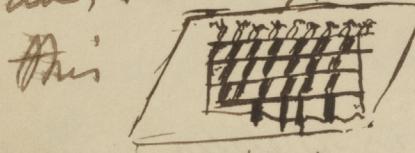
Dead Men's Toes, or do hands - Their spiculae are calcarous or siliceous crystallizing in the form of a cross looked at the side, & lie scattered through the soft like mass (see microscope) Another species (see microscope) *A. gelatinosum*.

4 family Pennatulidae - ex *Pennatula* - This family derives its name from *penna*, a ~~penn~~ which the animal resembles; & animal B one stalk magnified phosphorescent (see microscope in library)



These 4 families have all structures of the same type as anemones - There is 3 more families

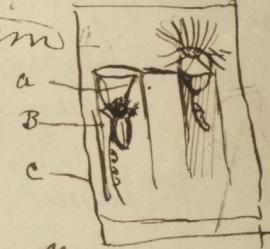
5 family Tubiporidæ - ex *Tubipora* - or tube coral - (red) structure of Polyp like anemone - Although this coral in its dead state is red, the Polyps are of a bright green colour. The structure is like this



a is the muscular bands which draw out

the polyp & back again - b is the body of the Polyp - c is the thin oval cord to which the ova are attached - Few species of these Polyps after a certain time all unite and make a flooring this causes the divisions across the tubes - ~~innumerable~~ ~~dead pores~~

6 family Madreporæ - Tunicæ - *Caryophyllæi Ascidæa Decandlinæ &c* Madreporæ differ from other corals in not having a smooth skeleton, but one indicated by numbers of small cells for the residence of the



living animal. - there are very visible in the Madre por mucicata - when the polyp is dead & decomposed ; but more distinct ~~wedges~~ in the ~~Calina~~ or rugosa or abra tanoide, as they are situated at the apparently broken stumps that branch from the bank of the skeleton. - The living polyps are most beautiful in their native waters, their varying colours adding to the richness of the hues covering the plains of the ocean.

Fungia an animal very like the anemone only considerably larger form a very large tribe of animals - several groups - one - has a great number of tentacula over surface of body & round mouth as in Fungia actiniformes -

Brown coral sometimes attains to the diameter of 5 or 6 feet - cells run into each other - grows upwards & leaves dead coral behind it - one a divine another group has no more than 12 tentacula another .. less or never more than 12 this comprises the common branch coral, those little prominences are on the same type of structure as Fungia - greater portion of corals Madre por

Asterias or star corals In the genus asteria the polyps are situated in deep polygonal luminated cells, & are connected by a thin gelatinous expansion covering the dark calcareous mass, which is generally of a convex or rounded form, externally

When the *Asteraea viridis* protrude themselves, & expand their numerous oral tentacles, consisting of a large & small one alternately, they resemble beautiful green flowers, with a blue centre, the oral disc being tinted with the latter colour - coral composed of carbonated lime.

^{last} Another group have their tentacula obsolete -

genus *Millepora* minute punctures can only be seen penetrating deep into strong ~~the~~ mass -

last family *Gorgoniidae* ex *corallium Gorgonide* (true corals)
these corals spread out to a great extent at the bottom of sea
like trees - immense number of polyps

inhabit warm climates - genus *gorgonia* true coral
(red) of commerce, their support is a dense calcareous matter.
no cells - each looks like when contracted a button, on the
on the stalk, when they are uncontracted like flowers
spread over the branch - slow growth.

Plant Benthadermatum -

Class V. Echino-dermata - This class is the chief of this sub-kingdom
Order 1. Crinoidea - ex Asterias Ophiura Euryale.

of this order there are few now living, most are extinct; central body or stem of no great size, with rays projecting from a sort of cup on top. The Crinoidea were at least the greater number of them, of an oval shape, & covered by an armour of small flat plates, which were always of an angular form, & accurately fitted together, so as to enclose the animal completely like an egg in its shell. Attached to one end was a long flexible stalk & in or near the center of the other extremity, a small aperture, which served the purpose of a mouth. Around the mouth there were ranged in a circle, a number of arms more or less branched in the different species, & pinniped on the inside with two rows of tentacula, which most probably with the arms were used in capturing such food as the crinoid subsisted upon. The stalk at its lower end, was attached to the bottom of the ocean, & supported the animal like a flower upon its stem.

Such is a general description, which will apply to all the true crinoids - Fossil remain abundant in all lime stone. This order is divided into 2 families, Encrinidae, almost with one exception. 2 Comatula some living. We will first take the comatula -

1 Comatula - ex (comatula rosacea) live at the bottom of sea, these creatures are very hard rarely to be got, being only sometimes dredged up from a great depth. This creature in its perfect state swims freely, it can creep with its arms, & also swim with the same, but the arms are chiefly used in obtaining prey. The arms are very brittle, ~~this being~~ by the fact it can escape nearly all its enemies, for no sooner does it find itself seized, than it contracts the muscles of the arm that is held & drops it off & so ~~swims~~ ^{swims} off. The only way in which a specimen can be procured is by suddenly lifting the whole body out of the salt water & dropped into fresh, which immediately kills it. Young state of Comatula like Hydra something, their arms stems are composed of calcareous joints. When old they break off from their stems & are free moving animals. Stems muscular. The 2 family Encrinites ^{must have been} were very abundant, in the ancient seas, judging from the ~~far~~ ^{most} abundance of their remains, in the rocks. The only creature resembling the Encrinites, living now, is the Pentacrinus Caput Medusae. We have notice this family above, & there you say nothing more here.

2 order - Asteroidea - Starfishes - we will take for example the common Asterias Rubens of our coasts. The skeletons of these creatures are of carbonate of lime; the mouth is central it has not teeth, but is provided with a suctorial apparatus, with which it sucks up its prey - They have been seen in hauls young a mussel or oyster, with these little tubes projected in between the valves. The alimentary canal is the shape of the body of the star fish. It has a tough membranous skin covered with spines which are moveable. In Fig a section across ~~the~~ ^{the} Starfish is shown - a spine on surface.

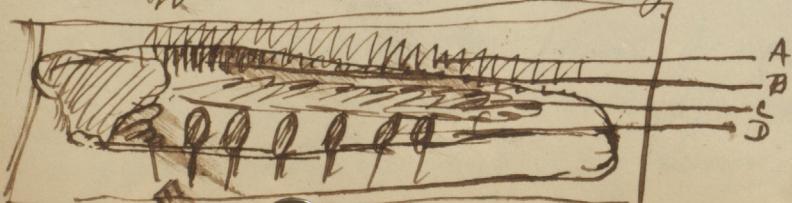
B Plates placed over the top of arm. C Sacks for the contraction & projection of suckers.

D Suckers - (For particulars of sacks & suckers see Notes on N. H. in Sybray -)



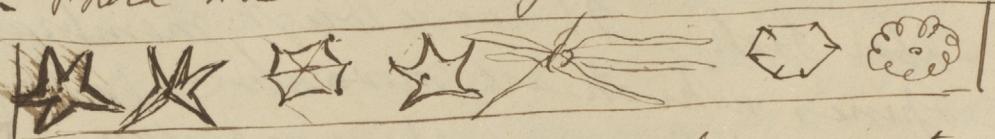
Far out in my wound mouth also venous ring, from which three arms project into each ray arm fig.

On the top of star fish is a small perforated plate - service not exactly known, but is thought to supply a fluid to the contracting sacks. Section of arm in next figure.



A Spines B Calyx on outside always in motion keep up current of water.
C & body part of stomach.
D Sacks
E Organs of reproduction (see Sybray)

The parent attends the young till almost perfect. Their first state are like animal cules, but do not move much. Intermediate form precedes - 3 state & last Starfishes. Organs of sensation not known, the eye is thought to be at the end of the rays being in connection with the nervous cord. Their motion is slow, they move along the shore by slowly moving each ray. There are varieties of forms - some slender, others thick & some forms



Another the *Hopkinsia* - is a more slender creature altogether. Stomach & tube feet central. Stomach does not project into each ray, little spines instead of tube feet in rays. youngs not like slender

2 type Cystole - The difference from last type is that the arms divide & subdivide making up a network - central disc viscera - see works -

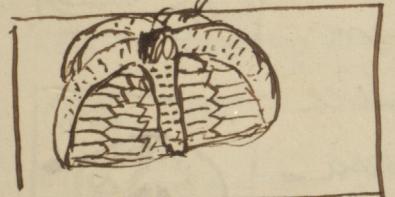


3 Order Echinoidea - Sea urchins - These have for the most part lost the star form - the most typical one is one found on our coasts in great abundance, the *Echinus Granularis*. Shell composed of pentagonal plates.

They grow by constant additions to the edges,

2 kinds of plates ambulacral & inambulacral

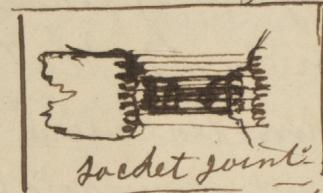
The inambulacral plates are those plates down the sides, which are perforated with small holes for the tube feet - The ambulacral are those plates which have the spines & are not perforated - The sea urchin is like a star fish, with the rays bent ~~together~~ down & round in the shape of a ball & the openings filled up with pentagonal plates.



The shell is not altogether an external skeleton, for when alive the outside is covered with muscles so that it may be termed in all propriety an internal skeleton - The tube feet of this creature unlike those of the star fish, have an internal skeleton or frame work, which however does not in the slightest impede its contraction - They are also capable of great extension, they are extended & contracted on the same principle as star fish. Some of the tropical species have spines 2 or 3 inches in length. They are fastened to the animals body in the following manner.



On the ambulacral plates are rows of small tubercles & at the end of these spines are small balls or cross-joints to the tubercles - round the tubercles are small knobs, & also round the spine, on to these muscles are attached & render it a perfect moveable socket joint, by these muscles the spines may be bent in any direction. Spines are chiefly organs of defence, but sometimes are used for burrowing themselves in the sand.



socket joint

Digestive system complicated, they have organs of mastication, consisting of 5 jaws each provided with a long tooth, edged like a saw in the middle but sharp & chisel like at the end

long intestinal canal, from mouth & then turns back round the shell & out at the anal orifice -



It is tubular throughout, on one small expansion about the middle - on the top round the ~~anus~~ orifice are eye spots - & other openings for the excretion of theova -



Two other organs are noticed on this creature -
The first is a sort of foot stalk with three little fingers on top
The second is a pair of denticles ~~for~~ ~~serrations~~ They are supposed to be used for removing any parasitic animal which may infest either some starfishes & Dolphi have the name - It is evident the the food of the sea urchin must be pretty well ground up by the jaws

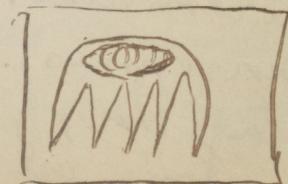
Circulation is carried on by a ring of ^{blood} vessels round mouth & stretching round to ~~the~~ anal opening, & connected by other blood vessels, they have no separate organ for respiration, it being carried on by a current of sea water always passing through it.

If you were to cut one opening you would see a great quantity of sea water on it, having been taken in by the opening for respiration, when these animals are spawning long strings of ovum is cast along the sides from fore to pole & it is then that they are eaten by some natives.

Nervous ring round mouth sending off branches, all wound shell, ~~which~~ forms the epiphaster, has the anal orifice at the edge, but they open ~~on~~ top. When living is covered with minute spines - generative organs central - some fossil sea urchins are stalked, although none recent. also arms. They are between stars & urchins. Cestidians.

The spawn of the sea urchin, produces a medusa like being, with ~~the~~ an alimentary canal like medusae, but soon in the center of this medusoid form, a shell commences to form, like the sea urchin & is soon fully developed.

young of sea urchin



4th order Holothuridae - This creature when first looked at would be said to be quite different from the sea urchins, never the less, it is a sea urchin, lengthened out. look close & you will see the ~~plate~~ & tube feet, Body wormlike form, the radiated structure is scarcely recognizable in these creatures, except in the crown of tentacula on the one end of the animal round the mouth. The body is always more or less elongated, with the mouth at one end, & the anal opening at the other. The calcareous deposit on the skin is reduced to scattered granules, & in one family the ambulacral are entirely wanting. They are ridged down the sides & back, with spines. They have also tube feet ~~all~~ down sides. They live for the most part in warm climates, but are sometimes seen here. They have an intestinal canal like Echinus. Branches, little canals down body leading from them. Distinct apparatus for respiration - & the gills of this creature ~~are~~ are very beautiful. (That substance called trepan is made from them dried.)

5th last order - Sipunculidae - Sipunculus - worm like creatures, like last order. They have internal structures, but no tube feet nor spines, tentacula radiated - The body consists of rings joined together, you see that they here approach near to worms - Some are found under stones & buried in sand -

6 Glass Entosoa - aberrant Radiates - Doubtful to what class they properly belong, but we will in the meantime class them under the Radiata. The Entosoa are almost all parasitical on the intestinal organs of other animals - Many of them infest various parts of the human body - as the intestinal tube, the bronchial glands, the kidneys, & the voluntary muscles; & the injury they occasion, when their numbers become excessive is well known. The habits of these worms are as simple as their habitations; & the purpose they answer in the economy of nature is quite a mystery. They have colourless blood circulated in the vessels in a closed system of vessels, without an auricle or a ventricle. They have no visible respiratory organs, but depend on the animal which they inhabit, no articulated members for locomotion, & no organs of sense. They have organs of reproduction & digestion. Two sub classes. 1 The Sterelmintha, 2 The Gobletmintha
1 The Sterelmintha = 3 orders -

2 The Gobletmintha

1 Taenioidae This order contains the simplest forms of these creatures. Asaphologytes are globular filled with yellow like fluid, cells produce new creatures like insects. These creatures are supposed to be imperfect forms of other worms. Ciliat forms genus Ciliocampus inhabit eyes & brain of sheep & burrowing through the solid structure go through several changes.

They inhabit man himself. Cestoid or worm like form. Their form is a mere sac or stomach with a mouth, which infests the liver & other organs as we have mentioned above. The young grow in the interior of parent, which perishes when they come to maturity. allied to this animal is the distoma or fluke but it belongs to the next order. Cestoid or worm like form, Tænidian tape worm sometimes reaches to a great length,

The tape worm of Africa reaches 10 feet. This creature is composed of an indefinite series of parts, all connected by one alimentary canal, but having reproductive organs on each part & which has been known to reach 15 feet in length. A head, with four mouths, surrounded by a double circle of small hooks, enables the animal to attach itself to a nourishing surface; & should all the parts except a small number be broken off from the head, new ones will be formed, & the individual animal will continue to live. Each division

is provided with a opening for the ejection
of the spawn. Male & female generative organs



These joints may be removed from the animal without injury to it. In some when the divisions are taken off, ~~the~~ fall on moist ground, the worm abandons & deposit spawn along their track which is soon hatched, & they then die.

Genus *Bothrycephalous*. Head desultate of hooks. Joints much shorter than tape worm, & double orifices for the excretion of spawn. One great question which arises is how do these animals find their way into other creatures. It is not fully known, but we will give ^{1 or 2} examples. First the worm that infests Pigeons, is while yet in the egg, passed out in the excrement, & snails & other grubs inhabit this; the Pigeon eats these slugs & so get the worms back again into its ~~now~~ canal. Then maybe others in the shape of animalculæ.

2 order - Trematoda - Distoma - Liver of sheep & give rise to severe disorders. This creature has two suckers, one serving it for a mouth & the other for attachment. Nutritive tubes run down both sides of body - over down sides, with double apertures, stomach is divided. The Planaria is a similar parasite, but residing in the water, where it attacks the surface of different animals. In the forepart of its body

are two specks, believed to be eyes; the sucker or mouth is on the centre; & the reproductive apparatus is behind back of these parts, when separated & freed, becomes a complete animal.

3 order Acanthocephala - genus, *Echinorhynchus* - distinguished for Boiling Apparatus, worm like, structures more highly developed, approaching to the next sub-class - spur of cavity within, male & female. one nozzle & anal tube worm, burrows through wall of canal, & causes more annoyance to cattle than any other creature. sometimes fatal.



Boiling apparatus & instrument -

2 Sub Class - Goolelmantha - Order 4 - Gordiacean
genus *Gordius* - sexes quite distinct. The Gordius or hair-worm is not always parasitic, but in its ~~first~~ last state is a free moving being - only being parasitic in its first stage; but it soon break through the body of the animal into the water. When the water of the pond or pool in which these creatures live, is dried up, these creatures

lie buried in the mud at the bottom, & become so very
thin they break up if handled roughly, yet when
the water returns they become back to life & vigorous.

The gordius or hair worm, is supposed, in one of its species, to
if uncautiously handled, to inflict a bite at the end of the
fingers, & produce the complaint called the whitlow. Inhabit's
soft stagnant waters, is from 4 to 6 inches long, & is
almost perpetually twisting itself into various contortions
& knots. Genus Trichina - exist only in the bodies of
other animals - one species is found in the muscles of many
swelled up in a cell, another very similar in the cod fish
open fish -

Order Nematoida - Filaria - much larger than hair-
worm - (the species most dreaded is the Guinea-worm. (*Filaria*
medenensis) which insinuates itself under the skin.
It is equal in size to a Pigeon's quill, & is peculiar to hot
countries) Their bodies are long slender & thread like. They
are also found in insects - larvae - & in various mollusks
These creatures are of a more complicated structure than the
Trichina

They have always two openings - posterior & anterior -
Genus *Strongylus* - The ♀ - ginzas - infect the kidneys
they are about 3 feet long & an inch diameter - colour
dark red - head rounded, mouth to capillae, large
stomach extending the whole length of animal.
Male ~~eg~~ generative organs through body, & female do.
Ascaris - round worm - common intestinal worm -
like earth worm in shape. Bare tubercles at mouth
instead of six, other extremity acute in male rounded in
female - Bands along sides & across back. The
intestinal straight from end to end. The produce
great quantities of ovum - early stages not known.
Ascaris Vermicularis - larger than the last -
(interesting class but not much known)

Class VII. Rotifera - These interesting creatures are were & are
still in some measure, ~~but~~ doubtful to what class they should belong.
They were ~~for a long~~ till lately classed, in an order under the class
Inferioria - But are now classed by themselves, under the
Radiatae - They live for the most part in water; but it

does not appear necessary ~~that they~~ to their existence that they should be enveloped by this fluid. They are frequently found in moist earth, & some species are known to reside in masses & sea weeds - They differ from the Infusoria in being much larger & more complicated - Their shape is generally ~~slimy~~ - Some species have jointed abdomen - approaching in this point to the articulates. Some again have tough glutinous shell - They have at the head, ~~the~~ two lobes surrounded with cilia, which are kept in constant motion - They differ here again from the ~~animalculæ~~ Infusoria, for they have the cilia only at the head, not all round the body - They have only one stomach, & teeth & jaws to supply them wants - They can elongate & contract their bodies, & some species have at their extremities, a kind of tail with a sucker, by which they affix themselves to extraneous substances, while the cilia is in rapid motion, & thus prevent the superior portion of the body, being drawn in by the force of the rotatory action.

They multiply by eggs; but some bring forth their young alive.
Both the animal & its eggs, possess a extraordinary tenacity of
life, & will undergo the most opposite extremes of circumstances
without destruction to the living principle.

When it takes food it has powerful jaws
for retinaculating it - (see fig D) They are also possessed
with two species - (a) cilia (B) - gizzard muscular.

Sexes distinct - generative organs -

eggs large in proportion to the animal -

The respiratory tubes pass down sides

of animal - constant current of water

increase very rapidly - a single one in ten days having

a family of 1,000,000, in 11 days 16,000,000 & in 12 days

The venerable Mogen don was surrounded by 16,000,000 of an
active & happy race - locomotion is performed by swimming,
the rotatory action of the crowns of cilia, compelling it

forward; & sometimes swims by jerks - We will now go from

the general view of these creatures, to take one or two examples
more minutely - I forgot however to mention some points.

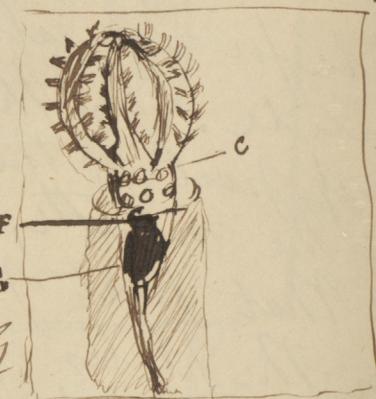


The eggs are of an oval form, & from 20 to 30 may be seen in an animal. Some are of a brown colour, & others of a delicate pink & deep golden yellow. In those of a light, the young may be seen with their cilia in active vibration. The body of the wheel-animalcule is of a whitish colour; its form will be seen by their graving; & its tail has six points. The tube for respiration, appears to allow of water passing to the inside. On the food being drawn, by the currents to the cup part of the wheels, it passes down canals in the neck to the mouth, which is situated, at the lower extremity of that part of the body. The food is crushed by the teeth on the plates of the jaw, with an action like a hammer. From this it passes on to the alimentary canal, for the sustenance of the animal. There are numerous families of these creatures, one of which we take as examples. The rest may be found in a Book on the Microscope in the Library - The Siphonoceros or crowned Animalcule. This creature is about the $\frac{3}{6}$ th of an inch in length. It is enclosed in a transparent, cylindrical case, from which it protrudes, five long flexible arms which meet at ^{their} points, & so get their name from which they derive their name.

These arms are furnished with several rows of cilia, which retain the prey, until it is swallowed. The case is attached to what may be termed the animal's shoulders; so that when it sinks down into its transparent home, ~~face~~ of the case is drawn inwards. It is fastened to the bottom of its case, by an elongation of the body; & this part as well as the body, contracts, instantly on the approach of danger, the arms coming close together into the sheath. The mouth differs from the common worm animalcule, having two distinct sets of teeth, with which it tears & crushes its food. The eggs of this creature after leaving the animal's body, remain in the crystal-like shell until hatched, when they escape from the lower part. a cluster of eggs may be generally seen in the ovisack. Besides the Stephanocephalus, there

are the, Limnias Ceratophylli - *Flos culana* -

F. Proboscidea, *Melicerta Rinsens* - &c. These may all be found at leisure in the library - They have been divided in the last place, into 4 groups - 1 those attached & some but can move about - 3 always free but can attach themselves, 4 jointed body organs at the head not like Rotifers. more like worms, but not decided.



F - mouth
G - stomach
C center of nervous matter

Class VIII Bryosva — The difference between these & the Polyps (analogous)
consists in the polypidom being a living portion of the polyp,
while all others are unorganized; & that most of the zoophytes
we have examined are devoid of cilia, whilst in the Bryosoon
these are most bountifully supplied. The play of the cilia is
most energetic, for the purpose of securing an abundant supply
of food, almost without exertion on the part of the creature
itself. But it has been discovered that Bryosoa possess
higher organization than any of the preceding families
of zoophytes; & also, from the presence of striped muscular fibre
in their bodies, naturalists have transferred them, with other
animals, the Flustra, Lepralia, Anquimaria, Notamia &c, to the
sub-kingdom Mollusca. Bryosoa are generally found living together
in great numbers, & always clothed with hardy coverings or
polypidoms. They subsist on animal bodies, & differ from most
other mollusca in being able to protrude themselves from their shells.
When the animals draw themselves within their protective homes, to
the bottom of which they are attached by a sinewy ligament, they double
themselves up by bending the lower part of the body upwards.
When the creature stretches forth, it presents a beautiful sight, from
its blossom-like appearance & busy cilia; its protraction & retraction
are performed with surprising quickness, as it has two sets of

muscles for the purpose, one acting on the body of the animal,
the other upon its cell. The oral extremity is surrounded by a circle
of long tubular tentacles covered with cilia; at each of these
feelers or arms there is an aperture, the one at the base com-
municating with a canal that passes round the edge
of the oral aperture or mouth. The food passes down a long
gullet, that contracts during the process of swallowing.
At the end of this is an orifice that opens into what appears
to be a gizzard, having two bodies, opposite to each other,
with a rough surface, as is for the comminution of food,
moved by muscular fibres - Those of the species without
this gizzard have a digestive stomach that secretes a
coloured fluid. From the upper part of the stomach near
the entrance from the gizzard arises an intestine, having
a narrow opening surrounded by cilia that proceed up-
wards, ending in an orifice near to the tentacles from
which the refuse food is ejected. The wall is fringed
into little gemules. To the cells of the flustra there is a
weapon of defence attached, it consists of a slender muscular
stalk with a hook at the end which holds ~~the~~ any thing
that would in any way injure it - like the Ctenins -

The Bowebankia is a beautiful example - (see Microscope)
 There are seven families - of which the Vesiculidae Bowe
 & are ~~just~~ marine animals all having
 crowns of cilia - The 7th however is a fresh
 water family - which have only one pair
 of ~~feelers~~ ^{one} - Calyzonellidae - (Plumatella)

2. Grizziidae	<i>grisina</i>
3. Tubuliporidae	<i>tubulipora</i>
5. Cocharidae	<i>cochlea</i>
4. Celliporidae	<i>lepraria</i>
6. Myzomillidae	x <i>Holodactylus</i>

We have not time to describe any of these families - as we have given
 a general account of them. (See Liberry) Microscope - Violin

The fresh water ones may be found on sticks & stones -

There are two sorts of ova here like the Rofflers - one gelatinous case
 & another strong thick cases for keeping through winter.

We have now finished the Radiata & will take a brief look
 back at their classification - Radiata

- 1. class Protosoa may be thus figured 
- 2. " Hydriosa having a sack & tentacles 
- 3. " Acalae phae - disc & stomach below 
- 4. " Anthozoa - stomach & sack 
- 5. " Echinoderata radiata - 

Mollifera
Entosoa
Bryozoa

We have here showed after the Entosoa, former the varied structure of
 the first 4 classes - The Mollifera & Bryozoa coming between the two last
 the Anthozoa & Echinodermata -

Province II Mollusca - These creatures are a different type
of structure altogether than the last province - They possess
no skeleton at all of any kind, hence their name, soft-
bodied - They are all invested with a thick muscular
skin, called the ~~membrane~~ or mantle - it gives form & support
to the animal - In most of these creatures there is an apparatus
for secreting layers of sticky matter which when deposited
on the outside, is quite free from every thing - is not part of
the animal, but its house - And here we come to bilateral
symmetry - The nervous system is unsegmented being
composed of a ring enclosing the gut, & connected with
ganglia or nervous masses in other parts of the body - Organs of
locomotion in a few, & very simple, but in most none at all.
They have organs of nutrition & all being possessed with an
alimentary canal, of respiration, & a nervous system - They
are as a whole higher in nature than the Radiolaria as
a whole. They are divided into 2 great divisions -
1 A cephalized or headless & 2 Cephalophores - with head -
1 The cephalized are divided into 3 classes 1 Tunicata &
Brachiopoda
2 Lamellibranchiata 3 The Tunicata are divided into four
two orders - 1 Ascidiae 2 Benthon

Families You will find a general account of the Funiculars, in the beginning of this book, page 29 - so we will proceed at once to the separate families & orders. Before doing so however, I will mention a few general

particulars which I before have learned since - The first is that the outer coat of the Funicula, secretes a woody sort of starch, which make it very tough. Order Ascidia

1 Fam. Ascidiidae - genus Cynthia - see fig

No living action observed but a slow contraction & expansion of the sides, in some they are regular in others, at intervals - They are complex & interesting - Two external orifices, the upper for respiration, & the lower for the ejection of the water so taken in - The third coating is a respiratory sack inclosing the animal

which is covered on the inside with like leaf like expansions provided with cilia; for respiration, ~~& which also~~ (see letter e fig) which is largely provided for in this way. Nutrition.

The mouth of the animal is at the bottom of the sack as seen in (fig - H) the water taken in at the upper orifice, is directed down towards the mouth of the cilia on the inside bringing down animalcula on which it preys -



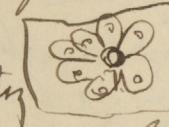
a respiratory orifice
B excretor "
C leaf like gills (cilia)
D circulation canal
E generative organs
F canal
G stomach
H mouth

The canal winds through the body & back out at the lower orifice. The circulation carried on by a vessel down the side, which pulsates & drives the blood back & forward, as is described page 29 - ~~now~~ There is a nervous ganglion ^{at} near the base of each the upper orifice, surrounded with tentacles supposed to be an eye - in some species near a round base of orifice - generative gland (ovip.) ov - no distinct sexes - various forms -

2 Fam Batyillidae - genus Batyillus - a flat surface expanded over a stone or some other surface - it is several animals, having one common orifice, for respiration but each one a separate one for excretion - attached to one another of them was nothing else -

Sub-division & gemmation, & multiplication by over

3 Fam Glavellinae genus Perophora - differ very little, only a flesh stem along bottom of sea with them attached - Each individual of compound polyp, less complex than independant ones -

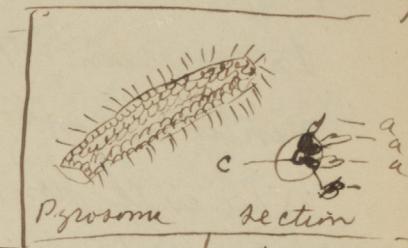


4 Fam Phrynosomidae. *Phrynosoma* - This & other creatures have caused much inquiry, but they are merely one mass of small creatures of the same structure as the others we have been mentioning. They have a common opening down the middle. An respiration each creature having a separate one.

- 1 Duck Hawk or Penguin
- 2 Pigeon Hawk
- 3 Gull Hawk
- 4 Iceland Gull
- 5 Sparrow Hawk
- 6 Goshawk
- 7 Coopers Hawk
- 8 Sharp Shinned Hawk
- 9 Swainsons Buzzard
- 10 Bairds Buzzard
- 11 Red-tailed Hawk
- 12 Brown Hawk
- 13 Red-tailed Hawk
- 14 Red Shouldered Hawk
- 15 Broad winged Hawk
- 16 Rough legged Hawk
- 17 Black Hawk
- 18 Marsh Hawk

- 19 Golden Eagle
- 20 Northern Sea Eagle
- 21 Washington Eagle
- 22 Gray Sea Eagle
- 23 Bald Eagle
- 24 Fish Eagle or Osprey

with a leaf



Pyrosome

section

as *Salpa* for a great length

a tentacles

B Polyp

c opening

Phosphorescent -
the lower end the other at
parent, the same species
is curious, first & each
from these are produced
again & then eggs become

The have instead of
diagonally across the body.
violent contraction of
the animal.

which the blood is carried
They possess the rudiments of a nervous system, ~~an eye~~ & a spec
has been discovered in some supposed to be organ of vision.
Voluntary motion confined to expansion & contraction of sack-

The canal winds through the body & back out at the lower orifice. The circulation carried on by a vessel down the side, which pulsates & drives the blood back & forward, as is described page 29 - ~~now~~ there is a nervous ganglion ^{at} near the base of each the upper orifice, surrounded with tentacles supposed

base of v.

sexes -

2 Jam 1:

expand
animal

but each
attached
sub-div.

2 Jam 6
a flesh stalk
each indivi
independant one -

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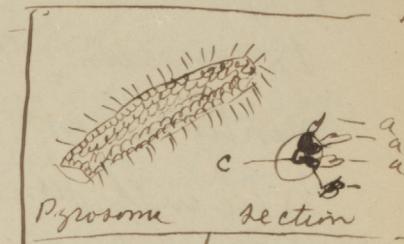
else -

or

le, only



4 Fam Phrynosomidae. Phrynosoma - This & other creatures have caused much inquiry, but they are merely one mass of small creatures of the same structure as the others we have been mentioning. They have a common opening down the middle. In respiration each creature having a separate one. In excretion - each creature is furnished with a leaf like tentacle.



Order Bipora - genus Salpidae is Salpa. The animals are found in bands of ~~to~~ a great length. Heads all directed in one direction - They are phosphorescent.  There organ for respiration is at the lower end the other at the other. They are gelatinous & transparent. The same species is also found alone - Their reproduction is curious, first & each individual of the band lays an egg, from these are produced a single animal again each of these lay again & then eggs become each a band & so on continually - They have instead of the respiratory sack a gill running diagonally across the body. They have heart fully developed by the expansion & contraction of which the blood is circulated through the animal. They possess the rudiments of a nervous system, ~~an eye~~ & spec has been discovered in some supposed to be an organ of vision. Voluntary motion confined to expansion & contraction of sack-

No remarkable metamorphism, in these creatures. The young of
Acidians are first tad pole like & then loosing their tail become
perfect animals - 2 Glass Brachiopoda -

In reviewing this class, we will take a very brief look at it
mentioning only a few of the new facts concerning the different families.
You will find a long & correct account at page 31 of this book.
We will however, ~~still~~ sketch review this class - To take a few general
remarks of them, they are deep water animals & are consequently
very rare, they take a conspicuous place in the geological
chart of the world, however, 1000 species being known fossil, &
only 10 recent - They are all attached, some with long others
with short & others again hardly any peduncle, here differing from
the Tunicates, which are seldom attached - A muscular
tunic forms two leaves, opening with a hinge, making necessarily
a nude opening for respiration, compared with that of the
Tunicates - These leaves are protected by the plates, composed
of Phosphate of lime instead of carbonate of lime as in other
bivalves, these shells as you will see reading page 31, have no
hinge or teeth, but are fastened together by muscles - The Peduncle
is simply a continuation of the mantle externally, but internally
is composed of muscles - These shells can always be told by a

sort of notch, they have, for lifting out the stalk - Always two teeth - viscera near hinge; organs of phrensis long spiral ciliated arms, twice long of shell, by which they cause currents, for nutrition & respiration, so that the arms may be called organs of respiration. They have two muscles for opening & shutting the shell, also two adductor muscles in front of shell, & a pair of plucky muscles for holding shells together. Arm tubular, extending & contracting by means of muscles set obliquely - Intestinal canal opens posteriorly - Heart fully developed & in some double-line for each side - Nervous system not fully developed. Only a few species have been examined, as they are hard to obtain, living so deep down. Live in minute creatures in water - In the shell is a process for the attachment of the arms, of different shapes in different families -

1 Family - Teribratulidae ex *Terebratula* - Ventral valve notched, short peduncle, two teeth, loop attachment of arms in this form shell tubular, that mantle on surface of shell

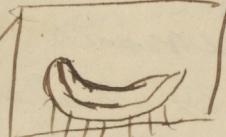


a loop
c tubular
shell

a family *Spiriferidae* ex *Spirifer* - extinct, a long hinge, & notch, dorsal valve small, hinge process - spiral apparatus for arms instead of loop thus

3 family - Rhynchonellidae ex Rhynchonella, althyia Bentheimer
notched beak - short brachial appendages - teeth for winding
arms in - 

4 family Ostreidae ex within Septaria - wedge form, valves
like - shell wide - It is extinct -

5 Family Productidae - Productus, lower valve deep, upper
concave, very little room for animal, lay like a cup on
the bottom, slight notch, the lower valve has spines, for
keeping it steady on the ground. 

6 Family Brachiidae ex Gramia - one valve stuck
on bottom, other valve just laid on top of it, only a ligamentary
ring -

7 Family Discinidae hole through lower valve, through which
a peduncle passes & so fixes -

8 Lingula ex Lingula no proper hinge, long peduncle

Class 3 Lamellibranchiata - They differ from the Brachiopoda in having regular gills, arranged in lamellae, down the sides of the body & also in having their valves shutting laterally. They differ also in having the mantle not entirely open as in the Brachiopods, but in some only open in two places in others the larger opening again. They have not the long ciliated respiratory arms of the Brachiopods but respire by means of the regular gills. Their tentacular apparatus are usually few & short. They have 4 rows of gills. They create ~~current~~ currents through the round about the shell - For example we will take first - The

Monomyria *Mytilus Edulis* from coasts - You will see by the figure the structure of this animal. You see that the mouth leads to a muscular stomach, which altogether surrounded by liver, which in these creatures occupies the greater portion of the animal. The canal runs down & ends opposite the ejector orifice. The sea is kept round the canal & afterwards is passed into the gills & thus out into the sea - The ~~byssus~~ foot is sometimes used as an organ of locomotion but is generally that of attachment.



a tentacle round mouth
 B Byssus to foot
 C Gills
 D Stomach
 E Ejector orifice.
 F Respiratory orifice
 G Ova
 H Canal
 K Liver round stomach -

The water comes in at F & passes up the gills, to the mouth,
then down again & is ejected at other openings. The young
appear like too little grubs in the parents gills, & were for
a long time thought to be the young an intestinal worm
of some sort - Two adductor muscles - In some an elastic
trunk for opening shell when wanted - Foot characteristic
of molluscs - nervous system in these molluscs. There has
been found in ganglia near the mouth, another near the

large adductor muscle, another near ~~root of canal~~ foot -
Another example is the oyster - mantle open all round, gills
long & all round body. tentacles round & fleshy - stomach surrounded
by a green mass of liver, which is supposed to secrete
lysle - Canal short - one large adductor muscle in center -

Just above this muscle is the heart - the circulatory center -
two divisions an acale & a ventrical - no foot, or at any rate
only rudimentary - Shell fixed to sea bottom - gill covered with
minute cilia, in both muscle & oyster family -

Another example is the Tellina - in which the mantle is closed
all round, except in two ~~the~~ places where tubes protrude. These tubes
are found in all those molluscs which burrow like the Tellina in
sand or mud.

For while the animal is covered the siphuncles or proboscis.
These tubes serve for the same purpose, as the openings in the
mantle of the tunicates. At the end of these siphons are bristle
like points for defence - two adductor muscles - The gills
in all the molluscs differ as the openings or tubes differ, for
they have to be opposite one of the openings or tubes -
They have a large foot, for burrowing, & in most of ^{the} ~~these~~ ^{link-like}
~~burrowing~~ molluscs the foot is very ^{tube}  ^{foot}
fully developed -

Structure of shells. A shell is divided into three distinct layers,
1 The epidermis or coating, which is an animal substance & protects
the inner & true shell from chemical action - The next layer is com-
posed of ~~and~~ two kinds - 1 Prismatic structure, 2 Lamellar -
The first is a succession of plates or cells filled with shell matter, second
a hard smooth surface, being next to the animals body - the
shell is developed from mantle - Shells are marked in two ways
lengthways & across - both at hinge, for inter locking valves -
cardinal & lateral teeth -

We now proceed to the Classification of the Molluscs.—
First they are divided into 3 great groups

A Monomyaria or one adductor muscle

B Dimyaria those have two

C " Siphonifera) those having two muscles & also
two tubes or siphons—

(A) Monomyaria - Fam. 1 - Ostreidae - As we have
said something about it before we will only mention a
few here - This creature is placed under this class having
only one adductor muscle - There were thought to be
3 distinct species on our coast, but they are now all
thought to belong to the genus *Ostrea Radiata*

another genus the *Ammonia* are nearly allied to the Oysters,
but have a remarkable peculiarity about the shell - The
adductor muscle passes through ~~the~~ a foramen in the
lower valve, to be attached to a sort of plate by which
it adheres to rocks or wood in the sea.



The pector is another of the same group - It differs a little from the others in having a much longer hinge line - has a small foot & well developed eye spicis.

as we have described a great many of these latter fully in the last year's course, we will only speak a few words on each family - This year however they are much better classified therefore we will again go over them.

The Spondylus & Plicatula are also examples of this group - They are inhabitants of the warm seas. They are found ~~on rocks & reefs~~

(B) Dimeraria & The avicula ~~they can open shell the~~ mucula having the appearance of a bird flying when expanded. The foot is rather small & channelled & has a ligament - The mouth is furred & has two lobed appendages & it has a large strong adductor muscle & two pairs of small retractile muscles of the foot. The shell is inequivalve - with a notch on the left valve, through which the ligament passes - The hinge is linear, with one primary tooth on each valve - beneath the apices, which are oblique small & not projecting - (see Encyclopedia A B C E F)

Another the Meloquinus - or Pearl oyster - The pearl is caused by the ~~the~~ piercing of some foreign substance through the shell, which gets & covered with pure pearl -

another the Pinna - of much the same character, but most of the shell is of the Prismatic structure

Fam 3 Ptylididae - We have mentioned the Mytilus Edulis - another the Modiola - & Lithodomus. These curious molluscs are the one that cause so much destruction of engineering works, as they eat away stone & rock very rapidly, the manner in which they are thought to do this, we will mention hereafter -

Fam 4 Arcidae ex area - easily recognised by their resemblance to a ship - shell inequilateral - the apex distant - & separated by the angular area, of the ligament - which is always external - the hinge is placed on a right line in most species - another the Guttulae & the Nuculae - (see Encyclopedia)

Fam 5 Solenellidae ex Solemya & Yoldia & seda -
very similar to last

Fam 6 Trigoniidae ex Trigona - foot here very large & strong
it is the shape of a foot - they have great powers
of leaping - nearly all extint like Brachiopods

Fam 7 Unionidae ex Unio - differ from last of the
thinness of shell - mouth valves united between the
apertures for siphons - the common one of our coast
is the Unio Radularis - there are three kinds Unio,
Alasmodon & Anodonta ^(see cyclopedias) the Anodonta has no teeth at all

(C) *Dingaria diffinis*) Fam 8 Chamaidae genus ~~Chama~~
~~This family may be called typical molluscs, having~~
~~thin shells regular, shells ^{some} equivalent & ^{some} inequivalve - genus Chama~~
This shell ~~however~~ is inequivalve, irregular, heavy rough,
& full of spines - having the faculty of clinging itself to
other bodies - or to each other in groups, by means of its
lower valves - ligament external & inserted - A great
many beautiful shell belonging to the genus Diceras - in this
family - cockle foot large for burrowing -

Fam G Hippuritidae - all extinct - When first found fossil they were thought to be ~~corals~~ corals, but the upper valves of the shell being discovered it was seen to be a shell - closely allied to Chlamys -
The shell was of the form & seen in figure
These marks on the shell show the progress of growth - This shell, on the top where the other valve shuts down has two teeth, which correspond with others on the upper valve - no real hinge but the adductor muscle is fastened onto the upper valve in the middle & so pulls it down on to these teeth which thus by these means is quite firm -



Fam W Tridacnidae - ex Tridacna - differ very little from last, ~~with the~~ of a larger foot - genus Hippopus -

Fam II Cardiidae - cardium - typical bivalves - cockles large foot for burrowing in sand - these molluscs with perhaps only one exception inhabit the sea where they

exist, hidden at a small depth under the surface of the sandy beach, sometimes haphazardly covered - short tube -
(see Cyclopædia)

Fam 12 Scuticidae - Scuticaria - carinis & tellinii - differ very little, with the exception of the foot which is longer - little known however

Fam 13 Cyprididae ex cyclospira Grenna Pisidium - fresh water shells - adult state like cockles creep along in the same way - When young they can move with great rapidity & can even climb plants, a thin, few molluscs can do - & then fasten themselves by byssus & hairy toes - when young good microscope objects - (see Cyclopædia)

genus Grenna, found in rapids rivers & streams; they are thick & solid shells sometimes of great size - genus Pisidium much the same

Family 15 Veneridae - Venus - Cytherea Petricola

The most common of the genus Venus is the *V. mercenaria* which inhabits muddy & sandy bottoms. It used a great deal as an article of food. Some of the natives cut up this shell into circular pieces & string them & they then pass for money. They are of two colour, white, & blue. Genus Cytherea has a great number of species. They were blended Linnaeus with the genus Venus. but they differ from that genus by having all four primary teeth on one valve, & only three united on the other, with an isolated cavity, oval, & parallel to the margin. The lateral teeth divergent to the summit. All marine, solid, regular, equivalve, inequilateral, apices equal, recurved, & slightly projecting. Genus Petricola much the same.

Fam 16 Mactidae. *Mactra solidissima* - well developed foot for burrowing in sand or mud. The foot is flat & strong - some species attain a large size - as this species - the substance is generally very thin, & covered with an epidermis. (For description see Cyclopedie)

The character of the hinge is very singular, & clearly distinguishes this mollusc from all other bivalves; on each valve beneath the apex, is a compressed tooth, bent or angular, like two divergent pieces, at the side of which is a subcardiform oblique cavity, to which the ligament is attached; there are also two lateral teeth compressed & inserted - one of them more or less near to the cavity of the ligament, & the other near to the primary tooth.

abundant in all seas, but fossil species few -

genus *Glyptodon* - is another of the same family -

Family 17 Tellinidae - *Tellina sanguinalaria* Donax
Tellina - shell elongated laterally - siphon long -
& foot large & flat - for burrowing - Teeth different -
genus *Sanguinalaria* - is another genus of this family & the
genus *Donax* another -

Family 18 Solenidae - *Solen* & *Machaera* / *Solen* a ~~Basa~~ fish -
shell long & narrow, burrow to a great depth, & for this purpose
have a large foot, occupying the greater part of the shell, the siphon,
in this long shell are short, but in some species shell short siphoning -

These molluscs bore down into the sand & when they have burrowed deep enough, they attach their foot to the bottom of their burrow, & extend protrude their siphons above the burrow, but on the slightest noise they contract themselves with their shell into their burrows -

The shell at the both ends is open - so that the foot can be protruded without opening the shell - other shells however have generally to open their shell slightly to protrude their foot -



Fam 19 Myciidae - *mya taxicava*, *Glycimeris*.
mya - something of the same structure of both as *Mactra* - more fully developed - burrow's deep, & requires the shell slightly open for the protrusion of the foot -
 Siphons long - The *mya truncata* is a well known example - This mollusc has a projection of the animal, from one part of the shell which is truncated - at the end of this projection are the siphons which are surrounded with stiff bristles to keep out the sand -

mya
truncata



Saxicava rugosa - This iso-mollusc instead of burrowing in sand, burrows in hard limestones - or attaches itself (when the place is destitute of rocks) to mussels - This mollusc has a greater burrowing power than any of this family - There are various ways stated in which this creature burrows, but none is yet determined, it was thought & is yet to be an acid secreted in the animal's body - by means much the same as others -

Fam. 20 Anatoniidae - *anatina* - Pandora

anatina - Shell thin, semitransparent, pearly, longitudinal gaping, & much inflated at one end, somewhat resembling a duck's bill - whence the name - It is equivalve very inequilateral - Anterior side rounded & much longer than posterior; summits rather distant hinge indented, ligament, internally attached to each valve on a spoon shaped process.

Fam 21 Gastrochaenidae ex *Gastrochaena* - shell equivalve & wedge shaped; the anterior opening oval, oblique & very large; posterior one nearly closed, hinge linear, no teeth & marginale. Penetrates stones like Pholas $\frac{1}{2}$ inch in length.
inhabits the British coast

Fam Pholadidae ex Pholad & Teredo = Pholads most energetic burrowers - eat up quantities of stone - They emit a strong light, not determined whether phosphorescent or not. Teredonovatus Ship worm - animal bore much elongated shell on at end - which is formed in the shape of an auger by means of which they cut their hollow chambers in submerged wood - They are found ~~LCP~~ in great numbers about the mouths of rivers to ~~such~~ assume the floating wood which would stop up the river, & make navigation dangerous - It is generally buoys with the grain except when a boat comes against its way - Lays interlock with shell, & one tube never runs in to another - Throws out most of the burrows but ~~not~~ some - has been found in its stomach -

We have not mentioned the organs of sensation which are in a few, for instance the Pectin (one species) has well developed eyes placed round mouth as in figure -



Glassy Pteropoda - At Glass between, the Bivalve shellfish
& Gastropoda - They have a distinct head. They swim
on the surface of the sea, & are generally seen far from
land - They are seen sometimes in great numbers - They are
in fact between sea snails & Univalves, limited to warm seas.
These creatures instead of the foot of the bivalves, have
two wing like projections, for locomotion, they keep them in
constant motion, making them meet both ways - These
fins were once thought to be respiratory organs, from their
stifled appearance underneath - but since there has been found
a perfect ear, without doubt. It consists of two sacs con-
tinuing to small oblong, or ear stones, each swimming about
free in a liquid by means of cilia - Some of them have a foot
in the rudimentary state - They are of various forms; no
organs of sensation except the ear have been discovered -
in a good many - They are of a small size, being large at
most, never or rarely exceeding it - They are divided into
(a) with external shell & (b) without external shell

(a) With external shell - The gill are packed in shell -

(those without shells approach nearer to the next class & are therefore higher in the scale) hence with shells - 1 family Haliidae -

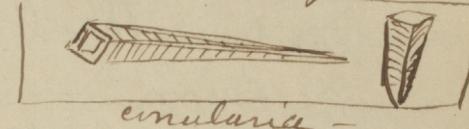
Hila - shell external to body - The shell is of a thin transparent horn like substance, differing in that respect from the common character of shells, as they are generally undivided - Its form is bicuspidated with hollow points - & finely striated transversely. The valves are united, or soldered together as it were.

They are unequal; one being subglobular, ventricose, & anteriorly shortened, occasioning an aperture through which the animal protrudes the two wing shaped portions of its body; the other is larger, & has its under part nearly flat. 

They are called Sea Butterflies - alimentary canal more complicated than mollusc (Bivalve) an aerophagus, leads to a crop ~~then~~ then along to a gizzard - The gizzard has in its interior hard stony substances for the mastication of its food - The canal is surrounded with a mass of liver - The heart is under the aerophagus, & has two cavities the auricle & ventricle - From heart nervous chords extend into animal's body see figs



Gills down both sides of shell - In this creature the ear is the only organ of sense - Still they feel the influence of light - There are a great number of forms another form the Glædora ~~is~~ is the shape of a needle, they look like a number of the same swimming about - another which is only found fossil & is thought to belong to this class, though much larger, is the Gonularia, it was of the ~~that~~ same long needle like shape only marked as in figure



Gonularia -

Family Limaciniidae - differ in external covering only some internal organs - Shell spiral to the left - they can withdraw themselves into their shells when they like - The slug has a prominent head with four tentacles, & at the end of the longer pair, the eyes are situated - These tentacles (usually called horns) can be drawn in by a process resembling the inversion of the finger of a glove.

On the back is a kind of shell or disc which sometimes encloses a small shell, & under which is placed the pulmonary sac or breathing apparatus - The Spirula is another genus -

(b) Without shells - *Glio-Borealis*, length about an inch - tentacles at head, which is distinct, two distinct eye spots - two tentacles for touch near each eye - rudimentary foot & generative organs organs there being only ~~one foot~~ one sex - cluster very complicated, surrounded by small suckers. They feed on minute annelids & crustaceans. They are abundant in the Arctic Seas, it is said the artist who paints in them -

Class 5. Gasteropoda - an extensive class of molluscs & perhaps the most typical of their province, since they have its general characteristics, of a well developed nutritive system & sluggishness of habits, in the highest perfection. They derive their name from (γαστήρ, the belly, & πόδος, a foot) from their organ of locomotion, which is a muscular disc projecting from the abdomen, & capable of progress by alternate dilatations & contractions - In the more perfect forms there is a distinct head, with the rudiments of eyes, which generally appear as a couple of black specks, either at the tips of the longest pair of tentacles (as the horns of a snail) or at their base -

Most of the Gasteropoda are marine; but some dwell in fresh water, & a considerable number, unlike the mollusca in general, are inhabitants of the land, though usually fond of moist & shady situations. Except in a few species they are provided with shells. The shell is in all except a few, of one piece (univalve); besides which, the animal has, in some instances, a small operculum, or lid, of calcareous or horny substance, which it draws down upon the mouth of its shell, so as to close itself in. The gills are comb-like, & in some spread out like a leaf. These gills are concealed in a cavity in the animal.

Order Nucleobranchiata Fam. Ficilidae - genus *Gurinina*
Sea snail - length about an inch. Head quite distinct - The animal has a sort of proboscis which covers a mastigiferous apparatus, which is a long extensible horny tongue, all toothed like a rasp - In some there are a distinct pair of jaws. Two tentacles, which are organs of touch - The gills are bent & liver, are in a small shell on the back of the animal as seen in figure it shows a portion of the animal's body showing the shell & below a flat extension of the mantle, like a fin



This little shell is supported on a small stem, a space is left by this between the body of the animal & rim of shell - between which, the ends of the gills project from under the shell, the flat expansion ~~serves~~ the purpose of a foot - at the edge of this expansion, there is a sort of sucker, by which the animal can hold on to any thing - It is however generally in motion -

Fam 2 Atlantidae genus atlanta - extinct shell-fish -
The difference is, that they have a shell for all the body - while the others had only one for the heart liver gills -
also genus Bellerofton & Maculinea

2 Order Opisthobranchiata - There are two tribes under this order - (a) Nudibranchiates - or naked gills
(B) Tectibranchiates - or covered gills -

(a) Nudibranchiates - ex Colis - Glaucus Doris -
Colis - body oval & like that on a snail; the head very distinct,
with two or four superior tentacles, besides two labial;
The tranchiae, are formed of a great number of small soft flexible
scales, imbricated on each side of the back. No shell sea snails.

gills coloured, sometimes very beautifully - foot length of body -
swim & walk - Genus *Glaucus* faunae very sea - don't
(see cyclopedias) -

(B) *Gasteropoda* - ex *Phyllidia aplonica Bulla* -

In these the gills are hid in a fold in the mantle -
Aplysia - body thick, fleshy, & oval, provided beneath with
with a rather thin flat foot; on each side there is a matutinal
appendage; above & posteriorly, there is a kind of operculated
button, internally solidified by a rudiment of shell, more
or less calcareous & regular, covering the cavity of the branchiae &
two pair of slit articulated tentacula, the one occipital, the
other labial, with very small sessile eyes, placed between these
two. The *Bursa bulla*, this creature floats upon the sea - It is
very large & inhabits the Indian seas. There is no trace of shell
& the animal is thus described: - The body subglobular, its lower
part offering an oval formed space, surrounded by thick
lips, indicating the foot, the upper part with a thick edge
oval slit symmetrical & formed by a complet union of the
swimming appendages of the mantle, communicating with
a cavity in which are found, a very large free branchia & anus,

four divided & branched tentacles, besides two buccal appendages.
The Bulb due one of this genus - mantle covers shell - operculum
They can be filled to a great size & ejected again -

Order 3 Pulmonifera (pulmo = a lung) Snails & Slugs -

The most advanced of Gasteropods, are furnished, instead of branchiae, with a vascular net-work of pulmonary vessels, fitting them to breath the atmospheric air. Most of them accordingly, are land animals; & those which are aquatic - living chiefly in fresh waters & brackish pools - are obliged, like the whales & seals, to come occasionally to the surface to breath. All the breathing Gasteropods feed chiefly on vegetables & many of them exclusively so; but some are extremely voracious, & will devour almost any organised matter that falls in their way. They are diffused through all climates, particular species being restricted to each. They have all four tentacles, the eyes being placed at the extremities of the longest pair - When the creature wishes to contract these long tentacles - it turns them ~~on~~ outside in - The smaller tentacles are

organs of touch - They have some very strong muscles for withdrawing themselves into their shells - When they draw themselves in to the shell they at the same time contract their tentacles -

The pulmonary sack is quite separate from the viscera, & has a narrow door for keeping it from becoming full & swollen in water to exclude it. The circulation is carried on by a single heart - Organs of mastication, ~~inside~~ outside in the mouth (which is either an incisor or bilobial) consist of a long tongue sharply toothed -

The teeth vary in the different species - Both sexes are combined in one animal - We will now proceed to group them

(a) Operculate (B) Inoperculate or those with & without

an operculum - (a) operculate - There are few animals of this order under this group - *Glycostoma* - These shells are all terrestrial - The aperture or mouth is always circular - The margin is thin, sharp, & outwardly reflexed, at right angles with it - Inhabit Indian, African, & American continents - have operculum -

Genus *Helicina* - terrestrial, some feed on trees others on earth, (See *Oxlopedia*)

genus *Aciacula* - shell elongated -

(B) In opercularia - I am *Aciacula* - The animal of this genus has its foot entire. The shell is thick, solid more or less smooth, oval, oblong; the spine short & obtuse; the aperture entire, oblong, enlarged, rounded in front, becoming much narrower backward; the edges disunited, the right constantly thickened & turned outwards; the left or columellar side, almost always presenting, one or several teeth, or thick decurrent plaits, on the columella. It is found near the sea in brackish marshes - shell broken near lips -

2 Jam - *Limnicia* - Shell thin, all inhabitants of fresh water rivers, or stagnant pools, frequently merely floating on the surface, & sometimes at the bottom. The form of these shells vary considerably; but the substance of the shell is constantly thin, & the external edge always sharp. Spine - head more flattened in the *Aciaculas*. In the cold of winter these creatures bury themselves in the mud & become torpid, they do the same in the heat of summer - They have a secretion by which they can close up the entrance to the shell. It is a sort of slime which hardens & becomes horny -

genus *Dysca* - whorls turn to the left -

genus *Acanthas*. not of this country - (see Encyclopedia) - shells on back - genus *Purorius*. discoidal shell - like *Anomia* - some live in sea -

3 Fam. *Oncidiidae* - not covered with shell - abounds. throughout the tropical climates - near coasts -

4 Fam. *Slimaciidae* - common slugs & forms. those with shells & those without - when alarmed contract tentacles. Some have a small ~~egg~~ shell on back - long rush like tongue - the slimy character of these creatures proceeds from ~~the~~ a series of secreting organs in the body, & the body is always kept moist by this -

5 Fam. *Belicidae* - a well developed external shell - no opercle - epiphram closes mouth - genus *Belis* (see Encyclopedia) genus *Achatina* - very large shells, they climbs trees & eat leaves - & some have the power of spinning a hyssus & so hang in a rapid state from the tree - a zebra is one species - genus *Pupa* - so called from their resemblance to a pupae all these shells can only live in damp moist places -

Order Prosobranchiata - (a) without septa - These molluscs exhibit the highest form of structure; they have organs of sight, smell hearing - their hearing organs are sack with two otolites or ear stones swimming in a fluid. Respiratory gills - digestive organs complicated - They have aerophagus, crop, stomach, & folding intestine - Sexes combined - Eggs laid in cases - The young when first produced do have two lobes, like rotifers, covered with cilia.

Form of shells - Among the shells of this class a great part are univalve & also spiral, but there are rare exceptions. In the limpet, the beak is a little turned, showing the tendency to the spiral form - This is more seen in the Galiotis - & again more in the Natica - some again have their whorls quite separated from each other thus another form is the Planorbis which is discoidal & others as in the Helmit shell have an opening for the mouth length of shell - others have the whole shell composed of whorls. - Shells nearly all

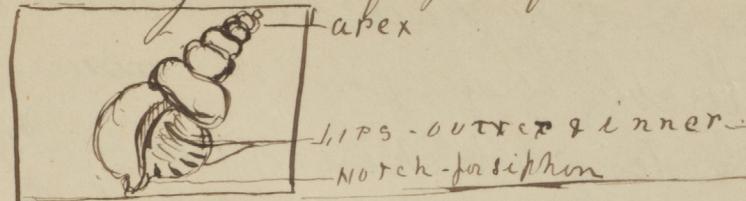


turn from right to left (dextral) but some as the *Phryoa*
turns from left to right (sinistral) — See figure for name of
different parts of shell -

The notch is generally the
chief point in determining
shells - another part of the shell is the operculum -

This order is divided into so many families that
it would be impossible to give anything like an account
of such we will briefly look over them - This small order contains
all the rest of the Univalve shells -

(a) Without siphons - Fam. - *Chitonidae* ex *Chiton* -
These mollusks are covered by a shell formed of eight distinct portions
arranged along the back in a single row, & attached to a
mantle which resembles leather, being very tough & wrinkled.
The edges of this mantle extend beyond the borders of the plates
which overlap each other, so as to constitute a kind of armour
very different from the conical shell of the limpet, or the hibernated
that is twisted, case of some of the Boreses. The coverings are variously
marked, so that each distinct species is known by its peculiar
pattern as a knight of old by the Quartermas of his shield.



All the mantes, however, have scaly, or spiny margins. In this coat of mail, the animal can roll itself up, & so be tolerably secure from its enemies; it has an oral foot, the sides of which are covered with small leaflets by means of this, it can attach itself to rocks, like the limpet. Its distinct head - mouth furnished with long tongue, curled up spirally, like a watch spring & armed with horny teeth. (see Cyclopedi'a)

Fam. 3 ~~Patellidae~~ ex ~~Patellae~~ - Power of locomotion in these at the lowest ebb, for they seldom remove far from the spot on which they were produced, & many of them, from the shape of the shell corresponding to the surface of the rock, appear never to have left it. The common Limpet (*P. Vulgaris*) is universally distributed around our coasts. It lives on sea-weeds of different kinds - (see Cyclopedi'a) - *Acanca* is another -

Fam. 3 *Ventralium* Spherical testaceous tube, nearly regular, slightly curved, gradually attenuated towards the posterior end, & open at both extremities - like an elephant's tooth. Head distinct, oral

a terminal mouth in the middle of a digitated lip, a pair of lateral jaws armed internally with very singularly formed dental processes. (See *Gyrodapedia*)

Family 4 - *Galyptaeidae* ex *Galyptaeæ* - *Crepididae* - *Pleopaidæ* -
The shell is an oval or oblong, with a much depressed concave exterior, the spine inclined obliquely to one side, the margin entire, & the opening partially closed horizontally by adhesion giving it the appearance of a half decked boat; some have angular longitudinal ribs on the surface, others have them armed with spines or prickles; they never possess an operculum, which marks a strong distinction between them & the *Nucula* - The muscular impression is in the shape of a dove ~~shell~~ - We can only give one of each family -

Family 5 - *Fissurellidae* - differs in many important particulars from *Batælla*; shells of this family are in the form of a very depressed ~~cone~~ truncated cone, oblong or elliptical, & perforated at the summit, vertically towards the anterior part; the orifice is in connection with an internal mantle, & never quite circular, but more frequently resembling a key hole. Margin of shell thickened & sometimes crenulated, & the exterior

surface, longitudinally ribbed, & sometimes striated transversely - (see Cyclopedias)

Fam 6 Haliotidae ex ~~Haliotis~~ Pleurotomaria Murchisonia Iantheina - Haliotis - The substance of the shell, is internally brilliant nacreous; it is extremely depressed, more or less of an oval form, with a very small spiral termination, & very flat - The aperture is the full size of the shell, its edges continuous, the right one thin & trenchant, the left flattened, enlarged & sharp, parallel to the left side; a series of folds exist, which serve for the passage of the two pointed lobes of the animal's mantle - There is only one great muscular impression, ^{the right} the animal is entirely covered by its shell - (In ~~particular~~ see Cyclopedias)

Fam 7 Turbinidae - ex Turba, Terebrus, Euomphalus
This family is characterised by the shells being of a regular turbinated form, generally much elongated, & a mouth entirely circular. Frequent sub-marine banks covered with sea-weed, & are all vegetable feeders. A few are natives of fresh water, & I think number respiration air-

The brood has its remarkable form, its peculiar habit of horning into other shells. - The Eumorphalus is an extinct shell. (see Cyclopedic) Fam 8 - Neritidae - ex Nervita a marine shell - it is solid, semi-globular, concave beneath, & not umbilicated; The aperture is entire, semi circular; The summit very obtuse, left side flattened & septiform, sharp, & often denticulated; The inner one slightly concave, & generally with granulations. The operculum constantly calcareous & subspiral, The summit of it marginal at the left extremity, with one or two apophyses of muscular adductor on its posterior edge, opening as the animal protrudes its body, & closing shutting when the animal is at rest. Shells never opened but variously striated or sculptured; ~~& Lammek~~ (see Cyclopedic) -

Fam 9 Paludinea - ex Paludinea ampullaria -

P. aludinea - a shell very common in our freshwater ampullaria - The animal is globose, spiral, the foot oval, with a transverse at its anterior side: The head large; The upper tentacles long, conical & sharp pointed, eyes at the retinal margin, on the mouth, mouth & lips &c (see Cyclopedic in rest)

10 Fam Turritellidae ex Turritella Vermelus Scalana -

* We can not say anything about this as we must run on
a long account of the scalana will be found in the Cyclopedea
I will only mention that the vermelus have shells the
whorls of which are quite separate -

11 Fam Littorinidae ex Littorina Riosa Lacuna
(see Library works)

12 Fam Melanidae ex Melania - these shells are abundant in
all our creeks - (see Siliqua - Cyclopedea &c.)

13 Fam Neritidae ex Neritium aporphairis -
(see Cyclopedea)

14 Fam Pyramidellidae ex Odostomia taxonoma

15 Naticidae ex Natica Velutina -

(all these may be looked up & studied
at leisure)

(B) With siphons -

Fam 1 Gyrinidae ex Gyraea. - cony shaped -

" 2 Volutidae ex Voluta



" 3 Conidae ex Conus

" 4 Buccinidae - B. Purpurea - cassis Purpurea (abundant)
oliva - (all interesting shells).

- 5 Muricidae ex Marek, Triton *Strichotropis* Pygula Fossas.
6 Strombidae ex Strombus, *Pteroceras*,
(turn these up at leisure) -

Glossy cephalopoda - Order 1 Tetrabranchiata or 4 gills -
but to you make a few general remarks, they have distinct
& well developed heads, organs of locomotion attached to
head - brain protected by a cartilaginous case - all carnivorous
male & female - male small & incomplete as often
occurs in the classes after this - But to go on with the
first order - Tetrabranchiata - 4 gills - external shells divided
into chambers - Fam 1 Nautilidae - ex *Nautilus* *Lituatus* -
The animal in the *Nautilus* is rarely found, only the shell.
that black or bluish spot ^{seen} on the ~~A~~ *Nautilus* at the opening
is the place, which is covered by a sort of hood - a modification
of the mantle - It is of no use defending the shell, as it
is known to all. The animal inhabits the largest of
these whorls, & is connected with the other chambers - by a sort
of siphon - Many are the writings of the strange things this
mollusc could do, like putting up oaks, & sowing them with ears
But these are quite fabulous - the position of the shell in the

The creature has tentacula to the number of 90 attached to its head - these tentacula are attached to two lobes which are at the animal's head.  The siphon passes out underneath the head - eye distinct, in the centre of tentacular mouth - furnished with what is called the beak, that is, a hard portion resembling the parrot's beak, by means of which this mollusc possesses the faculty of crushing smaller shells, crustacea, &c indicating its being carnivorous. Nervous system, liver connected with gall bladder - heart. The locomotion of this creature is that of which so many fabulous stories have been told - The most correct way is, that the animal moves chiefly by ejecting currents of water from its siphon - & in fact the arms help it on.  The tentacles are mostly fossil, but they resemble the spirula very much, which we will come to just now.

Fam. - 2 Orthoceridae ex Orthoceras, Gomphoceras, Gyroceras &c.
1 Orthoceras - all of this family are extinct - they inhabited long & chambered shells, straight - like the nautilus straightened out - in one large chamber the animal resided, the siphon ran down one side. (see Cyclopaedia for rest 2.)

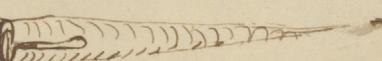
Fam 3. Ammonitidae ex Ammonite Hamites Baculites - extinct
Ammonite - closely allied to the Nautilacea, outer rim
of shell much elongated for a protection to the animal's body.
Hamites, only known in fossil state - may be con-
sidered a species of ammonite. 

Baculites - only fossil - form straight, more or less, com-
pressed, conical & much lengthened, the opposite sides
smooth, & depressed, sutures with lobed dentations, the
septae at irregular distances, pierced by a marginal
siphon - sometimes found of great size.

Order 2. Cephalopoda. (a) Decapoda - Fam 1. Teuthidae
ex Soligo Belemnites, Only choteuthis.

The ordinary name for this are the cuttle fish. These creatures greatly
resemble the animal of the Nautilus taking out of its shell.
But there is here a new organ, namely an ink bag, by which
the animal can discharge such dark coloured matter
as it can escape from the enemy which may be pursuing it.
They have a sort of tail or rudder, to guide their course
generally 2 long tentacles & other small ones.

They are often of beautiful colours - some are of enormous size -
their arms are all lined with suckers, & when once,
they take a hold, the arms have to be cut off before the animal
would can be made to drop off - some have besides these
suckers hooks -

Fam 2 - Belemnitiidae ex Belemnite - all extinct - & all
that is found fossil, is the a bone-like shaft which runs
down the back of the Soligo - on some specimens a
good part of the animal has been discovered with this shell
it is of this form -  in the upper there is a
series of chambers, for floating the animal & the rest of the shell
is used as a sink being solid - it is made of carbonate
of lime - allied to the squids, only that the sucker
is placed in this case about the middle of the animal's
body - the bay - arms all of same length, possessing both
suckers & hooks - a notch runs down a short way on one side
where the siphon was placed -  (see Cyclopedicat)

Fam 3 Sepiidae - ex *Sepia* - The cuttle fish proper -
Ink Bag - ~~sometimes~~ sometimes eaten by the natives -
immense arms, used sometimes as legs - Eyes large &
fully developed - like Vertebrates - Eggs of the cuttle fish are
attached together in clusters, & are commonly called sea grapes.
Fam 4 Spirulidae - ex *Spirula* - The shell altogether interior -
& is in the animal as a kind of float -

(B) Octopoda - Fam 1 Octopodidae ex *Octopus* - 8 organs
of prehension - equal length.

Fam 2 - Argonautidae - no internal chambers - animal
similar to other cuttle fish - & it was long thought that
we had not ~~ever~~ found the true animal, but that the
animal had taken possession of it when the true owner died, but
it is not true - it has arisen from the argonaut not being
attached to its shell, but holding it on with two broad
expansions of the tentacula - it is only the female
that has a shell - for the protection of the spawn - the
male is naked -

Province III Articulata - jointed external skeleton - simple & composed of joints - Nervous chord chord running down body & a series of ganglia stretched along over abdomen - ring round gut a great number - Glass, Annulata - order Fuctoria

ex Sanguisuga - or ~~medicinal~~ common medicinal leech
But before going further, I will give a few characteristics of this class - mostly aquatic, soft bodied, series of rings joined by several varieties of muscles - locomotion either by suckers, or bristles - along sides of body - canal two openings - moist blood red - But to go on with the Fuctoria - Sanguisuga,
a sucker at each end, long canal - series of rings over rings epidermis - & true skin - transverse oblique & longitudinal muscles - oral apparatus a large sucker armed with three jaws, placed at right angles - short esophagus - stomach large & long - retains the undigested food for a long time, even for months - mucous glands - along sides - respiratory function not certain - circulation performed by four vessels. Dorsal vessel main agent in circulating the blood towards the head - & the ventral vessel sending it back two lateral ones also - a ganglia - double chord like spinal cord of Vertebrates - ~~the~~ /

Locomotion performed by alternately attaching & detaching
the suckers - The blood they suck is used for reproduction -

Order Terebellidae - Earth worm & Naiads (the latter
are aquatic animals) - The structures of Epidermis & muscles are
the same as that of leach - but the earth worm has a series
of organs called bristles down both sides of body - The way
in which it pierces into the ground is as follows - When
the ground is soft enough it inserts its pointed head a little
under the earth & then expanding it, enlarges the opening
& so on till it gets all its body under to a good depth -

at the anterior point of this creature is a sort of proboscis, in
which is the mouth. It feeds entirely on vegetable mould.

large stomach length of body, breathing pores down sides of body -
(which we will see a good deal of). This worm has no eyes -
while the leach has 10 - these creatures are very abundant during
the night, being altogether a nocturnal animal. They also are
food to a great many nocturnal birds.

3 Order - Errantia - Marine worms, mostly of a disagreeable to
look at, but some are made to look rather pretty from the tufts
of ~~top~~ on them coloured - They differ from the last 2 orders in
possessing gills which are usually external, they are buried in
form - organs of locomotion are but rather complicated -

Poses horny jaws - no apparent eyes, but are sensitive to light -
resemble previous orders in their internal structures - but the
circulation is of course different having gills externally - they have
2 hearts alike both ventricle - ventral vessel for circulatory
the blood back ~~to~~ to a this ventral vessel sends out branches -
which go to the gills - there is a series of lateral vessels above
external organs varied in form - These belong to this family
The Arenicola Syllis Nereis aphrodite

We will say a few words on the Nereis - to explain the compound foot
The Nereidae or sea centipedes - exhibit a long worm like form -
with legs down each side - they are found under stones & on
sea weeds - they have feet adapted for whatever mode they have
of making their living - if they live on sea weed, they have sharp
claws to hold on by - if mostly to swim, the have large paddle shaped
feet, which answer the purpose of gills - ~~feet~~ The foot
is composed of 3 parts as in figs -



fin foot hook foot

They have great power of reproducing a part that has been broken
off - one first wormlike - in others like an annule, with
cilia - spontaneous division -

Order of Tubicolae - ex *Serpula* *Labellaria* *Amphitrite* *Terebella*
Spirorbis - These are curious creatures - some most beautiful
in habit tubes of shell, sometimes from a stick lance secreted in
the animal, at other times of sand, & bits of wood - glued together.
We will take the *Serpula* as the first & most beautiful example -

In my form irregular twisted tubes, sometimes grow together
in large masses, generally attached to shells & similar
objects; whilst those genera which like *Terebella*, build
their residence of stones & sand, appear to prefer a life
of solitude - The *Serpula* when taken from its tube, is seen
to have the lower part of its body composed of a series of
flattened rings, entirely destitute of limbs or any other
appendages. Its food is brought to its mouth by the
currents created by the cilia on the branchial tufts.

Many very beautiful specimens of this family may be seen
alive in the tanks of the Zoological Society -

These creatures have feet of two kind, one set with hooks which
are attached inside the shell to draw the animal back again
another set push against the sides & so push it out the
animal - There is a stopper or operculum to the shell -
which when lifted, show the beautiful feather like gills -

This stopper is often beautifully sculptured -

The small spiral shells seen on sea-weeds belong to this order.



Class 11 Epizoaa - very like entosoa - are parasitic upon fishes - hanging on the outside of the body - to the gills, or eyes of other fish - They have structures that place them between the Worms & Crustacea - They are of great number - Here we have the first & by no means last, instance of retrograde development - namely the young being higher in the scale of animal life than the parent - The young possess eyes - locomotive limbs - Then it is quite free - but as it grows older, it loses its eyes

lungs - & becomes attached - Order 1 - Cephaloaea - ~~from~~ ex Peniculus

Peniculus - infects eyes of Salmon Cod &c - 1 inch length.

2 - Sack - these attach themselves by hooks - Here we have a distinctly formed head supported by neck, (approaching something like the insect form) & also cephalothorax - to this in diments of feet are attached - abdomen containing a very long stomach - nervous chords down sides of body - two ovaries sacks -

There are a good many of these sacks in the lower articulates -

The Searnian Parasites, are of very various shapes--

2 Order Brachium - ex Achthores - Prehensile arms for attachment
Strong mandibles - between anterior limbs - circulation a dorsal
vesicle or heart in cephalothorax - lengthened stomach in abdomen -
which is divided, & supported by a muscular band - liver -
2 nervous chords & ovaries - The male is quite different, the
male is not always attached - but is free to move when it
likes - young very unlike parent - 3 stages -

3 Order Onchuna ex Dichestium - these are all attached
by hooks not much known about them -

Gloss 3- *Gymnophidia* - Order Thraecidae - Fam. Balanidae - ex Balanus -
These shells are usually of a conical form - more or less elevated - sometimes
narrower at the base, in the form of a tulip, irregularly shaped, from
the circumstance of their being crowded together in large clusters, on
the substances to which they are affixed - (for description see Cyclopedea)
One side of this shell is called the carina the other the rostrum -
They are hard shells to determine - animal is doubled up in shell
They are very abundant everywhere, stones shells fish wood being
covered with them in all directions -

Some affix themselves to the bodies of Whales, others form a lodgement
in the hollows of corals & sponges. Once fixed they remain so during
life, & taking their chance of such suitable food as may come
within their limited sphere of action. At an earlier stage of their
existence, both their shape & habits are very different, being lively
little creatures, swimming swimming about without either like
water fleas. They are about the tenth of an inch long, & of most
graceful appearance, having 6 jointed legs set with hairs,
the whole being so arranged, that they act in concert, &
striking or flapping the water send the little body along
in a series of bounds; then the creature has two long arms,
each furnished with hooks & a sucker, & a tail tipped
with bristles, which is usually folded up under the body -
its large staring eyes are pedunculated - it has a house
on its back like a bivalve shell, into which it can
collect its scattered members when occasion requires. When
of sufficient age to settle itself in life, & become a staid
member of submarine society, it fixes itself to some
convenient object, throws away its eyes as no longer useful,
gets rid of its preposterous limbs - enlarges its shell & remains -

2 fam - Vermicidae - ex Verruca - The only difference from the last family, is that they have their valves united on one side & left open on the other -

3 fam - Leptodidae - ex Lepas - The animal has an oval body, more or less compressed, the mantle divided at its posterior portion - The mantle is prolonged on the other side by a ~~long~~ fleshy pedicle or stem, more or less capable of extension or contraction - This is attached to submarine bodies, & acted upon by a transverse adductor muscle. The testaceous portion, is formed of five valves, 1 dorsal & median; two laterally anterior; & two laterally posterior. These molluscs are invariably fixed on various floating or other submarine bodies, in very extensive groups, or thinly scattered, hanging as it were with their heads now upwards, ~~then~~ but it is not so, for their heads are crowded up next to the stem - They appear to delight in the constant motion of the waves, which contributes to supply them more easily with food, which otherwise they have no mode of seeking, beyond the limited locomotion, the length of their fleshy stalk permits them to enjoy - They are carnivorous seizing their food by means of the articulated appendages, with which the posterior part of their bodies is provided; these are in continual agitation -

The nervous system is at the lowest form in these creatures, that we can have in the Province. It consists of a ring round mouth from which 2 chords run down the body, quite ~~as~~ separate - along these chords are ganglia - rudiments of eyes, sacks with statoblasts showing that ^{they} possess the ^{sense} of hearing - They also have olfactory pouches - also retrograde development - male small - & is generally attached to the females - ~~they have 2 to 3~~ They pass through 2 or 3 distinct stages - they moult twice or three times, like all the articulates - after the young has sailed about a sufficient length of time it fixes itself by its two antennae & these become joined into the one peduncle - When it casts its skin it casts its eyes along with it - They are very like the Cephalo - strange story connected with these shells

2 Order Abdominalia ex- *Cryptophialus* - Not much known only one genus.

3 Order (Apoda ex *Proteolepas*) - — do do

Class 4- Crustacea - are so called from their hard calcareous covering, they are also characterised by a branchial respiration & a dorsal ventricle or heart - Chiefly marine - & carnivorous - Head, thorax, abdomen, in some combined in one piece - In the

head compound eyes, a mouth with mandibles, frequently furnished with palpi, & maxillae, in some prolonged into a pair of feet - from the throat 4 pairs true legs - & one pair of claws, sometimes of a large size. moult periodically ~~now~~
Cuvier divides it into two great sections, *Malacostraca*
& *Ceropagostacea* - *Ceropagostacea* those which
have the integuments of the body of slender consistence, &
corneous or horny rather than calcareous.

Order, Trilobites - ex *Asaphus Galymene* *Trinucleus* -
The bodies are composed of three ~~distinct~~^{transverse} parts, & divided longitudinally by two deep impressions, forming three elevated lobes.
No organs of locomotion or antennae have been observed, & it appears to have been the habit of these animals to roll themselves up into a ball by bending the extremity of the body beneath the head, & bringing it into contact with the head.
They are all extinct, *the sea Limulus* being the most nearly allied -

2 Order Hymenura - ex *Limulus* - nearly allied to Trilobites, still retaining the three lobes - body covered by a large rounded shell, divided into two parts, the anterior being large & semilunar, & the posterior toothed at the sides, & deeply notched behind, & terminated

by a very long & acute spine; the mouth is not provided with any sucker, the coxae of the six anterior pairs of legs being dilated & spined, & performing the office of jaws; the anterior pair of legs is very short, & seem to serve as a pair of claws assisting in carrying materials to the mouth; the five following pairs are larger, & terminated by small bifid claws, but do not extend beyond the margin of the shell. The terminal legs which are 10 in number, are transformed into thin lamellated plates serving for branchiae. They inhabit the tropical seas, & frequenting the coasts, & appearing to be found only in the East Indies & the shores of America.

Are eaten by Chinese. The eyes are 4 in number & compound & simple behind a point on the animals forehead - The eyes are covered by the head part of the animals shell continued - The stomach is in advance of the mouth so that it may be considered as doubled up in its shell - The stages not known

3 Order - Phyllopoda - ex Branchipus - These are minute crustaceans found in the fresh water - Eyes placed on foot stalks - the body is narrow, long, & compressed. The head distinct, with two horns between the eyes - 11 pair of legs - the abdomen long & cylindric -

with two terminal ciliated plates - Males distinguished -
by a pair of large horns attached to the mouth - The eggs
are born by the females in a pouch attached to the
base of the abdomen - When full grown about an inch
& a half long - Found in great numbers in puddles of
standing fresh water - Swim well upon their backs, & their
legs, which are incapable of assisting locomotion, are kept in
constant motion, which has for its object, the forming
of a current of water between these organs, & which following
the canal of the breast, conveys to the mouth the small
particles upon which the animal feeds. Moved by repeated
jerks of the tail; so that when upon its back it appears
just like a small fish - Eggs yellow. (see Cyclopedias)
~~These~~ one of these creatures can survive after a drying of months -
commonly called water fleas -

Order Glaucera - ex Daphnia - The body is in an oblong oval -
& compressed form, enclosed in a bivalve shell, attached to the skin,
having its aperture beneath the body, & its hinge above the back -
The head is distinct, & produced beneath into a kind of snout -
furnished with a central single eye - From each side of the head -

arises a large antenna-like organ, having a long basal point, at the end of which, each antenna is divided into two long articulated branches, each of which supports a number of long bristles -

From which comes their name - help in swimming. The animal is suctional, & requires no jaws, they have feet jaws but these do not help as jaws - but are used solely to obtain fix edness of place, while the Thoracic feet again are not organs to walk or creep on, but are only calculated for swimming, which we can conceive, it may often have occasion to do. Within the shell of the *Daphnia* are to be observed 10 small leg-like organs, having the second joint vesicular, the eight anterior ones being terminated by a dilated joint, margined with hairs, & serving as oars, the anterior pair appears, however, to be employed more especially in pre hension; the posterior pair of legs is differently constructed, by a curious provision the eggs are deposited in a dorsal kind of pouch beneath the shell within a nick they are hatched; at the end of the fifth day the young have acquired sufficient power to take care of themselves, & are expelled by the female. (*Caligula dapedia*) = alternate generation - young differ from parent -

5 Order - Ostracoda - as Cypris - swim with great velocity in standing & fresh waters - their bodies being inclosed in a kind of bivalve case, united by a hinge, which enables them to close their shells on the approach of danger. They have only 6 legs, & the antennae are terminated by a whorl of hairs like a pencil; the body is without distinct articulation, terminated posteriorly by a soft tail. They have one large eye, they can both swim & crawl - very predaceous - feed on animalculæ &c - moult 6 times month - no changes - The Cypris, has eight long legs, & the antennae are not terminated by a bush; the species of this genus are confined to the salt water of the ~~other~~ ocean.

6 Order - Copepoda ex cyclops - These little creatures which abound in fresh & standing water, are seldom more than than one-eighth of an inch long, & may constantly be observed jerking about by the assistance of their long tails, resemble a miniature lobster, the thoracic part of the body being oval in form, furnished with a single eye in front whence the generic name of the group). This part of the body is divided at its hinder part into several segments, which are succeeded by an articulated tail or abdomen, from the base of which in the females, depends on each side a large membranous bag containing the eggs.

The abdomen is forked at its extremity, each division being furnished with strong setae; the upper antennae are very long & multiarticulate, but the inferior are short & four jointed. The legs, which are very short, consist of five pairs, each leg being divided into two cylindrical branches. (see Cyclopedias) - External oviposets -

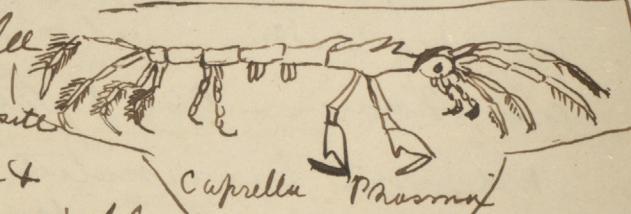
one compound eye - large antennae used for ears, gills attached to them - Sub Class 2 - (Mala costata) - (a) sessile types -

Order 1 - Laemodipoda - ex Caprella

Body narrow, & of a linear form, ~~not~~ compact eyes placed behind, the upper antennae & ocelli wanting, & the legs long & slender - & variable in number, the end of the second pair being toothed on its under side. Seldom exceeds one inch - found among marine plants, creeping along in a similar manner to the larger caterpillars. When swimming they bend the extremity of their body - (see Cyclopedias) as seen in the figure there are two rudimentary limbs - which answer the purpose of gills -

2 Order 1 Isopoda - ex Orisus - Tricula - Limonaria - Cypratthen -

This order is distinguished by the animals being enveloped in a hard skin substance, the eyes not being raised, the body being divided into ~~an~~ series of nearly equal sized & generally flattened segments -



& the legs of nearly equal size, & four keen in number, the anterior pair not being cheliferous, or armed with large claws.

Oniscus - The body is of an oval form, with four antennae, the intermediate pair being very small, & only two jointed. The abdomen is six jointed, & very short, with two or four terminal styles, & without any lateral swimming plates; some are aquatic, whilst others are aquatic terrestrial, & the modifications which the organs of respiration undergo in those different species are very interesting. The restricted genus *Oniscus*, of modern authors, comprises only terrestrial species, being confounded with the *Glomeris marginata*, under the common name of wood louse. They have eight joints in the lateral antennae, the base of which is not exposed - the two external appendages of the tail, are much larger than the two interior. Frequent cellars, caves, cracks in a wall &c - also in rotten window sashes - beams, decayed trees &c - Feed upon vegetable & animal matter in a state of decay - creep ~~safely~~ slowly & easily alarmed - the eggs are enclosed in a pectoral pouch, in which they young are hatched - these, at their birth are deficient - wanting one segment & a pair of legs - which they afterwards acquire.

Habits curious, breath by means of gills - The limnora is another of these fresh water crustaceans, belonging to the Zoopoda. Eyes granular antennae four in number, & inserted nearly in a line, & four jointed; the legs similarly formed & fit for walking; the abdomen 6 jointed, the last segment being large & suborbicular. The only species is the Limnoria linebrana, which does not exceed one sixth of an inch in length. A great wood-eater, & has great powers of multiplication. It attacks piles of wood immersed in the water, in our dock-yards, flood-gates, timber bridges, & wharves, &c, & which in a very short time, it completely perforates in a most alarming manner, boring to depth of several inches, in every direction. Found on the coasts of G. Britain, & Ireland, & France. Eats decaying timber from the water.

Another the Gymnotaea - Antennae short, & inserted in pairs one above the other. Body oval, convex or depressed, abdominal portion divided into several segments, of which the basal ones are very short, & the terminal one large & broad; legs short, & very robust, being terminated by a hook point. Somewhat the appearance of wood lice, but habits very distinct, being parasitic upon various kinds of fishes inhabiting the ocean, to which they attach themselves by means of their strong hooked feet, & then suck their blood.

The eyes are not on tubercles, & are formed of minute facets;
abdomen 6 jointed, & ~~mandibula~~ mandibles not directed.

(*Oniscus aestuans*)

3 Order Amphipoda - ex *Gammarus* - the type of leaping shrimps -
the body is compressed at the sides, curved, & composed of a series
of equal sized segments, in which respects it is at once distinguished
from the true shrimps & prawns, the anterior segments of which are
swallowed together into a large thoracic shield or shell, & as this
structure prevails also in the lobster & crab families, these animals
have obtained the name of shell-fish, although they have no more
to do with the true fishes, than any other perfectly distinct group
of animals which happens to be aquatic in its habits.

In the shrimps, lobsters, & crabs, moreover, we perceive only five pairs
of legs, but the mouth is furnished with three pairs of foot jaws.
Whereas, in this family, & indeed in the other groups of sessile-eyed
hard-shelled crustaceans (except the Laemodipoda), the body is
furnished with seven pairs of legs, attached in pairs to the seven
segments succeeding the head; but the mouth possesses only a single
pair of foot jaws, so that it is quite evident not only that
certain organs which, in the Decapoda, are mouth-organs, are trans-
formed in the amphipoda into legs, but also that the part of the

body which, in the former, constitutes the head, is composed of several segments soldered together. Legs of different forms, some of them the anterior being hooked, being claw-shaped, & the others simple. In the typical genus *Gammarus*, the four anterior legs are formed into small claws, & the upper antennae offer a character which is unique in the order, that of having a small articulated seta at the internal extremity of the third joint. The typical species, *Gammarus pulex*, is a small leaping animal, found in great quantities in ditches, ponds, & springs of fresh water, exceeding a centimetre, & varying much in size. Its motions are effected in a manner similar to those of the spiny-tailed insects, Podurae, by bending the tail, which is terminated by several appendages, beneath the breast, & then letting it go with force, thus giving, as it were, continual filips to the water, in which it resides, & by which means it is impelled forwards. Another species is much more slender in its form, & its lower antennae are very strong, & as long as the body, none of the legs however are provided with a large claw. It is the *Pancer grossipes*, & is about an inch long. It inhabits the coasts of various European countries, & is called Pernys by the inhabitants of the coast of La Rochelle where it resides in holes which it makes in the mud,

covered with the wood-work erected by the muscle catchers. The *Cerophtium* appears at the beginning of May, & immediately commences warfare against the Nerids, which take up their abode in the same places. It is very curious to observe at the rising of the tide, myriads of these crustaceans swimming about in every direction, & heating the mud with their long antennae, & turning it over, in order to find their prey. Respiration combined with locomotion. swim a leap.

(B) Stalked eyes - cephalo-thorax - Order of Stomapoda - ex Squilla

This order is a very interesting one, from their singular structure. The branchiae are not affixed at the sides of the Thorax, & placed in a particular cavity prepared for them, as in the crabs & lobsters, but where there exists particular organs of respiration, they are found under the form of membranous ciliae, attached to the sub-abdominal appendages - These animals have the ligaments slender & transparent, & not of that firm consistence which is found in the lobster. The carapax or shell is often divided into two parts, one bearing the eyes & antennae, the other the appendages of the mouth & the thoracic legs; in other groups it is formed of a single piece, & exposes a certain number of the terminal thoracic segments; the abdomen is generally very much developed

& always composed of seven joints; the eyes are affixed upon moveable footstalks; (for further description of the order see Cyclopedie)

1. *Squilla* - Body long & semi-cylindric, somewhat resembling that of a lobster, being arched above & flat beneath, the last segment rounded & spinous, or toothed, on its posterior margin; the eyes are placed on very short footstalks. The interior antennae have 3 filaments, the exterior single, but covered at the base by a broad scale; the thoracic shield is broad & somewhat depressed.

The first pair of legs or rather leg-like organs, are long & strong, & formed for powerful prehension; the last joint shutting upon the preceding, ~~one~~ with strong spines, in the same manner as the fore-leg of one of the Mantidae; the four following

pairs of legs are short, especially the third pair, terminated by a small, flattened, & wounded plate, & a curved apical spine, the three posterior pairs of legs being very slender, the femora being furnished with a long & slender teliform appendage. The species are somewhat numerous. They are chiefly inhabitants of the seas of warm climates, but one or two species have occasionally been taken on our own coasts.

Squilla Mantis - grows to length of seven inches -

gills exposed & are tufted -

Order 5 Decapoda - (a) Macroura ex Homarus, astacus, Grangon

This order signifies 10 legs - it comprises all the larger species of the class, the head intimately united with the thorax, & covered by a large shell or shield; a mouth consisting of numerous pairs of organs, of which the outer pairs, in some of the species are elongated; but the most characteristic trait, consists in the existence of gills or branchiae, more or less numerous, fixed in a peculiar cavity beneath the sides of the shell. (a) macroura - Long tails - eyes placed at the extremity of footstalks, & the abdomen elongated, squalling in size the remainder of the body, & not concealed, but simply bent under the breast, & terminated by a fan like apparatus or swimmeret, having also on its under side five pairs of small upper daces or false legs, with two filaments at the extremity of each - Abdomen always swollen, & antennae generally long & exerted, the outer foot jaws long, & not entirely covering the inner parts of the mouth. The shell is longer & narrower, than in the Brachyura or crabs, & generally terminated in front by a spine. These are marine, & do not quit the water, like some of the land crabs.

The genus *Asterias* - belongs to this sub-class - In this family the abdominal portion of the body is much longer than the thorax. The eggs are retained in a large pouch, beneath the breast, the first pair of legs, are generally very large & terminated by hooks, claws, no machine for swimming, & the antennae, of which there are two pairs, are inserted in the same dorso-ventral line.

The intercarines with moderate or long footstalks, & terminated by two filaments, & the outer ones naked or furnished with a scale, which never entirely conceals the base. These characters will at once distinguish the lobsters from the hermit crabs (Paguridae) & prawns & shrimps (Palaeomorphae). The moulting of these crustacea is very curious, but as we have mentioned it before - We have also mentioned before the power the lobster has of reproducing after limb is broken off. The eyes are compound-organs

of smell & hearing at base of small antennae, & hearing organs at base of large ones. The organs of mastication are very complicated, & similar to what we have in the monobrachiate insects. The smaller legs are organs for holding food & bringing it to mouth - 1 claw is large & strong for holding, the other sharper

& more fit for snapping - The walking limbs also have each
a pair of pincers - gills along side of body - & cavity between
filled with sea water - wonder abdomen small swimming
& also used for holding spawn - strong tail - young goes
through no changes, but are from the first the same shape
as parent - remain attached sometime. The cray fish
from fresh waters is another example - The genus *Gazunyon*
or the edible shrimp is another example - The two anterior
legs are terminated by a ~~muscle~~ claw; the second pair rather
~~longer than~~ the preceding; rostrum short, & bell mouth;
abdomen rounded, wrists not articulated, & legs not
provided with a basal appendage.

(B) Anomura - Hermit crabs - have the abdomen prolonged,
but destitute of a shell so that the tail is soft. They are
remarkable for their habit of living in the deserted shells of
mollusca, exchanging also for a larger as they increase in
size, & fixing themselves to their strange habitation by
peculiar processes which seem developed for the purpose.
The claw is the operculum to their dwelling -
The two fore legs are terminated by a dactyl claw, the four
following by a simple point; but the four posterior, which

are smaller than the others, are armed at the end by a small pair of didactyle claws; the basal joint of the footstalk of the lateral antennae is turned back with a spine or elongated point. (see Cyclopedic.)

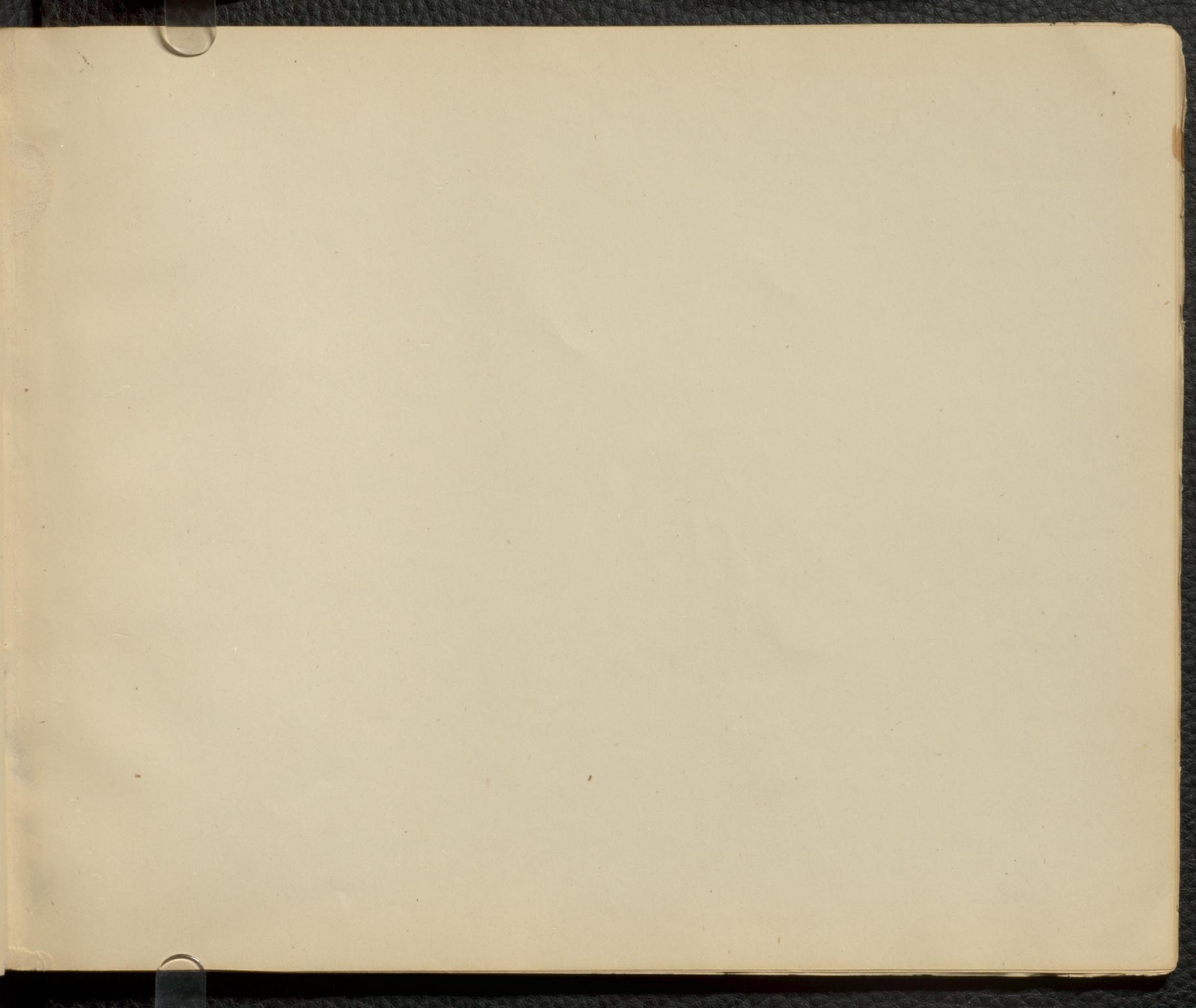
(c) Brachyura - ex Cancer - Pinnotheres - This order has the body encased in a hard shell, eyes are rudimented, & legs ten in number, are common to the greater portion of the whole class, the animals which possess them are of large size, being in fact the giants of the class - Cancer this creature belongs to this sub-class which we will just now speak of.

In the various animals which compose the division Brachyura, the shell or carapace which covers their bodies, also encloses the greater portion of the abdomen, its transverse diameter exceeding, or at least equaling its length, its upper surface exhibiting various areas divided by impressions which correspond for the most part with the insertion of the muscles within the shell, & which form so many regions corresponding with the internal organs immediately beneath the different areas. The front of this shell bears a pair of eyes on footstalks, & two pairs of antennae

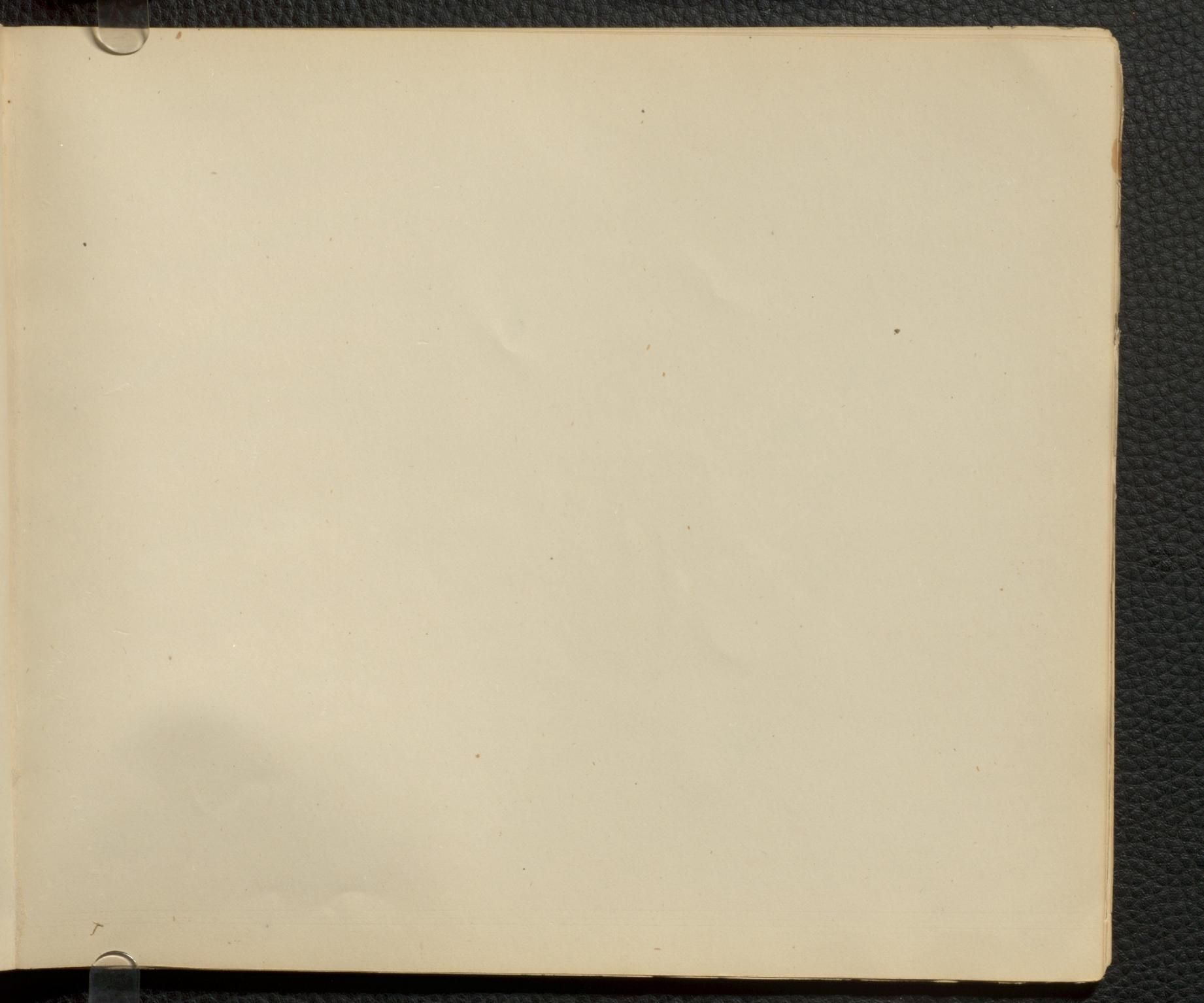
& beneath these is perceived a pair of large, flat, & articulated pieces, which when raised, we found to conceal a very complex apparatus composing the mouth, & consisting of an upper lip or tongue, a pair of horny mandibles bearing a jointed palpus, a pair of internal & external maxillæ, & three pairs of stout jaws gradually increasing in size, furnished with palpi, the largest of which, is the external pair first mentioned above. Beneath the antennæ are two apertures which have been regarded as organs of hearing.

The members which immediately succeed the external post-jaws constitute the legs, & are also five pair in number; they vary considerably in size; those of the first pair are always prehensile, & terminated by a didactyle & well-formed claw; in general the four posterior pairs of legs are simply ambulatory ~~or~~ nutatory, they are never didactyle. The abdomen is but slightly developed, its length never exceeding three fourths of an inch, that of the entire body, & its thickness not equal to more than one-sixth or one-tenth of the body, being in fact lamellose, always closely applied to the sternal excavation.

In general much larger in females than males, being oval
in the former & somewhat triangular in the latter.



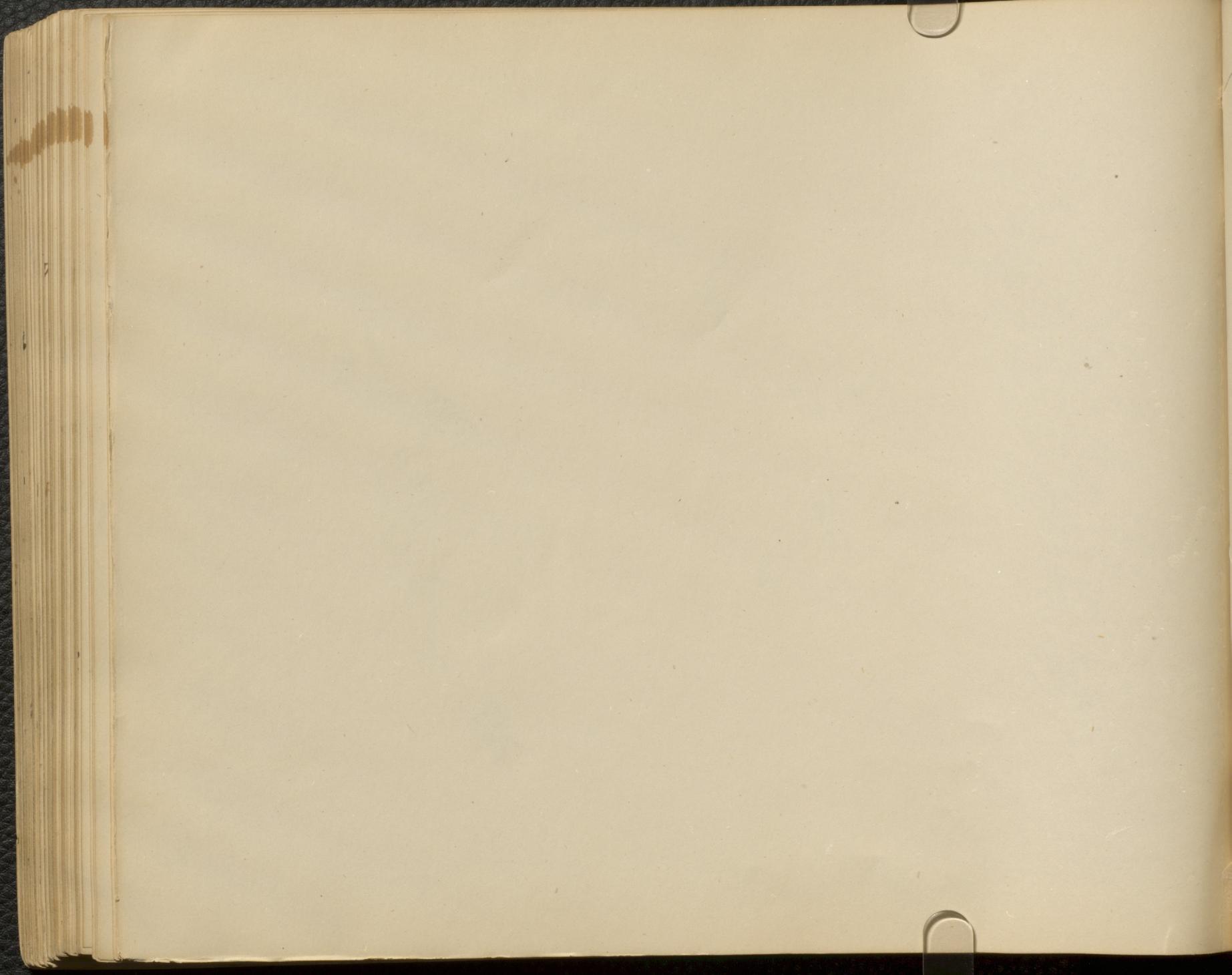
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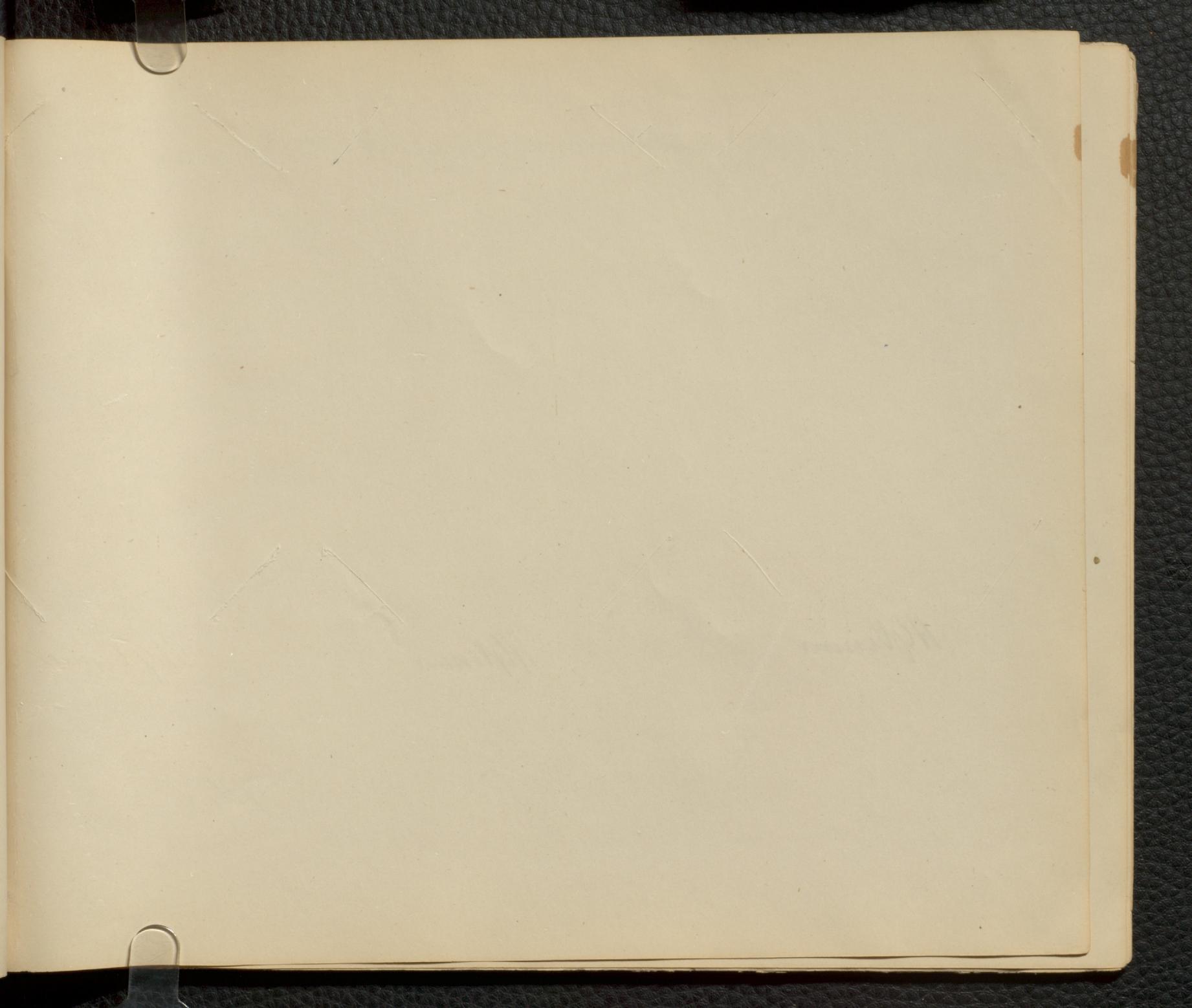


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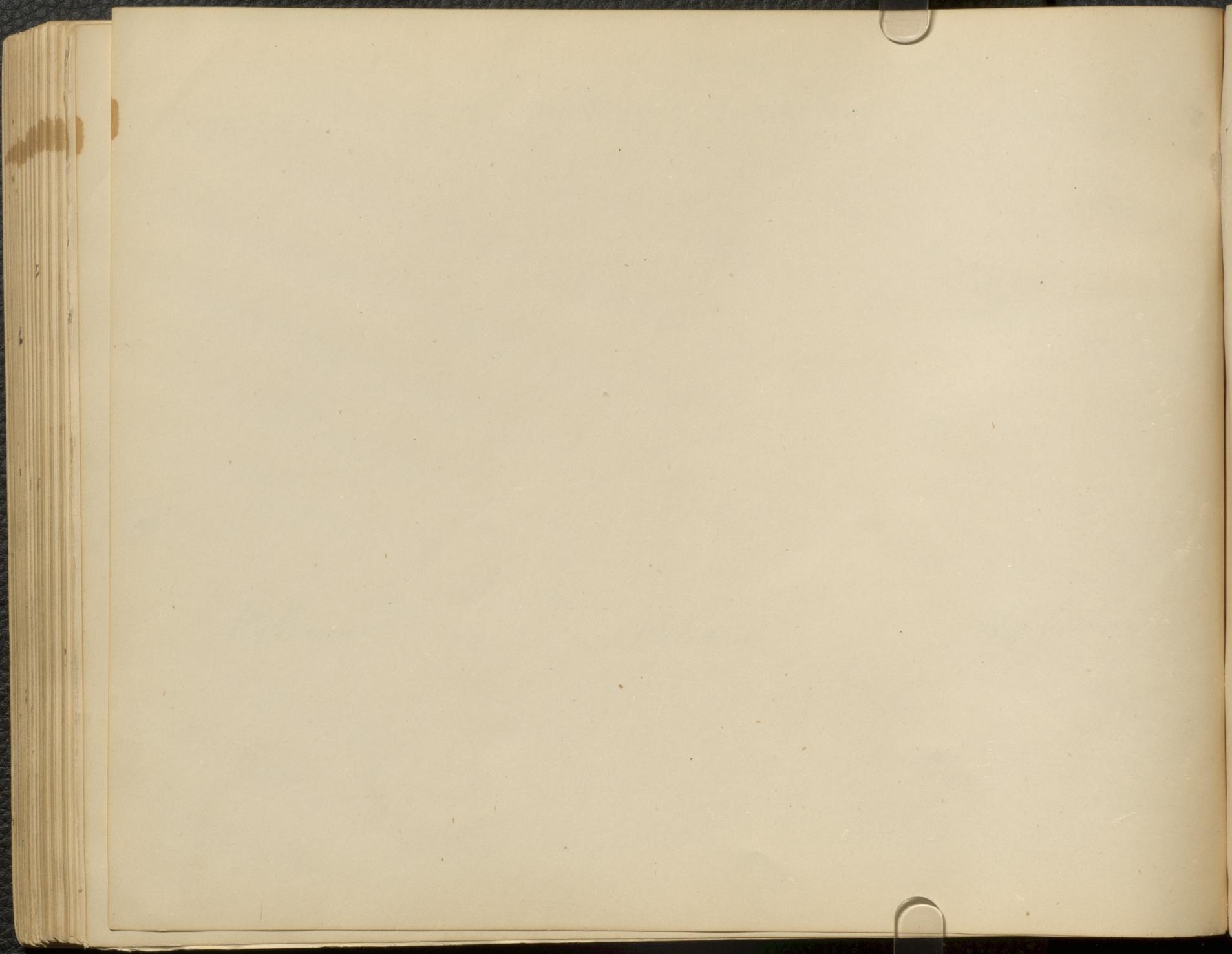
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Canadian Reptilia -
Some of the inhabitants of our Woods and fields



W. G. Vinne

