



*P*ALAEONTOLOGY.

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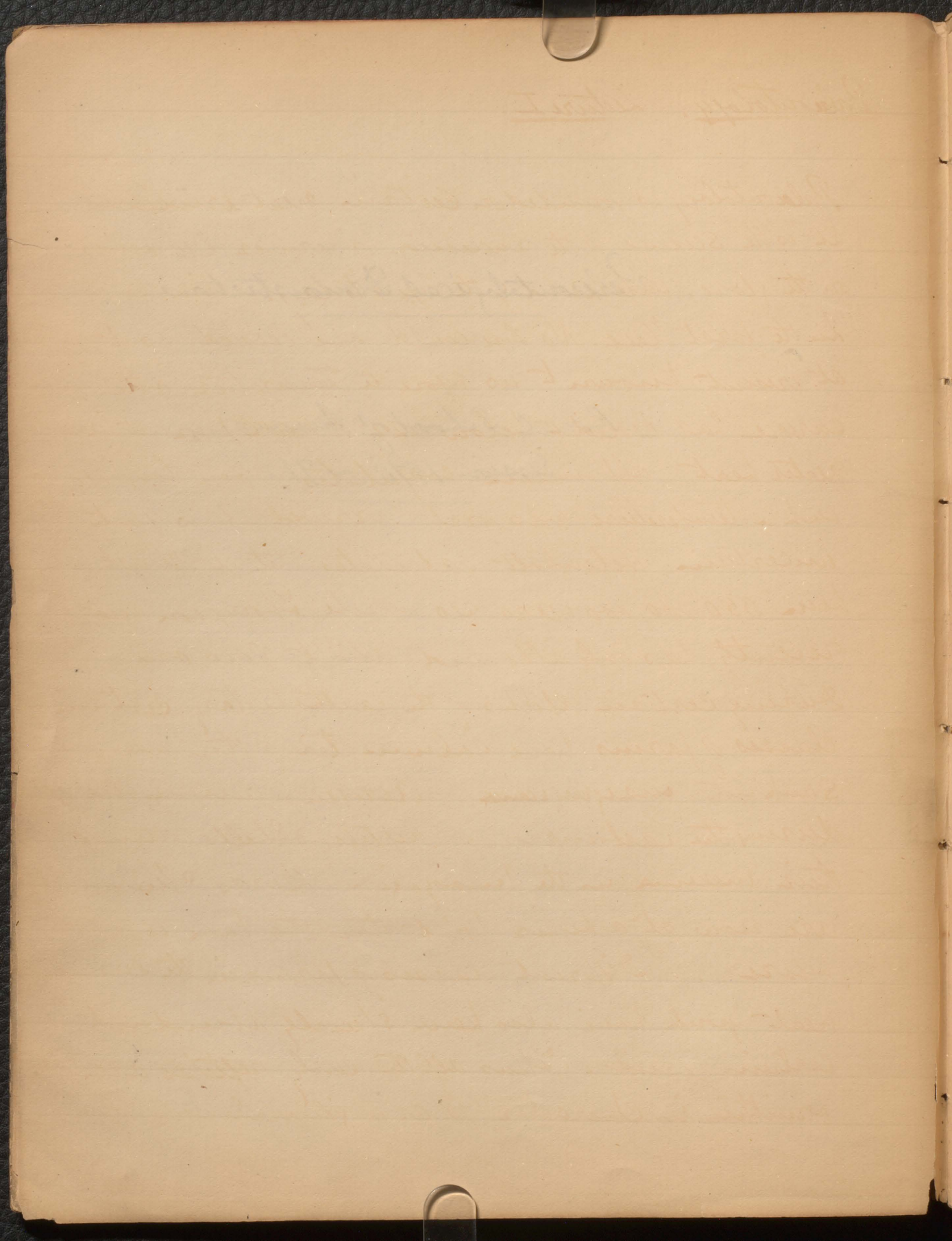
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Paleontological Demonstrations

Royal School of Mines.
Session 1870 - 71.

George W. Dawson
May 2. 1871.



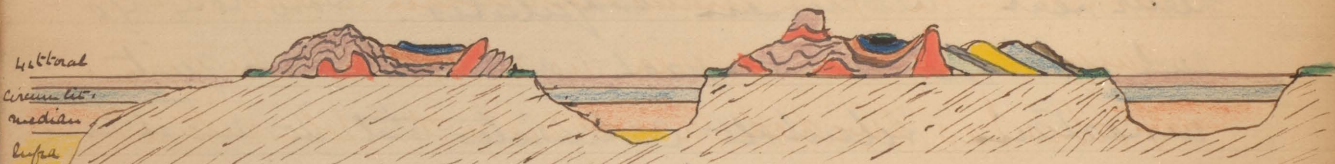
Palaeontology. Lecture I.

Palaeontology is founded on certain great principles. It is the science of the succession of former life forms on the globe, interpreted by the life of today.

In the first place. No life could have existed, as it is at present known to us, before the temperature of the Earth's surface had cooled to below 122°F (50°C) for at a greater heat, albumen coagulates. How long ago such a temperature was first arrived at is quite uncertain, Helmholtz calculates that it must have been 350,000,000 years ago, while Thompson more recently, has only allowed about 5,000,000.

During certain epochs of the earth's history certain classes of forms have culminated, & then again sunk into insignificance. Acropora culminated during the Carboniferous. Reptiles & Shells attained their maxima in the Mesozoic. Birds & Mammals are now at a higher point than they have ever been before. Different classes of forms in the same great group have also been specially abundant at certain periods. Thus all the early reptiles are ornithic in character, & as a general rule early forms seem to belong to more embryonic conditions.

In the British Islands we have a greater succession of rocks, & better shown than in any other known area of the same size. Indeed save the Muschelkalk, Maestricht Chalk & a few minor beds we have all more or less perfectly represented. Thus if one walked Eastward, from the Great Western Paleozoic axis of England - Say from Halden to Dover - Every formation would be passed over.



The contour of a coast is determined by the sinking or rising of the Land, & by the eroding action of the water. The Sea level itself never changes. Coasts are surrounded by zones of life which Forbes has called Littoral. Circum littoral, Median, & Lupra. If England was to be depressed say 100 fathoms, all these levels of life would move up, & the Median would be where the littoral was before. By a not very great elevation, England & the Continent would be united, a little more, & Ireland would be attached to England. The ^{granite} Caradoc fossils deposited round the Longmynd, when it rose out of the waters as an island, are strictly littoral in character, though of such great age.

The distribution of forms in space depends sometimes on well marked circumstances, but at other times is capricious. During the Quaternary the isthmus of Panama did not exist, & the Atlantic & Pacific marine faunas were the same. Now the life forms are mostly distinct, the separation having existed for so long a period. *Pholadomya*, & *Pentacrinus*, forms so common in English seas during the white Lias, are now only found in the West Indies & Caribbean areas. For this migration to another area no reason can be given. Forbes has divided the surface of the globe into a series of great-Horologioic belts. First-comes the N. Polar belt. From this belt-came all the shells of the Glacial period. Then the Circumpolar, sometimes called the Boreal belt. Then the Celtic in which all Britain lies. Then the Lusitanian & lastly the great central Equatorial zone. The lines between these zones are not-arbitrary but distinctly marked in Nature. Some forms recur in Northern & Southern belts & are nowhere else found. *Patina* is found only in two small spots. Near Cape Farewell, & in the Falkland Islands. *Mitra* is altogether tropical, except one small Icelandic species. Such facts it is almost impossible to explain.

Such facts brought Forbes to the doctrine of the Polarity of life in time. The Ganoids & placoids are now polarized & the Cycloids & Ctenoids.

Eutomostrocons crustaceans, represented by the trilobites had their polarity in the Paleozoic. In Cainozoic times they are polarized by the malacostracans. Tetrabranchiate Cephalopoda so numerous in paleozoic times are now polarized by dibranchiate.

Brachyopoda are at the present-day polarized by lamellibranchiate. Besides the relative polarity of the great groups, classes of these groups showing various plans of structure have been polar at various periods. Four starred corals are very characteristic of the paleozoic, 6 starred of the mesozoic. The first coral known is the *Nebulipora* from the *Black Hills*. About one fifth of the 16 families into which all may be divided, range through all time. Only 6 are completely extinct.

Dibranchiate cephalopods? lived through all secondary time, & then died away. *Ammonitidae* came in with the Carboniferous as *Forciatites* (? Devonian) & survived to the top of the Chalk. *Orthoceratidae* appears with the first Silurian & continued to the top of the Carboniferous. It is

Strictly a Palaeozoic ~~group~~ family. The Spiriferidae
begin in the middle Silurian, & find their last represent-
ative in the Spirifer Dumortieri of the Lias. Orthisidae
began with the oldest Silurian & ended with the
Coal. Productidae began with the Devonian & finished
with Productus barrida of the Magnesian Limestone.
The Hippuritidae so abundant in the Chalk of France
& Spain, & forming hippurite limestones, are now
all dead. Of Nautilidae only one remains, though
25 fossil genera are known. Rhyssobanella is
extinct except one or two widely scattered forms.
Trigonia swarming in every obolite quarry is now
only found in Australia. Graptolites began in the
Llandovery, quickly reached their maximum, & died
out in the Upper Ludlow.

Australia is a nucleus around which many
remnants of ancient forms & types seem to have
gathered. They are the remnants of old forms,
for there is no such thing as the reappearance
of the same form or species, after it has once
become extinct.

Lect II. Brongniart has constructed a scheme of the vegetable Kingdom with special regard to fossil botany, or palaeophytology. He divides all plants into 6 classes.

Cryptogamic.

Amphigens
(Lichens sea-weeds &c)

Acrogens.
(Mosses. equisetums
ferns. Lycopodiums &c)

Phanerogamic

Dicot: Gymnosperms
(conifers. cycads &c)

Dicot: Angiosperms
(all common trees &c)

Monocotyledons.
(palms lillies &c)

Though so great changes have happened during geological time, we nowhere find plants that will not fall under one or other of the above groups. There is no group of plants which during geological time have become extinct. In this plants differ from animals.

ap. I.

acrogens. From the Upper Silurian we have only the remains of one or two plants. In the Upper Ludlow beds, quant-
ities

of sporangia are found, together with a few undetermined fragments of plants. Hooker has called these sporangia *paucytheca*, & they are in all probability *Lycopodiaceae*.
In the Devonian we have a rich flora, *Coniferae*, *ferns*, *Sigillaria*, *Stegmaria*, *Calamites*, *Sterbergia* are all known.

In the Carboniferous *Weyer* has counted up more than 700 plants found in Europe, & *Bronghart* gives 500 species of *ferns* alone. These plants belong to some 35 or 36 genera, *Ferns* are specifically the most abundant.

In the Permian a great change takes place. Here the Permian flora is very poor but in the shales of *Thuringia* & *Russia*, *ferns*, *Cycads*, & *Lycopodiums* are found in abundance.

Age II. Gymnosperms commenced with the Lias & White where *Cycadites*, *Stegmaria*, *Zamites*, *Strophylloa*, *Wilsonia*, are very common & *coniferae* as The Waiden has a very remarkable flora, many *Cycadites*, *Zamites*, *Zamiostroides*? & *Clathrelia*
Lycopodium an *episetum*

Age III Angiosperms, mono- & di-Cotyledonous.
The Cretaceous flora though unknown in Britain

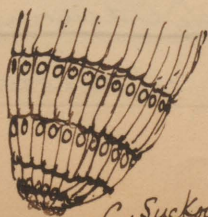
is rich, & Characterised by monocotyledonous
 Angiosperms. The Tertiary formations on the
 contrary abound in dicotyledonous. The Miocene
 is only known in two spots in England Britain, partly
 aside the Hempsted beds, which though they hold a
 flora similar to the Miocene, must not on that
 ground be correlated with it. Most of the wood in
 the Miocene deposits of Bovey Trace is Coniferous.

Equisetaceæ

Calamites. Very common in the Carboniferous. Bark
 very thin. Stem reed like, jointed, furrowed longitudinally
Articulations studded with tubercles, which are
 mostly in the centres of the ridges. Leaves whorled &
 encircling the stem. Surface corticated which is not
 the case in Equisetum. Centre of stem cellular, surrounded
 by a ligneous sheath, hollow, probably a pith.
 Scars almost always elevated.



Type C. cystii. & C. Suckowii ~~Wii~~, about 25 species incl.
C. Lindleyi. C. approximatus.



C. Suckowii.

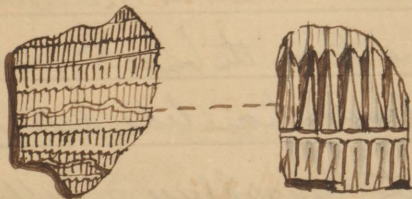
Equisetum or Clathraria. From the Wealden. Stem cylindrical & articulated, but joints very long. Articulations unbraced by regularly dentated sheaths. Leaves verticillate & linear. Equisetum Lyell type & only known species.

Σ

Equisetites 14 or 15 species in the oolite of Yorkshire, the coal bands of which were most likely produced by these plants. They were often fossilized in an erect position, & were 20 or 30 feet high, & 12 or 14 inches in diameter.

Surface of stem smooth. No cortical covering. No dentulations on sheath. Fructification unknown.

Type Σ. Columnaris, from the Superior oolite. E. tetralis comes from a Yorkshire bed doubtfully correlated with the great-oolite. E. Buchardii from the Wealden. E. Brodiei from the Lias. doubtful.



4 Σ. Columnaris

Asterophyllites. Stem articulated branching, rarely
ever tumid, Branches always opposite.



Pinnules numerous, verticillate, linear, acute,
& equal lengthed; placed around articulations.
Single median rib. Bases of whorls slightly united.



Inflorescence in ear like receptacles on the extremities
of, or sessile on branches. Show nothing but linear
structure. Asterophyllites are said to be ~~disseminated~~

They may be the foliage of Calamites or Calamodendron
but probably were more nearly allied to the ferns.

They are all Carboniferous.

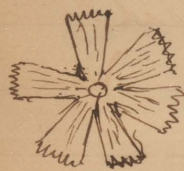
A. Fortalis. A. longifolia. A. Equisetiformis.



Sphenophyllum Stem branching from articulations.

Pinnules verticillate from 6 to 12. Wedge shaped.

Truncated at top, & serrated, bilobate, denticulate or
furcate. Nerves ascend from the base & fork equally.



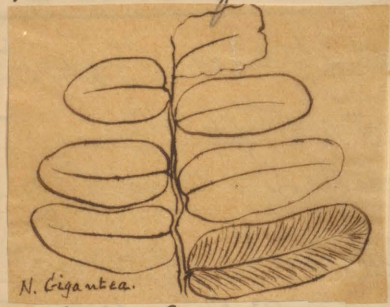
Stem furrowed. Reproduction like Asterophyllites

Not improbably allied to the Marallaceae or Pepper-worts.

S. Dentatum. S. Schlottheimi. S. Fimbriatum.

Filices

Neuropteris. Doubtless a true fern. Frond bipinnate, or tri-pinnate. Pinnules usually cordate, or cordiform. Always entire. Broadly ovate or round. Sides of pinnules never adhere, always joined to stem by nerve, which is sometimes elongated to a sturd pedicle. Midrib vanishes about middle of leaf, & subdivides to a number of small veins. Nerves oblique, curved, delicate themselves dichotomous. Sometimes flabellate at base. Fructification by sori. Sori lanceolate covered with indusium arising from the veins. N. Accuminata. N. Gigantea. N. Loshii. N. Rotundifolia. N. Macrophylla. about 30 species in all.



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N. Gigantea.



474.

N. Loshii.

Cyrtopteris. Common cool & superior solite fern. Frond simple & entire. Somewhat kidney shaped & orbicular. Sometimes slightly lobed, or denticulate. Veins numerous radiating from the base. Dichotomous at extremity of nervules. equal?



C. Digitata.

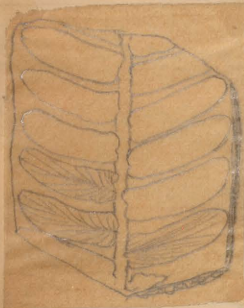
No midrib. Fructification marginal. Found all over world. About 8 Carboniferous species as C. Reniformis. C. orbicularis. C. Trichomanoides. oblong as C. Bearii. C. Digitata.



C. Bearii

474.

Otopteris. Frond pinnated. Pinnules originate obliquely from stem. Auricled. Attached by leaf their bases. No trace of midrib. Veins very close & nearly parallel from point of origin. Bifurcate at ends. Lower Leaves O. obtusa. Superior oblite. O. acuminata. O. lanceolata.



O. obtusa.

Pecopteris. Frond once, twice, or thrice pinnated. pinnules adherent by whole base to rachis. Usually confluent. Midrib runs to apex of pinnule. Veins sometimes oblique midrib. Simple or forking. Fructification at extremities of veins. double ranked. One of most widely distributed ferns. 30 Carboniferous. 28 oblite species. Carboniferous P. Searlii. P. Loshii. P. Hiltonii. P. Cristii. Inf. oblite P. acutifolium. P. denticulata



P. Searlii

Alethropteris. Sub genera of Pecopteris. Ligulate or strap
shaped pinnae. Veins always at right angles to midrib.



Carboniferous A. Louchitidis. A. Sternbergia.
A. Trophyllia, Walden. A. Elephas.

Sphenopteris. Abundant in the Coal measures where
30 species. 13 or 14 in the Upper White & Walden.

Frons, bi- or tri-pinnatifid. Pinnules wedge
shaped. Narrowed at base. deeply lobed. not
adherent to rachis. Lower lobes largest. Frons
palmate & divergent. Veins radiate from base,
the primary go direct to the margin, the Secondary
fork once or twice. Somewhat flexuose.

Carboniferous. S. Elephas. S. Latifolia. S. Linearis.
S. Cuneata. S. Affinis. Upper White? S. Crenulata
S. denticulata. Walden S. Mantelin. S. Phillipsoia.



S. Latifolia



S. Linearis.

Lycopodiaceæ

Sigillaria. Large tree like, sometimes 5 feet in diameter & 60 feet long, tapering gradually towards the top. Surface fluted, by deep longitudinal parallel ribs. (In some species smooth)

Leaf scars regularly disposed in rows, between the furrows. Not distinctly spirally arranged?

Cicatrices disciform, oblong or round, mostly angular sides. Upper part emarginate, or toothed.

In the middle small scars, usually in threes, sometimes in pairs, marking the exit of vessels.

Stem no side branches. Dichotomous at apex.

Bark hard & durable. Internal structure allied to cycadæ. The most important plant in the coal.

S. Ulyan. S. mammularis. S. Renjarnis.

S. Tessellata. Sigillaria has been called at

various times. Reticulolepis. Alveolaria.

Favularia. Catinaria.



S. Tessellata.

Stigmalaria. The root of Sipillaria. cylindrical, but
 having a depression on the under side. Surface
 covered with numerous pits or areolae, disposed in
 quinquefedral order. Markings oval or circular,
 with a small elevation or tubercle in the centre.
 From these markings long strap like, originally hollow
 rootlets proceed. Axis or core cylindrical,
 extends through stem like medullary column. Not
 central, but on lower side over the inferior groove.
 Divided into wedge shaped bundles, bounded at
 their inner edges, by the emission of numerous
 medullary rays. Sometimes 8 inches in diameter
 (whole root) The woody axis is peculiarly marked, with
 narrow interrupted ridges, showing where medullary sheaths
 were given off. S. Ficoides. S. Melocactoides.
 S. Minusumum.



S. Ficoides.

Psilophyton. branches dichotomously. Surface of branches
 covered with interrupted ridges, caused by closely
 appressed minute leaves. Stem spring vertically
 from a

Rhizome. Rhizome covered with peculiar circular areoles, & irregularly dotted with minute punctations. areoles same of rootlets. The punctations probably remains of rammenta. The axis of the stem shows distinct scalariform vessels, & is surrounded by parenchymatous cells. An outer cylinder composed of elongated woody cells.

Strong affinity with Lycopodiaceae. From upper O.S. of Scotland. Very common in American Devonian.

Cordaites Stem erect, ringed by the persistent bases of leaves. Axis of scalariform vessels. Leaves simple, half embracing the stem, long, linear, somewhat obovate. 1 1/2 inches broad. Veins parallel very fine, equal. never forking. Lowest Carboniferous. Only last year found in Carboniferous of Fifehire, though in large quantities in America. American species. C. Robbi. C. Bresipolia. C. Simplex.



Knorria. is a common plant in the Coal measures but is not well understood. Stem large, tree-like branched, not furrowed. Very strong projecting scars of petioles placed acutely spirally. Long strap shaped, densely crowded leaves. Upper end of scar always blunt. Three species are known in Britain.
K. Imbricata. K. Seloni K. Talina.



Halonia. Stem somewhat like Lepidodendron, but has nodes & is not furrowed, but covered with indistinct rhomboidal marks. Tuberos projections arranged quinquangulately. L. B. may supposed to be the root of Lepidodendron.
H. gracilis. H. disticha. H. tuberculosa.
Very abundant in mid England & Scotland.



Brit. Mus.

Lepidodendron. Stem cylindrical, branches dichotomously. Covered at extremities with simple linear leaves. Surface always covered with

impressions of bases of leaves. They are elevated rhomboidal ^{or oval} areoles, arranged spirally & always longer than broad. Acute at both ends. Impression marked in upper part with a transverse scar, triangular, rhomboidal, or deltoid. In the centre of the scar are three points. From the horizontal edges of the scar two ridges descend. Below the scar are two oval diverging hollows, & above it usually ~~is~~ a triangular spot called the crown.



Variations in the form of scar give several subgenera *Saxinaria*, *Haspidinaria*, *Burpria*. Differs much from *Sigillaria* in internal structure. Has no woody cylinder or medullary rays. But an eccentric vascular zone, filled with cellular tissue, & surrounded by vessels from which fasciculae of fibres go to the petioles.

L. Elephas. *L. Sternbergii*. *L. Searli*. *L. Selaginoides*

Lepidostrobus. the Cone or fruit of Lepidodendron.

Is a cylindrical strobilus. Imbricated from above downwards; & composed of winged scales. Their proximal extremities terminating at a single, deeply fitted rhomboidal axis, which is hollow. The distal ends of the scales terminate in linear, lanceolate bractae. The cones are rounded at both ends & from 2 to 7 inches long. Spores single rowed, in a cavity extending nearly the whole length of each scale.

L. ornatus. L. Variabilis. L. Pinaster.



Flemingites. Each scale supports a double series of rounded sporangia. In F. Galilis, the only species well known, the cone is cylindrical, rounded at top tapering at base. The axis is solid covered with numerous imbricating scales, about two in a whorl. Apex of each scale long & slender sporangia have three distinct ribs of attachment.

Wolodendron Stem covered with rhomboidal
 areolae, usually broader than long. Never known
 to branch. Never furrowed. Scars few placed
 in vertical rows. Each scar appears to be composed
 of a series of broad cuneate scales, or scale like
 lodges. Very probably mark the places of sessile
 cones. E. Alleni. E. Major. E. Pinus.
 E. Comberi.



Cycadae. Have the aspect of the modern Zamia, but
 differ especially in fructification. Internal
 structure of stem like conifers. A central
 medullary column, surrounded by a lignous
 cylinder, traversed by medullary rays. Thick
 cellular tegument, or investment. (False bark).
 formed of persistent scales, the bases of petioles.
 Leaf always strong midrib (none in Zamia.)
 from which parallel veins go ^{directly} ~~right~~ to margin.
 No true cycas is found in the Coal. They abound
 however from the New Red Sandstone to the present
 day.

Fittoria. Syn. Clathralia. Trunk short, woody axis very slender. Enlarging upwards. Scales, the bases of petaloid leaves, very large imbricated. Oblong with acutely rounded apices. Petioles loosely shaped at point of attachment to stem, being very concave shape. Contracted at the base. Cicatrices loosely shaped. At distal ends of bracts marks of vascular bundles. Confined to the Walden? F. Squamata.



Bennetites. Trunk ovoid. Elliptical in section. Covered with long permanent bases of petioles. Medulla almost entirely cellular & contains many gum canals. Surrounded by an uninterupted cylinder of woody matter. Fruit borne on secondary axes, not protruding much beyond bases of petioles. Bennetites is made up of three old genera. Bucklandia Zanites. & Cycadites. B. Portlandicus & B. Puchianus from the Portland beds. B. Sabbianus Walden & L. Greensand. B. Maximus. L. Greensand.

Williamsonia. Stem elliptical in outline, marked with equal, tumid, rhomboidal scars.

Leaves ovate or linear lanceolate. Segments very numerous. Small pectiniferous. Veins strong, numerous, parallel, save a slight divergence at the base. Flowers terminal.

W. figas. Leaves large lanceolate, much attenuated at base. Numerous segments. Closely approximate but do not touch. Sub-furcate at apex. Veins simple parallel. The commonest plant on the Yorkshire oolite.

Williamsonia includes 3 old genera. Lamella. Pterophyllum. Palaeozamia.

W. figas. W. lanceolata. W. Pecten. W. Hastula.



Mantelia. Syn. Cycadites. Echinoctipes. Cycadiidea.

Stems sometimes 2 feet high & 3 across. Subcylindrical covered with closely appressed rhomboidal scales. scars?

for the attachment of the leaves. Widest transversely
Medulla perfectly cellular, with waxy green canals.
 Surrounded by woody cylinder striated at right angles
 to axis. Fruit borne as before on secondary axes.
 Very abundant. Differs from Bennettites by more
 elongated petiole impressions, & longer secondary axes.
Petioles covered with denseramenta.

M. Nidiformis. Trunk cylindrical. petioles
 large, lozenge shaped, 1 to 2 inches broad. Meshes in
 woody cylinder small & scattered, numerous
 secondary branches.

Portland beds. M. microphyllia. M. Nidiformis.



M. nidiformis.



M. nidiformis.

Endogenites. An endogenous tree of unknown species.
Stem from 1 to 8 inches in diameter & sometimes 6
 feet long. Tapered in the middle, tapered toward
 both ends. Surface covered with peculiar
 channels giving an eroded appearance. Arranged
 longitudinally. Always silicified. Bark usually
 well preserved. E. Erosa only known species, from
 Wealden.

Araucarites . may be a coniferous plant.

Stem covered with acuminate scales. Scales taper towards base, imbricating, strongly ribbed or lined. Fruit not known.

Range from N.R. Sandstone to Chalk.

Lias. A. Peregrinus. Stousfield slate
A. Bradii. One species in chalk.

#

Lycopodites. Branches pinnated. Leaves inserted all round stem. Strap shaped. Curve upwards. Never leave well defined scars. Midrib & distinctly marked veins. Common in the Duf of Yorkshire. One in Chalk Marl.



Aroides. The only fossil aroid in Britain. Core has been hollow. Externally cylindrical portion composed of subquadrate, peltate, plates, with ^{margin} arranged in linear series round the core. Each plate closed, a short hexagonal tube.

Stousfield slate. Aroides stattersii only known species.

Plants.

T. Sil. U. Sil. Devon. Carb. Perm. Lias. Lias. T. Oo. M. Oo. U. Oo. Proter. Wealden. T. Jura. Sant. U. Green. L. Chalk U. Chalk Co. Aus. Plis.

Equisetum

- Calamites.
- Equisetum.
- Equisetites.
- Asterophyllites
- Sphenophyllum.

Filices

- Neuropteris.
- Cyclopteris
- opteris.
- Pleopteris.
- aliopteris
- Sphenopteris.

Lycopodium

- lyellaria.
- Stymaria.
- Psyllophyton.
- Conditio.
- Knarria.
- Halonia.
- Lepidodendron.
- Lepidostrobus
- Elmington.
- Wolodendron

Cycadae

- Fittonia.
- Bennettites.
- Williamsonia.
- Mantillia.
- Endospites.
- Araucarites.
- Lycopodites.
- Aroides.

	T. Sil.	U. Sil.	Devon.	Carb.	Perm.	Lias.	Lias.	T. Oo.	M. Oo.	U. Oo.	Proter.	Wealden.	T. Jura.	Sant.	U. Green.	L. Chalk	U. Chalk	Co.	Aus.	Plis.	
Calamites.				X																	
Equisetum.												X									
Equisetites.						X?	X	X	X	X	X	X									
Asterophyllites				X																	
Sphenophyllum.				X																	
Neuropteris.				X	X	X	X	X													
Cyclopteris				X	X	X	X	X													
opteris.						X	X	X													
Pleopteris.				X	X	X	X	X	X	X		X	X								
aliopteris				X	X	X	X	X	X	X		X	X								
Sphenopteris.				X	X	X	X	X	X	X		X	X								
lyellaria.				X																	
Stymaria.				X																	
Psyllophyton.			X																		
Conditio.				X																	
Knarria.				X																	
Halonia.				X																	
Lepidodendron.				X																	
Lepidostrobus				X																	
Elmington.				X																	
Wolodendron				X																	
Fittonia.												X	X	X	X	X					
Bennettites.											X	X	X	X							
Williamsonia.								X													
Mantillia.										X	X										
Endospites.												X									
Araucarites.						X	X	X	X	X	X	X	X	X	X	X	X	X			
Lycopodites.								X	X	X	X	X	X	X	X	X	X				
Aroides.								X													

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Stoussfield slate. *Aroides stuterdii* only known spec.

Brachiopoda

Brachiopoda. Pallio-branchiata of Blainville.

Bivalve molluscs. Always equal sided, never quite equivalve. The valves are dorsal & ventral. The ventral valve is usually largest, & has a beak, by which it is attached, or through which the organ of adhesion passes. Dorsal or smaller valve always free & imperforate. Valves articulated by two curved teeth, developed from margin of ventral valve, & passing into sockets in the other. Hinge so complete that the valves cannot be opened without injury. A few genera, Lingula, Obolus, Crania, Calceola. have no hinge. Thus Deshayes divides the brachiopoda into two great groups, having articulated & non articulated valves. The articulated are opened by muscles acting on the cardinal processes of the dorsal valve. In the non articulated the pressure of the fluid in the perivisceral cavity. The arrangement of the muscles in the two groups are very different. The unarticulated group possess no anal aperture.

The shell is composed of numerous flattened prisms, arranged parallel to each other, & obliquely to the surface of the shell. The surface of which is imbricated by their outcrop.

Vertical canals pass through the shell at regular intervals, lined with caecal prolongations of the mantle. The spines of the productidae, are prolongations of these.

Family Zerebratulidae. Shell. Minutely punctate usually round or oval. Smooth or striated. Ventral valve with a prominent beak, & two curved hinge teeth. Dorsal valve with depressed umbo. A prominent cardinal process between the dental sockets, & a slender shelly loop. (Scleridium rudimentary).

Zerebratula.

Shell, oval longitudinally or transversely, smooth or fluted. Valves convex. Margin even or uneven. Hinge line curved.

Beak, short, truncated, perforated with circular foramen

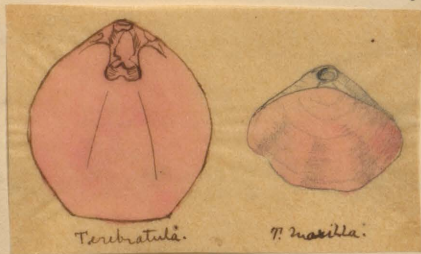
which is partly emarginated by a deltidium.

Deltidium, of two pieces frequently blended

Loop, very short, confined to about posterior third of shell. Simply attached to hinge plate. No internal Septum on dorsal Valve.

No true terebatulata found in Silurian. Very important from Devonian to present day.

Typical species. Devonian. T. Virgo. Carboniferous. T. hastata
T. Saccula. Permian T. elongata. Trias. T. Edwardii
T. punctata. Jur. White. T. simplex. T. maculata.
T. plicata. T. Cardium. L. Greensand. T. bella
T. Altica. W. Greensand. T. biflicata (obesa)
Chalk. T. Carnea. Cray T. grandis. London Clay. T. Beina^{ata}



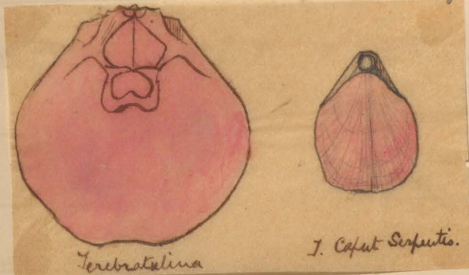
Terebratulina.

Shell longer than broad. oval, usually strongly ribbed. Striated or costellated transversely. Dorsal Valve flatter than Ventral.

beak obliquely truncated.

deltidium. usually rudimental.

Coop. short, annular in adult
L. Clalk. J. Striatata. J. gracilis. Clalk J. Striata.
 Now alive. J. Cepus-Serpentis & a few others.



Terebratula

Shell smooth or radially fluted. dorsal valve longitudinally impressed? Oval longitudinally or transversely.

hinge straight, or nearly.

beak. Truncated obliquely, foramen large, circular or oval. partly margined & deltidium.

deltidium, in two pieces incomplete.

Coop., elongated. 3 parts of length of shell. attached to hinge plate, & also to median septum.

L. pensand. J. Menardi. U. pensand J. Pectita.

Pl. 00. Hemispherica.



Terebrarostra

Shell, more or less oval. finely fluted. cardinal processes very prominent.

beak, considerably elongated, curved, with narrow
circular apical foramen.

Altidium, long, narrow, flat, with pleurae?
Apical setae in smaller valve.

Loop. Short, annular in adult

L. Chalk. *T. striatata*. *T. gracilis*. Chalk *T. striata*.

Now alive. *T. Cephal-Serpentis* & a few others.



Thecidium. Shell small, thick, punctate, attached by the beak.
of Ventral valve. Hinge area flat. Small indistinct pseudo-deltoid
Dorsal valve, rounded, depressed. Interior with a broad
thickened granulated margin. Cardinal process prominent.

Ventral Valve, hinge teeth prominent. Two large smooth impressions
of Cardinal muscles. Curva & loops usually well shown.

St-Cassian beds, Lias, Infoolite & L. Chalk. Very common in Lias
oolite. Lias *T. Buchardii*. Infoolite *T. triangularis*. L. Chalk *T. Westervillei*.



Rensselaria. Shell inequivalve. ovoid (sometimes elongated) or
suborbicular. No mesial fold. Beak prominent acute, more or
less incurved. Foramen terminal, round, sometimes concealed
Shell punctate. Radially marked. — Quite peculiar to the
Devonian. Very common in America. On the Rhine & in some
parts of English Devonian *R. stripiceps*.

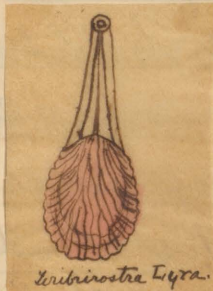


R. ovoides.

beak, considerably elongated, curved, with narrow circular apical foramen.

deltidium, long, narrow, flat, with false area?
Mesial septum in smaller valve.

U. Pensand & J. Lyra.



Majas.

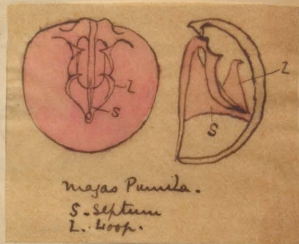
Shell. Small, smooth, conspicuously punctate.

beak. Slightly truncated, with angular foramen.

deltidium, rudimentary.

Loop. Longitudinal septum prominent. Reflected portions of loop disunited. Forming two calcareous lamellae on each side of septum.

U. Pensand. Chalk & Pumila



Argiope.

Shell, minute, transversely oblong, or semioval.

Semiorbicular, variously costated. Hinge-line straight.

beak. Produced, foramen large. large triangular area.

deltidium, rudimentary.

loop. 2 or 4 lobed, adhering to sub-marginal septa.

oolite. U. Pensand, Chalk. ? Tertiary
a Mytrea. & living.

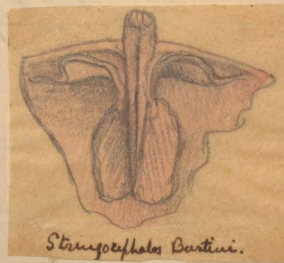
Stringocephalus.

Shell. Transversely oval, punctate. (smooth lth)

beak. prominent, with large angular foramen in the young shell, gradually surrounded by the deltidium & rendered smaller oval in the adult.

deltidium. composed of three pieces.

Great mesial, longitudinal septum in ventral Valve, extends from posterior, to front of shell. Very thick at posterior part. Cardinal process very prominent, extremity piked. Teeth prominent. Confined to Devonian, very abundant in mid Devonian S. Burtini. S. Giganteus.



Family Spiriferidae

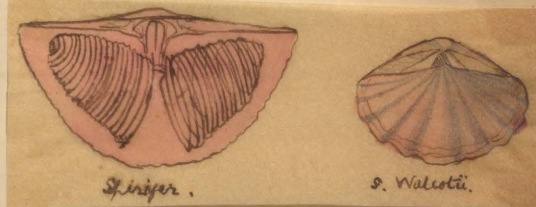
Shell furnished internally with two calcareous spiral processes, directed outward towards the sides of the shell. Valves articulated with teeth & sockets.

Spirifera

shell. bicover, trilobed. median dorsal ridge & ventral furrow. Usually radiating rounded ribs. Wide straight hinge line, which may be of equal length, with the

height of the shell - Cardinal angles obtusely rounded
 sometimes wing shaped. Beak straight or recurved
Hinge area in ^{Ventral} dorsal valve. large, or narrow. Area of
 dorsal valve small linear. Foramen angular, open
 in the young afterwards progressively closed.

Spiris, conical directed outwards, nearly fill shell, crura
 united by oral loop. L. Silurian to End of Lias.
S. Plicatella. U. Silurian. — U. Silurian. S. Crispa.
S. Elevata. Devonian. S. Disjuncta. S. Historica.
S. Levicosta. Carboniferous limestone. S. Cuspidata. S. distans.
S. Glabra. S. Fungis. S. Striata.
Permian. S. Alatus. S. Cristatus.
Lias. S. Innumeri. S. Rostratus.
S. Walcotii.



Cyrtia (Cyrtia)

Shell, trigonal, valves very convex. In ventral, two contiguous
 vertical septa, which coalesce in one plate & so nearly to edge
 of shell. Mesial fold on dorsal valve. Hinge line long
 as width of shell.

straight or very slightly recurved. Area very large, &
 equiangular, triangular.

fissure covered by pseudo-deltidium, seems to have been in an
 line. Porphyreted near beak & small round foramen.

Devonian to Lias. Carb. C. Septosa.

Carbonif. P. t.



Zonitoid shaped

Athyris. Shell usually smooth, convex. Transversely oval or sub-orbicular. Sometimes developed into wing like expansions. With or without median fold. Beak usually overlies umbos of smaller valve, with round foramen. (Imperforate. etc.) Hinge line curved. area of deltidium obsolete. No defined beak ridges.

U. Silurian to Permian. etc. Silurian to Liass. Wood.

U. Silurian. A. Compressa. Devonian. A. oblonga. Carboniferous

A. Ambigua. A. Rozeii.



Retzia. Shell ^{*rhynchonella*} functate. Zonitoid shaped. Beak truncated by round foramen, rendered complete by a distinct deltidium. Hinge area small triangular, sharply defined. Interior with diverging shelly spires.

U. Silurian to Carbonif. etc. Silurian to Trias Wood

U. Sil: R. Salterii. Carb. Limestone. R. Terreta?



Retzia serpentina.

Urcites. Shell, oval, valves nearly equally convex. Beak very long incurved. Truncated in young specimens & small apical foramen. Deltidium large, deeply concave. partly surrounds foramen. Umbony Socket Valve considerably incurved, & concealed & Ventral Valve. Spiral processes directed outwards, no hinge area. Devonian. U. Gryphæ.



Family Rhynchonellidae. Shell impunctate. oblong or trigonal, beaked. Hinge line curved, no area. Valves articulated convex, often sharply flatted. Foramen beneath the beak, usually completed & a ~~foramen~~ deltidium. Sometimes concealed. Hinge teeth supported & dental plates. Hinge plate deeply divided, supporting oral lamellae. Rarely provided with spiral processes.

Rhynchonella. Shell trigonal, sometimes transversely or longitudinally prolonged. Valves unequal & convex. With or without mesial fold. Ventral Valve flattened. Beak prominent, acute, entire, Foramen in

young an angular notch, in hinge line of Ventral Valve. Placed below the beak. In adult deltidium usually renders it complete. Deltidium in two pieces.
 L. Silurian to Present day. U. Sil: R. borealis.
 U. Sil: R. Cumata. U. Sil: only Stricklandi. Dev: R. Laticosta
 Dev: & Carb: R. Pleurodon. Carb: R. Accuminata. R. Papyrus.



R. Acuta. — Lias. R. Remisa
 R. Tetradra. Inf: oo: R. Plicatilla.
~~Stony Plate~~. Kim: Clay. R. Lucostana
 R. Greensand. R. Depressa. Chalk & U.
 Greensand. R. Laterna. Chalk R. octoplicata
 Cray & Living Pittacea.

Atrypa. Shell impunctate, oval or nearly circular. Usually variously fluted & ornamented with squamose lines of growth. Dorsal Valve gibbose. Ventral depressed in front. Beak small, often closely incurved. Truncated by very small round pramen. Sometimes completed by small deltidium. Often concealed. Two broad spiral lamellae, vertical, closely appressed & directed towards centre of Valve.

L. Silurian to Devonian & the Carboniferous Atrypa reticularis (the only shell common to the U. Sil. Dev. & Carbonif.?)

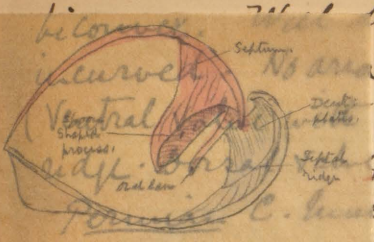
U. Sil: A. Disjuncta. A. Lemispherica.

Sil: & Dev: A. Reticularis.

U. Sil: A. Grayi.



Camarophoria. (Sub-gen. of Rhynchonella.) Shell sub-triangular impunctate
 bilobed, sinus & mesial fold. Beak acute entire
 No area no deltidium. Fissure ~~below~~ beneath beak, angular.
 converging dental plates, supported on a low septal
 prominent septum supporting a spoon-shaped central process.
C. multiplicata. C. Schlotheimi.



Pentamerus. Shell impunctate, ovate, ventricose. Ventral valve most
 or may not have mesial fold. Beak large
 acute, incurved. Conchals an angular foramen.
 dorsal valve two contiguous, longitudinal.
 of ventral septum & enclosing a chamber.
 (characteristic of L. Landover). U. Silurian:
 of Ansty, Limestone.) Devonian? Brevirostris



Carboniferous? P. Carbonarius.

Family orthidæ. Shell transversely oblong, depressed, rarely
 foraminated. Hinge line wide & straight. Beaks
 inconspicuous. Valves plano-convex, or concavo-convex.
 Each with hinge area notched in the centre. Ventral
 valve with prominent teeth.

Orthis. Shell transversely oblong, sub-obicular. May
 or may not have sinus. Hinge line straight, usually
 shorter than width of shell. Area below L both
 valves, divided by an open fissure? Somewhat triangular?
Beaks of both valves more or less incurved, ventral
 being most produced. Surface usually striated by

young an angular notch, in hinge line
 Valve. Placed below the beak. In adult
 usually renders it complete. Deltidium
 L. Silurian to Present day. U.S. Sil:

U. Sil: R. Cumata. U. Sil: only Stricklandi. Dev: R. ...
 Dev: & Carb: R. pleurodon. Carb



R.

R.

St

L.

Queensland. R. Latona. Chalk. R. octoplicata
 Cray & Living Pittacea.

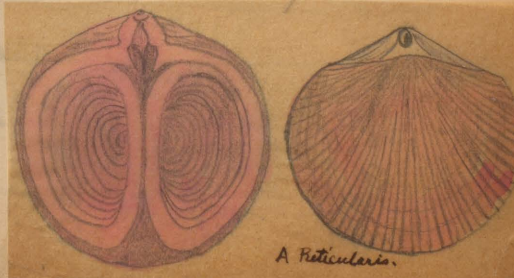
Atrypa. Shell impunctate, oval or nearly circular. Usually
 variously fluted & ornamented with squamose lines
 of growth. Dorsal Valve gibbous. Ventral depressed
 in front. Beak small, often closely incurved
 truncated & very small round prawn. Sometimes
 completed by small deltidium. often concealed.
 Two broad spiral lamellae, vertical, closely appressed
 & directed towards centre of Valve.

L. Silurian to Devonian & the Carboniferous Atrypa reticularis
 (the only shell common to the U. Sil. Dev. & Carbonif.?)

U. Sil: A. distincta. A. hemispherica.

Sil: & Dev: A. reticularis.

U. Sil: A. grayi.



Camorophoria. (Sub-gen. of Rhynchonella.) Shell sub-triangular imbricate
biconvex. Well defined sinus & mesial fold. Beak acute entire
incurved. No area nor deltidium. ~~Subarea~~ ^{Fissure} beneath beak, angular.
(Ventral valve with converging dental plates, supported on a low septal
ridge. Dorsal valve prominent septum supporting a spoon shaped central process.)
Permian C. multiplicata. C. Schlottheimi.

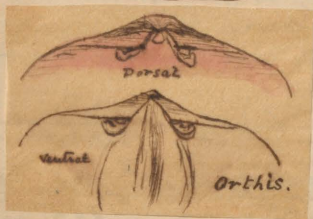
Pentamerus. Shell imbricate. ovate. Ventricose. Ventral valve most
convex. Usually plicated, may or may not have mesial fold. Beak large
acute, much incurved entire. Conceals an angular foramen.
No area or deltidium. In dorsal valve two contiguous, longitudinal
septa, meeting trough like top of ventral septum & enclosing a chamber.
L. Silurian P. oblongus. (Characteristic of L. Llandovery). U. Silurian.
P. linguifer. P. Knightii. (Char. of Annsby Limestone) Devonian P. Brewinostis
Carbonif P. Carbonarius.

Family orthidae. Shell transversely oblong, depressed, rarely
foraminated. Hinge line wide & straight. Beaks
inconspicuous. Valves plano-convex, or concavo-convex.
Each with hinge area notched in the centre. Ventral
valve with prominent teeth.

Orthis. Shell transversely oblong, sub-obicular. May
or may not have sinus. Hinge line straight. usually
shorter than width of shell. Area belongs to both
valves, divided by an open fissure? Somewhat triangular.
Beaks of both valves more or less incurved, ventral
being most produced. Surface usually striated, by

Simple or bifurcating ribs. usually minutely punctate.

L. Silurian to Carboniferous. Sil: *O. Calliprumba*.



L. Sil. *O. grandis*. L. Sil.: *O. Sactonia*,

Carb.: *O. Resupinata* (~~to~~ *O. Reduli*, *O. Carosii*.)

Carb. lime: *O. Saxon* *meschellina*.

Cambrian. *O. Vatica*.

Strophomena. Shell. Semicircular, widest at the hinge line. Concavo-convex. (Ventral convex) depressed, radiately striated. Area double, edges parallel, inner edges acuminate. Beak usually entire, sometimes small circular foramen in young (Ventral valve with an angular notch progressively closed by convex pseudodeltidium). L. Silurian to U. Carbonif.

L. & U. Silurian. *S. Antiquata*. *S. Eudiffa*. U. & L. Silurian & Devonian. *S. Rhomboidalis*. Carboniferous *S. Rhomboidalis*. Var. Analoga.

(often undulated lines of growth.)



S. Rhomboidalis

Leptaena. Valves regularly curved. Vent dorsal concave.
thickened. Area double sometimes small circular foramen.

Surfaces smooth or striated. (Muscular impressions elongated)

U & L. Silurian. L. Serricia, L. Transversalis.

Devonian. L. Laticosta. L. Silurian L. Quinqucosta.

Lias. L. Bouhardii. & L. Liassiana.



Davidsonia. Shell. Solid. Always attached to outer
Surface of Ventral Valve. Coels generally —. Valves
plain articulated. Attached valve with wide area
& angular foramen covered by convex deltidium.

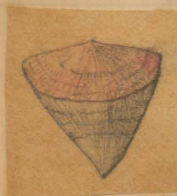
Disc of attached valve occupied by two conical elevations
obscurely grooved by spiral furrows. Indicating
soft spiral arms. Only Devonian. D. Verneuli.

Calceola. Shell thick. Triangular. Valves plain, not articulated.

Ventral pyramidal, area large, flat, triangular, with obscure central
line. Hinge line straight, crenulated. Beak acute bent backwards.

Dorsal valve, flat, operculiform. Semicircular with narrow area.

& slightly elevated septum? Devonian. C. Sandalina

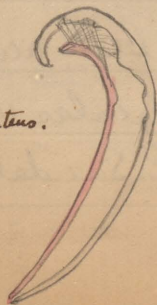


C. Sandalina.

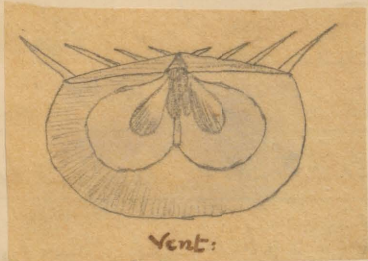
Family Productidae. Concave-convex. Straight
 hinge line. Valves rarely articulated (teeth closely
 appressed). Furnished with tubular spines.
 Ventral valve convex. Dorsal concave. Interior
 dotted with conspicuous funnel-shaped punctures.
 Dorsal valve with a prominent cardinal process.
 Ventral valve with a slightly notched hinge line.

Productus. Shell very variable. Transverse or
 elongated. Lateral angles always auriculate.
Valves. Ventral convex, dorsal concave. Costated
 or striated. sometimes decussated (concentric lines of growth)
Hinge line always straight. Area long, narrow.
 (Cardinal process lobed striated. Ventral valve deep with
 two rounded or sub spiral cavities in front) Spines
 usually numerous, most so on auricular expansions.
Beak large, rounded, incurved. Devonian P. Sabaculites
Carboniferous. P. Cora. P. Giganteus. P. Longispinus.
 P. Pustulosus. P. Lemnoreticulatus. P. Striatus.
Permian (also Carboniferous) P. Horridus.

P. Giganteus.



Chonetes. Shell, compressed. Hinge line straight as long as width of shell. Area double, wide & parallel sided. Valves radiately striated. Articulated. On upper edge of ventral area a row of delicate, tubular, spines. Fissure covered by pseudo-deltidium. U. Silurian Carboniferous. U. Silurian. C. Striatella, C. Lata. C. Lepisma. Devonian & Carboniferous C. Hardreusis? Carboniferous. C. Buchiana. C. Pappilionacea.



Family

Unarticulated Brachiopoda.

Craniadae. Shell orbicular, Calcareous, limyless. Attached by the umbo, or whole breadth of the ventral valve. rarely free. Dorsal valve limpet-like. Anterior of each valve with a broad granulated border. Disc with 4 large muscular impressions (for attachment of 4 adductors common to all non-artic) & digitated vascular impressions structure punctate.

Crania. Shell. surface smooth radially striated (spring with radiating costae or foliaceous expansions etc) Concave or subquadrate, partially or entirely attached to lower valve. Attached valve usually the thickest. Umbo of dorsal valve subcentral. of ventral valve subcentral, marginal, or prominent & Cap. like. Lower Silurian to present day. U. Sil:
C. Craniolaris. St. ophite. C. Antiqua. Chalk. C. Costata.
C. Inequivaleis. C. Zuehrburgensis.



C. Zuehrburgensis



D. Vol I. Pl. II. C. Zuehrburgensis.

Family Discinidae. Shell attached by a pedicle, passing through a pramen in the ventral valve. Values not articulate minutely punctate

Discina. Shell circular or oval in outline, with concentric lines of growth or smooth. Upper valve, limpet-like apex behind the centre. Ventral valve, flat or ^{concave} crucial. Operculiform. Perforated by long oval slit. Radially placed & spring from near the centre to near the edge. Interior polished. L. Silurian to Present day. L. Sil: D. Crassa, D. Forbesii. U. Sil: D. Coninckii. Carb: D. Nitida. Permian D. Laevigata. Lias D. Townsendii. L. present D. Reflexa.



D. Nitida.
D. Vol II. Pl. LXX.

Siphonotreta. Shell oval, bicarinate. Calcareo-corneous. Conspicuously punctate or spiny. Beak straight, perforated by a tubular foramen. no area nor deltidium. The surface often shows numerous lines of growth. The spines are hollow, dilated at the base. Usually quincunc. Silurian. Llandilo S. Uricula.



Family

Lingulidae. Shell oblong or orbicular. Sub-equivalve attached by a pedicle, passing out between the valves. Horny. Minutely tubular.

Lingula. Shell, oblong, or tongue shaped. Compressed. Slightly gaping at each end. Truncated in front rather pointed at the umbones. Surface usually smooth or delicately marked with concentric lines of growth etc. (Dorsal Valve rather shorter, with thickened hinge ~~area~~ ^{margin} & an internal raised central ridge. Wad)

Note. The Primordial lingulae are now called Lingulella. They have a grooved hinge line & two small teeth. L. Silurian & living. L. Sil.: Lingula (Lingulella) Davisii. L. Lemesii. U. Sil.. U. Sil.. L. lata. U. Llando: L. Crumena.

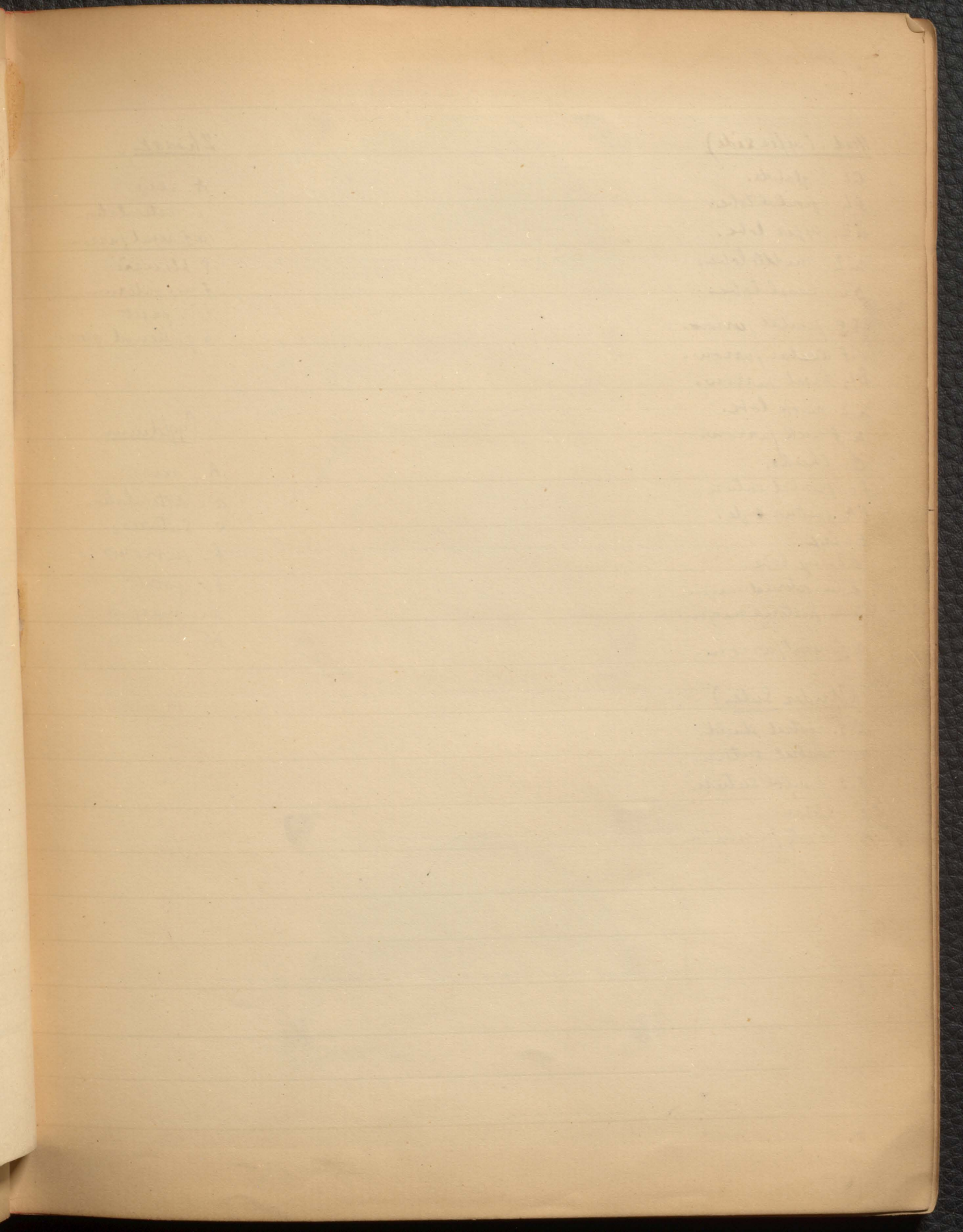


F. F. Lewisii.

Family

Legislation

81.00.10



Trilobita.

Trilobita.

3

		T. Sil.	U. Sil.	Devon.	Carb.					
A						T. Sil.	U. Sil.	Devon.	Carb.	
<u>Phacopidae</u>	Phacops.	x	x	x						
	Trinucleocephalus.			x						
<u>Chonetidae</u>	Chonetes	x	x	x						
	Sphaerocoelus.	x	x							
	Cybele	x								
	Staurocephalus	x								
	Siphon.			x						
	Encrinurus.	x	x							
<u>B.</u>										
<u>Acidaspidae</u>	Acidaspis.	x	x							
<u>Lichada</u>	Lichas.	x	x							
<u>Cyphaopidae</u>	Cyphaopis.	x	x							
<u>Harpedidae</u>	Harpes.	x	x	x						
<u>Calymenidae</u>	Calymene.	x	x							
	Hondondontes	x	x	x						
<u>Conocephalidae</u>	Conocephalus	x								
	Asphina	x								
<u>Olenidae</u>	Olenus.	x								
	Remophleuroides.	x								
	Paradoxides.	x								
	Cyphoniceras	x								
<u>Asaphidae</u>	Asaphus	x								
	Elleanus	x	x							
	Oxygia.	x								
	Asphina.	x								
<u>Brontidae</u>	Brontes	x	x	x						

		T. Sil.	U. Sil.	Devon.	Carb.
<u>Proctidae</u>	Brachyproctus.				x
	Griffithides.			x	x
	Phellipsia			x	x
	Proctus	x	x		
<u>C. Trinucleidae</u>	Ampyx	x			
	Trinucleus	x			
<u>D. Agnostidae</u>	agnostus	x			

A. Phacopini. B. Asaphini. C. Ampycini.
D. Agnostini.

Head. (u)

G2. qd

fL. fo

u2. up

m2. m

d2. Le

f.5. fo

o.f. oca

bj. bas

n.2. m

m.f. m

C. che

f.s. fo

P.A. pas

E. Cyb

c.2. cy

e.m. c

p.m. fo

o.f. all

(Und)

R.S. no

rs. nos

f.S. fo

L. lat

C. car

qH

Trilobita.

Trilobites are divisible into 4 great groups. According to the position & character of the facial suture, & nature & position of the Eyes

Group A. Trilobites with a facial suture ending on the external margin. Eyes well developed.

Two families are included in this group. Phacopidae & Chernoviidae

Phacopidae.

Phacops. Cephalic shield Semicircular, margin strongly developed, & terminating in posterior angles. Glabella ~~triangular~~ broadest in front. Clavate or club-shaped. Divided into 3 lobes.

Eyes faceted & uniform. Very prominent. Hypostome oblong rounded at ends, with 2 expansions. Thorax 11 somites

(Sometimes 10) Pleurae sub-falcate, & sub-truncate. Faceted.

Facets large triangular. Pygidium. Semicircular, ^{or} pointed.

~~is~~ strongly ribbed. Composed of from 8 to 15 segments. Margin entire or spinose. Mucro long or short. L. Sil.: P. Alipons.

P. Dalmanii. P. ~~caudatus~~. L. M. Sil.: P. Caudatus. P. Downii.

P. Stokesii. Dev.: P. Punctatus. P. Latipons. P. Granulatus.

None found higher than Devonian.



Trimeroccephalus. Compact. Glabella inflated, much expanded in front. Lobes obscure except basal. Eyes small strawberry-like. Pleurae rounded, faceted. Pleural area, wider than axial. Axial segments often tuberculated at edges. Pygidium small & composed of few segments. Thorax composed of 11 somites. Only Devonian. T. Lewis.



T. Lewis.

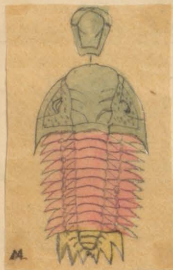
Chiruridae

Chirurus. Head strongly trilobed. Glabella large in front with three lateral lobes. Basal one circumscribed near neck. Eyes faceted. Facial suture ends on exterior edge, (as with all group.) Cheek scrobiculate. Hypostome inflated, oblong, truncated at end, with marginal furrow. Thorax 11 segments. Sculptured. Pleurae

strongly nodular as far as fulcrum. feet 8 jointed.

Pygidium composed of 3 or 4 somites, feet at ends.

L. Sil.: C. Octolobatus. C. Claviporus. U & L. Silurian
Bimucronatus. Dev.: C. Articuletus.



C. Bimucronatus.

Spherexochus. Head very convex, very much inflated.

Glabella very large nearly spheroidal. 3 furrows on each side. Thorax 11 segments, 8 no furrows. parallel

sided. Pygidium 3 segments, palmate. Hypostome sub-trigonal. Eyes very small, placed near glabella, below middle of head, oblong. Convex. minutely faceted.

Cheeks not scorbiculate. Rostral shield not known.

L. Sil.: S. Boops. L & U. Sil. S. Mirus.



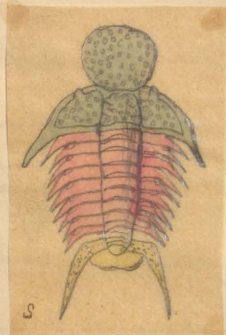
Cybele. Body ovate, tapers rapidly. Head semicircular
Lateral angles form short spines, spreading outward.
Stabella short, clavate, has three segmental furrows.
Neck segment long & smooth, pronounced. Cheeks
 triangular & ~~very~~ flat. Very coarsely tuberculated.
Eyes very small, tubercular, near middle of anterior margin.
Thorax 11 segments. Pleurae strongly divided, nodular, free.
Pygidium triangular, with rounded axis. Double row of
 strong tubercles, many joints. Side lobes vertical 7ab.
L. Sil.: C. Verucosa. C. Rufosa.



C. Verucosa.

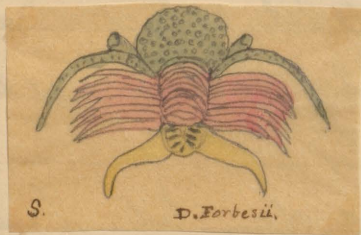
Staurocephalus. Head cruciform. Stabella smaller
 in front to a large spherical lobe. Base
 narrow cylindrical. Three pairs of furrows.
Cheeks very convex, & possess serrated margin.
Eyes pedunculated. Thorax composed of about
 10 segments. No pleural grooves.
Pleurae pointed & thrown backwards (downward etc.)

Pygidium composed of two somites. Axis of segments free.
L. Del. S. Globiceps.



S. Globiceps.

Sciphon. Glabella large, globular. No furrows. Long
spinous fixed cheeks. Eyes prominent but not stalked.
Hypostome narrow. ^{hexagonal} granular or scabrate. No ventral
shield. ~~Lobes~~ ~~hexagonal~~. Thorax 10 segments. Axis very
convex. Pleurae linear with free, curved, spinose ends
nearly at right angles to axis. Pygidium short, about
3 joints. Wenlock & Woolhope. Sciphon Forbesii.



D. Forbesii.

Encrinurus. Body ovate tapers rapidly. Head tuberculated
Glabella clavate, narrower towards base. Lateral angles
form short spines parallel to body. Cheeks triangular,

flattened, very coarsely tuberculated. Posterior margin
very thick & smooth. Thorax 11 segments, end in spine
 processes. In some species spines from axes of 7th & 11th
 somites. Pygidium triangular, many joints. Axes
 rounded, ornamented with a single row of tubercles.
Labrum longitudinal, rounded in front. L. Lib:
E. Sexcostatus. E. Multisegmentatus. L. O. Lib:
E. Punctatus.



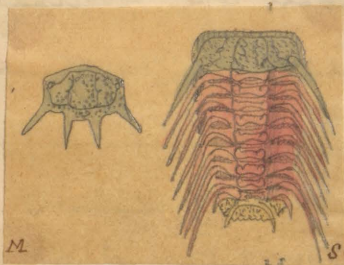
Division B. Trilobites with facial suture ending on
 posterior margin. Eyes moderately developed & smooth.

Acidaspidae ^{or reticulated, not faulted.}

Acidaspis. Head short, broad, & elongated. Truncated
 in front. Glabella broadest at base. Cheeks always
 thickened, generally spinose. Eyes small very convex
 sometimes pedunculated. Nick segment thick.
Thorax 10 segments, narrow axes. Pleurae first 10
 out horizontally then drop suddenly. Pygidium very

(comb like)

Small, only 2 joints. The hinder bearing ^{4 or 6} spines. \wedge
L. Sel: *A. Barrandii*. *A. Quinquispinosus*. *A. Caractici*.
U. Sel: *A. Dana*.



a. Barrandii. *a. Buckii*.

Lichadidae

Lichas. Body flat. Whole surface granulated. Head
 Semicircular. Glabella very large. ^{one} Segmental furrow
 curving inwards & downwards. Neck segment
 broader than base of glabella. Cheeks very small. Eyes
 moderately large. Facial suture cuts margin near spine.
Thorax 10 or 11 segments. On each, sigmoidal or V shaped
 furrows. Pygidium semioval, with undivided axis.
L. Sel: *L. Hebronicus*. U. Sel: *L. Anypicus*.



L. Hebronicus. *L. Anypicus*.

Cyphaspidae.

Cyphaspis. Head tubercular strongly margined. Glabella very convex. large. elongated in front. shorter than head. No transverse lobe. Basal lobe, longitudinal oval deeply divided from base of glabella. Eyes smooth no ocular ridge. Rostral shield very small. Thorax generally about 12 segments (11 to 17) Posterior cornua of cephalic shield thrown out from body. Body tuberculated. Pleurae probably not-faceted. on 6th or 7th segment a spine (long median). Pygidium small. L. Sil. C. Tuberculatus. U. Sil. C. Myalops.



C. Myalops

Harpesidae

Harpes. Head resembles that of Trinucleus, by having three distinct lobes. Surrounded by a horse-shoe shaped fringe, not perforated, but deeply punctate. Thorax about 25-segments (20 to 30). Furrows pass nearly across glabella. Labrum doubtful. L. Silurian to Devonian. L. Sil. H. Sarani. H. Flauvayii. Dev: H. Macrocephalus.



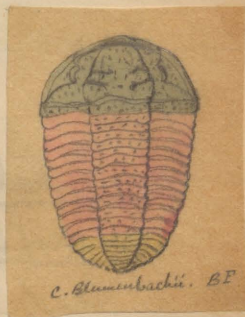


Harpe Ungula

Calymenidae

Calymene. Head semi-orbicular, reflected at anterior margin. Posterior margin obtusely rounded. Glabella narrow in front. Trilobed, basal lobes very large. Cheeks & glabella tuberculated. Eyes in middle of cheeks, uniform, prominent probably faceted. Thorax about 13 segments. Axis very convex. Lateral lobes much wider than axis. Strongly bent down at ends. Facets large. Pygidium narrower than head, semi-oval. Axis broad & prominent. L. Sil.:

C. Brevicapitata. C. Duplicata. C. Obtusa. U. Sil. C. Tuberculata
C. Blumenbachii.

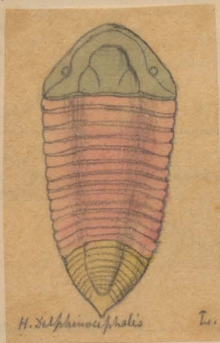


C. Blumenbachii. BF

Hemulonotus. Body elongated, convex. steep at sides. Axis very broad. Structure of shell scabrous. Head semi-elliptical & convex in the middle. Depressed in front. No lateral angles. Glabella indistinct. Sub-quadrate

truncated in front. Sides sometimes concave. Front depressed in centre. Eyes small prominent, reniform. Quite in middle of cheek. Eye line continuous round front of glabella. Thorax 13 segments. Slightly arched, Pleural ^{grooves} sutures deep. Very imperfectly trilobed. Axis double the width of the pleurae. Pleurae strongly faceted. (U. Sil. Sp. usually smooth Devonian generally spinose.)

Pygidium sub-trigonal mucronated. L. Sil.: # Rudis
H. Opiocephalus. U. Sil.: H. Delphinoccephalus. # Knightii.
Dev.: H. Herschelii.



Conocephalidae

Conocephalus. (Synon. Atenocephalus. Conocoryphe.)

Head transverse, wide & broad. Glabella short narrow in front, ending in a rounded point.



Three oblique furrows. Eyes-when visible-reticulated, not faceted. Rostral shield almost always present. Surface of glabella scabicate.

10-15
2-8

Thorassic segments 10 to 15. Alis narrow, Pleurae very broad, nearly vertical. Pygidium cuneate 2 to 8 segments. L. Dil., a primordial type. Tremadoc & Landulis C. Sedgwickii. C. Depressa.



C. Depressa

15
4

Angelina. Body depressed or flat. Head smooth, no furrows nor lobes. Cephalic shield has posterior angles nearly as long as body. Thorax about 15 segments. Pleurae of ^{thorax} segments angular. Pleurae of tail with curious angular notches. Pygidium 4 segments. Eyes small reniform. Labrum emarginate, angular. Tremadoc. A. Sedgwickii.



A. Sedgwickii

Alenidae.

15
3

Alenus, Glabella very large & round. Slightly pointed in front. Furrows scarcely pass across. inclined to axis. Head spines short & strong. Thorax 15 segments. Pygidium very small. 3 segments. Eyes remote, lunate

Connected with glabella by ridge. Cheeks spinous
 no rostral shield. Margin of Cephalic shield reflected.
Labrum oblong. Tremadoc O. Scareoides. O. Cataractes.
L. Sil. O. Humilis. O. Microurus.



O. Microurus L.



M.

O. Cataractes

Remopleurides. Body elongated tapering. Cephalic
shield very globular. Round in front. Posterior angles
 extended outwardly, strong. Glabella quite or nearly
 circular, occupies most of head. Surrounded by kidney-
 bean shaped eyes. Cheeks very small produced to spines.
Hypostome truncated in front. Thorax 11 segments.
 Long spine proceeds from pleurae of 7th on each side.
Pleurae hooked or falcate. Axis very broad. Pygidium
 very small but broad. 2 segments. 4 terminal spines.
Caradoc. R. Dorsospinifer. R. Laterospinifer.



R. Dorsospinifer

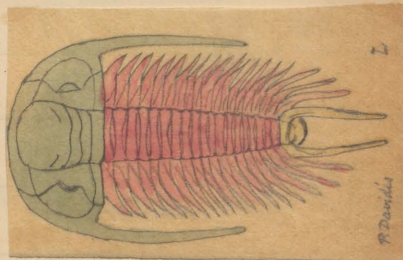
Paradoxides. Body very long. Thorax 17 to 20 segments.

Pleurae all spinose. Glabella club shaped or clavate, very broad in front. Inflated. 3 lower furrows pass across.

posterior angles nearly as long as body. Pygidium very minute. 3 or 4 segments. 2nd upper bears long spines

reflected backwards. Eyes large smooth. Labrum large, truncated in front. Not known above Caradoc.

Lingula flap. P. Davidis. P. Hicksii. P. (Tschamneri doubtful)



Cyphosiscus. Small. Body oval convex. Head very large oval.

Glabella oval, gibbous, no lobes. Encircled by furrow. Cheeks narrow

Thorax 7 segments very convex. Pygidium small, only one segment

Pleurae bent down from fulcrum about half way from axis.

Eyes very minute linear. L. Sil. P. Socialis.



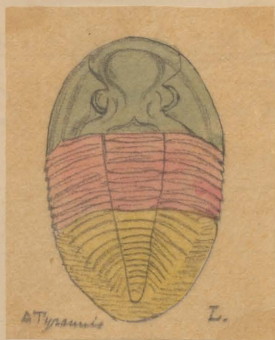
C. Socialis

Asephidae

Asaphus. Large. ^{oval} Slightly convex. Head semicircular smooth.

8 Glabella clavate, & very broad in front. Thorax 8 segments
(ft 10) Axis very broad. Pleurae very strongly faceted & grooved.

12-14 Pygidium large, jointed, longer than head. Parabolic. 12 5/4
segments. Labrum deeply cleft, forked at ends. Eyes prominent
smooth. L. Sil.: A. Gigas. A. Powisii. A. Rectifrons. A. Typanii.



Illoëncus. Head globose (like quarter of a sphere) Glabella indistinct. Eyes remote, lunate. Labrum entire pointed. Thorax

9-10 segments. Axis indistinctly marked much wider than
Pleurae. Pygidium resembles cephalic shield in shape. no segments.

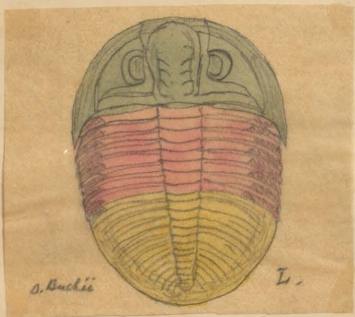
Pleurae not grooved. slightly faceted. Rostrel shield very nearly
straight. Pygidium & head strongly marked with concentric
lines, inside & out. L. Sil.: I. Beamanii. I. Perovialis. I. Holtstockii.

U. Sil.: I. Barriensis.



✓

Ogygia. Body oval, flattened. Head semicircular very wide.
Thorax 8 segments. Axis convex, narrow. Glabella indistinctly
 clavate. 5 furrows (4 usually distinct) Cheeks very large
 continuous beneath front margin. Eyes semicircular uniform
 smooth. Pygidium semi-elliptical, longer than head, with
 narrow distinct axis, composed of 13 distinct segments.
Hypostome entire. Distinctly striated concentrically. Pleurae all
 pointed, very strongly grooved & faceted. Head angles slightly produced.
 closely appressed to body. Surface of shell finely corrugated.
L. Sel.: O. Buchii. O. Portlockii.



Aegina. Body oblong. Head very convex. destitute of posterior angles. Glabella
 large, parabolic in front, very indistinctly lobed. Eyes very large occupy all
cheeks. Thorax 8 segments. Two nodes on axis of 3rd. Pleurae strongly
 grooved. Pygidium, large smooth. No rostral shield. L. Sel. A. minor
A. microbelis. A. Binodosa.



A. Binodosa

Brontidae

Bronteus. Head very large. Glabella depressed ovoid. Very broad in front. Three segmental furrows passing forwards.

10 Thorax 10 segments. Axis narrower than pleural. Eyes granulate. Pygidium fan-shaped Semiarbicular. Strongly ribbed, ribs scarcely going to margin. Flattened. Suture. Axis of one segment. Triangular. L. Sil B. Hebronicus. U. Sil: B. Laticaudata. Dev: Flabellifer.



Proctidae

Brachymetopus Head & body densely tuberculated. Glabella short highly ornamented. Thorax 9 segments. Eyes very large. Pygidium semioval. 17 divisions in axis. Facial suture invisible.

9
17

Carb: B. Uralicus??



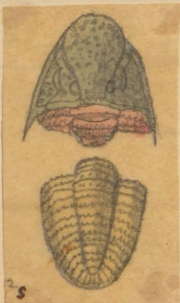
B. Uralicus.

Griffithides. Body elongated. Head semicircular. Stout posterior angles.

9
15

Glabella very large swollen in front. Very narrow at neck. Eyes uniform very smooth. Thorax 9 segments. Pleurae faint

Pygidium semi-oval. Axis & lateral lobes distinct furrows
margin entire. Axis ornamented, pleural very rarely.
15 Segments. Dev: & Carb: Sp Longiceps. Carb: D. Deelyensis.



G. Longiceps.

Phillepsia. Body elongated oval. Generally smooth? Head & Pygidium
equal. Axis well defined, elevated. Slightly tuberculated.
Head semi-elliptical, with pronounced lateral angles. Flabella
sub-cylindrical, 3 furrows. Pair small postero-lateral
lobes. Eyes reniform reticulated. Thorax about 10 segments
broadly faceted. Pygidium semi-oval. 11 to 16 segments on axis
& 5 to 13 on pleurae. Dev: P. Pastulosa. Dev: Carb: P. Brönnigartii.
P. Seminifera.



P. Pastulosa

Proetus oval, not elongated. Very convex. Flabella parabolic.
2 lobes on each side. Segments 8 to 10. Axis strongly defined.

line of junction of pleural & axis very sharp. Pleural
 bent down, faceted, round at points. Pysidium, round
 or parabolic. 4 to 13 segments. Eyes large reticulated.
L. Sil. P. latifrons. U. Sil. P. Stokesii.



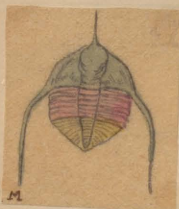
P. Curvati



Group C. Facial suture obscure, or sub-marginal or
 none, eyes often absent.

Amphipoda

Amphip. Cephalic shield not fringed. Low frontal spine &
Very much produced lateral angles. No eyes, nor facial suture
Glabella claviform, rounded in front. Marked on either
 side, by two or three indistinct furrows. Thorax 6 segments
 faintly or strongly marked. Convex, & of width equal to
 base of neck. Pysidium large entire, triangular, deflected
 prominent axis of 9 or more somites. Planorbis.
 A. Mammulatus. A. Nudus. A. Rostratus.

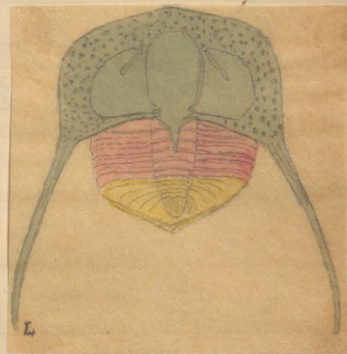


A. Nudus.

Trimucelus. Head in one piece without visible suture.

margin produced L-hollow fringe, perforated. Eyes minute
Sometimes Absent. Hypostome Cornice elongated smooth.

6 Thorax of 6 segments, flat, bent-down at edges. No ornamentation
on axis. Glabella lobes very indistinct. Pygidium rounded
truncated behind. Lancelets. T. ornatus, T. Lloydii.
T. Concentricus.



Group D. No facial suture, nor eyes.

Agostus. Head rotundo-quadrate. Length & breadth about equal.

Cheeks usually narrower than glabella. Glabella rounded,
or pointed in front. Surface minutely roughened. Thorax

2 only 2 segments. Head & Tail alike in shape, but small
tubercle on tail axis. Lingula flaps. A. In Coyii. A. Princeps.
A. Pisiiformis. A. Limbatus.



Branchiopoda
Phyllofoda

Fam. Limnadiidae

Hymenocaris. Carapace very convex. Thin, large, semi-oval. Narrowed towards front. Composed of one piece bent over. No Rostrum. Body Somites 8 or 9. On Tail 6 setae or spines, two outer & two inner of equal length. Intermediate layer. No Eyes. No appendages or antennae known. Lingula Flaps. H. Vermicaudas.



Ceratiocaris. Carapace bivalve, united by a well defined articulated hinge. Rostrum projecting, not soldered to carapace. Valves ovate or semi-oval. Truncated behind, minutely ribbed longitudinally. Wrinkled. Thorax 14 to 15 divisions. Tail three-pronged. Longest spine strongly articulated to the last tail somite. Distinct eye spot. C. Ellipticus. C. Popillio. C. Leptodactylus. C. Murchisoni. U. Ludlow & Caredoc.



Sictyocaris. Carapace very large, entire, bivalve. Somewhat triangular in shape; truncated behind. Marked by a close-set reticulation. Body rings unknown. L. Sil. D. Slimonia. See Carl D. Communis.



Dithyrocaris. Carapace nearly flat, marked by three imbricated ridges. Values soldered together, by median ridge, strongly imbricated. Surface granulated. Rostrum not firmly united. Thorax 2 somites. Tail three praped. Probably 2 eyes. Carl. D. Coleii.



Peltocaris. Carapace flat. Values apparently not articulated. Round or shield shaped. Bivalved. Imperfectly joined along dorsal line & deeply emarginate in front. Notch filled during life by a parabolic plate. Probably analogous to a rostrum. Body rings unknown. Probably 3 somites to tail. Blindillo. P. Peltacoides. P. Harknessia.



Caryocaris. Carapace pod-shaped. bivalve. Distinct hinge
fits. Rounded in front. Sub-truncate behind.
Surface smooth, except oblique wrinkles near margin.
Body unknown. 2 tail spines. C. Wrighti, Laudulo.



Estheria Valves inequilateral, sub-ovate, with distinct
concentric ridges. Umbo near anterior end.
Hinge line nearly straight. O.P.S. Membranacea.
Carb E. Striata. Perm. E. Portlakii. Keuper. E. Minuta.
Rhaetia. E. Murchisonae Oolite. E. Concentrica Wald.
E. Subquadrata. Still living.



E. Minuta.

Xiphosura

Merostomata

Xiphosura

Belinurus Carapace Sub-orbicular, Semicircular, slightly arched. Glabella prominent, surrounded by flattened margin, which terminates in much produced lateral angles. Thorax 5-segments, all spined. Narrow posteriorly. Pycidium composed of a few radiating segments. A long telson articulated. Two tubercles, on last axial segment.
Carb: B. Regina.



B. Regina

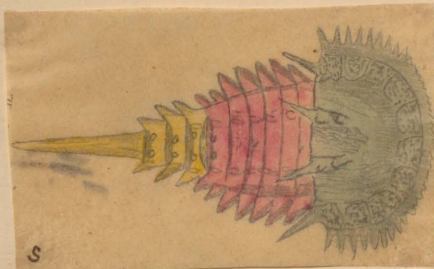
Prestwichia. (Limula, Limuloides ♂?) Abdominal & thoracic segments united. Head shield rotundato-quadrate. 5 Thoracic. 3 Abdominal segments. P. Rotunda. Carb:



P. Rotunda

Hemiaspis. Carapace like Limulus. Facial suture slightly indicated. Glabella ornamented by a semicircle of 9 tubercles, from which costae radiate. Two small tubercles on posterior margin of Carapace. Whole surface minutely tuberculated. Lateral margin 6 to 8 spines.

posterior angles short spines. Thorax 6 strongly trilobed segments. Row of spines down axis. Abdomen 3 joints. Telson long, strong. 6th somite of thorax much more arched than others. L & U Ludlow. H. Limuloides
H. serratus.



H. Limuloides

Edriothalunia

Isopoda

Archæoniscus. Abdomen appears to have had branched limbs. Thoracic limbs uneminated. 9 or 10 somites.

Pygidium semicircular in one piece. Has a peculiar tubercle, or divided elevation. Eyes 2. Strongly lobed.

Pleurae faulted, not grooved. Peculiar to Barbec whole beds being full of this animal. A. Brodie.



A. Brodie.

Podophthalmia

Brachiura. Canceridae

Xanthopsis. Cerata ovate, convex, very nodose.

4 lobes on front edge, between eyes. Orbits wide, angles in front, bent down. Whole surface of Cerata covered with minute elevations. Lateral margin usually has

112 Broad Street, 3 1/5 united. 7 triangular.
5 processes or elevations. Abdomen ~~with~~ joints. Broad &
short. Anterior pair of legs very robust. unequal, right
being largest. first 4 joints quite smooth. Hard tuberculate
legs smooth, round, no spines. Surface of carapace deeply
pitted. ? London Clay. X. Lechii. X. Tuberculatus. X. Reipinae.



X. Lechii.

Dromiadae

Basistopus. Carapace rough, almost scabrous, longer than
broad. Rostrum short, triangular, deeply channeled.
Short process on each side. Tubercle forming inner
angle of orbit. Lateral margin of carapace armed with
5 long spines. Gastric region about half length of
carapace strongly tubercled. Anterior legs, equal
smooth, twice as long as carapace. Abdominal segments
free. Whole surface punctate. L. Locne. B. Lawarkii.

Styus. Carapace twice as broad as long. nearly plane from
side to side. Anterior margin segment of circle, armed.

with three or four tubercles. Nasal furrow goes quite across & divides body into 2 parts. Leps. long slender smooth. Body tuberculated, tubercles surrounded by strong rims. ♂♂ Gault. E. Martini.



E. Martini.

Palaeocryptes (notopocryptes) Cerata tuberculated.

♀ minutely granulated. Strongly carinated, depressed. longer than head. divided into distinct regions by furrows. Rostrum small triangular. Orbits small two ^{fissures} furrows on outer margin. Mouth opening very narrow. Leps robust, except posterior pair, which are smaller & placed higher. Abdomen parallel sided 7 segments. 5 short. 6th quadrate 7th semi-oval. Gault to Chalk Gault. N. Stokesii. Charente N. Certarii.



N. Stokesii

Encoristes. Cerata depressed, as broad as long. Thorax anterior portion sculptured by numerous equal

flattened ridges, separated by sulci. Rostrum tridentate
 Lateral teeth longest. Orbits transverse very large
 2 or 3 blunt-teeth on front margin between eyes.
U. Greensand of Cambridge & Carteri.

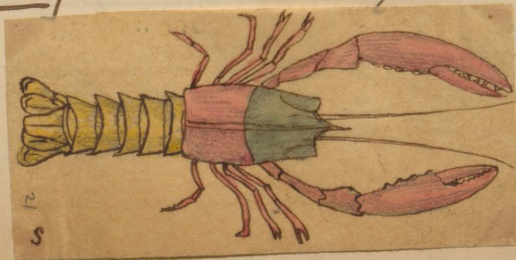


U. Carteri.

Marora

Astacoidae Marastacoidae

- 1 Hoplarya Carapace sub-compressed-grooved. - bicarinate
Rostrum about $\frac{1}{8}$ length of body, ($\frac{1}{2}$ length of Carapace)
 Elongated tubercle on each side of base. Small tubercle
 close to eye. Cheek elevated to strong keel, with three
 large spinose tubercles. Abdomen rounded. Segments
 smooth, slightly polished, very finely punctate. Legs
 very robust, unequal. Arm elongated rhomboidal
 furnished with strong spine. (Hand of some species
 scabrous. Lias. U. Green: H. Longirana.
London Clay H. Belli H. gammaroides.



H. gammaroides.

Crayfishes

5- Archaeocerabus. Carapace twice as long as broad.

Covered with oval, sub-squamiform, flattened, tubercles. The blunt-apices of which are thrown forward. Cervical furrow very deep & broad.

Abdomen about twice as long as Carapace. Semi-cylindrical. Smooth. Strongly punctate. Eyes large & reniform with short-peduncle. London Clay
A. Bowerbankii.



A. Bowerbankii.

Astacodes.

2 Meyeria. Carapace compressed, high. Strongly tuberculated. Tubercles bend forwards. Sharply ridged along back. Several distinct carinae. Rostrum very small, acute. about $\frac{1}{4}$ length of carapace. Abdomen sculptured with ridges, & tubercles arranged in lines. Segments have small spines at posterior edges. Legs very long slender. Compressed. 1st pair triangular in section with several rows of small spines. 2nd pair large remaining three small. Neocomian (Atterfield)
M. Vectensis. (Sin. Magna).



M. Vectensis

3. Scaevus. Cephalothorax about one third longer than deep.
Rostrum prominent, curves upwards. Armed with double
row of curved spines. Cervical furrow deep, well marked.
Antennae, outer pair very long, multiarticulate. Lower three

see
type

Echinodermata

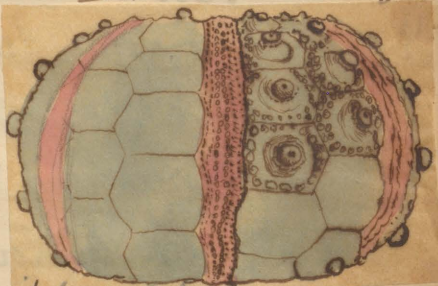
Group A. Echinodermata endocyclica. Test-circular.
Spheroidal, more or less depressed at poles. Mouth
in centre of base. ^{anal} Anus in centre of upper surface, &
opposite mouth. Surrounded by 5-ocular & 5-genital
plates. Mouth always armed with 5-jawed
calcareous jaws. Spines large.

Group B. Echinodermata exocyclica. Test-sometimes
semicircular & spheroidal, but often pentagonal
clypeiform. Mouth either circular or
eccentric, sometimes provided with jaws. Anus
external to ocular & genital plates. Never opposite
mouth. Elements of jaws placed horizontally. Only 4
genital plates perforated.

Gr A

Cidaris. Test-inflated at sides, round, depressed at both
poles. Ambulacral areas narrow elevated. Sinuous.
Have two marginal rows of granules. Two other rows near
poles. Interambulacral areas wide. Two rows primary
tubercles. Aredae wide, deeply excavated. Surrounded

by circle of prominent tubercles. Set on shield like
 or ornamented
 lamboresses. Miliary zone filled with 4 or 5 rows of small
 granules. Mouth opening small. Peristome pentagonal.
Apical opening very large. Primary spines large thick cylindrical
 tapering at the point. ornamented with longitudinal
 rows of spines, projecting forwards. Secondary spines
 short spatulate. Lias. C. Edwardsii. Lupoo: C. Licarta
C. Brawandorii Bradford clay C. Bradfordensis. Calc. sup:
C. Smithii. Gaull. C. Gaulliana. Chalk. C. Clavifera.
U. Chalk. C. Vesiculosa. Livins.



2
Archaeocidarus. Several rows of interambulacral plates
 (all secondary & tertiary species have only 2) Tubercles perforated
 surrounded by elevated ring, which is margined with
 small secondary tubercles. Primary spines very large
 armed with strong side spines, pointing forwards.
Interambulacral plates except those next to ambulacral
 areas hexagonal. Carboniferous A. Ureii.



3

Hemisidaris Test-sub-globose or sub-conical.

Ambulacra slightly undulating at summit of test.

With double row of minute perforated, marginal tubercles. 6 pairs of semi-tubercles at base of ambulacrum

Interambulacral spaces, have 8 pairs prominent tubercles, or bosses with deeply crenulated summits.

Apical disc not prominent, pentagonal. 3 genital plates larger than the rest? Right-antero-lateral plate

bears madreporic tubercle. Mouth opening large.

Peristome deeply notched, divided L-10 unequal sized lobes, deep cut into ambulacral areas.

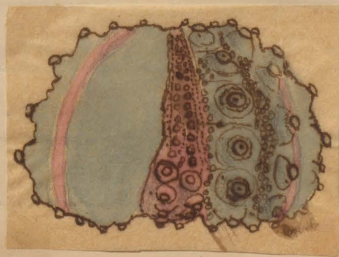
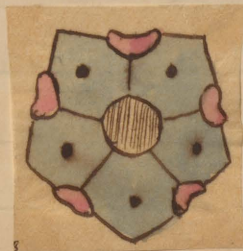
Spines long, round. Tapering to blunt point. Very minutely longitudinally lined. Base tumid.

sculled ring prominent, with smooth ring above.

Jaws large. Pores annularly arranged down ambulacrum in single file. Inf 00. H. Bravenderii. L 06.00.

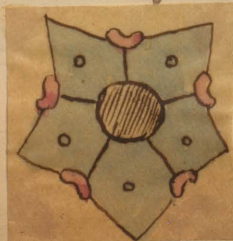
H. Brennosa. 11.00. H. Wrightii. Coral ray intermediate.

Portland H. Davidsonia. Parke H. Parkeensis.



6 Pseudodiadema. Includes all fossil forms formerly called Diadema. No Pseudodiademata are living. The genus is divided into 3 types, or groups as follows. Gr. I Includes those having only 2 rows of primary tubercles on interambulacra, & pores arranged uniserially. (e.g. Pseudodiadema depressa from Luf oo. : .) Gr. 2. Two rows of primary & two rows of secondary tubercles in interambulacral areas. Pores ^{one or} biserial. (e.g. P. Versifera ^{castro}) Gr. 3. 4 rows primary tubercles in interambulacral areas (e.g. Brogniartii from the Chalk.)

Pseudodiadema. Mostly small, thick. Pores, ^{one or} two rows in each ambulacral area. Poriferous zones narrow straight. Apical disc, seldom preserved small. Genital plates, anterior larger than posterior. Mouth very large. Peristome deeply notched. Spines rarely longer than width of shell. Cylindrical. Hulled ring strongly marked. Rim of acetabulum strongly crenulated. Leas. P. moreii (1) Luf oo. P. Depressa (1) Lt. oo. P. Pentagonia (3) Coral oo. P. Versifera (2) P. mammelata? (2) Cretaceous. P. Variolarium (3) P. Brogniartii (3)

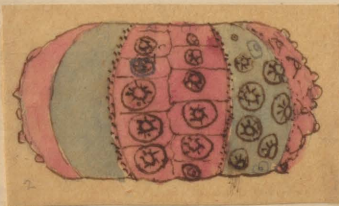


P. moreii.

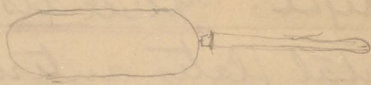


P. moreii.

7 Cyphosoma. Test of moderate size. Circular or sub-pentagonal. Inflated at sides. Poriferous plates undulate. Usually uni- sometimes bi-gemminal at apical disc. Crowded at mouth. Primary tubercles nearly equal on both areas. Arææ smooth, wide, well developed. Bosses sharply crenulated. Mammææ imperforate. Peristome slightly notched. Apical disc pentagonal. One angle Invaginate deeply into right antero-lateral interambulacral plate. Spines solid, long, sub-cylindrical, spatulate, or aculate. Stem smooth finely lined longitudinally, nulled ring strong. Acetabulum crenulated. Chalk. S. Königii, S. ornaticornis.



C. Königii.



8

Hemifidina Test small. Spines long, set on large bosses with smooth, perforated, summits. Ambulacra, two rows of tubercles on margins of plates. Interamb: 4 or 6 rows abreast (2 of primary) Spines long, slender, needle shaped. Longitudinally marked. conical head. nulled ring narrow. Lias. H. Bowerbankii. H. Rechii. Lyo H. Bakeri. Et. 50 H. Davidsoni. Corubra H. Woodwardii. Coel reg H. Tuberculosa. Linna. Clay. H. Cunninghami.





Palaemonetes ...
 8. *Cylindricus* ...
 9. *Carinatus* ...
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Sides Very tumid.
 with small tubercles
 equatorial rows
 des. Intambul:
 inar tubercles.
 near at equator?
 deeply notched &
 in much the largest.
 with rounded
 brach P. Pusilla

Test Very Small
 Each interambulacrum
 nullary zone.
 short. Have 4 rows
 by straight-grooves
 erous close set
 Tubercles at bases
 apices. Apical disc
 ring-shaped.

7 C44

Terebratula

Shell, smooth, convex. Beak truncated & perforated. Foramen circular, Deltidium of 2 pieces, frequently blended. Loop very short simple attached by its Crura to hinge plate.

Terebratulina

Shell finely striate. Auriculate, Deltidium usually rudimentary. Foramen incomplete. Loop short rendered annular in adult by union of oral processes

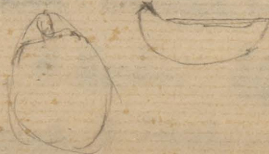
Terebratella

Shell smooth or radially fluted. Dorsal valve longitudinally impressed? Hinge line straight or not much curved. Beak with a flattened area on each side of the deltidium. Foramen large, deltidium incomplete. Loop attached to the septum.

8
Hemip

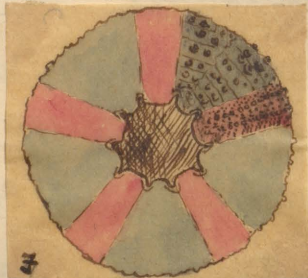
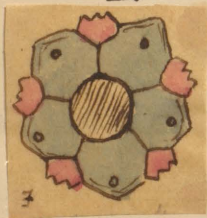


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- 9 Pedina. Test semicircular or pentagonal. Sides very tumid. Shell very thin. Plates covered densely with small tubercles. Ambulacral areas very narrow. Two marginal rows small, numerous, equal, close-set tubercles. Interamb: area three times width of Amb: 2 rows primary tubercles. 4 rows secondary, between them. Disappear at equator? Mouth small. Peristome decagonal, very deeply notched & with unequal sized lobes, the ambulacral being much the largest. Apical disc moderate size. Plates 7-sided, with rounded points. Inf oo P. Rotata. P. Bakerii. Cambrach P. Pusilla



Cidaridae.

- 4 Maurotia. (Echinopsis, Arbacia & Echinus) Test very small hemispherical. Divided into 15 unequal lobes. Each interambulacrum being divided to two lobes by median depression in nulloary zone. Ambulacra straight, narrow, equal width throughout. Have 4 rows equal, closely set tubercles. Poriferal zones in deep straight grooves. Pores unigenicinal. Interamb: wide, numerous close set equal tubercles. Base deeply concave. Mouth large. Tubercles at bases of interambulacral spaces. Apical disc small prominent ring-shaped. Inf oo M. Forbesii.



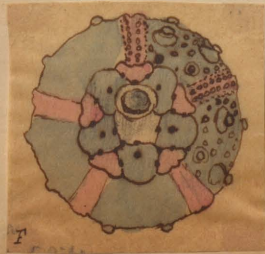
M. Forbesii.

- 5 Polydiphus Interambulacra divided as in last. Periferal zones
 wide, depressed. Paris in triple oblique pairs. Near peristome
 crowded. Mouth opening very large. Peristome pentagonal,
 notches shallow. Apical disc prominent, ring shaped.
 (5) Euf. P. Normannus. Carubrash. P. Deslongchampsii.



Salaeniidae.

- 10 Salenia. Body sub-globose. depressed above. Apical
disc broad. Sinuous outline. Centre occupied by suranal
 plate. Usually hexagonal broader than long, excavated in post
 L-form anterior margin of anus. Ocular plates small.
 At angles of junction of every three plates, deep excavation.
 also in centre of union of every two plates. & thus of faces round
 sides of each plate. Anus sub-circular, bordered by prominent
 ring. Ambulacra. 2 slightly sinuous periferal grooves.
 2 large & two smaller tubercles. Very narrow single ranked
 Primary tubercles conspicuous ^{rows} 2 in each area. Perforated.
Mouth round, slightly notched surrounded by thickened rim.
U. freusand L. Chalk. S. Personata, S. Umbrella.



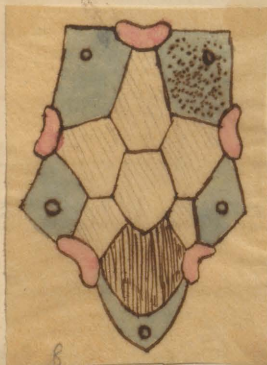
S. gilba.

Acrosalenia Ambulacral area straight or nearly, & has two rows small crenulated, & perforated tubercles. Inter. amb. wide. 2 rows primary, perforated, tubercles, on large crenulated bosses. 7 & 8 in each row. Pores unigenital. Apical disc smaller than in salenia. Subanal plate single or more usually composed of several pieces. Anterior genital plate largest. Single posterior genital plate small crescentic. Madriporeiform tubercle covers nearly all right antero-lateral plate. Mouth large, peristome decagonal notched. Primary spines long somewhat angular, very finely lined longitudinally. Milled ring very pronounced. Acetabulum crenulated.

Les. A. Minuta. Lyp. 00. A. Hemisideroides. A. Lyellii.
Forst. Warb. & St. 00. A. Hemisideroides. Corbrash
A. Wilsoni. Cor. rap. A. Decorata.



A. Hemisideroides.



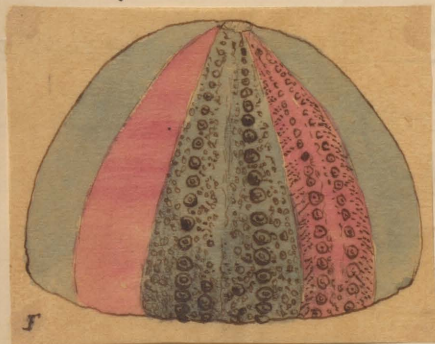
Echinadæ

12. Stornelinus. Tub conical & high thick. Amb. areas.

2 rows primary tubercles. 30 or 40 in row. Pores,
3 rows wide trigeminal, ^{1/2} lie very obliquely across
zones. Interamb. 1 Central row primary, & two
rows secondary tubercles on each side unitary zone.
Milliary zone wide very finely granulated, with
naked median depression, from base to apex.

Apical disc small, slightly excentric, genital plates very
narrow & long. vent somewhat oblong transversely.

Base concave. Mouth very large. Peristome with deep
bifid notches. Inf. oo. S. geminous. St. oo. S. microcephalus
Coel. ray S. Nodus.



S. geminans.

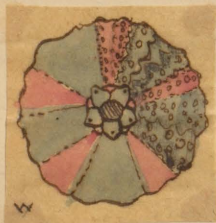
13

Echinus. Tub more or less spherical. Amb. & interamb.

areas, bear on entire margined plates tubercles of various
sizes. Apical disc circular, not furnished with calcareous
plates, but membranous with ossicles. genital & ocular
plates 5 each all perforated. Pores trigeminal.

Spines of one order only? Crag. E. Lamarkii. = E Wood-
wardi. E. Henslowi.

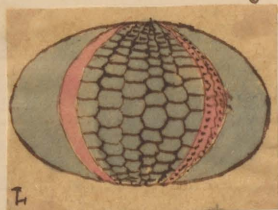
- 14 Leurechinus. (Leuropleurus). Test sub-conical.
Amb, δ interamb. much developed. Sutures of plates
deeply excavated. Tubercles & spines of various sizes.
Mouth Central, sub-pentagonal. Apical disc 5 prominent
ocular δ 5 prominent genital plates. Much elevated
anal opening round. Amb. area single pair of pores
Very distinctly rasped. (all having notched plates,
like Leurechinus, are now inhabitants of tropical seas)
⑤ Coralline Crag T. excavatus.



T. excavatus.

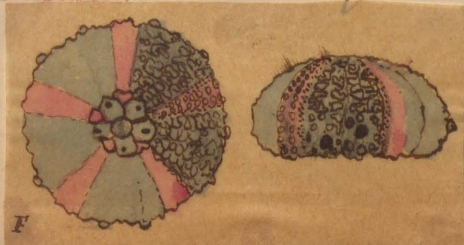
- 15 Palaechinus. Ambulacral areas 2 rows pentagonal
plates, perforated by two rows of pores. Ant. amb.

two rows pentagonal or ~~hex~~³ or more hexagonal plates. Covered with spiniferous tubercles, destitute of pores or ligaments. Anal aperture membranous. Ovarian plates usually separated by three apertures. Mouth ventral, central. Ocular plates double (instead of single) perforation. Carb. P. Elegans. P. M. Coxi.



P. Elegans.

16 Glypticus. Test very small, thick, ^{depressed} Amb. areas ~~depressed~~ narrow have two rows regular, marginal, tubercles. Periperal zones narrow, pores unigenital. Interamb. 2 rows well developed tubercles at base, at upper part of area regular tubercles disappear, the surface is curiously sculptured. Apical disc large. Genital plates prominent sculptured. Eys. plates large, 2 lines between them strongly marked. Mouth wide decagonal. Carb ray G. Heterophicus.



G. Heterophicus.

Group B Exocyclica

Casidulidae

1 Pygaster. Test orbicular, depressed or ~~subconvex~~.

Ambulacra simple throughout, of equal width. Tubercles

perforate crenulate; disposed in very regular series in

both areas. Pores single ranked. Arms large,

superior, keyhole-shaped, placed in or near apical disc.

Mouth ~~depression~~ ~~located~~ ~~between~~

or mouth
lower
lectus.

Echinidea

Group A.

Sidariidae

Sidaris

Archaeosidaris

Hemiosidaris

Cytohypota

Polyciphus

Diademidae

Pseudodiadema

Cyphosoma

Hemipedia

Saleniidae

Salenia

Acrosalenia

Echinidae

Stomachinus

Echinus

Zenarchinus

Palaechinus

Glypticus

	Carb.	Perm.	Trias.	Lias.	T.oo.	M.oo.	U.oo.	Proboc.	T. Green.	Gault.	U. Green.	T. Chalk	U. Chalk	Eocene	Miocene	Red. Cray.*	Red. Cray.	
<u>Sidaris</u>				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<u>Archaeosidaris</u>	X																	
<u>Hemiosidaris</u>					IX	X	X	X										
<u>Cytohypota</u>					IX													
<u>Polyciphus</u>					IX													
<u>Pseudodiadema</u>				X	X	X	X	X	X	X	X	X	X					
<u>Cyphosoma</u>												X	X					
<u>Hemipedia</u>				X	X	X	X											
<u>Pedia</u>					IX													
<u>Salenia</u>											X	X						
<u>Acrosalenia</u>				X	X	X												
<u>Stomachinus</u>				IX	X													
<u>Echinus</u>															X	X	X	
<u>Zenarchinus</u>															X	X	X	
<u>Palaechinus</u>	X																	
<u>Glypticus</u>						X												

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H. Hemisphericus. oral ray H oblongus.

two rows pentagonal & ~~hex~~³ or more hexagonal
plates. Covered with spiniform tubercles,
destitute of pores or ligaments. Anal aperture
membranous. Ovarian plates usually perforated
by three apertures. Mouth ventral, central.
Ocular plates double (instead of single) perforation.
Carb. P. Elegans. P. M^c Coyi.



16
Glypt

(10)

group B Exocyclica

Casidulidae

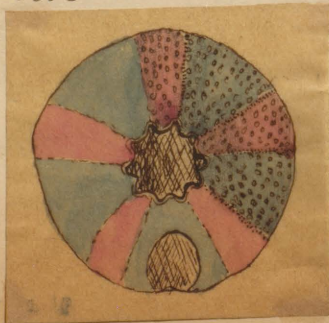
1 Lygaster. Test orbicular, depressed or ~~subconical~~.

Ambulacra simple throughout, of equal width. Tubercles perforate crenulate; disposed in very regular series in both areas. Porus single ranked. Anus large, superior, keyhole-shaped, placed in or near apical disc. Mouth decagonal, notched, Base concave near mouth flat at edges. Posterior pair ambulacrae arch over anus. Apical disc unknown. Lyo 00. P. Semisulcatus. Combresh P. Moisii. Coral Rag P. Umbrella.



2

Holictypus. Test hemispherical, or somewhat conical, outline circular. Base flat or nearly. Mouth central, peristome decagonal anal opening large, pyriform. Between mouth & edge of test, or on edge. Amb. lancet-shaped ^{rows} 6 to 8 tubercles ~~at edge~~. Inter. amb. 16 to 20 ^{very} rows tubercles. Apical disc ^{very} small. 4 perforated genital plates. Prof. zones very narrow, porus unijuminal. ocular plates small heart shaped. Lyo 00. H. Depressus H. Hemisphericus. Coral Rag H. oblongus.



3. Hypoclypeus. Test disciform, subpentagonal, sometimes convex.

Amb. narrow, slightly convex, three anterior, straight.

Posterior pair sinuous, most so at anus. Interamb.

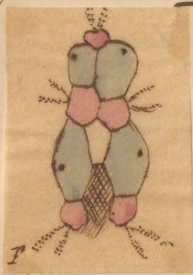
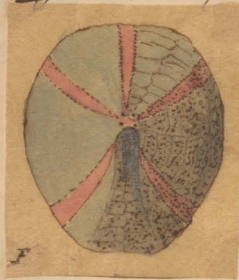
Very wide unequal. Plates densely covered with microscopic tubercles. Apical disc central small.

Anal valley deep, walls ^{perpendicular} ~~parallel~~ sides, parallel.

Mouth small, subcentral. Peristome feebly decagonal.

Porif. zones very narrow, Porif. unigen. on upper surface

Luzoo. H. Agariciformis. Coral rag. H. Stellatus.



4. Collypites. (Dyaster) Test discoidal, sub-discoidal, or pentagonal.

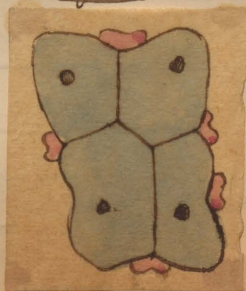
Upper surface convex. Amb. simple, continuous, radiating.

Posterior pair separated from rest; converge & meet over anus,

thus forming a second pole. Mouth sub-central, round, small.

Tubercles perforated, Vent pyriform, situated on curious sulcus on posterior margin. Interamb. very tumid below.

Porif. zone unigen. Luzoo. C. Ruyens. Coral rag. C. Bicordata.

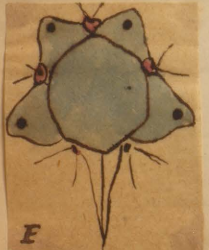
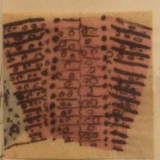


Pyliastridae. (Nuculolites)

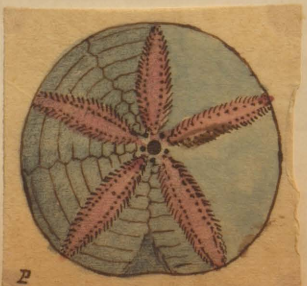
5 Echinobrissus. (Nuculolites) Test sub-quadrate, anterior border rounded, posterior bilobed. Dorsal surface convex & high inclines abruptly towards back. Anal valley deep lanceolate, extends from apex to border of disc. Amb. areas narrow petalate at top, convergent at border. Base concave amb. grooved below. Mouth pentagonal, nearest anterior side. Zuf 00 E. Clunicularis. Zf-00 E. Grishackii. Corubash E. Quadratus Coral ray. E. Scutatus. Portland. E. Brodiei.



6. Clypeus. Dorsal surface. Amb. petalate. Anterior pair & odd-ambolacrum about same width. Post. pair much wider. At base narrow depressed zones fores closely approximated. Pores on inner side of row dot-like, round, on outer form delicate fissures. (This in all secondary, in all tertiary both rows dots) Five grooves unite fores & fissures. Interamb very unequal in width. anterior pair narrowest. Single interamb. contains anal valley. Tubercles perforate, in V shaped rows. Apical disc very large in depression behind vertex. Madreporiform occupies whole disc.



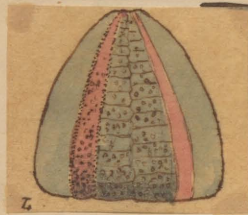
C. Mulleri.




C. Hugii.

Base nearly flat. Mouth slightly nearer ant. border. Peristome has 5 strong lobes formed by interamb. Zuf 00. C. Plottii. Zf-00 C. Mulleri. Coral ray C. Subulatus.

7 Galerites. Test pyramidal. Base flattened. 10 distinct areas formed by straight, radiating ambulacrae. Interamb. 3 or 4 times width of amb. Outline elongated posteriorly. Test thickened at posterior end for anus. Anus large longitudinal, broadly elliptical. 1/5 larger than mouth. Mouth round sub-central. For. unigen. Small down dorsal surface. Trigeminal at base. Apical disc nearly round. 4 genital perforations. Madreporium round. Chalk G. Albojalarus. G. Subrotundus. G. Abreviatus.



G. albojalarus.

8 Discoidea. Body hemispherical, circular, with flat base. Dorsal surface sparingly granulated with minute tubercles.  Divided to 10 zones. Under surface flat, similarly divided. Anus between mouth & margin, ^{acute at each extremity} longitudinally oval. Primary tubercles all perforated, or crenulated bosses. Mouth small, central, sub-pentagonal, densely surrounded with tubercles. Apical disc strongly lobed. Ocular plates distinctly perforated.



D. Cylindrica

Base densely tuberculated, for. unigen. Chalk marl D. Cylindrica.

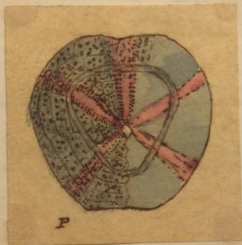
9.

Pyrina. Test oval, tumid, flattened above & below
 Ambulacra, simple; continuous; radial; lanceolate.
 Tubercles, perforated; densely spread over test.
 Apical disc. madreporiform sub-central. Anterior.
 Mouth, central; elliptical. Anus, posterior;
 supra marginal. Pores, unigenital.
Chalk Marl. P. Pratti.



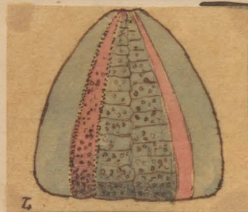
Spatangoidae. Hemiasteridae.

12 Hemiaster. Test obtusely cordate, tumid. Ambulacrae dorsal,
 lodged in depressions, dissimilar. petalate. Surrounded
 by simple peripetal fasciole. Tubercles on dorsal surface
 small. Anus supra-marginal, no fasciole. Mouth
 bilabiate. Madreporiform tubercle quite in centre.
Pores, ~~anterior~~ outer row slit shaped. Chalk Marl, H. Murchisoni.
 H. Murchisonide.



H. Murchisoni?

round. Chalk *G. Altopolaris*. *G. Subrotundus*. *G. Abreviatus*.



G. altopolaris.

8

Discoidea. Body hemispherical, circular, with flat base.

Dorsal surface sparingly granulated with minute tubercles.

☀ Divided to 10 zones. Under surface flat, similarly divided.

1 Annus between mouth & margin, ^{acute at each extremity} longitudinally oval.

Primary tubercles all perforated, or crenulated bosses. Mouth

⑤ Small, central, sub-pentagonal, densely surrounded with tubercles.

Apical disc strongly lobed. Ocular plates distinctly perforated.

Base densely tuberculated, foris

unigen. Chalk marl *D. Cylindrica*.



D. Cylindrica

Clypeastridae

- 10 Catopygus outline elongated, narrows ^{ant} anteriorly. Truncated behind, anus on upper surface of truncation. Tubercles round. Mouth very conspicuous, few on dorsal surface. Ambulacra petalate, narrow. Pores, outer ^{row} face slit-like oblique. Inner round. Outer & inner pairs connected by distinctly marked line. Mouth near anterior edge, somewhat-pentagonal. U. Greensand. P. Carinatus.



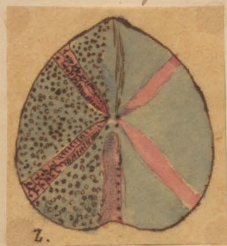
Spatangoidae. Hemiasteridae.

- 12 Hemiaster. Test obtusely cordate, tumid. Ambulacrae dorsal, lodged in depressions, dissimilar. petalate. Surrounded by simple peripetal fasciole. Tubercles on dorsal surface small. Anus supra-marginal, no fasciole. Mouth bilabiate. Madreporeiform tubercle quite in centre. Pores, anterior outer row slit shaped. Chalk Marl. H. Murchisoni. H. Murchisonide.



H. Murchisoni ?

Spot
 13. Micraster. Test cordate. Ventral surface slightly tumid, or nearly flat. Anus on truncated extremity, high up. Aperture circular, occupies depression, bounded by fascioli. Mouth very near anterior edge, at inferior termination of the deeply impressed odd-ambulacrum. Amb. Dorsal parallel sided. anterior differs from others, & variable in development. Madreporium anterior. Eye plates all developed. distinctly perforated. Chalk. M. Coranguinum



M. Coranguinum

Spot
 14. Hemipneustes. Test cordate, truncated posteriorly, tumid. Anus oval, near top of truncation. Mouth transversely oblong, in depression very near anterior margin. (opposite antial furrow, or odd-ambulacrum.) Apical disc small, 4 perforations closely approximated. odd-amb. $\frac{1}{3}$ wider than others, width equal through. Amb. Antero-lateral superficial, gracefully curved at top. About 30 pairs pores in petaloid portion. Petals narrow down sides. Postero-lateral. Also superficial.

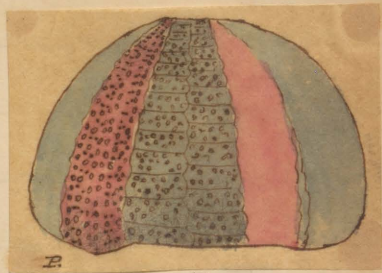
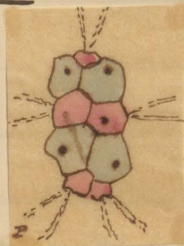


H. Radians

shorter, about 18 pairs pores. Tubercles very minute, all perforated, boss's crenulated. H. Green's. H. Greenii.

Statae
Anaechytedae.

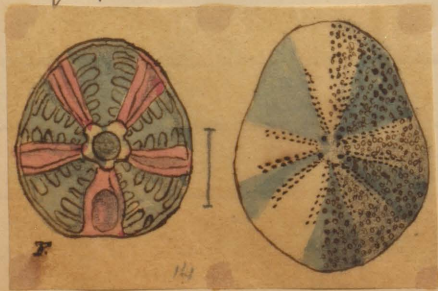
15 Anaechytes Test, oblong, tumid, conical. Amb. Homogeneous dispersed over surface of test, become obscure at base. No true fasciole. No dental apparatus. Anus terminal set obliquely on edge, longitudinally elongated. 4 perforated genital plates & 5 ocular perforations. Apical disc Very much elongated. Surface of test covered with very minute miliary granules, & delicately tubercled, bosses small, crenulated. Pores each pair in single plate, & near its centre. Shallow groove connects one pair with another. Mouth, transversely elongated. U. Chalk, a. ovatus.



a. ovatus

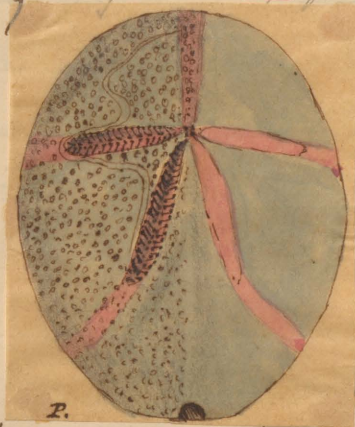
Clypeasteridae.

11 Schinoscyamus. Test depressed, flattened, ovate, very thick. Strengthened internally with ribs. Surface densely covered with small similar tubercles. Spines short. Amb. Heterogeneous dorsal portions forming pseudo-fascioles. Avensius nearly parallel sided. Anus inferior, near edge. Mouth round, central, large, crenulated round edge. Rd. Gray, E. Parillus, E. Suffolkensis.



Spatangoidae

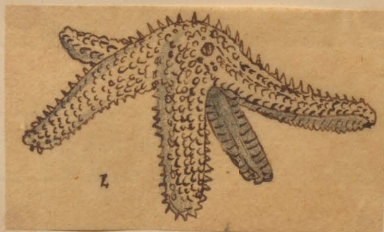
16. Brisanus Test oval, oblong. Tubercles on surface all similar. Dorsal amb. Sub-petalate, circumscribed ^{strongly} hyaloid peri-petal fasciole. Odd. amb. not depressed. amb. lateral. narrow, linear, very deeply impressed. 2 antero-lateral at right angle to length of test. Postero-lateral thrown backwards. Annus lenticular supramarginal. Mouth transversely elongated. Lil. prominent. Coral Reef
B. Scillae.



B. Scillae

Asteriadae

Palaeaster. Annus thick, convex, short, covered with many rows of small spinose ossicles. Ambulacra, deep, with transverse ossicles & single zone of ambulacral plates. No disc plates between rays. Madreporiform very small, single. L & U. Selurian. Caradoc P. asperimus.
U. Sil. P. Ruthvenii.



P. asperimus

16. Priscula sea urchin, oblong. numbers on surface all

ate
Palai

transverse ossicles & single zone of ambulacral plates.
No disc plates between rays. Madreporeiform very small,
single. L & U. Silurian. Caradoc P. asperimus.
U. Sil. P. Ruthvenii.



P. asperimus

~~1878~~
Palæasterina. Disc flated, angles between arms filled
up. depressed. Arms slightly produced. 3 to 5 rows
 principal tubercles above. Amb. shallow, composed of
 sub-quadrate, & transverse ossicles. Bordered by a single
 row of square-shaped plates bearing spines. Ludlow
 P. Primaeva.



P. Primaeva.

Protaster. Ophiuroid appearance. Arms elongated, 5
 extend very far beyond the disc which is closely ^{membranous} reticulated.
Arms formed of 2 rows plates, quadrate, spinose.
deeply sculptured. Oral apparatus, about 10 pieces.
Ludlow. P. Multonii. P. Sedgwickii.



P. Sedgwickii.

Palaeodiscus. Disc pentagonal, flated, large,
Arms do not extend beyond disc. are not distinguish-
-able from it on upper side. Amb. Small, crowded
transverse ossicles in double row, basal joints of
which are much enlarged. L. Ludlow P. Ferot.



Palaeocoma Disc membranous & flat, all the centre scattered
with delicate star like spiculae. Angles of a cross
filled with membrane, similarly spiculate. Arms
formed of several rows, quadrate, reticulated ossicles.
External rows fringed with spines. Amb. shallow,
narrow. bordered by 2 rows square ossicles, outer row
fringed with spines. L. Ludlow. P. Marstoni. P. crispus

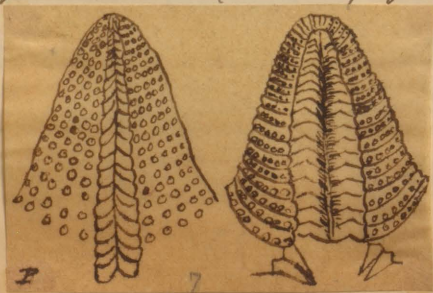


P. marstoni.

Asteropecten Body covered with quadrate tessular plates, which bore coronated spines. Rays 5, short, triangularly lanceolate, pointed at extremity, sides straight. Margins bordered by regular series of square plates, about 18 in each row. Lias & living. Lias. A. Hastingsae Duf 00. A. Cotswaldiae, A. Scarburgensis. St 00. A. Whitsii. Kelloway Rek A. Claviformis. Coral rag A. Rectus. Locne. A. Criophates.



Tropidaster Body stellate, Vent probably on dorsal surface. 5-rayed. Arms (rays) Convex, carinated above. Carina composed of double row squamose imbricating plates. Dorsal Surface Spinose. Spines simple, of one order. 5 distinct interamb. ossicles at base of arms, round mouth. Amb. bordered by transverse plates, having spiniferous crests on their ~~anterior~~^{top} margins. Madrepapirum coarsely granulated, deeply grooved. Suckers biserial. Only Middle Lias. T. Pectinatus.



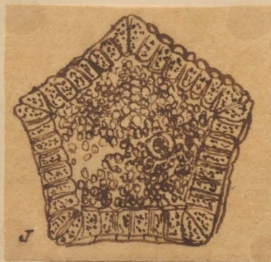
T. Pectinatus

Goniaster. (astrogonium) G. Corubii Zuff.

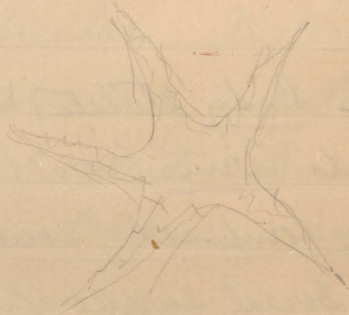
Body, sides deeply lunate. Angles long tapering.
Marginal ossicles about 30 in row. Usually
oblong. Quadrate. convex, coarsely punctate.
Abrupt at sides.

G. Lunatus Zuff. Arms short, ossicles about
13. Very steep sided, punctate, quadrate. Amb. groove
deep, bordered by 2 rows square ossicles. Eye plates
usually well seen.

Chalk. G. Corubii. G. Lunatus. G. Rayatus. G. Parkinsoni.
Eocene. G. Stokesii. G. Bowerbankii. G. Tuberculatus.



G. Parkinsoni.



Oreaster. Disc convex, more or less stellate, often large
tubercles or spines. 2 large rows at sides of arms.
Arms swollen.

O. Boysii Zuff. Disc convex, pentagonal, ^{steep sided} Arms prolonged
bordered by marginal, imbricated, centrally punctate
ossicles. ossicles large globose, centrally punctate
with smaller intermediate ossicles between them.

O. Bulbiferous Type. Disc convex. Plates, in centre flat, many lobed very deeply punctate. regularly formed arms run down arms. Madreporiform very delicately rayed. Arms swollen at ends to spheriform masses, composed of larger plates.

All U. Chalk. O. Boysii. O. Bulbiferous. O. Squamatus. O. ocellatus.



Lepidaster. Body depressed, about 12 rayed. Rays short, tapering, lanceolate, covered above with regular ossicles. on ventral surface 4 series oblong, imbricating, squamose ossicles, 2 on each side of groove. Inner ambulacral series oblong, outer polygonal. Mouth with 12 blunt ossilets. Disc large (like Solaster papposa)
Winlock. L. Grayii.

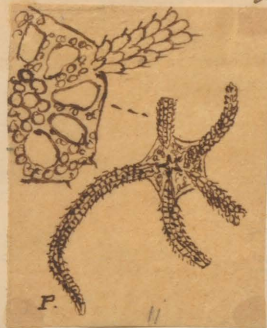


L. Grayii.

Ophiuridae

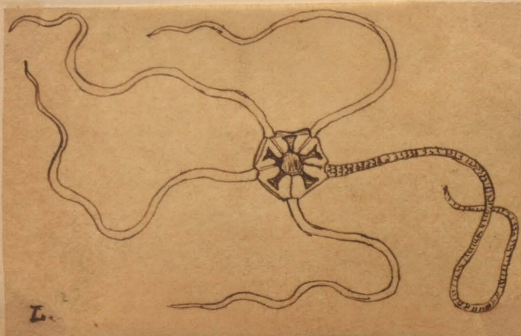
Ophiura. ^{O. Segrete type} superior ray plates pelaloid. rounded above at least of arms? Tapering & sub-truncate below. Lateral ray-plates do not touch, bear on upper margins Conical spines which scarcely equal the ^{radius} ~~radius~~ in length. appear to be 6 or 7 in row round arm. . L. Chalk.

O. Wetherelli. London Clay. Dorsal surface covered with smooth plates. Curious interbrachial shields at base of arms, with fringe of minute spicules on margin above mouth. Shields closely appressed to arms.



O. Wetherelli.

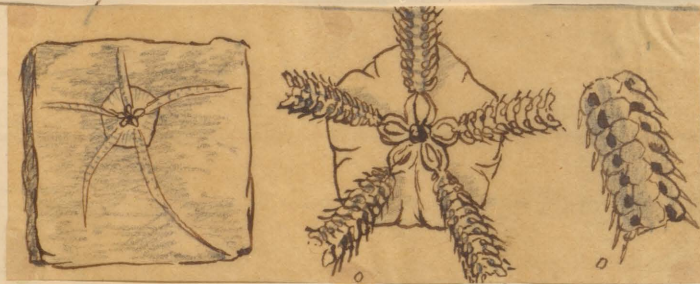
Ophioderma. Disc, round, small, flat, Arms long, smooth, cylindrical. becoming felyform at ends. 10 or 12 times diameter of disc. Dorsal surface flat, smooth, Ventral surface smooth. 2 long triangular ossicles point towards mouth from between ~~each~~ ^{every} pair of arms. Scales on arms transverse imbricated. M. Lias. O. Egertoni. O. Grayii.



O. semi-brachiata.

Ophiurella. Disc very large, nearly round, membranous.

* Rays long, slender, taper to point, Ventral ray flat, lateral, ray pentagonal large. Lateral, long, clasp sides of rays in an imbricating manner, bear stout spines. Mouth slit-like, surrounded by 5 blunt ossicles. Cerubraea O. Giesbckii.



Cystidians None found above the Wenlock formation.

Usually have manillate stem. Provided with three kinds of openings. 1. Mouth. 2. Core composed of 5 perforated pieces most likely ovarian. 3. Plates covered with numerous pores, or covered canals, called pore rhombs. Arms fixed. Ant. amb. upon large. Divided into two groups by Von Buch.

A. Body composed of a definite number of plates.

B. Body composed of an indefinite number of plates.

A. Pseudocrinites. Body circular compressed, sides nearly flat with thick plain margin, on which the arms rest, on their edge. Base 4 plates, 3 pentagonal, one hexagonal. All ornamented with radiate ridges.

Pectinated rhombs 3, each situated on a pair of plates

slightly reniform, transversely grooved, & with raised bordering ridge. Arms 2 (or 4) extend round edges of flattened body, do not go quite to base. Composed of curviform ossicles in double row. Appear alternate larger & smaller. P. Bifasciatus. P. Quadrifasciatus. U. Sil.



P. Bifasciatus.

Aplocystites. Body oblong, 4 sided. Sides equal, & usually flattened. The 4 angles flared off & slightly grooved, to receive the arms which proceed from the acute apex & run down the whole length of the body. Base truncated, composed of 4 plates, one hexagonal & 3 pentagonal. Stem often absent, composed of plates, tapering. Arms as long as body composed of 2 alternating series of ossicles. Pore chambers small, have not elevated borders like last.

U. Sil. A. Pentramatoides.



A. Pentramatoides

Group B. Aplocrinites. Body hemispherical, slightly depressed, with concave base & tumid margins. Mouth on summit from it radiate 5 deep canals, regularly bordered by parallel salcations. Arms lie in these, & are all curved in one direction. Composed of 2 alternating series of plates. Ovarian pyramid in upper half of disc, in one of interfaces. No pectinated rhombs. Caradoc A. Bouchianus.



Blastoidea All carboniferous. Body globular or elliptical. Said to have very short, jointed stalk, the joints of which have radiated articular surfaces. Body composed of polygonal plates. Oral aperture minute, at summit, surrounded by 5 openings. 4, double openings ovarian. 5th larger, probably anal. 5 petaloid ambulacrae of variable length, radiate from mouth. Furrowed down centre & striated across. Extremity of each line of striation has ^{ambolacral} ves. pore.

Pentamerites. Pelvis small pentagonal, of 5 pieces. These support 5 supra-basal pieces or scapulae. Each of which has a long narrow fissure to receive a pseud-ambulacrum.

[?]
ovarian plates 5. Pseud-amb. 2 rows minute
 pentagonal plates & oblique pairs of pores. ~~Surface~~
Column round. Surface of articulation minutely radiated.
P. orbicularis. Carb. Limestone.



P. Pyriformis.

Codonaster. Body conical, upper part broad truncate.
Pelvis deep, conical, composed of 3 pieces. 1 tetragonal
 2 pentagonal. Mouth, above, in centre of disc. Front
 5-prominent, minute, pseud-ambulacra diverge.



C. acutus

Crinoida

Pentacrinus. Column composed of numerous pentagonal plates
 or joints. Alternating layer & smaller. Articulating at
 surfaces by penta-stellate, semi-striate, compressed margins.
Axillary arms abundant, made up of much compressed
 sub-oval joints, proceed at intervals from column.

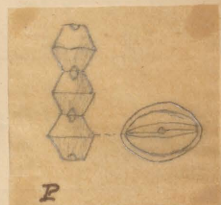
Pelvis of 5-joints. Support 5-first costals, 5-second joints.
 Arms 10. L. Lias. P. Briarius. M. Lias. P. subangularis
P. Basaltiformis.



Bourgetorinus. Column without ramules or side arms.

Composed of graduated joints. Articular surfaces plain, or marked with transverse ridge, never stellate. Small central perforation. Body enlarged pyriform, composed of 2 sets of pieces. Cup. Very shallow, formed by five rays. Mouth hooked all round. B. Ellipticus Chalk.

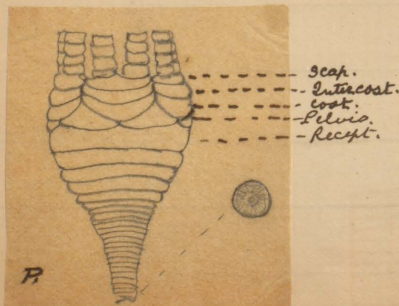
B. Londonensis London clay.



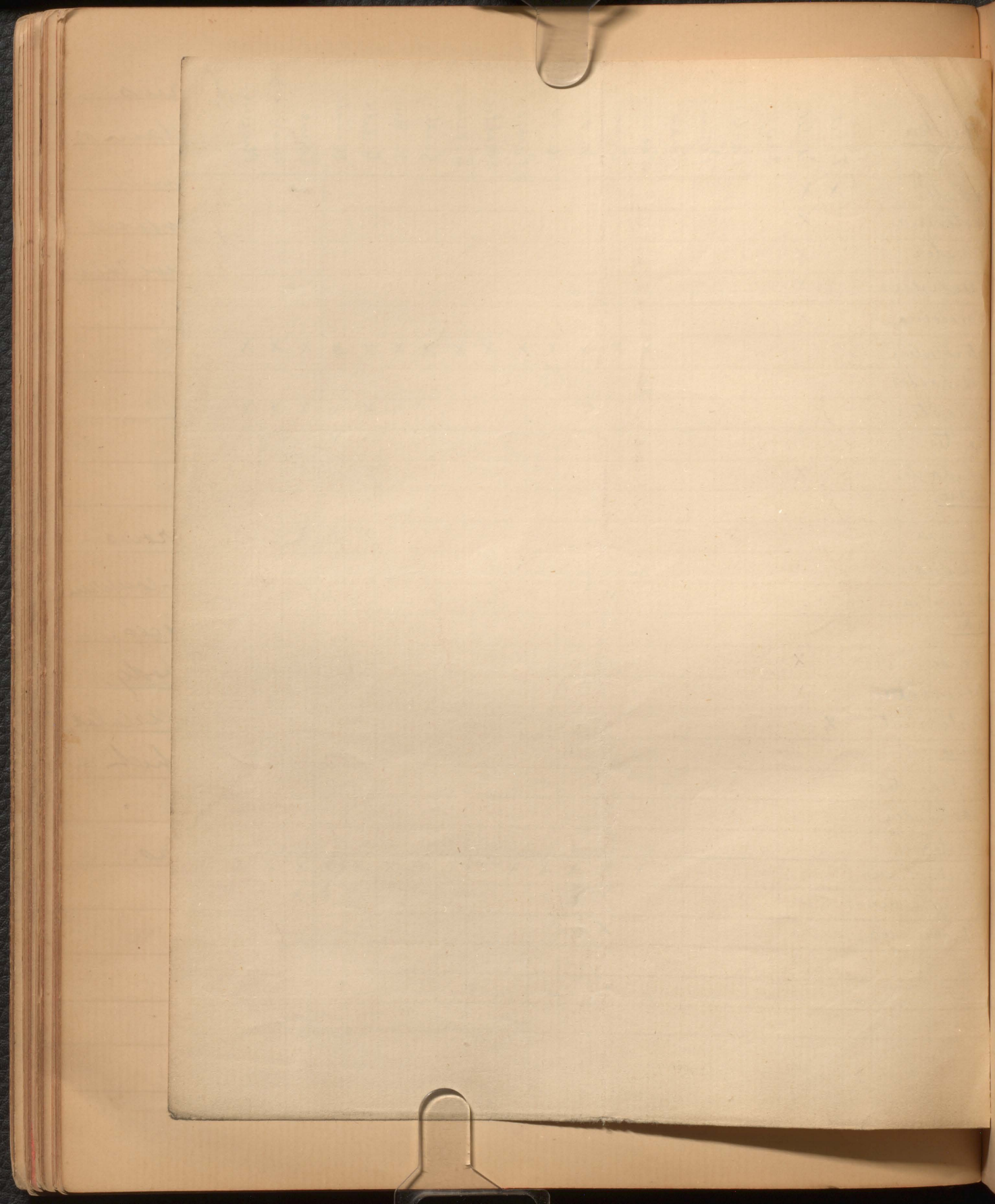
B. ellipticus.

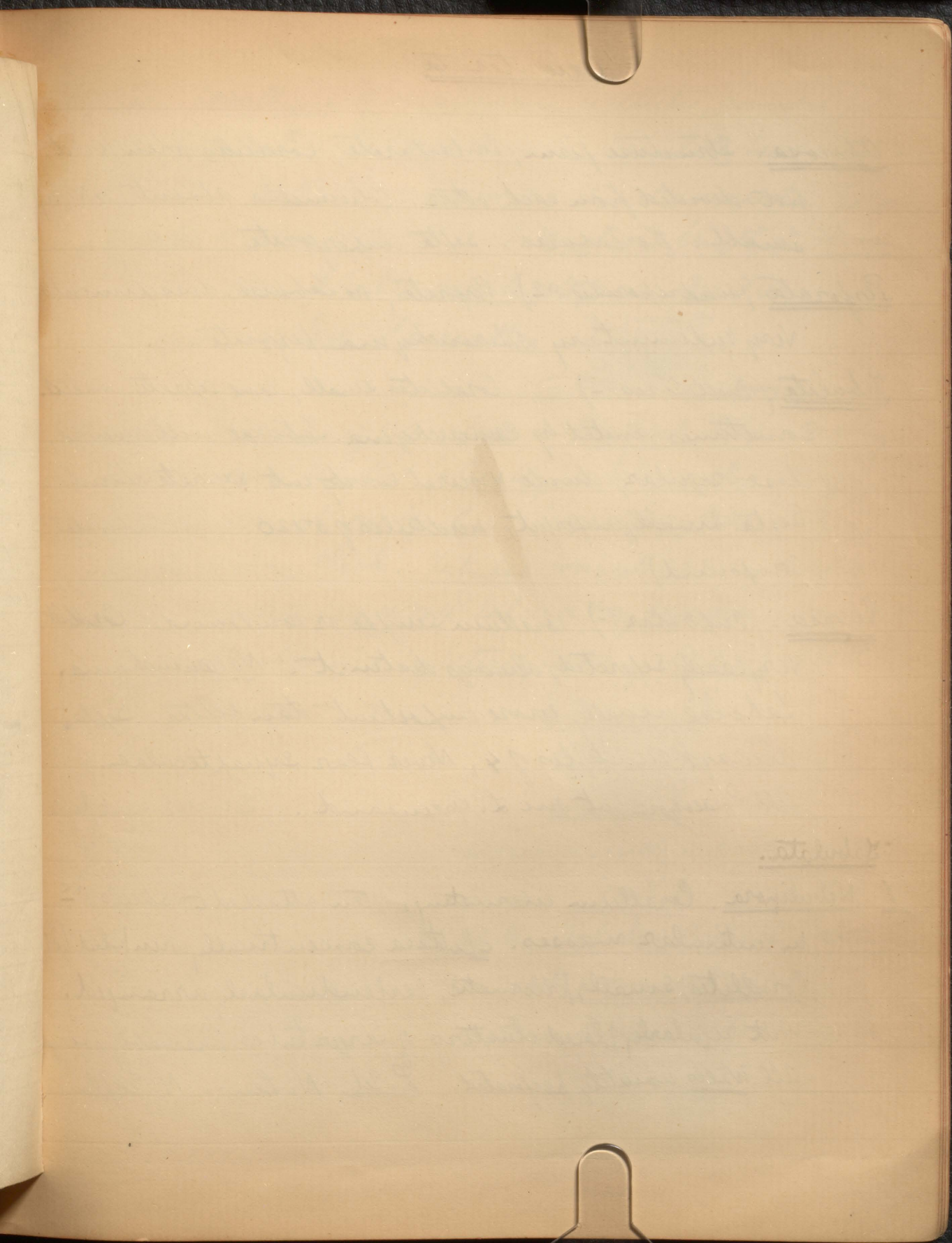
Apicorinus. Body conical, composed of superposed rows of plates. Namely receptacle of one piece. Pelvis of 5 sub-coniform pieces, 5 costal plates, 5 intercostal, 5 scapular pieces, 5 pairs of arms. Stem round, at first as large as body, tapering by degrees down to root. Articulations circular, slightly elevated, pierced in centre by round canal which seems to be alimentary. Surfaces radiated.

Et. 00. 5 Bradford Clay A. Parkinsoni. A. Rodendus.



A. Parkinsoni





See genus Calenterata.

Calenterata

3 Aporosa Structure firm, imperforate, Corallites when perfect, not divided from each other. Columella absent, or very small. No Tabulae. Septa imperforate? x6

4 Perforata (madreporidae ♂♀) Perforate, no Tabulae, dissepiments very rudimentary sclerenchyma perforate.

1 Tabulata (millipores ♂♀) Corallites small, have separate walls. Sometimes united by Coenenchyma. Tabulae well developed, close, regular, divide visceral cavity into separate chambers. Septa small, imperforate, multiples of 5-20. (All Tabulata compound)

2 Rufosa. (Cup & star ♂♀) Corallum simple or compound. Corallites very easily separated, always distinct. No Coenenchyma. Tabulae usually more important than septae. Septa always multiples of 4, Never bear synapticulae. All Palaeozoic but one L. Greensand. (Development by Calicles ^{buds})

Tabulata.

1 Nebulipora. Corallum encrusting, often attached to shells ♂♀ in lenticular masses. Epitheca concentrically wrinkled below. Corallites, small, prismatic, perpendicularly arranged. With regularly placed clusters of larva tubes (probably ovarian) all walls minutely perforated. L. Sil. N. Lens. N. Explanata.

2 Favosites. Corallum of basaltiform corallites, rounded, prismatic, or polygonal. No Coenenchyma. Tabulae horizontal. No Septa. Walls perforated with distinct connecting pores. Mouths of tubes open at right angles length. U. Sil. F. Alveolaris, F. Gothlandica. F. Goldfussii. Sw. F. Cervicornis (Polymorpha) Carb. F. Parasitica.



F. Basaltiformis.

3 Halysites Corallum of numerous elliptical tubes, rarely dichotomous. United laterally in labyrinthic groups. Mouths open at one level, in loose chain like pattern. Epitheca very thick. Tabulae horizontal & very numerous. Each corallite has 14 or 16? sulci, or very ~~regular~~ imperfect septae. Development by lateral budding. L & U Sil. H. Catenularia H. Escharydes.



H. Catenularia.

6 Heliolites. Corallum polymorphous, generally sub-globular. Epitheca concentrically waved. Corallites have twelve sulci, or rudimentary septa. Tabulae distinct. Coenenchyma tubular. Calices irregular with prominent edges. U. Sil. H. Interstinctus. H. Megastoma. H. Grayi. Sw. H. Porosa.



H. Megastoma.

4. Syringopora. Corallum of thick, minutely porous, rarely dichotomous tubes. Tubes united by numerous cross branches (like synaptae) have numerous funnel shaped diaphragms. U. Sil S. Serpens. Carb. S. Ramulosa. S. Reticulata. S. Geniculata. Septa 12 ~



5. Miscelanea. Corallum surrounded by well developed epitheca at sides, & below. Epitheca has radicular prolongations. Tabulae convex, sub vesicular, & very strongly perforate. Septa mere traces. Carb. M. Favosa. M. hypostoma.



7. Thecia. Corallum encrusting? Surface mammulated. Tubes not distinctly divided from each other. Calyces shallow, with very small deep fossula. Cenenchyma absent. Tabulae strong. Septa 12 to 18. Thick, closely set, equal, go nearly to centre of calyces. After L-foss over & join those of neighbouring corallite. U. Sil T. Swindermans. T. Grayana.



M.F.

T. Grayana.

Rufosa Cyathophylloidea

Arachnophyllum Corallum Carg., incrusting, polymorphic

4 Corallites with depressed flattened centre in which the septa meet. Septa very thin, perforate, granular, bifurcate, or trifurcate outwards. often continuous with septa of next corallite, which are ^{thus} indistinctly divided.



U. Sil. A. Zypus - Dev. Q. Battersbyi.

1. Petraea Corallum simple, turbinate, with deep cup or calyx. Radiating lamellae of 2 or 3 different sizes. Lower go to centre, become twisted & form columella. Vertical edges of septa perforated by small holes. No Tabulae. L. U. Sil. Bina. U. Sil. Elongata. Dev. Celtica.

13.

Amplexus Corallum simple, cylindrical when old, conical when young.

Flexuose. Epitheca (wall) very thin, marked with vertical lines

Corresponding to septa. Septa marginal, thin, far apart. 28 to 50, or 60.

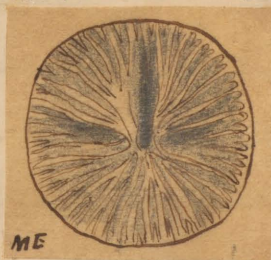
Tabulae very highly developed.

Carb. A. Coralloides. Dev. Zortosus, (probably same species as Carboniferous).



14.

Lophrentis Corallum simple, trochoid, conical, often much elongated, Epiteca wrinkled. Calyx deep, oval. Septal fossulae strongly developed. No Columella. Tabulae slightly developed, bear on upper surface series of septa. Septa, all calicular edges denticulate. Carb only Z. cylindrica. Z. Cornucopia. Z. Patula.



Z. cylindrica.

Ornophyma Corallum simple, turbinata, usually straight. often

5. twice as broad as high - Epiteca rudimentary, bears radiceform prolongations. Septal Fossula pronounced. Septa very numerous (more than 100) divided into 4 groups. Tabulae well developed. U. Sil. Turbinata Dev. Murchisoni.



O. Turbinata (sect).

8 Cyathophyllum Corallum simple, or composite, Calyx concave. Septa, numerous, well developed, usually extend to centre, where they are twisted to form a Columella.

No external longitudinal costae. Tabulae occupy only centre of visceral chamber. Outer portions of tabulae have numerous vesicular dissepiments, sometimes arched at edge.

Gemmation Calicular. U. Sil. C. Truncatum, C. Frochiforme. Dev. C. Ceratites, C. Obtortum. Carb. C. Murchisoni, C. Wrighti, C. Rejium.



C. Truncatum.

11.

Endophyllum Corallum composite. Corallites more or less connected by rudimentary outer walls, which are of irregular vesicular tissue. Inner walls strong & double. Chef septa about 32. Thinnest inwardly with an equal number of smaller septa. Tabulae developed. only Dev E. Bowerbankii.



6. Aser ria. Corallum composite. Corallites have double investment, which divides visceral cavity into two chambers, an inner, central, Columnar, & outer annular. Septa well developed.



A. fusci

Tabulae imperfect. No Columnella.
U. Sil. A. Luxurians. A. Ananas.
Dev. A. Goldfussi. A. Pentagona.

14.

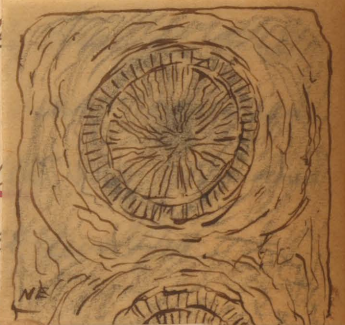
Lophrentis Corallum simple, trochoid, conical, often much elongated, Epiteca wrinkled. Calyx deep, oval. Septal fossulae strongly developed. No Columella. Tabulae slightly developed, bear on upper surface series of septa. Septa, all calicular edges denticulate. Carb only Z. Cylindrica. Z. Cornucopia. Z. Patula.



Z. Cylindrica.

Ornithyma Corallum simple, turbinata, usual

5. twice as broad as high - Epiteca rudimentary, prolongations. Septal Fossula pronounced. Septa (more than 100) divided into 4 groups. Tabulae well U. Sil. Turbinata Dev. Murchisoni.



O. Turbinata (sect).

8 Cyathophyllum Corallum simple, or composite. Calyx concave. Septa, numerous, well developed, usual extend to centre, where they are twisted to form a Columella.

No external longitudinal costae. Tabulae occupy only centre of visceral chamber. Outer portions of tabulae have numerous vesicular dissepiments, sometimes arched at edge.

Genus Calicular. U. Sil. C. truncatum, C. Frochiforme. Dev. C. Ceratites, C. obtusum. Carb. C. Murchisoni, C. Wrighti, C. Rejium.



C. truncatum.

11. Endophyllum Coellum composite. Coellites more or less intimately connected by rudimentary outer walls, which are made up of irregular vesicular tissue. Inner walls strong sometimes double. Chief Septa about 32. These inwardly alternate with an equal number of smaller septa. Tabulae well developed. only Dev E. Bowerbankii.

6. Acerularia. Coellum composite. Coellites have double mural investment, which divides visceral cavity into two chambers, an inner, central, columnar, & outer annular. Septa well developed.



A. Goldfussi

No Tabulae imperfect. No Columnella.

U. Sil. A. Luxurians. A. Ananas. Dev. A. Goldfussi. A. Pentagona.

Family Goniophyllidae

2. Goniophyllum. Corallum, simple, tall, straight.
5 quadrangular. Epitheca strong, rugose, deeply folded.
Calyx square, deep, ~~at~~ Septa about 50 90 quite to centre.
U. Sil. G. Fletcheri.



Family Sauridae

- Polycalia Corallum simple, conical, cyathophylloid appearance
20. Septa primary, meet near centre, 4 in number.
Tabulae horizontal so quite across. Budding from within the cup.
Only Permian, & only permian coral. P Profundis.

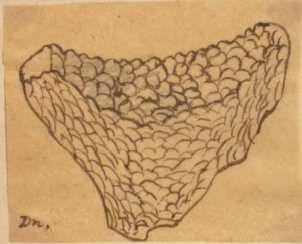


Family Cyathophyllidae

3. Ptychophyllum. (Heliophyllum, Strophodes.) Corallum simple,
pedicellate, straight, or curved. Borders of calyces much
everted giving a mushroom-like appearance. Circular, shallow
round central fossula. Epitheca wrinkled. Columnella small,
formed by twisted septa. Septa nearly 100, unequally developed,
alternate in thickness. P. Patellatum.
U. Sil.



*
7. Cystiphyllum. Corallum turbinate, sub-cylindrical, with very thin outer walls longitudinally striated. Septa quite obsolete. Visceral chamber filled with small vesicular lamellae, forming cells which curve upwards in the centre of the cavity. Columnella absent. U. Sil. C. Cylindricum. Dev. C. Vesiculosum.



C. Siluricut.



Sect.

9. Clisiophyllum. Corallum simple turbinate. Epitheca wrinkled. Calyx somewhat shallow. Septa well developed, raised toward centre of cavity to form a crestiform pseudo-columnella, or boss. U. Sil. Carb. U. Sil. C. Brevilamellatum. Carb. C. Turbinatum. C. Costatum. C. Bowerbankii.



15.

Litostrotion. (Includes Lithodendron)

Corallum composite, the Corallites often separable, round, prismatic, or hexagonal. Outer surfaces strongly longitudinally striated, & marked with ^{transverse} concentric lines of growth. Calyx, 40 to 45 radiating septa, about half of which reach the centre. Sub-Visceral Columnella formed of twisted septa. Tabulae strong. Carb. L. Basaltiforme. L. Genticum. L. Martini. L. Flemingi. L. Irregularare.



L. L. Basaltiforme.

10 Lousdalia. Corallum composite. Corallites astraciform, prismatic, unequal in size, separated by well developed clotheal walls. Calyces very deep. Septa - chief - about 24 alternate with an equal number of smaller. Columnella strong, very prominent, compressed, shows on its surface curved ascendent ridges.

U. Sil. only one species L. Wenlockensis. Carb. L. Floriformis.



L. L. Floriformis.

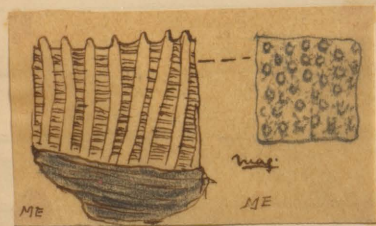
16.

Phillipastrea. Corallum resembles Acerularia, or Strombodes. Massive, flat, astraeform surface. Corallites hardly appear separable, the septa being confluent. & no apparent external walls. Calyces irregular in size, edges prominent, ^{central} internal chamber deep. Small tubercle in the middle, columella like, resting on tabulum. Carb. P. Radiata.



17. Family uncertain

Labechea. Corallum massive, forms encrusting somewhat flat expansions. Surface covered with small granular tubercles. Epitheca wrinkled. Calyces very small, confluent indistinct. Septa indistinct. Tabulae closely set in visceral chamber. U. Sil. L. Conferta



L. Conferta.

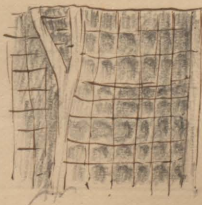
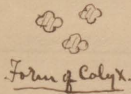
Family uncertain.

- Palaeocyclas. Corallum simple. circular, discoidal & 18. compressed. Upper surface depressed in centre, with thick ciliated rim. Epitoca covering under side, strong, concentrically wrinkled, pointed in the centre. Peduncle very small. Septa large 20 to 30. uniformly developed, alternate with equal number of smaller, edges all crenulated. N. Sel. P. Popfita. P. Fletcheri.



Fam. Stauridae

- Holocystis. Corallum composite, massive, astraeform. 19. Corallites increase by extra-calicular gemmation. Calices sub-polygonal with deep fossula. Costae small usually with an intermediate set. Septa well developed. Tabulae well developed. Columnella small styleform. L. Greensand. H. Elypus.



Aporosa

Codentata

8.

	I. Sil	U. Sil	Dev.	Carb.	Perm.	Trias.	Lias	Jur.	Crete	Palaeoc.	Westden	T. Green	Sauv.	U. Green	T. Chalk	U. Chalk	Eocene	Miocene	Pliocene.
<u>Actinopora</u>																			
<u>Tabulata</u>																			
Nebulipora	X																		
<u>Sarcinidae</u>																			
Favosites		X	X	X															
Halyptites	X	X																	
Eryngopora.		X	X	X															
Mischelonia				X															
<u>Mitiporidae</u>																			
Heliolites.		X	X																
<u>Cladidae</u>																			
Thracia.		X																	
<u>Rugosa.</u>																			
<u>Opathophyllidae.</u>																			
Petraya	X	X	X																
Gonophyllum		X																	
Ptychophyllum		X																	
Arachnophyllum		X	X																
Oruphyra.		X	X																
Acerularia		X	X																
Cystiphyllum		X	X																
Gastrophyllum		X	X	X															
Clysiophyllum		X	X	X															
Lousdalia		X	X	X															
Endophyllum			X																
Arupherus.			X	X															
Zaphrentes.				X															
Lithostrotion				X															
Phylloporina				X															
? Labechia.		X																	
? Palaeopora.		X																	
<u>Stauridae.</u>																			
Holocystis.																			
Polyelia.					X														

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imples;
uctate.

Sulcata

Case.

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Family uncertain.

Palaeocyclas. Corallium simple. circular, discoid &

18.

Fam. St.

Holoc.

19.

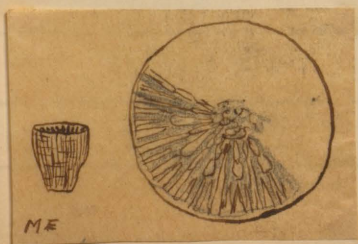
Aporosa

Fam. Turbinidae.

Turbinolia. Simple, turbinate, conical, usually straight
seldom any appearance of attachment. Wall very thin.
Septa exsert (standing above epitheca) thin, delicate & lamellar,
entire. Costae projecting, wall like, with double row of dimples,
forming interstitial grooves. Columella styleform, punctate.
London Clay. T. minor. T. Pustowichii. Bradleyan. T. Dixonii. T. Sulcata



- 1 Tecocyathus. Corallum simple. very short, with flat base.
6 adherent at any rate when young. Wall covered by very
complete, slightly striated epitheca. Constitutes a thick ring
round calyx. Calyx circular with very shallow fossula.
Septa not exsert. Palis thick. Columella large fasciculate,
formed of many plate like processes. flat papillose at top.
Lias. T. Moorei. T. Zintenabulum.



T. Moorei

2. Discocyathus. Corallum simple. free, discoidal.

Small central dimple on under surface.

Epitheca, thick, concentrically marked. Calyx slightly depressed in centre. Septa perfectly straight, exsert.

Very thin, arched over edge. numerous. Pali only about 10. Columnella formed of ~~XXXX~~ ^{Simple} plates.

Lyo 00. D. Endesii.



D. Endesii.

6 Cyathina Corallum simple, never gemiferous.

elongated, adherent, usually straight. base contracted.

Wall nearly smooth, polished towards base, delicately granulated. Calyx circular. Septa, exsert, closely set,

granular, 4 cycles. Columnella moderately developed composed of 6 or 8 vertical twisted processes.

U. Chalk Laevigata.



C. Laevigata.



C. Bowerbankii.

8 Paracypathus Corallum simple, sub-turbinate.

Calyx has large but not deep fossula. Septa broad, slightly evert. lateral surfaces echinated. Costae straight, slightly projecting. delicately granulated. Columnella broad terminating in papillose surface. London Clay P. Crassus.
P. Caryophyllis!! U. Weissand?



P. Caryophyllis.

9 Sphenotrochus Corallum simple, no trace of adherence.

Cuneiform. Calyx elliptical. Septa very broad, evert, slightly echinated. Costae very broad, not prominent. Have papillose tubercles looking like synaptae. About 13 cycles. Columnella very large, lamellar, upper margin often flexuose, sometimes bilobate. Cray. S. Intermedius.



Sect.

10. Flabellum. Coellum simple, compressed, generally free. Calyx elliptical, strongly arched parallel to ^{its} longer axis. with narrow & very deep fossulae. Septa, very numerous, not exsert, all papillose, or echinate. Columnella spurious. Wall slightly covered by them, epitheca. Crag. F. Woodii. Living.



F. Woodii



F. Woodii

4 Fam. Fungidae.

Comoseris. Coellum composite, massive, free, or fixed by a small portion of the epitheca. Upper surface convex. uneven, divided to numerous radiating vallies. most of ridges straight, or slightly flexuose, usually meet towards centre of coellum. Calyces very irregularly grouped, centre of each only made apparent by small well defined fossulum. Septa become parallel, & meet those of opposite coellite in curious crestiform ridges. qf-oo. C. Vermicularius. Coal crag. C. Irradians.



C. Vermicularius

3

Anabasia. Corallum simple, circular, with thick rounded edge, 8 small circular shallow fossola. Septa about 150 very close equal, regularly denticulated. Small septa join larger & often appear L-bifurcate before reaching centre of corallite. Dup 00 to corumbreak
A. orbulites.



A. Bouchardi

5 Microbasia. Corallum simple, lenticular, plano-convex. Epitheca forming base, covered with numerous radiating lines. Septa very thin, not very numerous, straight, slightly echinate. Costae closely set, narrow, echinate. Columnella small oblong papillose. U. Greensand M. Coronula.



M. Coronula. (Mag)

Fam. Astreae

- 11 Thamnastraea. Corallum composite, massive, fungoid, basal plate often lobate. Calyces very shallow, unequally developed. Closely set, arranged in concentric series. Septa 26 to 30, closely set, upper edges delicately denticulate. Loo I. Syraniana. Middle oo Far. Arachnoides.



- 14 Isastrea. Corallum massive, composite, always slower. Epitheca complete, covering base. Calyces shallow, polygonal. Septa 28 to 44, slightly exsert. Closely set flexuose, denticulate. Upper edges nearly straight. (Only Coral known to secrete silica etc.) Loo oo I. explanata. Portland. I. oblonga.



I. Helianthoides.

- 12 Thecosmilia. Coellum Composite, prolate, stout common trunk, from which ascend fasciculae of corallites, which are enveloped in a thick common epitheca. Calyces when free nearly regular circles, often irregular, & united in twos or threes. Septa very exsert, edges strongly denticulate. Coral ray T. Annularis. Coral Ray & Carubrash T. Gregaria.



T. annularis.

- 13 Stylinia. Coellum massive, convex above, flat below, Corallites nearly cylindrical, diverge in fasciculae from a common base. Calyces circular, somewhat uneven with deep fossula. Septa 22 or 23, forming about 3 complete cycles. Costae marked by single row of granules. Zyoo S. Solida. Coral Ray S. Tubulifera.



S. Solida.

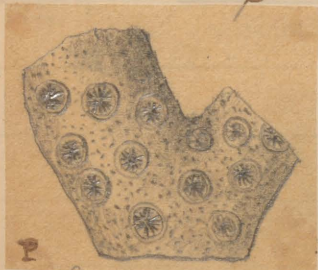
- 15 Paraemilia. Coellum simple, small, pediculate, adherent, usually twisted. Calyx nearly circular very deep. Septa exsert granular, arched at apex. Walls strong, costated, slightly granulated. U. Chalk P. Centralis. P. Filowii. (Columella spongy.)



P. Centralis.

16

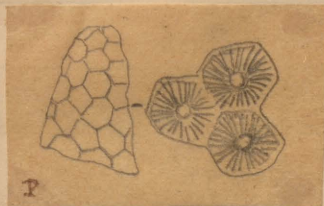
Cryptangia. Corallum agglomerate. Corallites, cylindro-turbinate, imbedded in an extraneous mass of Caenenchyma. Epitheca striated, complete, Calices have deep fossalae. Septa thin, far apart, upper edges straight, dentate, Columella papillose well developed. Coral Crag C. Woodii.



C. Woodii.

Perforata.Fam Poritidae.

17 Litharia. Corallum composite, made up of very irregularly reticulated sclerenchyma. Wall almost obliterated by perforations. Almost always attached to pebbles. Calices shallow. Septa well developed near walls. Columella spongy. Brookham L. Websteri.



L. Ameliaana.

Fam Madreporidae

Sub. Fam. Eupsamidae

18

Dendrophyllia. Corallum composite, arborescent,
Coellites cylindrical. Calyses circular with very deep
fossulae. Septa thin, closely set, not erect. Columella
very well developed. Costae narrow, vermiculate,
made up of granules. Walls very thick. Spunation
lateral. Brecklesham ♂. Dendrophyllodes.



D. Digitata.

19.

Balanophyllia. Corallum simple, cylindro-turbinate.
Adherent by broad base, erect but not tall. Walls composed
of porous tissue, covered by a peculiar epitheca.
Septa well developed, bifurcate, & trifurcate. Costae
narrow, equal, closely set. Columella narrow,
elongated, crowded? Cray & Living. Cray. B. Calyculus.



B. Subcylindrica.

Coelenterata.

Actinozoa

Aporosa

Turbinolidae.

Thecocyathus.

Dicocyathus.

Fung

Anabasia.

Comoseris.

Microbasia.

Cyathina.

Turbinolia.

Paracyathus.

Sphenostrocha.

Flabellum

Astridae.

Thermostrea.

Thecosmilia.

Stylina.

Isastrea.

Parasmilia.

Cryptangia.

Perforata.

Poritidae.

Litharea.

Eupomidae.

Dendrophyllia.

Balanophyllia.

T. Sil

U. Sil

Dev.

Carb.

Perm.

Trias.

Lias

S. oo

M. oo

U. oo

Purbec

Walden

T. Green

Gault

U. Green.

L. Chalk.

U. Chalk.

Eocene.

Miocene.

Pliocene.*

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Class

Cephalopoda.

for description vide Woodward p. 15-5.

order Tetrabranchiata.

Animal creeping protected by an external shell.

Head retractile within the mantle. Eyes pedunculated.

Mandibles calcareous. Arms very numerous. Body attached to the shell by adductor muscles, & by a continuous horny girdle.

Branchiae four. Funnel formed by the union of 2 lobes which do not form a complete tube.

Shell external, camerated & siphuncled; The inner layers & septa nacreous; outer layer porcellanous.

Very long; straight, or folded, or coiled. Internally divided into chambers by septa, connected by a siphuncle.

Edges of septa curved, as in nautilus & orthoceras, zigzag as in goniatites, or foliaceous as in ammonites.

Family Ammonitidae

Shell. Body chamber elongated, aperture guarded by processes & closed by an operculum. Sutures angulated, or lobed & foliated. Siphuncle external.

Genus Ammonites.

Shell discoidal, inner whorls more or less concealed; septa undulated; Sutures lobed & foliated; siphuncle dorsal.

The ammonites are divided into 6 sections by the characters of the back of the shell.

Section a. With entire, dorsal keel.

Is divided into three groups.

1. Arietes. 2. Falciferi. 3. Cristati.

Group I. Arietes. Shell. sides ornamented with simple radiating ribs; back squared, with median keel, in which the siphon placed. Mouth; almost always beaked. Sutures; of unsymmetrical lobes & saddles. Lobes; dorsal, usually deep as broad. Saddles, dorsal short; lateral long. Only Lias. L. Lias. A. Bucklandii. A. Combereri. A. obtusus. A. Brookii.



A. Bucklandii

Group II. Falciferi. Shell compressed; sides ornamented with sigmoidal folds; never tuberculated; Back Sharp Keeled, no furrow at sides of Keel. Lobes & Saddles unequal. Lias & oolite. U. Lias. A. Serpentinus. A. Biprons. U. Lias & Lufoo. A. Falcifer. Lufoo. A. Murchisonae. (A. Elyans. & A. Planorbis, perhaps come under this group.)



A. Biprons

Group III. Cristati. Shell, sides ornamented with bifurcated, bent, ribs. Compressed. Keel prominent. Mouth, beaked by extension of dorsal ridge. Lobes & Saddles equally developed, & symmetrical. Cretaceous. Gault. A. Cristatus. U. Greensand. A. Rostratus. U. Greensand & L. Chalk. A. Varians. Chalk marl. A. Coepii.



A. Varians

Section B. Back channeled.

Group 4. Tuberculati. Shell has lateral ribs, 8 tubercles which always alternate along the back. Back sharply excavated along centre, for canal. Mouth rostrated. Lobes unsymmetrical; dorsal shorter than supra-lateral. Saddles unsymmetrical. Middle Cretaceous. Gault. A. Tuberculatus.
A. Latus. Chalk marl. A. Falcatus.



A. Latus.

Section C. Back sharp, but not keeled.

Group 5. Clypeiformi. Shell compressed; delicately ribbed; nearly smooth. Strictly involute, the last whorl embracing all the others. Lobes very unsymmetrical. Inf 00. A. Clypeiformis. L. Lias. A. oxyotus. Cornbrash.
A. Discus. off. Clay. A. excavatus. Gault. Abicurvatus.

Section D. Back prominent crenated.

Group 6. Amalthei. Shell ornamented on sides by gently folded, arcuate, or sigmoidal ribs; Back Sharp Crenated.

Mouth beaked dorsally. Lobes unsymmetrical, dorsal shorter than supero-lateral. Saddles unsymmetrical.

M. Liás. A. Margueretatus (= A. Amaltheus. A. Stokesii)

A. Spinatus. A. Caudatus. Corubrasch. A. Lamberti. A. Fleicosatus.

off. 8 km. clay

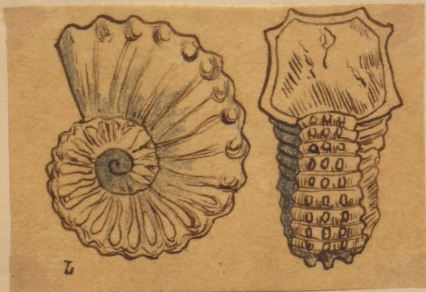
(Woolgarii. L. Chalk)



A. Margueretatus

Group 7. Rhotomagensis. Shell inflated; whorls square or oval; ornamented with oval ribs which bear several ranges of tubercles; one row always along centre of back. Lobes & Saddles symmetrical. L. Chalk.

A. Rhotomagensis. A. Mantellii. A. Woolgarii.



A. Rhotomagensis

Group 8. Palchella. Unrepresented in Britain,
unless by A. Crenatus of the Oxford Clay.

Section E. Back excavated, sides tuberculated.

Group 9. Dentate. Shell, inflated; laterally ribbed; Ribs
often bifurcating. Tubercles on each side of back, at
extremities of ribs, prominent. Lobes unequal. Saddles equal.

Division I. Tubercles on sides of back alternate.

Gault. A. Interruptus. A. Splendens. A. Tuberculatus?

Division II. Tubercles on sides of back opposite.

Gault (at base) A. Mammularis (only English species).



A. interruptus.

Group 10. Ornat. Shell inflated; back very slightly hollow,
narrow; bordered by tubercles; Usually another range
of tubercles along middle of sides of shell. Lobes unsymmet.
dorsal usually short, Supero-lateral projects & forms beak.
Saddles unsymmetrical. Oxford clay & Kelloway rock.
Ox. clay. A. Jason. A. Duncan. A. Castor, A. Pollux.
Kelloway. A. Callovicensis.



A. Jason

Section F. Back more or less squared.

Group 11. Flexosi No British example.

Group 12. Compressi No British example.

Group 13. Armati. Shell with square whorls.

Back, ^{broad} furrows do not go distinctly across;
row of tubercles on each side. Sides usually
with one, sometimes with two ranges of tubercles.
Lobes unequal. Saddles equal.

L. Lias. A. Armatus. A. Dudereri. A. Birchii.

Coral Rag. A. Perarmatus. A. Catena.



A. Perarmatus



Group 14 Angulicostati. Shell thick; whorls nearly round;

Back narrower than sides; elevated ribs from the
sides pass over it; a line of spines along each edge.

Lobes unequal. Saddles nearly equal.

(Differs from Planulata by having square back.)

Cretaceous. L. Greensand. A. Deshaypii. A. Martini.

A. Hambrovi. L. fr. & fault.



A. Deshaypii

Group 15: Capricorni. Shell with convex whorls, having
 simple & plain ribs, inflected forward over dorsal edge.
 Inner whorls all exposed. Back broad. Lobes unequal.
Saddles equal. All Middle Lias. A. Capricornis.
 A. Planicostatus (= maculatus) A. Mayanisti.
 A. Brevispina.



BF

A. Planicostatus.

Section G. Back rounded & convex no keel.

Group 16. Heterophyllia. Shell compressed, involute,
 sides smooth, or radially striated. Back very convex
 narrow. Lobes very much ramified unsymmetrical.

Division I. Saddles unsymmetrical. U Lias. A. Heterophylla.
Division II. Saddles symmetrical. Cret. A. Lewisensis.



BF

A. Heterophyllia

Group 17. Lijati. Shell usually compressed, smooth,
or undulated; marked at intervals by verices.
Back convex slightly compressed. Lobes unequal. Saddles
equal. Gault. A. Rotula. A. Bendaui.

Group 18. Planulati. Shell discoidal compressed;
whorls striated, or very closely ribbed. Ribs byurcate
about middle of side; often serrated, Whorls sometimes
spined. Lobes unequal. Saddles equal.
Mid. Lias & Portland. M. Lias. A. Davii. U. Lias.
A. Communis. A. Annulatus. W. Clay. A. Achilles.
Kim Clay. A. Biflex. A. Triplicetis. Portland. A. Giganteus.



BJ

A. Communis.

Group 19 Coronati. Shell. folds do not overlap.

Lobes unequal. Saddles equal. Ribs bifurcate. Simple at sides, divide over back 3 or 4.

(Distinguished from Planatuli by having a tubercle at point of bifurcation of ribs.)

M. Lias. A. Beechii. Supra. A. Blaydeni, A. Braikenridgii.
A. Humphreianus. A. Liczac.



A. Braikenridgii.

Group 20. Macrocephali. Shell like coronari, but more inflated; tubercles almost always round deep umbilicus. Ribs bifurcate. Supra & Supra-lateral Lobes both above tubercles. Supra. A. Bronniarti. Clay & Kelloway.
A. Macrocephalus. Kelloway A. Sublaevis. A. modiolaris.
Neocomian. A. Nutfieldensis.



A. Sublaevis.

Group 21. Fimbriate. Shell discoidal; whorls cylindrical just touching. Smooth, or ornamented at certain distances by salient ribs, marking the successive positions of the mouth. Lobes equal. Saddles equal. M. Lias. A. Fimbriatus. U. Lias. A. furensis. Inf. oo. A. Endesianus. Neocomian. A. Strangulatus.

Family Nautilidae.

Nautilus. Shell involute, or discoidal; few whorled. Siphuncle central. Septa transverse concave, margins simple. Umbilicus small or obsolete in the typical nautilus where the whorls enlarge rapidly. In the Palaeozoic the whorls increase slowly & are sometimes scarcely in contact. In recent the shell smooth, in many fossil corrugated. Subt recent. Dev. N. Megasypho. Carb. N. Biangulatus. Lias. N. Latidorsatus. Inf. oo. N. obtusus, N. Lineatus. Inf. oo. N. Hexagonus. Neoco. N. Pictatus. Lond. clay. N. Imperialis. Permian N. Frieslebeni. Lias. N. Pomphilius.



N. Imperialis.

Discites (sub-genus) Shell discoidal, compressed; whorls all exposed, quadrangular; Back flat or concave. Siphuncle nearer dorsal margin than in nautilus. Septa concave, simple. Carb only. *D. Discus*. *D. Complanatus*. *D. Mutabilis*.



3 Clymenia Shell discoidal, whorls exposed; Siphuncle on inner edge. Septa nearly smooth, but have angular lobe on each side.

Devonian. *C. Undulata*. *C. Phillipii*. (nearly all in U. Devonian)



C. Linaris



Family orthoceratidae

Orthoceras. Shell straight; conical; many chambered
4 body chamber small. Siphuncle central or nearly,
almost cylindrical. Septa transverse, simple.

Caradoc. O. Annulatus. L. Sil. O. Shek. U. Sil. O. Bellatius.

Dew. O. cylindricum. Carb. O. Distans.

L. Sil. O. arcuolopatum. O. Andak. L. Sil. O. Filosum,

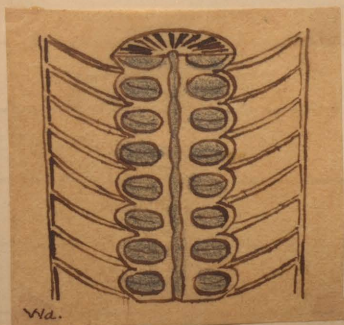
U. Sil. O. Bullatum.



Actinoceras Shell straight, & resembles orthoceras.

5- Siphuncle large, inflated, or beaded, between the chambers
contains an inner tube, connected with the walls of the
siphuncle by radiating lamellae. U. Sil. & Carb.

U. Sil. A. Bristii. Carb. A. Laterale.



Phragmoceras. Shell curved, compressed, conical.

6 Septa simple, edges crossed by sigmoidal lines of growth.

Siphuncle ventral, slightly dilate between septa.

Mouth contracted in the middle.

L. U. Sil. L. Sil. P. Mantileum. P. Ventricosa. P. Pyramis.



P. Ventricosa.



Cyrtoceras. Shell somewhat conical in section.

7 Curved. Whorls do not touch. Last chamber nearly straight. Siphuncle dorsal. Septa simple or slightly

aperture ^{elliptical} waved. L. Sil. to Carb. U. Sil. C. proximatus. See.

C. reticulatum. Carb. C. Ruyosum.



8 Lituities. Shell spiral, last chamber produced & straight.

Whorls usually in contact at first. Siphuncle Central, or slightly dorsal, circular. Septa simple, deflected backwards along dorsal margin.

L. Sil. L. Anguiformis. L. U. Sil. L. conuarius U. Sil. L. articulosus



L. ligatus



(Family Ammonitidae)

9 Goniatites. Shell involute; body chamber occupies more than one revolution of shell. Siphuncle delicate, dorsal. Lobes & saddles of septa have no lateral denticulations.

Carb. G. Grevista. G. Henslowii.



G. Grevista



Order. Tetrahanchiata

Class. Cephalopoda

* 10.

Family Nautilidae.

Ammonites.

Sect. A.

Arietes.

Falciferi.

Cristati.

B. Tuberculati.

C. Clypeiformi.

D. Amalthei.

Rhotomagens.

(Palchelli.)

E. Dentati.

ornati.

F. (Fleusii.)

(Compressi.)

Armati.

Amplicostati.

Capricorni.

G. Heterophyllia.

Ligati.

Planulati.

Coronari.

Macrocephali.

Fimbriati.

Goniatites.

Nautilidae

Nautilus.

isocetes.

Clypeunia.

Orthocerasidae

Orthoceras.

Actinoceras.

Phragmoeras

Cyrtoceras.

Lituites.

	L. Sil.	U. Sil.	Dw.	Carb.	Penn.	Trias.	Lias.	L. OO.	M. OO.	U. OO.	Packe.	Walden.	L. Spem.	Sault.	U. Green.	L. Chalk.	U. Chalk.	Colona.	Miocene.	Pliocene.
Arietes.	U						IX													
Falciferi.	U						UX	IX												
Cristati.	E													X	X	X				
B. Tuberculati.	U													X	X	X				
C. Clypeiformi.	U						IX	X	X	X	X	X	X	X	X					
D. Amalthei.	U						MX	X	X	X										
Rhotomagens.	E													X	X	X				
(Palchelli.)																				
E. Dentati.	UE													X						
ornati.	U							X												
F. (Fleusii.)																				
(Compressi.)																				
Armati.	UE						IX	X	X											
Amplicostati.	UE												X	X						
Capricorni.	UE						MX													
G. Heterophyllia.	UE						UX	X	X	X	X	X	X	X	X	X	X	X	X	X
Ligati.	UE												X	X						
Planulati.	UE						MX	X	X	X										
Coronari.	UE						MX	IX												
Macrocephali.								IX	X	X	X	X	X	X						
Fimbriati.	E						MX	X	X	X	X	X	X							
Goniatites.				X																
Nautilus.		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
isocetes.				X																
Clypeunia.			X																	
Orthoceras.	X	X	X	X																
Actinoceras.		X	X	X																
Phragmoeras	X	X																		
Cyrtoceras.	X	X	X	X																
Lituites.	X	X																		

Phragmoeras.

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Order Debranchiata

Animal swimming, naked. Head distinct. Eyes sessile prominent. Mandibles horny. Arms 8 or 10, provided with suckers. Body round or elongated, usually with a pair of fins. Branchiae two. Ink gland always present. funnel a complete tube.

Section Decapoda.

Family Belemnitidae. Shell consisting of a few, terminating posteriorly in a chambered cone, sometimes invested with a fibrous guard, or ossilet. The air cells of the phragmocone, are connected by a siphuncle, close to the ventral side.

Belemnites. Phragmocone horny, slightly nacreous with a minute globular nucleus, or spherule at its apex. Divided to numerous chambers by concave septa. Pen represented by 2 nacreous bands on the dorsal side of the phragmocone, & produced beyond its rim in the form of sword shaped processes. Guard, fibrous, elongated, cylindrical, becoming very thin in front where it invests the phragmocone.

Belemnites are divided into five groups by the presence or absence, & position of furrows on their surfaces.

Sect 1. Acuari. No lateral furrows, nor dorsal or ventral grooves. Channeled at extreme point (Transverse section usually trilobed).

Lias. *B. Acuaris.* *B. Irregularis.* (*B. Bruyerianus*)
B. Elongatus. *B. acutus* (= *B. Brevis*). Lufwood 8 ft-00
B. Giganteus. Off. Clay. *B. Excentricus.* *B. Passianus*
(= *B. oweni*) Portland. *B. Souckii.*



2 Clavati Guard generally clavate. No dorsal or ventral grooves. Lateral furrows. Lias. *B. Clavatus.* *B. Tesoquianus*



3 Canaliculati. Deep ventral groove along whole length.
 No lateral furrows. Lyo. B. Sulcatus. Lyo & St
 B. Deblanvillii. St. B. Canaliculatus. B. Fusiformis.
 B. Bessinus.



4 Hastati Ventral furrow on part of length. Two
small lateral furrows at point.

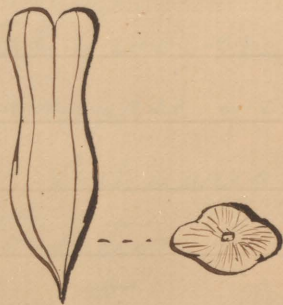
Lias. B. Subfusiformis. Og. Clay. B. Hastatus. B. Tricaniculatus
Noco. B. Semicaniculatus. Gault. B. Minimumus.



5. Dilitate. Dorsal groove & furrowed on each side.

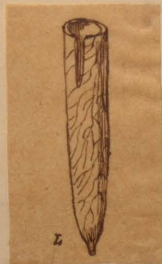
Guard compressed.

Neocomian. *B. Dilitatus*, *B. latus*. *B. Polygonalis*.



Belinmitella. The Guard has a straight fissure on the ventral side of its alveolar border; open above & closed below. Surface marked with distinct vascular impressions. Phragmone never preserved but was chambered & had an apical nucleus.

Chalk. *B. mucronata*. *B. compressa*.



B. mucronata



Order Tibranchiata

Sect. Decapoda

Fam Belemnitidae

Class. Cephalopoda

* 11.

Belemnites

Ocuari.

Clavati.

Canaliculati.

Hastati.

Dilitati.

Belemnitella.

	T. Sil.	U. Sil.	Dev.	Carb.	Perm.	Trias.	Jur.	T. oo.	M. oo.	U. oo.	Purbe	Melba	T. spm.	Quat.	U. spm.	T. Chalk.	U. Chalk.	Eocene	Oligocene	Pliocene
Ocuari.								X	X	X										
Clavati.								X												
Canaliculati.								X												
Hastati.							X	X	X	X	X	X	X	X						
Dilitati.													X							
Belemnitella.																	X	X		

233 Genera
In Tables.

57

Sililate

Ligati

about some paper.

Be

The parts of a typical corallite are these.

An outer wall or theca cylindrical in form & terminating distally in a cup or calice, & having its central axis traversed by a columnella. The space between this & the theca is divided into loculi, by radiating septa. These sometimes do not reach the columnella, but are broken up into pali, arranged in one two or 3 circular rows termed coronets. There are also often imperfect transverse partitions or dissepiments which growing from the sides of the septa interfere with the continuity of the loculis. The septa sometimes have their sides covered with echinate processes, which ~~occasionally~~ in some instances connect the septa, & form transverse props or sympetichalae. In other cases the dissepiments are replaced by complete tabulae. On the outer surface of the theca may occur costae corresponding in position to the septa within. Exothecae which arise from the sides of the costae & thus represent the dissepiments. A continuous layer or epitheca consisting of the coalesced external indications of the tabulae.

(Zimm. Man. of Coelenterata)

Notes.

Actinoptera. only known in fossil state by their calcareous skeletons or corals.

No Palaeozoic genus of coral survives that period, but Chaetetes which is found in the Trias. No Triassic coral still lives. 7 Jurassic still survive. 14 recent genera appear in the Chalk

Silurian. consist almost altogether of Tabulata & Rugosa.

Devonian. also almost wholly Tabulate & Rugose.

Carboniferous has the same character.

Permian. only known British coral Polysiphonia (Rugose)

Trias here the Astreaeae first appear.

Jurassic. No Rugosa known. & Millepora a recent genus is the only representative of the Tabulata.

The greater number of the corals belong to the Aporosa the Family Astreaeae being very well represented. The

genera Stylinia & Moutillivaultia are especially rich in species. Two genera represent the Perforata.

Cretaceous here Holocystis the last rugose appears. Tabulata are represented by 1 or 2 genera. The corals are chiefly of the orders. Aporosa & Perforata

The Tertiary has much the same character. Only one genus of Tabulata is known.

(Greene. Man. of Coelenterata)

Obtuse: only known in fossil state in the Carboniferous
 System in Canada.
 No larger form of coral known that could be identified
 with it in the same. No trace of coral still seen
 in the same strata. It is not known to occur in
 the chalk.

Sclerium: several distinct forms of Sclerium & Leptæa
 known from the same strata. Sclerium & Leptæa
Carboniferum has the same character.

Leptæa: only known fossil form is Leptæa (Purser)
 which has the character of the Leptæa fossil form.

Purser: No larger known form of Purser is known
 than the only representative of the Leptæa
 the greater number of corals belong to the Purser
 the family Leptæa and the Purser is the
 genus Leptæa & Purser is especially rich in
 these two genera represent the Purser

Leptæa has been identified to the last degree of the Leptæa
 the representative of the Purser the coral is
 of the order Leptæa & Purser
 the Leptæa has much the same character. The
 genus of Leptæa is known
 (Purser's Leptæa)

order. Trilobita.

There are about 46 Silurian. 22 Devonian, 1
4 Carboniferous genera.

Miss. Vol. 10

There are about 40 specimens of *Perissoneura*

perissoneura

1. Arietes

Lias. Bucklandii
Cuneberii
Obtusus
Brookii.

2. Falciferi

Lias. Serpentinus
Byronus.
oo. Falcifer
Murchisonae,

3. Cristati.

Cret. Cristatus
Rostratus
Cooperi.

4. Tuberculati

Cret. Tuberculatus
Latus
Falcatus.

5. Clypeiformi

Lias. otyrotus
oo. clypeiformis
Discus.
Excavatus
Cret. Bicurvatus.

6. Amalthei

Lias Marqueratus
Spinatus
Caudatus
oo. Lamberti
Flexicostatus

7. Rhotomagens

Cret. Rhotomagensis
Mantelii
Woolgarii.

8. 9. Dentati

Cret. I. Interruptus
Splendens
II. Mammularis.

10. ornate
ov. Jason
Dumalani
Castor
Pollux
Calovicennis.

11. 12. 13. Armate
Leas. Armatus.
Dudresseri
Birchii.
ov. Perarmatus
Catena.

14. Angulicostati.
Crit. Deshayzii. X
Martini.
Hambrookii.

15. Capricorni
Leas. Capricornis
X Planicostatus
Mangusta
Brevifera.

16. Heterophyllia.
Leas. I. Heterophyllia
Crit. II. Lewisensis.

17. Ligati.
Rotula
Beaudanti.

18. Planulati.
Leas. Davii
Communis
Annulatus
ov. Achilles
Biflex
Triplicatus
Sigaretus.

19. Coronari
Leas. Beechii.
ov. Blaydeni
Brakenridgii.
Humphreysianus
Lig. Lay.

20. Macrocephali

oo Bronquiarti.

Macrocephalus

Sabbevis.

Modiolaris.

Cret Nutfieldensis.

21. Fimbriati

Lias Fimbriatus

Jurensis.

oo. Eudesianus.

Cret. Strampulatus

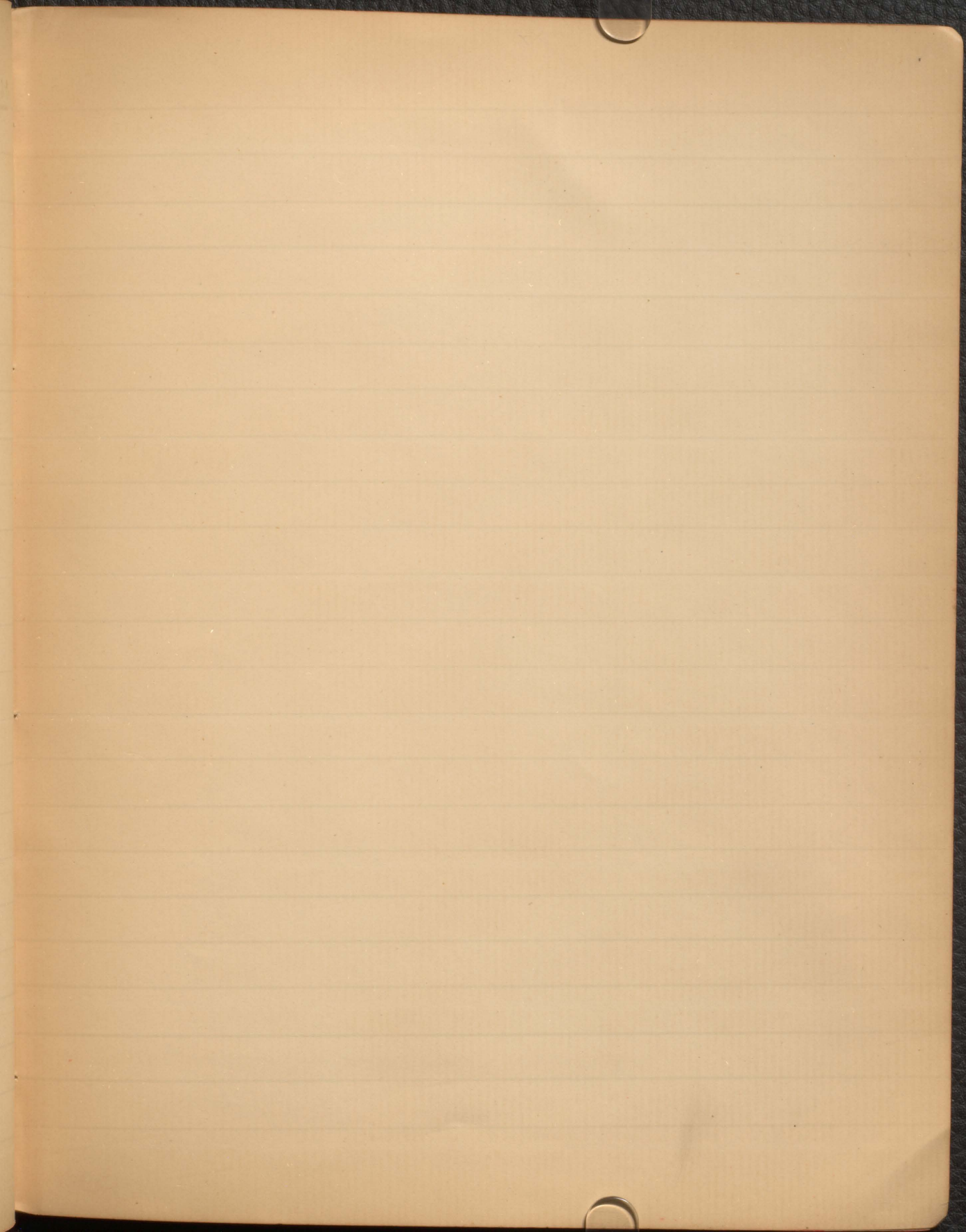
Age I Acropus U. Ludlow to Perm.

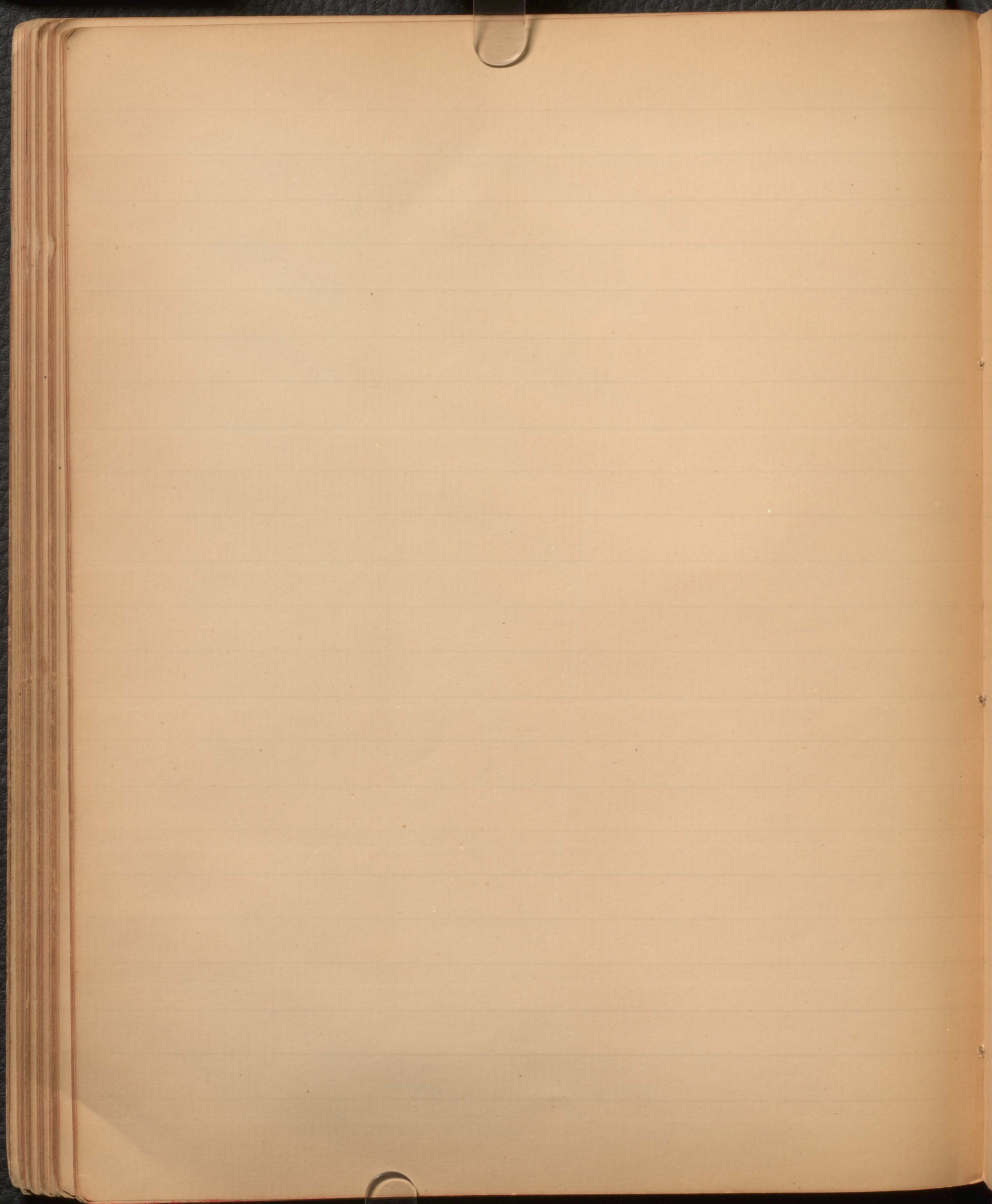
Age II. Gymnosperms Lias to Upoo.

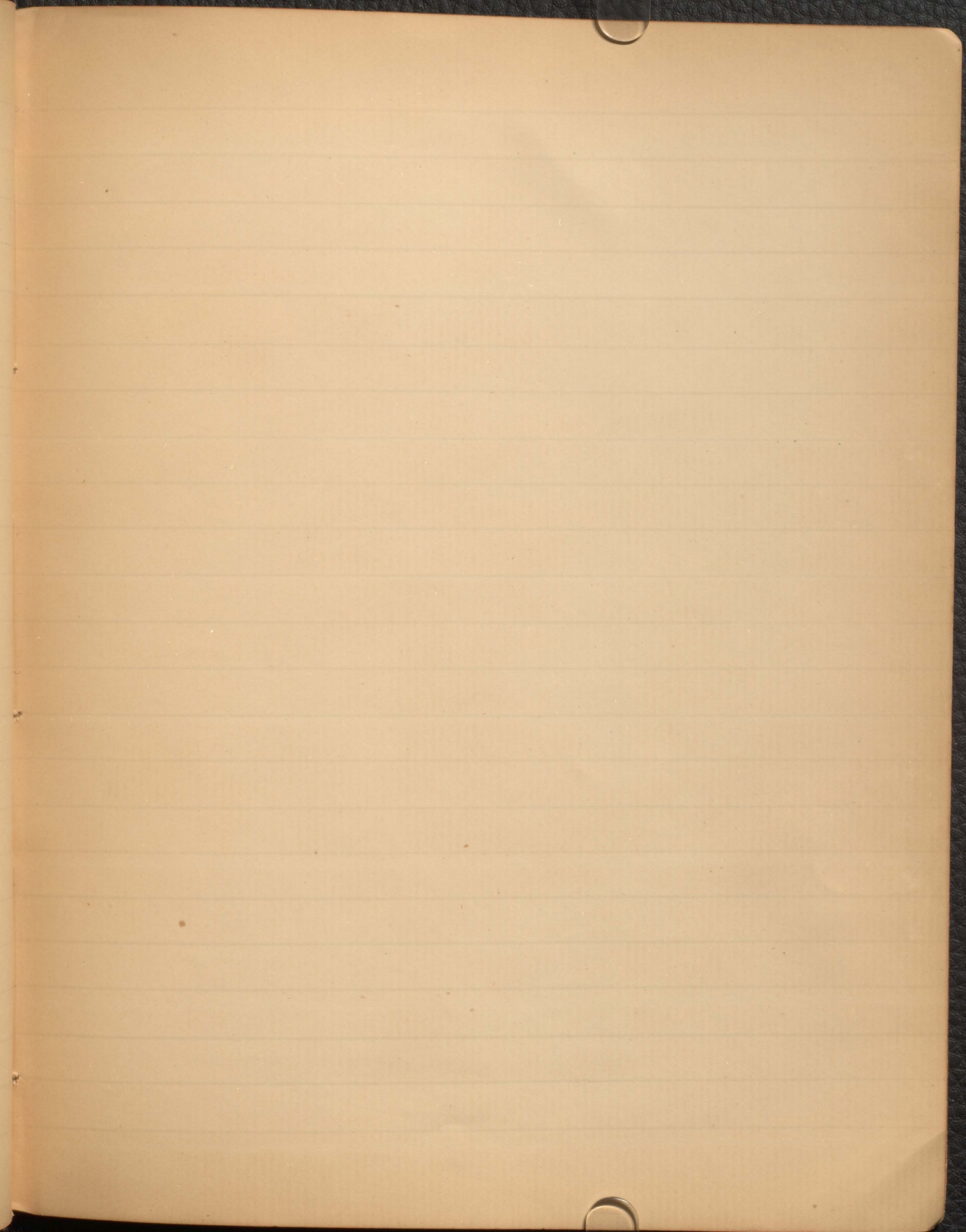
Age III. Angiosperms Cret to Modern.

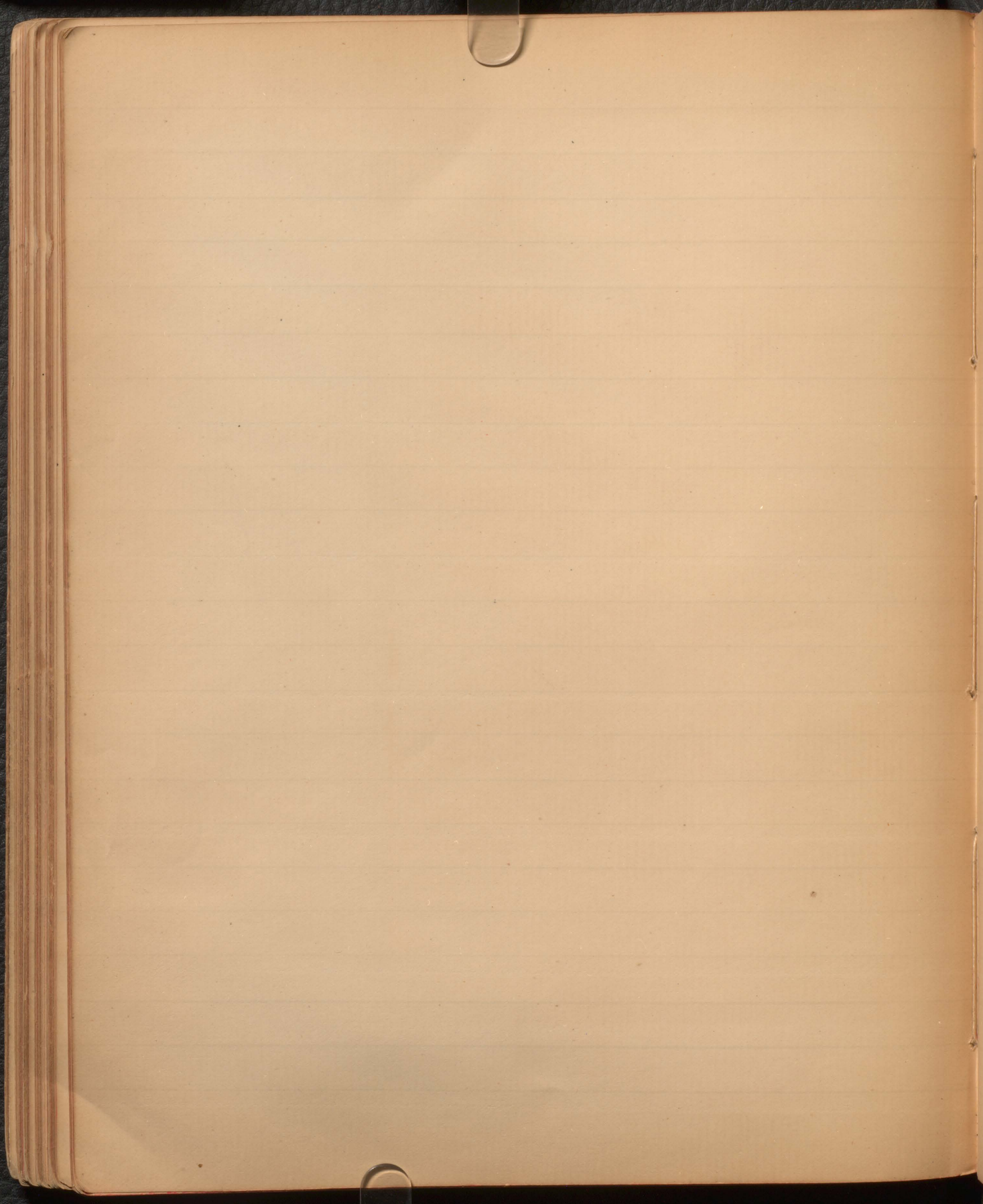
1870

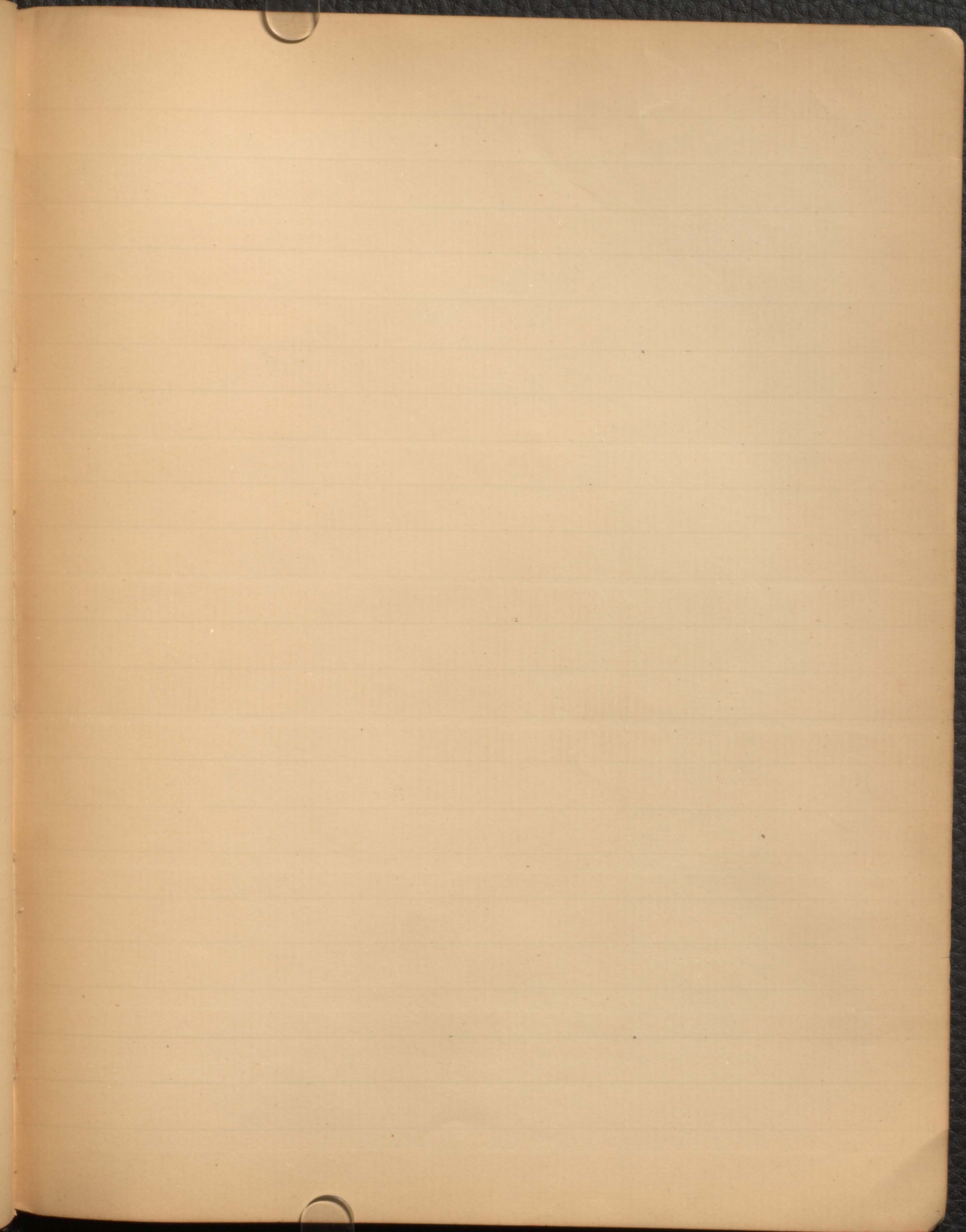
The first of the year
 was a very cold one
 and the snow lay on the
 ground for several
 days. The wind was
 very strong and the
 snow was blown in
 great drifts. The
 weather was very
 disagreeable and
 the people were
 very much
 distressed. The
 snow was very
 deep and the
 people were
 very much
 distressed. The
 snow was very
 deep and the
 people were
 very much
 distressed.

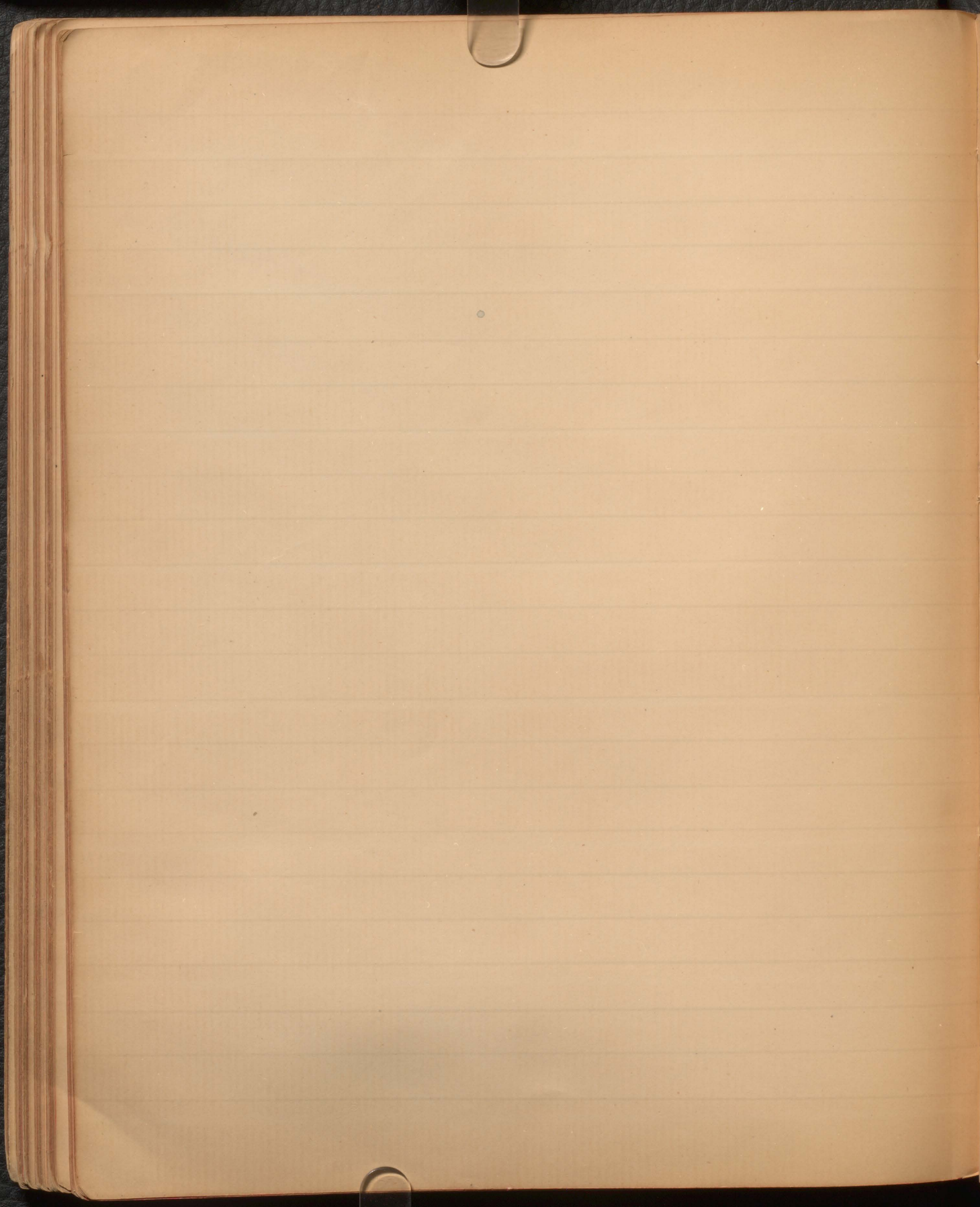


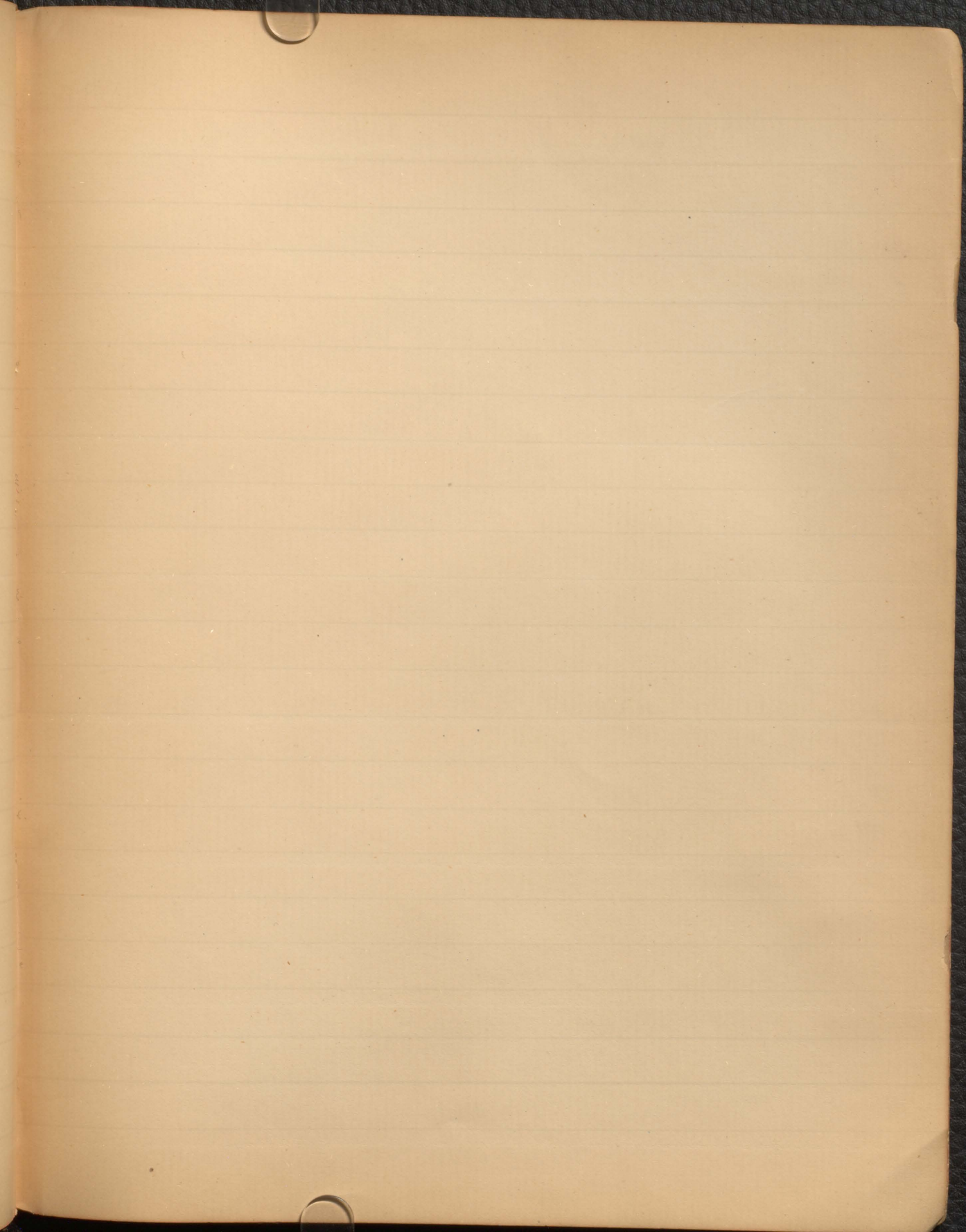


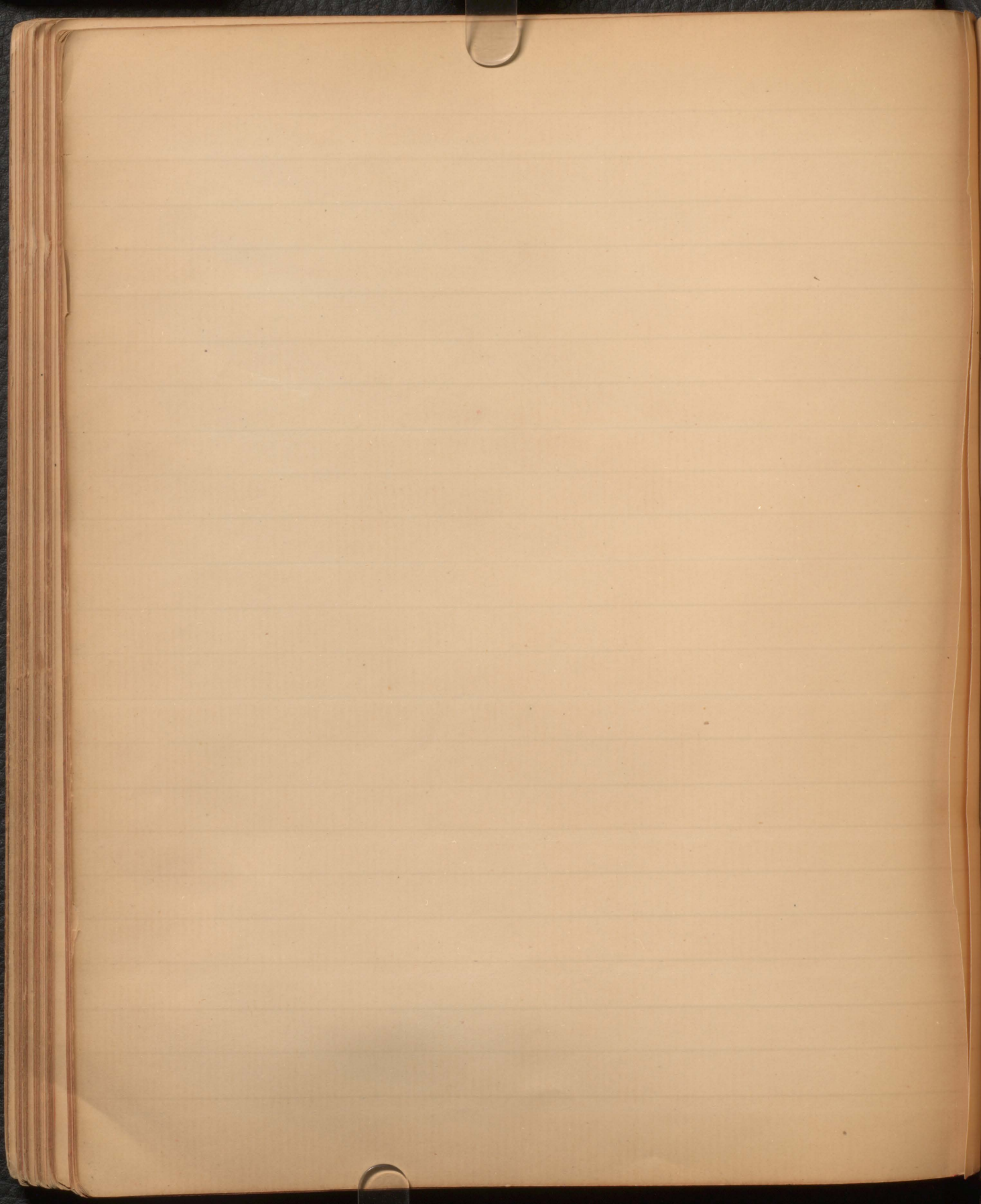


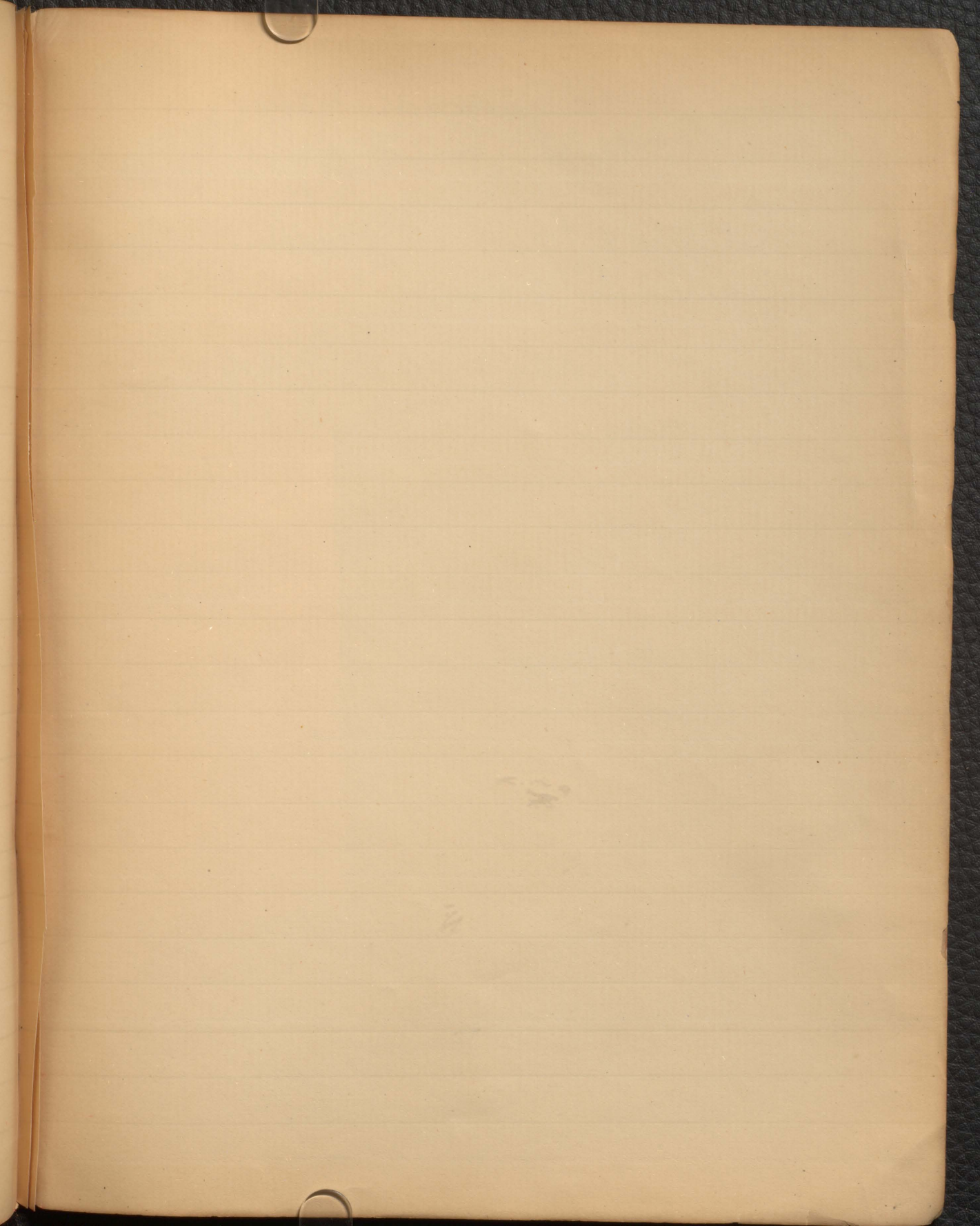










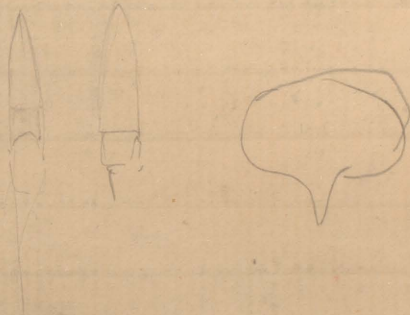


? *Brissus* *minimus* U. Chalk, Gault.
Spiratites *pori* Dew?

A. *Planicostatus*. L. Lias. ? only middle.

A. *Complanatus*. Falcifer M. Lias. ? only upper.

? *Woolgarii* *analthu* *abalgaria* or *Rhotomagensis*.



Dr. G. M. Carpenter.

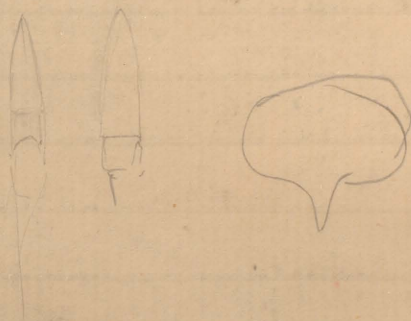
- D. Davidson's. Brit. Fos. Brachiop.
L. Hyatt. Student's Elements of Geology.
H. H. Lindley & Hutton's Fossil Flora.
J. Tukes's Manual of Geology.
P. Pictet. Traité de Paléontologie
B. F. Chart British Fossils.
M. Murchison. Siluria.
S. Salter's. Brit. ~~Ammonoites~~ Crustaceans (Chart).
D. Dana. Manual of Geology.
F. Forbes. Echinodermata of Brit. Tertiary.
O. Oolitic Echinodermata. Rep. Geol. Palaeont. Socy.
W. Woodward. Manual of Mollusca.
M. E. Lillie, Edwards & Haime. British Fossil Corals.

? *Bressus* . Minimum U. Chalk, 7 Gault.
Foriatites fori Des?

A. *Planicoctatus* . L. Lias . ? only middle.

A. *Complanatus* . Falciger M. Lias . ? only upper.

? *Woolgari* Amalthei ~~Woolgari~~ or *Rhotomagensis*



	DBS	C.	LO	NO
<i>Calamites</i>		x		
<i>Squianthia</i>			14	
<i>Actinophyllites</i>		x		
<i>Neuropteris</i>		x		
<i>Cyclopteris</i>		x	x	
<i>Stopteris</i>			x	
<i>Pecopteris</i>		20	20	
<i>Althopteris</i>		x		1
<i>Sphenopteris</i>		x	+	x
<i>Sigillaria</i>		x		
<i>Polyphyton</i>	x			
<i>Ordavites</i>		x		
<i>Knorria</i>		x		
<i>Halenia</i>		x		
<i>Lepidodendron</i>		x		
<i>Ulotendron</i>				
<i>Cyathium</i>			x	x
<i>Filices</i>				x

- D. Davidson's. Brit. Fos. Brachiop.
L. Huxl. Students Elements of Geology.
W.H. Lindley & Huttons Fossil flora.
J. Tukes's manual of Geology.
P. Pictet. Traité de Paléontologie
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