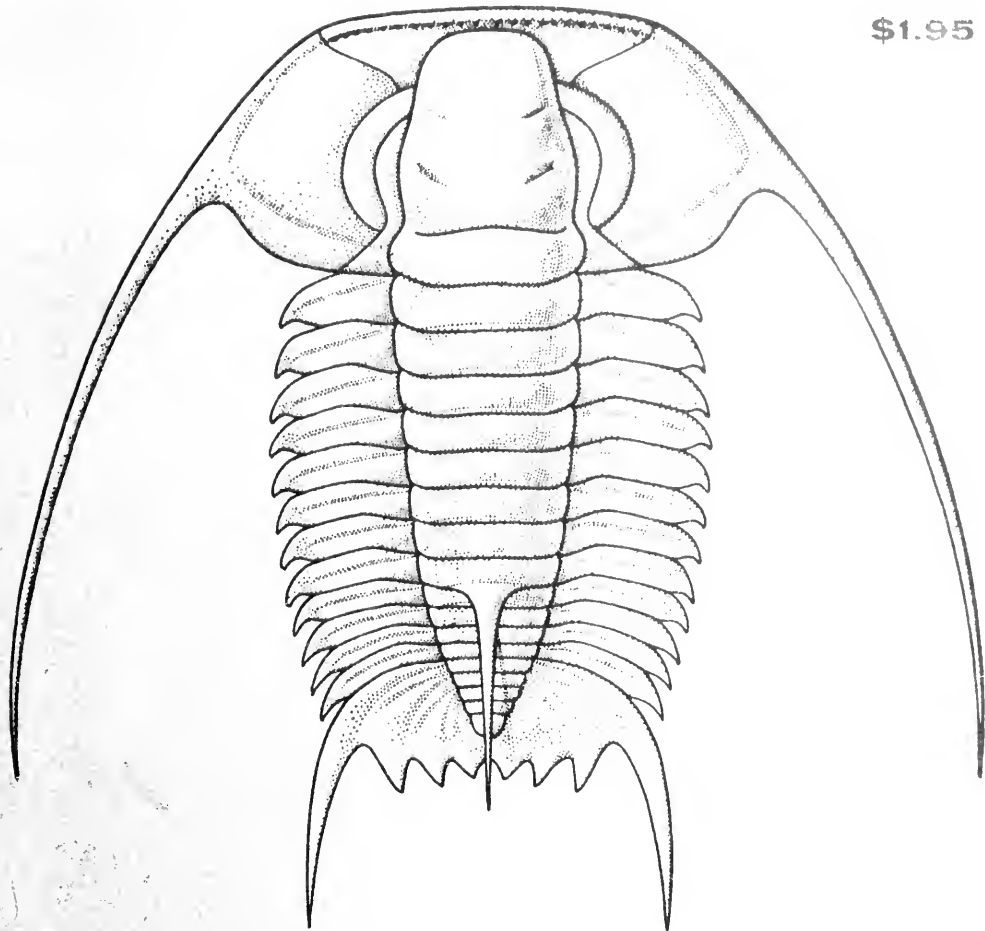


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Richard E. Blackwelder

Classification of the Animal Kingdom

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CLASSIFICATION
OF THE
ANIMAL KINGDOM

Richard E. Blackwelder



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INTRODUCTION

THE CLASSIFICATION OF ANIMALS is still very much a field in which discovery and revision are continuing, even after two hundred years of study. The importance of classification in biology increases every year, because the experimental and practical fields find increasing need for accurate identification of animals and for understanding of comparative relationships.

At least one outstanding biologist has opposed publication of this new classification on the ground that it would be accepted as final, *the* classification, and would tend to make students think that all higher classification is finished. The intention of the compiler is just the opposite. Just as this classification is different in detail from all previous ones, so will future editions be still different, as we learn more about the comparative features of animals.

It is anticipated that every new edition will spur students of the individual groups to propose improvements. It is therefore planned to issue corrected editions whenever appropriate. The very appearance of these subsequent editions will emphasize the growth of understanding of animal groups.

Only one ostensibly complete classification of animals, living and fossil, has been published in recent years. That classification, by A. S. Pearse of Duke University, is a good one, based on the views of many specialists. Certain mechanical faults make it less usable than it should be, and the need for revision gave the original impetus to preparation of the present classification. Because Pearse did not usually indicate the source of his arrangements, he is not here cited as an authority. Nevertheless, the two classifications are basically very similar. No other single classification has been found that agrees so closely with the conclusions of the present study.

It should be emphasized that, within certain limits, this classification is not a simple compilation of the views of specific workers. In nearly all details, choices have been made between conflicting schemes

of various authors, not on the basis of the reputation of those authors but on my judgment of the soundness of their supporting arguments or on my analysis of the data they present. In none of the larger groups has the work of any single author been accepted without modification.

Several considerations have influenced the decisions embodied in this classification.

First, a false picture is given by a simplified classification, because the existing diversity is one of the principal features of the animal kingdom. Therefore, no groups should be combined merely for the sake of simplicity.

Second, although the previous item would seem to require coverage of the groupings at all possible levels, to show the extreme range of division and subdivision, this is not in fact possible. Not only are there many conflicting groupings at certain levels, such as of phyla or orders, but there is no practical way to show these groupings in a general classification. It is a compromise that is believed to be effective to subdivide the phyla only into classes, subclasses, and orders. Other possible groupings, such as subphyla and superorders are referred to in the notes.

Third, two groups which are so distinct at any level that they cannot be described in common terms must be separated at that level. (For example, Pterobranchia and Enteropneusta; see the Notes on the Taxa.)

Fourth, groups which cannot be distinguished at any particular level by the type of characters used for their neighbors must be combined at that level. (For example, the sometime classes of Nematoda.)

Fifth, the discovery of groupings within a class, for example, does not justify the creation of new classes for each of the subgroups. The proper level for the new groups can only be determined by comparison with neighboring parts of the classification.

Sixth, although uniformity in the form (endings) of names at each level would unquestionably be helpful, it cannot now be attained without adding greatly to the total of name forms and synonyms. The systems so far proposed are so diverse as to introduce further confusion of their own. None of the systems has been widely enough accepted to be entitled to adoption throughout the Animal Kingdom. None has been so widely accepted on a world basis, even in one group, as to indicate

universal acceptance in the near future. Indeed, even the ordinal endings in *-iformes* adopted by American ichthyologists and ornithologists are almost entirely unused in the rest of the world. The resulting names are unnecessarily long and cumbersome. The system does not relieve anyone from learning the shorter forms also. The latter are used here, with the uniform-ending forms listed as synonyms. In other groups, usage of the source of the classification is followed as to spelling, in most cases. There are a variety of systems in use and no obvious trend toward adoption of any single system.

This classification attempts to show the various spellings as well as the various synonyms. Each zoologist will choose which one he wishes to use in each case.

Seventh, no single rule will suffice for choice of names where several apply to a single taxon. Reasons for each decision are given in the text in many cases, but in general it has been the goal to retain the best known names, at the most appropriate level, regardless of homonymy. Priority is considered to be of secondary importance at these levels.

Eighth, although considerable homonymy exists at all levels, even up to that of phylum names, there is almost no real confusion caused thereby. Until there are direct rules to govern the decisions, there seems to be nothing gained by replacing well known names, such as Decapoda (either in the Cephalopoda or in the Crustacea).

This classification is in three parts, the purposes of which are quite different. In order of preparation, these are: 1] the complete classification, including lists of the phyla and of the classes and orders, of all animals, living and fossil; 2] the justification for unusual features in this classification; and 3] a simplified classification of Recent animals for student use, with common names, again including lists of the phyla and of the classes and orders. The arrangement of these parts in the book is just the reverse of this.

In both lists, the phyla are first arranged in four subkingdoms, and one of these is divided into four series. Many other groupings of these phyla are possible, and several are shown in the footnotes of the section Complete List of Phyla. It is not here believed that these supra-phylum groupings are of much significance at this phase of the knowledge of animals.

In both lists of orders, these orders are arranged in the appropriate classes and subclasses. No other levels, such as superorder, are rec-

ognized. They may be of use in some circumstances but seem to be of little value in showing the arrangement of the orders on a practical basis.

Throughout, rejected synonyms are printed in italics, the accepted class names are in capital letters, and the subclass names and the order names are both set in capitals and lower case letters. In the footnotes, names that also appear in the classification above are printed in small capitals. The other names in the footnotes are somewhat in the nature of rejected synonyms, but as most of them are really the names of non-accepted groupings, they appear in capitals and lower case roman letters.

To the variety of spellings there is no end. No attempt is made to list *all* forms, but such spellings as would appear at a separate place in an alphabetical index are listed, along with those variations that are used for distinct levels; e.g., Echiuroidea (phylum), Echiurida (class), and Echiuroina (order).

In the Complete List of Orders the geologic range of each group is shown by symbols at the right margin. The meaning of these symbols is shown in the following table.

REC	Recent	JUR	Jurassic
QUA	Quaternary	MES	Mesozoic
PLE	Pleistocene	PER	Permian
PLI	Pliocene	PEN	Pennsylvanian
OLI	Oligocene	MIS	Mississippian
MIO	Miocene	CAR	Carboniferous
EOC	Eocene (+ Paleocene)	DEV	Devonian
TER	Tertiary	SIL	Silurian
CEN	Cenozoic	ORD	Ordovician
CRE	Cretaceous	CAM	Cambrian
TRI	Triassic	PAL	Paleozoic

There are a few points of discrepancy between the Simplified List and the Complete List. These are intentional, to make the simplified list more useful to students. The Complete List shows the definitive classification that is here being proposed.

The names included under the footnote heading "*Includes*" may be suborders, synonyms, rejected groups, or names of questionable application. They are all names which have at some time been used for orders or more inclusive groups and are included merely to indicate their approximate position in the scheme.

Several recent schemes of classification in particular groups are known to the compiler but are not followed herein. Some were received too late for study (e.g., part W of the *Treatise of Invertebrate Paleontology*). Some were not yet available in the form needed for our use and so were not considered (e.g., *Echinodermata* by H. B. Fell and *Mollusca* by Taylor and Sohl). There is no judgment of these schemes implied in this action; they will be considered for a subsequent revised edition.

It will probably be thought by some that this is an extreme classification in separating many small groups as distinct phyla. The compiler believes that it is a conservative classification even in this regard. He believes that an important basic tenet of classification, too often overlooked, is that all groups must be distinct and definable and that therefore forms are not to be forced into existing groups at any level if they do not agree with what are deemed to be the important features of that group. The important features in this case are those which caused the group to be set aside and maintained as distinct.

It is sometimes possible to enlarge slightly the scope of a group definition to admit forms previously unknown, but this does not justify including widely divergent forms that cannot be defined together effectively.

Simplified List

Subk Series Phylum

Kingdom ANIMALIA¹

EOZOA

Protozoa² [one-celled animals]³

PARAZOA

Porifera sponges

AGNOTOZOA

Mesozoa

HISTOZOA (*Metazoa*)

Enterocoela

Monoblastozoa

Coelenterata (*Cnidaria*) hydroids, jellyfish, medusae, corals,
sea-anemones

Ctenophora comb-jellies, sea-walnuts

Acoelomata

Platyhelminthes flatworms

Rhynchocoela (*Nemertinea*) ribbon-worms, proboscis-worms

Pseudocoelomata

Acanthocephala spiny-headed-worms

Rotifera (*Rotatoria*) rotifers, wheel-animalcules

Gastrotricha

Kinorhyncha (*Echinodera*)

Priapulioidea

Nematoda thread-worms, round-worms

Gordiacae (*Nematomorpha*) horsehair-worms,
gordian-worms

Calyssozoa (*Endoprocta*)

of Recent Phyla

Subk Series Phylum

Coelomata

Bryozoa (*Ectoprocta*) moss-animals
Phoronida
Brachiopoda lamp-shells
Mollusca mollusks
Sipunculoidea
Echiuroidea
Myzostomida
Annelida [segmented worms]
Tardigrada bear-animalcules, water-bears
Pentastomida
Onychophora
Arthropoda crustaceans, arachnids, insects, etc.
Chaetognatha arrow-worms
Pogonophora beard-worms
Echinodermata
Pterobranchia
Enteropneusta
Planctosphaeroidea
Tunicata sea-squirts
Cephalochordata lancelets
Vertebrata vertebrates

¹ For explanations, other synonyms, extinct groups, and other taxa above the phylum level, see the section Complete List of Phyla.

² The Protozoa are sometimes placed in a separate kingdom of organisms—the Protista.

³ Non-Latin names can be made for each phylum by merely using the English form of the name, such as protozoans for Protozoa or arthropods for Arthropoda. These are listed only where they are in common use.

Simplified List of Recent Classes and Orders

with Common Names

Class Subcl Order

PROTOZOA

- FLAGELLATA (*Mastigophora*) flagellates
 Phytomastigina [plant-like flagellates]
 Chrysomonadina silicoflagellates, etc.
 Coccolithophorida coccolithophores, coccoliths
 Cryptomonadina
 Phytomonadina (*Volvocales*)
 Euglenoidina
 Chloromonadina
 Dinoflagellata dinoflagellates
 Zoomastigina [animal-like flagellates]
 Rhizomastigina
 Protomonadina
 Polymastigina
 Hypermastigina

SARCODINA

- Rhizopoda rhizopods
 Proteomyxa
 Mycetozoa slime-molds
 Amoebozoa
 Testacea
 Foraminifera foraminiferans, forams
 Actinopoda
 Heliozoa sun-animalcules
 Radiolaria radiolarians

SPOROZOA

- Telosporidia
 Gregarinida
 Coccidia
 Haemosporidia
 Cnidosporidia
 Myxosporidia
 Actinomyxidia

Class	Subcl	Order
		Microsporidia microsporidians
		Helicosporidia
	Sarcosporidia	
		Sarcosporidia
		Globidia
	Haplosporidia	
		Haplosporidia
CILIATA	ciliates	
	Protociliata	
		Opalinida opalinids
	Euciliata	
		Holotricha
		Spirotricha tintinnids, etc.
		Chonotricha
		Peritricha
SUCTORIA		
	Suctoria	

PORIFERA

sponges

CALCAREA (<i>Calcispongea</i>)	[calcareous sponges, chalky sponges]
	Solenida
	Lebetida
	Pharetronida
	Thalamida
HYALOSPONGEA (<i>Hexactinellida</i>)	glass-sponges
	Lyssakina
	Dictyonina
	Lychniskophora
	Heteractinida
DEMOSPONGEA	
	Myxospongida
	Keratosida horny-sponges
	Haplosclerida
	Poecilosclerida
	Hadromerida
	Halichondrida
	Epipolasida
	Choristida
	Carnosida
	Lithistida stone-sponges

Class Subcl Order

M E S O Z O A

RHOMBOZOA

Dicyemida
Heterocyemida

ORTHONECTIDA

Orthonectida

M O N O B L A S T O Z O A

MONOBLASTOIDEA

Monoblastidea

C O E L E N T E R A T A

(*Cnidaria*)

coelenterates, medusae

HYDROZOA

Trachylinida
Hydroida
Milleporida (*Hydrocorallinae*) millepores
Stylasterina
Siphonophora siphonophores

SCYPHOZOA jellyfishes

Stauromedusae
Cubomedusae
Coronatae
Semaestomeae
Rhizostomeae

ANTHOZOA sea-anemones, corals

Alcyonaria

Stolonifera
Telestacea
Alcyonacea soft-corals
Coenothecalia blue-corals
Gorgonacea sea-fans, horny-corals, gorgonians, sea-feathers
Pennatulacea sea-pens, sea-pansies

Zoantharia

Zoanthiniaria
Corallimorpharia
Actiniaria sea-anemones
Scleractinia (*Madreporaria*) hexacorals, stony-corals

Class Subcl Order

Ceriantipatharia

Antipatharia black-corals, thorny-corals

Ceriantharia

CTENOPHORA

comb-jellies, sea-walnuts

TENTACULATA

Cydippida

Lobata

Cestida

Platyctenea

NUDA

Beroida

PLATYHELMINTHES

flatworms

TURBELLARIA planarians

Acoela

Rhabdocoela

Alloeoecoela

Tricladida triclads

Polycladida polyclads

TREMATODA flukes

Monogenea

Aspidogastrea

Digenea

CESTODA tapeworms

Proteocephala

Tetraphyllidea

Disculicepitidea

Lecanicephala

Trypanorhyncha

Cyclophyllidea

Aporidea

Nippotaeniidea

Caryophyllidea

Spathebothridea

Pseudophyllidea

CESTODARIA

Amphilinidea

Gyrocotylidea

Biporophyllidea

Class Subcl Order

R H Y N C H O C O E L A

ribbon-worms, proboscis-worms

NEMERTINEA

Palaeonemertea

Heteronemertea

Hoplonemertea

Bdellonemertea

A C A N T H O C E P H A L A

spiny-headed-worms

ACANTHOCEPHALA

Archiacanthocephala

Palaeacanthocephala

Eoacanthocephala

R O T I F E R A*(Rotatoria)*

rotifers, wheel-animalcules

SEISONIDEA

Seisonacea

BDELLOIDEA

Bdellacea

MONOGONONTA

Ploima

Flosculariacea

Collothecacea

G A S T R O T R I C H A

gastrotrichs

MACRODASYOIDEA

Macrodasyidea

CHAETONOTOIDEA

Chaetonotidea

K I N O R H Y N C H A**ECHINODERA**

Echinodera

Class Subcl Order

PRIAPULOIDEA

PRIAPULOIDEA

Priapulida

NEMATODA

nematodes, nemas, thread-worms, round-worms

NEMATOIDEA

Enoploidea
 Dorylaimoidea
 Mermithoidea
 Chromadoroidea
 Araeolaimoidea
 Monhysteroidea
 Desmoscolecoida
 Rhabditoidea
 Rhabdiasoidea
 Oxyuroidea
 Ascaroidea
 Strongyloidea
 Spiruroidea
 Dracunculoidea
 Filarioidea
 Trichuroidea
 Dioctophymoidea

GORDIACEA

gordian-worms, horsehair-worms

NEMATOMORPHA

Gordioidea
 Nectonematoidea

CALYSSOZOA

endoprocts

ENDOPROCTA (*Entoprocta*)

Pedicellinida

Class Subcl Order

BRYOZOA

sea-mats, corallines, moss-animals, bryozoans, sea-mosses

PHYLACTOLAEMATA

Lophopoda

GYMNOLAEMATA

Cyclostomata

Ctenostomata

Cheilostomata

PHORONIDA

phoronids

PHORONIDA

Phoronida

BRACHIOPODA

lamp-shells, brachiopods

INARTICULATA

Atremata

Neotremata

ARTICULATA

Protremata

Telotremata

MOLLUSCA

mollusks

MONOPLACOPHORA

Tryblidioidea

AMPHINEURA chitons

Neoloricata

APLACOPHORA (*Solenogastres*)

Neomeniida

Chaetodermatida

GASTROPODA snails, slugs, gastropods

Prosobranchia

Archaeogastropoda limpets, ear-shells, turbans

Caenogastropoda

Opisthobranchia

Pleurocoela sea-hares

Class Subcl Order

Pteropoda butterfly-shells, pteropods

Sacoglossa

Acoela nudibranchs

Pulmonata land-snails, slugs

Basommatophora boat-shells, ramshorns

Stylommatophora slugs

BIVALVIA (*Pelecypoda*, *Lamellibranchiata*) bivalves, oysters, clams,
mussels, pelecypods

Protobranchia

Filibranchia

Eulamellibranchia

Septibranchia

SCAPHOPODA tooth-shells, tusk-shells

Scaphopoda

CEPHALOPODA cephalopods

Tetrabranchiata

Nautiloidea pearly-nautilus

Dibranchiata

Decapoda squids, cuttle-fish

Octopoda octopuses, argonauts

Vampyromorpha

SIPUNCULOIDEA

[sipunculid worms]

SIPUNCULOIDEA

Sipunculida

ECHIUROIDEA

ECHIURIDA

Echiuroina

Xenopneusta

Heteromyota

SACCOSOMATIDA

Saccosomatida

MYZOSTOMIDA

MYZOSTOMIDA

Proboscidea

Pharyngidea

ANNELIDA

[segmented worms] annelids

Class Subcl Order

CHAETOPODA

Polychaeta polychaetes

Errantia sandworms

Sedentaria tubeworms

Oligochaeta earthworms, angle-worms, night-crawlers, oligochaetes

Plesiothecata

Prosothecata

Prosopora

Opisthopora

HIRUDINEA leeches, bloodsuckers

Rhynchobdellida

Gnathobdellida

Pharyngobdellida

Acanthobdellida

ARCHIANNELIDA

Archannelida

TARDIGRADA

bear-animalcules, water-bears

HETEROTARDIGRADA

Arthrotardigrada

Echiniscoidea

EUTARDIGRADA

Eutardigrada

PENTASTOMIDA

LINGUATULIDA

Cephalobaenida

Porocephalida

ONYCHOPHORA

PERIPATIDEA

Euonychophora

ARTHROPODA

arthropods

MEROSTOMATA

Xiphosura

Xiphosurida horseshoe-crabs

PYCNOGONIDA sea-spiders

Eupantopoda

Class Subcl Order

ARACHNIDA arachnids

Latigastra

Scorpionida scorpions

Pseudoscorpionida book-scorpions, false-scorpions,
pseudoscorpions

Phalangida (*Opiliones*) harvest-men, Daddy-long-legs

Acarida mites, ticks, chiggers

Caulogastra

Palpigradida microscorpions

Thelyphonida whip-scorpions

Schizomida

Phrynichida tailless-whip-scorpions

Araneida (*Araneae*) spiders, tarantulas, black-widows

Solpugida (*Solifugae*) solpugids, sun-spiders

Ricinuleida (*Podogonata*)

CRUSTACEA crustaceans

Branchiopoda

Anostraca brine-shrimps

Notostraca phyllopods, fairy-shrimps

Conchostraca

Cladocera water-fleas

Cephalocarida

Cephalocarida

Ostracoda

Myodocopida

Podocopida

Mystacocarida

Mystacocarida

Copepoda (*Eucopepoda*)

Calanoida

Harpacticoida

Cyclopoida

Notodelphyoida

Monstrilloida

Caligoida

Lernaeopodoida

Branchiura

Branchiura

Cirripedia barnacles

Thoracica

Acrothoracica

Class	Subcl	Order
		Ascothoracica
		Apoda
		Rhizocephala
	Malacostraca	
		Nebaliacea
		Anaspidacea
		Mysidacea opossum-shrimps
		Thermosbaenacea
		Spelaeogriphacea
		Lophogastridea
		Cumacea
		Tanaidacea
		Isopoda pillbugs, sowbugs
		Amphipoda scuds
		Euphausiacea krill
		Decapoda crabs, lobsters, crayfish, shrimps, prawns
		Stomatopoda mantis-shrimps

PAUROPODA

Heterognatha

SYMPHYLA

Cephalostigmata

DIPLOPODA millipedes

Pselaphognatha

Ancyrotricha

Lophotricha

Chilognatha

Limacomorpha

Oniscomorpha

AscospERMOPHORA

Colobognatha

Nematophora

Proterospermophora

Opisthospermophora

CHILOPODA centipedes

Pleurostigmophora

Geophilomorpha

Scolopendromorpha

Lithobiomorpha

Craterostigma

Notostigmophora

ScutigermORPHA

Class Subcl Order

INSECTA (*Hexapoda*) insects

Apterygota

Protura proturans

Thysanura silver-fish, bristle-tails, rock-jumpers

Entotrophi campodeids, japygids

Collembola springtails, snow-fleas

Exopterygota (*Heterometabola*)

Ephemera mayflies

Odonata dragonflies, damselflies, mosquito-hawks,
devil's-darning-needles, snake-doctors

Plecoptera stone-flies, salmonflies

Grylloblattoidea grylloblattids

Orthoptera (*Saltatoria*) grasshoppers, crickets, locusts,
katyids, mole-crickets

Phasmidia walking-sticks, stick-insects, leaf-insects

Blattaria roaches, cockroaches, croton-bugs

Mantodea praying-mantis, soothsayers, mantids

Dermaptera earwigs

Embioptera embiids, webspinners

Isoptera termites, white-ants

Psocoptera (*Corrodentia*) psocids, book-lice, bark-lice,
dust-lice

Zoraptera zorapterans

Mallophaga bird-lice, biting-lice

Thysanoptera thrips

Homoptera cicadas, leaf-hoppers, tree-hoppers, aphids,
scale-insects, spittle-bugs, mealy-bugs, frog-spit, psyllids,
lantern-flies, white-flies

Heteroptera bugs, bed-bugs

Anoplura sucking-lice, lice

Endopterygota (*Holometabola*)Neuroptera snake-flies, serpent-flies, lace-wings, ant-lions,
dobson-flies, fish-flies, orl-flies

Mecoptera scorpion-flies

Trichoptera caddis-flies, trout-flies, case-flies

Lepidoptera butterflies, moths, skippers, blues, woolly-bears,
caterpillars, millersDiptera flies, gnats, mosquitoes, midges, bots, maggots,
punkies

Siphonaptera fleas, chigoes

Coleoptera beetles, weevils, fireflies, claters, glow-worms,
water-pennies, meal-worms, wire-worms, white-grubs

Class **Subcl** **Order**

Strepsiptera stylopids

Hymenoptera bees, wasps, ants, sawflies, hornets, wood-wasps,
 ichneumon-flies, gall-wasps, velvet-ants, horntails,
 tarantula-hawks

CHAETOGNATHA

arrow-worms

SAGITTOIDEA

Sagittoidea

POGONOPHORA

beard-worms

POGONOPHORA

Thecanephria

Athecanephria

ECHINODERMATA

echinoderms

CRINOIDEA feather-stars, crinoids, sea-lilies

Articulata

Isocrinida

Cyrtocrinida

Comatulida

ASTEROIDEA starfishes, sea-stars

Phanerozoona

Spinulosa

Forcipulata

OPHIUROIDEA brittle-stars, sand-stars, basket-stars, serpent-stars

Myophiurida

Ophiocystiida

Aganasterida

Phrynophiurida

Laemophiurida

Gnathophiurida

Chilophiurida

ECHINOIDEA sea-urchins, heart-urchins, sand-dollars

Regularia

Cidaroida

Centrechinoidea

Exocycloidea

Class Subcl Order

Irregularia

Holectypoida

Cassiduloida

Clypeastroida cake-urchins, sand-dollars

Spatangoida heart-urchins

HOLOTHURIOIDEA sea-cucumbers

Aspidochirota

Elasipoda

Dendrochirota

Molpadonia

Apoda

P T E R O B R A N C H I A

PTEROBRANCHIA

Rhabdopleurida

Cephalodiscidea

E N T E R O P N E U S T A

acorn-worms, tongue-worms

ENTEROPNEUSTA

Balanoglossida

P L A N C T O S P H A E R O I D E A

PLANCTOSPHAEROIDEA

Planctosphaeroidea

T U N I C A T A

tunicates

LARVACEA

Larvacea

ASCIDIACEA sea-squirts, ascidians

Stolidobranchiata

Aspiraculata

Phlebobranchiata

Aplousobranchiata

Octacnemida

THALIACEA

Pyrosomata

Pyrosomatida

Myosomata

Cyclomyaria

Hemimyaria

Desmomyaria

Class Subcl Order

C E P H A L O C H O R D A T A

LEPTOCARDIA

Amphioxi lancelets

V E R T E B R A T A

vertebrates

AGNATHA [jawless fishes]

Cephalaspidomorpha

Cyclostomata lampreys, hag-fishes, slime-eels

CHONDRICHTHYES [cartilaginous fishes]

Elasmobranchii

Selachii sharks, dogfishes, angel-fishes

Batoidea skates, rays

Holocephali rabbit-fishes

Chimaerae chimaeras, ratfishes

OSTEICHTHYES [bony fishes]

Actinopterygii [ray-finned fishes]

Chondrostei

Holostei gars

Teleostei

Choanichthyes [lobe-finned fishes]

Crossopterygii coelacanths, etc.

Dipnoi lungfishes

AMPHIBIA (*Batrachia*) amphibians, batrachians

Salientia

Anura frogs, toads

Lepospondyli

Urodela salamanders, newts

Apoda (*Gymnophiona*) caecilians

REPTILIA reptiles

Anapsida

Chelonia tortoises, turtles

Diapsida

Rhynchocephalia

Squamata lizards, snakes

Crocodilia crocodiles, gavials, alligators, caymans

AVES birds

Neornithes

Sphenisci (*Sphenisciiformes*) penguinsStruthionones (*Struthioniformes*) ostriches

Class Subcl Order

- Rheae (*Rheiiformes*) rheas
 Casuarii (*Casuariiformes*) cassowaries, emus
 Apteryges (*Apterygiformes*) kiwis
 Crypturi (*Crypturiformes, Tinami, Tinamiformes*) tinamous
 Gaviae (*Gaviiformes*) loons
 Podicipedes (*Podicipediformes, Colymbae, Colymbiformes*)
 grebes, divers
 Procellariae (*Procellariiformes, Tubinares*) albatrosses,
 shearwaters, petrels, fulmars,
 Steganopodes (*Pelecani, Pelecaniformes*) cormorants,
 pelicans, gannets, tropicbirds, boobies, snake-birds,
 frigate-birds
 Ciconiae (*Ciconiiformes*) herons, bitterns, storks,
 hammerheads, spoonbills, ibises, flamingoes
 Anseres (*Anseriformes*) ducks, geese, swans, screamers
 Falcones (*Falconiformes*) hawks, eagles, vultures, falcons,
 caracaras, ospreys, harriers, secretary-birds
 Galli (*Galliformes*) megapodes, pheasants, quails, grouse,
 turkeys, fowls, peacocks, hoatzins
 Grues (*Gruiformes*) cranes, limpkins, rails, sunbitterns,
 bustard-quails, plainwanderers, trumpeters, coots, gallinules,
 kagus, sungrebes, bustards
 Charadriae (*Charadriiformes*) jacanas, snipe, oyster-catchers,
 plovers, turnstones, surf-birds, woodcock, sandpipers,
 avocets, stilts, phalaropes, gulls, terns, skimmers, awks,
 murrees
 Columbae (*Columbiformes*) doves, pigeons, dodos,
 sandgrouse, solitaires
 Psittaci (*Psittaciformes*) parrots, parakeets, lorries, macaws
 Cuculi (*Cuculiformes*) cuckoos, plantain-eaters, touracos,
 anis, roadrunners
 Striges (*Strigiformes*) owls
 Caprimulgi (*Caprimulgiformes*) goatsuckers, potoos,
 oil-birds, frogmouths
 Macrochires (*Macrochiriformes, Apoda, Micropodi*) swifts,
 humming-birds
 Colii (*Coliiformes*) mouse-birds, colies
 Trogones (*Trogoniformes*) trogons
 Coraciae (*Coraciiformes*) kingfishers, rollers, hoopoes,
 hornbills, todies, motmots, bee-eaters
 Pici (*Piciformes*) woodpeckers, toucans, honey-guides,
 jacamars, puffbirds, barbets, piculets

Class	Subcl	Order
		Passeres (<i>Passeriformes</i>) songbirds, warblers, thrushes, shrikes, creepers, nuthatches, titmice, vireos, finches, tanagers, blackbirds, starlings, orioles, crows, jays, magpies, swallows, butcher-birds, wrens, thrashers, mockingbirds, kinglets, flycatchers, wrentits, dippers, honey-creepers, grosbeaks, buntings, broadbills, woodhewers, antbirds, ovenbirds, lyrebirds, bulbuls, larks, babblers, wagtails, waxwings, weaverbirds, drongos, wattlebirds, bowerbirds, birds-of-paradise, etc.
MAMMALIA	mammals	
	Prototheria	
		Monotremata monotremes, platypus, echidna
	Metatheria	
		Marsupialia marsupials, opossums, Tasmanian-wolf, bandicoots, phalangers, koalas, kangaroos
	Eutheria (<i>Placentalia</i>)	placentals
		Insectivora insectivores, tenrecs, hedgehogs, shrews
		Dermoptera colugos, flying-lemurs
		Chiroptera bats, vampires
		Primates lemurs, tree-shrews, aye-aye, lorises, bush-babies, tarsiers, monkeys, marmosets, macaques, baboons, guenons, langurs, apes, gibbons, lars, chimpanzees, orangutans, gorillas, men
		Edentata sloths, anteaters, armadillos
		Pholidota pangolins
		Lagomorpha hares, rabbits, pikas
		Rodentia squirrels, chipmunks, marmots, pocket-mice, pacas, kangaroo-rats, beavers, rats, mice, muskrats, lemmings, voles, dormice, porcupines, capybaras, guinea-pigs, chinchillas
		Cetacea porpoises, dolphins, whales
		Carnivora dogs, wolves, foxes, bears, raccoons, coatis, kinkajous, pandas, weasels, minks, otters, badgers, wolverines, skunks, civets, hyenas, cats, seals, sea-lions, walruses
		Tubulidentata aardvarks
		Proboscidea mastodons, mammoths, elephants
		Hyracoidea hyraxes
		Sirenia sea-cows
		Perissodactyla horses, zebras, tapirs, rhinoceroses
		Artiodactyla pigs, peccaries, hippopotamuses, camels, llamas, alpacas, guanacos, deer, giraffes, pronghorns, cattle, antelopes, sheep, gazelles, musk-oxen, goats, etc.

Notes on the Taxa

Subkingdoms and their subdivisions

Animalia. Division of the Animal Kingdom into four subkingdoms is seen in many recent classifications, although some writers prefer to list the Parazoa, Mesozoa, and Eumetazoa as branches of Metazoa in contrast to the Protozoa. The use of the additional level "branch" is difficult to justify where so few groups are involved, unless there is definite information on the phylogeny of these groups. Such knowledge of the relationships of the groups is lacking, or, at best, highly speculative. The groups are generally recognized at the phylum and subkingdom levels, and these seem to be adequate for classification except within the Metazoa proper (see below).

Inasmuch as it is often stated that animals are either one-celled or many-celled, it would seem to be necessary to accept the older subdivision of Animalia into two subkingdoms, Protozoa and Metazoa. The fact is, however, that many undoubted protozoans exist only in aggregations of many cells, often with as much division of labor between cell types as in some undoubted metazoans. Removal of the Protozoa to a separate kingdom Protista solves part of this problem, but the remaining animals still represent the three very different basic structures: 1] a vase-like cylinder open at one end and with several types of cells in the walls but with the internal cavity not serving for digestion, 2] a solid body consisting of one layer of cells around a central cell or group of cells, and 3] a multicellular body with internal cavities of which one is usually a digestive tract and with walls of one, two, or three layers of cells.

These three types of construction are so different as to require recognition as primary divisions of the kingdom. With the Protozoa (when these are treated as animals), they form the four subkingdoms employed here: Eozoa, Parazoa, Agnotozoa, and Histoza.

Eozoa and *Agnotozoa*. In the choice of names for subkingdoms, it has been felt that only slight advantage results from having a single phylum known by a different name than is used for its subkingdom. However, with only four subkingdoms involved and with two of these consisting of two or more phyla, it appears to be reasonable to be uniform in this respect and use separate names for the subkingdom and phylum that include the protozoans and for the subkingdom and phylum that include the mesozoans.

Parazoa. The Porifera have long been recognized as constituting a group distinct from the rest of the many-celled animals. The extinct Cyathospongia, under one of the three available names, were placed with the sponges by Okulitch and others, and as a separate phylum in the Parazoa by Pearse and others.

Histoza. This name is accepted here because of the great ambiguity of the more familiar name Metazoa. As explained above, the incorporation of many cells into one body is not distinctive of any major group of animals, even if single-celled adult structure is found exclusively in one group. It was the desire to retain Metazoa which has led many writers to list the Parazoa, Mesozoa, and Eumetazoa as branches of a subkingdom Metazoa. Inasmuch as Metazoa cannot be effectively defined, to the exclusion of all Protozoa, it seems to be more realistic to recognize three or four subkingdoms of animals on the basis of the general body construction. Attempts to divide it on the basis of cell number are arbitrary and misleading.

The use of any of these subkingdom groups is of questionable value; it is the phyla that are important and that are most often definable. The distinction between even Protozoa and Metazoa is so com-

pletely nebulous that it no longer serves any clear purpose. Use of the subkingdom and series names herein is simply a recognition of their use in many recent classifications.

Division of the Histoza (Metazoa) into grades, series, or divisions has been attempted many times. Most of the groups so adopted in the past are employed in the face of obvious defects in the form of exceptions. Not all Radiata show any form of radial arrangement, and not all radially arranged animals are put in the Radiata. Bilateria included animals with quite diverse body plans, some with virtually no paired structures, no obvious "sides," no anterior and posterior, and only a remote similarity to the obviously bilateral animals. Some groups placed in the Schizocoela form their coelom in the enterocoelous manner, and at least one group placed in the Enterocoela forms its coelom by the schizocoelous method. Articulata has included animals that are *not* segmented. And so on.

It is here concluded that the histozoan (or eumetazoan) phyla cannot be grouped readily into clear-cut series. The number of these phyla is not so great as to force subdivision of the subkingdom, but custom seems to be sufficient justification for indicating some grouping of them. At this

Phyla and rejected phylum groups

Cyathospongia. Recent works on this extinct phylum have adopted either Pleospongia or Archaocyatha as the phylum name. Both of these names are of later date (1937) than Cyathospongia (1935), and Archaocyatha has been used more consistently for one of the included classes. There seems to be no firmly established usage that prevents us adopting the oldest name.

Mesozoa. There appears to be no reason for not adopting the name now in wide use for this phylum, especially as it is the oldest name (1877). The name has also been used at the subkingdom level, where the synonym Agnotozoa seems to be more appropriate.

Monoblastozoa. A new phylum named here for the unique metazoan *Salinella*, which has too long been left excluded from the classifications of animals. It contains only one genus and one species. The animal consists of a single layer of similar cells surrounding an internal tubular tract which has a "mouth" at one end, an "anus"

point it appears that the most useful grouping is the one based on the *type* of body cavity. Accordingly four groups are here recognized, those phyla with an enterocoel or gastrovascular cavity only, those with no cavities except a digestive tract, those with a pseudocoel, and those with a coelom. These groupings are all well known from Hyman (1940) and other works.

No satisfactory name exists for the first of these four groups. Radiata is inapplicable to many forms. Protaxonia is based on a concept of embryonic axes which would include extraneous groups. Enterozoa and Enterocoela were originally applied to much larger concepts. On the whole, Enterocoela is the most appropriate in meaning, and it is adopted here.

Radiata and *Bilateria*. The Histoza or Metazoa have sometimes been divided into the Radiata (Coelenterata and Ctenophora) and the Bilateria (all others) on the basis of their general body arrangement. The distinction is here held to be a fictitious one, because Ctenophora are much less radial than some Echinodermata, and such an animal as a bryozoan is so completely different in body arrangement from an annelid worm that it is meaningless to say that they are both bilateral.

at the other. The cells are thus simultaneously both "ectoderm" and "endoderm"; they are ciliated on both surfaces. Reproduction is asexual (by transverse fission), and there are indications of a sexual process in the form of fusion of two individuals. It is possible that a ciliated unicellular larva results from the sexual process.

Hyman suggested (1940) the phylum status for this peculiar animal, but she did not propose such a phylum directly and left *Salinella* unassigned to any group.

Graptozoa. The graptolites have had a more varied history than most other major groups. They were for years assigned to the Hydrozoa in the Coelenterata, but have more recently been transferred to the Hemichordata. In 1959 Hyman examined the arguments supporting the hemichordate assignment. After effectively disposing of all of these, she left the group without clear assignment, although she presumably retained them in the Hydrozoa, as she had doubtfully done in 1940.

Some features of the skeleton of graptolites are not duplicated in the Hydrozoa,

and the nature of the material of this exoskeleton is not known. It is not possible to say definitely that the graptolites are coelenterates, because the nature of the body cavity is not known, but there is no evidence that it is not a coelenteron. The graptolites may thus reasonably be included in the Coelenterata, even placed in the Hydrozoa because of general similarities, but information is simply lacking that would enable one to say that they did have the features of the coelenterates.

Inasmuch as there is some evidence of bilaterality, the skeletal tubes are different from those of Hydrozoa in manner of formation, and the almost universal form of the colonies is unmatched in the Hydrozoa, it is also reasonable to emphasize the differences by separating the group from the Hydrozoa as a class. Because of the lack of knowledge of all soft-part features and the possibility that some of these also are without counterpart in the Coelenterata, it is here preferred to emphasize this uncertainty by separating the group as a phylum distinct from Coelenterata.

The class Hydrozoa is already one of the most diverse in the Animal Kingdom. It seems undesirable to increase further its heterogeneity by including an additional series of different features. The distinctive features of the Coelenterata cannot be adduced to help us with the graptolites, so these fossils cannot be included in that phylum upon any firm basis.

Conularida. The same arguments as applied above to the Graptozoa are cogent for the separation of the Conularida as a separate phylum also. Apparently no coelenterates have a chitinophosphatic skeleton, which fact alone makes the inclusion of these animals in that phylum unsatisfactory. Of course, here also there is no direct evidence that the animals were actually coelenterate in nature.

This group has recently been assigned to the Scyphozoa, although also placed sometimes as a phylum near the Annelida or as a member of some other phylum. Although quite easily restored to look very much like elongate scyphozoans, the fossil remains of these animals show consistent differences in the steep-sided pyramidal form with four distinct sides, the closing of the aperture by lobes of the side faces, and the chitinophosphatic nature of the periderm. The arguments in the Treatise (F) for combining these with the Scyphozoa seem very weak.

Coelenterata. In some recent works (especially Hyman, 1940) this phylum has been called Cnidaria because Coelenterata has at other times included such groups as Ctenophora and Porifera. This reason for abandoning the universally known name Coelenterata would, if applied to other modern phylum concepts, result in changing most of the familiar names, including Porifera, Annelida, Arthropoda, Hemichordata, and Chordata. Such a change cannot, in the opinion of the writer, be justified by any benefits resulting therefrom. If it is thought to be necessary, the prior name Nematozoa would also have to be considered. (Furthermore, inclusion of the Graptozoa or Conularida (as in Hyman) would likewise necessitate a change in the phylum name, by this same argument.)

Aschelminthes. The proposal of this name by Hyman (1940) for all of the Pseudocoelomata except the Entoprocta has been adopted by some later works, but her alternate conclusion that the subphyla each be treated as a separate phylum has also been followed by some. It is surely premature to claim that the Aschelminthes has been conclusively accepted. Hyman (1951) removes one of the original seven groups (Acanthocephala) as a separate phylum.

The definition given for the emended phylum Aschelminthes in 1951 contains no clear-cut distinctions. Unless such exist, the supposed phylum must be concluded to be an indefinable assemblage. The fact that the included subgroups are mostly small and less well known is of no value in determining whether they are phyla, subphyla, or classes. It is here believed that they are adequately distinct by clear-cut features of fundamental nature (body plan, ciliation, "segmentation" of cuticle, presence of jaws, presence of flame bulbs or solenocytes, musculature, nature of nervous system, etc.) to be considered separate phyla.

Nemathelminthes and *Trochelminthes.* These two names were formerly applied to the thread-like and the ciliated animals more recently combined into the Aschelminthes. These groupings are also difficult to define. It is therefore preferred to treat their components as separate phyla. Nemathelminthes usually included the Nematoda, Gordiacea, Acanthocephala, and sometimes the Chaetognatha. The Trochelminthes included the Rotifera and Gastrotricha.

Nematoda. Hyman is followed here in rejecting recent proposals to change this name to Nemata.

Gordiacea. The best form of this name at the phylum level is a moot question. Little is gained but confusion by using *Nematomorpha*, whereas *Gordioidea* has generally been used at the class or order level. *Gordiacea* seems to remain as the most distinctive phylum name.

Calyssozoa / Endoprocta. Entoprocta is accepted by Hyman for this group, but this name (or the more distinctive spelling Endoprocta) is much more often applied at the class level. Calyssozoa was proposed originally (and followed by Kamptozoa) for the group as a phylum. Inasmuch as names are needed at both levels, Calyssozoa is accepted here for the phylum and Endoprocta for the single class. (The spellings Endoprocta and Entoprocta are both ascribed to Nitsche (1870). Both have been used extensively, but the former is more distinct from Ectoprocta and is therefore adopted here.)

Myzostomida. This peculiar and little-known group has previously been listed as a class of Annelida, as a subclass of Chaetopoda, or as part of the Polychaeta, but apparently never as a phylum.

These animals are disc-shaped, are non-segmented although with some paired organs, have five pairs of ventral appendages and four pairs of suckers, have ten or more pairs of marginal cirri or tentacles, lack blood-vascular and respiratory systems as well as multiple nephridia, have the central nervous system consisting of a single large ventral stellate ganglion and two nerve rings around the oesophagus and pharynx, have a complete digestive tract but with the stomach branching throughout the body, and have a trochosphere larva. These features would make the Annelida impossible to diagnose, and they result in an animal whose peculiarities are only obscured by inclusion in the Annelida.

Prenant (1960) in the *Traité* concludes that these animals are annelids but sufficiently distinct to be made a class. It is here believed that the features cited by Prenant make it necessary to remove the Myzostomida from the Annelida, just as the Sipunculoidea and Echiuroidea had previously been removed.

Myzostomids are reported from several geologic eras. As these are known only

from scars or galls, they cannot be assigned to orders.

Protarthropoda. The inclusion of Tardigrada, Onychophora, and Pentastomida in the Arthropoda as a subphylum (Protarthropoda, Pararthropoda, or Oncopoda) has been done, in every case traced out, without direct consideration of whether they have the basic features of arthropods, or whether the resulting agglomeration can be defined. Apparently it cannot be defined, and these three groups individually have only a few of the basic arthropod features. Until more correlation is demonstrated, it is held that they cannot reasonably be combined with the Arthropoda.

Tardigrada. This group is generally placed in either the Aschelminthes or the Arthropoda. Either position is untenable if Cuenot (1949) is correct in asserting that the animals are coelomate and enterocoelous. It is distinguished from Onychophora and Pentastomida, as well as Arthropoda, by features of considerable importance. It is certainly entitled to phylum status, even if the correct position for the phylum is still unknown.

Pentastomida. This group is generally placed in the Arthropoda, sometimes even in the order Acarida. Some of its characters have been ascribed to parasitic degeneration. They apparently have no cilia, do have a chitinous cuticle, and do have an arthropod type of nervous system. They lack an exoskeleton, jointed appendages, Malpighian tubules or coxal glands, circulatory organs, tracheae, and nephridia, and their appendages are of the type seen in the Onychophora and the Tardigrada.

As it would be impossible to place these definitely in any class of arthropods, and since they lack many arthropod features, it seems best to emphasize their differences by treating them as a separate phylum.

Hemichordata (Branchiotremata, Adelo-chorda). Nearly all recent classifications recognize a phylum Hemichordata that includes the Enteropneusta, the Pterobranchia, and perhaps such other groups as the Graptozoa. A good example of this is Hyman (1959). It is difficult to understand this grouping when every attempt at definition consists primarily of variable or relative characters. The components are so distinct that Hyman can only discuss them separately. Almost none of her statements apply throughout the phylum.

In this situation we only obscure the

diversity and the differences by pretending that they can be included in one phylum. Besides the Enteropneusta and the Pterobranchia, there have been placed here also the Planctosphaeroidea, the Phoronida, and the Graptozoa. The latter two have already been accepted as distinct phyla in a previous part of this classification (following many other classifications). The Planctosphaeroidea, consisting of certain ciliated larvae of unknown affinities, cannot be associated with any known adults. It is therefore impossible to combine them confidently with any phylum. It seems necessary to maintain them as a distinct group at the present time.

Chordata. It is now more than seventy-five years since the vertebrates and some supposed relatives were first combined under this name. Nearly all subsequent classifications have accepted this arrangement, although the included groups vary somewhat. At the extreme the Chordata have included the Hemichordata, Tunicata, and Cephalochordata, as well as the Vertebrata.

The inclusion of the Hemichordata is unequivocally rejected by Hyman (1959) and others. The arguments seem to be well founded, involving the absence of any substantial similarity in major features.

The Tunicata, included in the Chordata as a matter of course in many works, are excluded here because the similarities appear to be far outweighed by the differences between tunicates and vertebrates. Even if an homologous notochord be present, even if perforations of the tracheal

walls do occur, the extreme differences in arrangement of the digestive tract, the absence of paired structures in tunicates, the presence of the tunic and the substance tunicin in tunicates, the reversible blood flow in tunicates, and so on, all seem to deny a similarity so close as to justify inclusion in one phylum. With the tunicates included, the Chordata are extremely difficult to define effectively, except on the two features of notochord and pharyngotremy. With the tunicates excluded, the list of features held in common by the remaining groups is considerably increased.

The Cephalochordata can much more reasonably be united with the vertebrates. Nevertheless, the oral hood, the atrial system, the brown funnel, the multiple paired solenocytic nephridia, the single-layered epidermis, the peculiar liver-pouch, the absence of a heart, the multiple ductless gonads, and other features seem to show that the group is "more widely separated from the lowest fish than the lowest fish from a bird or mammal" (Parker & Haswell, 1897). It seems appropriate to recognize these substantial differences at the phylum level.

The use of the name Chordata for the restricted concept seems to be unnecessary as well as inappropriate. The name is younger and less well known than Vertebrata. It would seem to be an unnecessary name, based on overemphasis on a very few features held in common by the groups involved. At the most it might be considered to be a sort of "superphylum," but even thus it could reasonably include only the Cephalochordata and the Vertebrata.

Sources of class and order arrangements

Protozoa. The five classes of Protozoa are almost universally agreed upon in recent works. The use of the subphyla is not so widespread. Protociliata may be considered to belong in the Plasmodroma rather than in the Ciliophora, being there treated as a separate class. Suctorina are sometimes united with Ciliata as a subclass. Telosporidia (Amoebosporidia) are sometimes separated from Sporozoa as a third subphylum.

This is the classification of Kudo (1954) except for: 1] the elevation of Haplosporidia and Sarcosporidia to subclass level, following Hyman (1940); and 2] a few cases of different choice from available synonyms.

Porifera. Three classes are recognized in

most recent works, including the Treatise of Invertebrate Paleontology (E, 1955), but most paleontology books list also the Receptaculitida as *incertae sedis*. Inasmuch as it cannot be justified in any of the three classes, it must stand as a separate class. (The Nidulitida are now thought to be algae rather than sponges, and the Pleospongiae are treated as a separate phylum).

Many works divide each of the three classes into subclasses. In some cases these subclasses are based on features now believed to be of minor importance or taxonomic value, and the view of de Laubenfels is here adopted that subclasses do not add effectively to the classification of this group. Aside from this, the arrangement here adopted is substantially that of both Hyman and the Treatise (E).

Cyathospongia. The status and subdivisions of this extinct phylum are taken from Okulitch in the Treatise (E, 1955). The oldest of the three names for the phylum is accepted here. (Archaeocyatha remains as a class).

Mesozoa. In adopting this phylum most of the views of Hyman (1940) are accepted, except that the two orders are deemed to be amply distinct in basic development and histology to be treated as classes. This is the arrangement of Lankester (1901). It is also believed that Lankester was justified in separating the Heterocyemida from the other Dicyemida, and they are accordingly given ordinal rank; for this class the name Rhombozoa is available.

Monoblastozoa. (See remarks under Phyla, above.)

Graptozoa. The orders are taken from the Treatise (V, 1955).

Conularida. This arrangement is taken from the Treatise (F, 1956), but the treatment as a phylum is new here (see remarks under Phyla, above).

Coelenterata. The classification of the classes of this phylum adopted here is the usual one except for two features: 1] two extinct classes are added, and 2] one group often listed as an order or subclass is given class rank. The first two classes are dealt with as in the Treatise (F). The third one requires discussion here.

Stromatoporoidea. This group has recently been included in the Hydrozoa. The principal arguments in favor of this seem to be that there are other Hydrozoa showing some of the same peculiar colonial features. It appears that this is an argument for re-examining these other groups (such as Spongiomorphida), because their preserved hard-parts show few features of Recent Hydrozoa. It seems best to emphasize the considerable structural differences between stromatoporoids and typical hydrozoans by not merging them in one class.

The only reasons that can be given for retaining the stromatoporoids in the Coelenterata while removing the graptolites from that phylum are that the graptolites form a somewhat more distinct group and that the recent extreme divergence in views on their position in the Animal Kingdom lend credence to their more isolated position. Retention of the stromatoporoids does not at present alter the definition of the Hydrozoa.

The orders of Stromatoporoidea are accepted from Shrock & Twenhofel (1953) after Kuhn (1939). Other recent works divide the group into families, using no orders. The orders of Hydrozoa are those of Hyman (1940) plus the extinct Spongiomorphida. The orders of Scyphozoa are those of Hyman (1940) plus the extinct Lithorhizostomeae, being thus those listed in the Treatise (F) after the removal of the Conularida. The orders of Anthozoa are those of the Treatise, and they are those of Hyman (1940) except for the Ceriantipatharia and the extinct orders.

Ctenophora. The classification of Hyman (1940) is accepted both as to classes and orders. Nearly all recent works agree on this arrangement.

Platyhelminthes. Three classes are generally recognized here, but the most recent monographic work on the tapeworms (Wardle & McLeod, 1952) seems to justify the recognition of the Cestodaria as a class distinct from the Cestoda. Hyman (1951) included these in the Cestoda as a subclass, but she found them sufficiently distinct to require separate treatment in all respects from the rest of the tapeworms (Eucestoda).

At one time the Temnocephaloidea were treated as a class intermediate between Turbellaria and Trematoda. Although it has been claimed that this arrangement is now abandoned by all workers, it does reappear in Dawes' (1946) monographic study of the Trematoda. In deference to Hyman's studies on the Turbellaria, the group is herein placed in the Turbellaria as a suborder of Rhabdocoela.

The orders of Trematoda are taken from Dawes (1946), of Cestoda and Cestodaria from Wardle & McLeod (1952), and of Turbellaria from Hyman (1951).

Rhynchocoela. Many recent works have divided this phylum into two classes, the Enopla and the Anopla. While accepting this subdivision, Hyman (1951) considers "the great similarity of structure throughout the phylum" as reason for not making these two groups classes. She therefore lists them as subclasses, there being no class mentioned. There is no rule preventing the subdivision of a phylum directly into subclasses, but it is unfamiliar and disconcerting.

The features cited by Hyman as distinguishing the two subclasses seem to be no more fundamental than those used for

distinguishing the orders. It is therefore here considered preferable to consider the nemertines as consisting of a single class of four orders. (The orders are those cited by Hyman, 1951.)

Inasmuch as there are two well-known names available for this one-class phylum, it seems reasonable to retain one for the phylum and the other for the class. There is little reason to choose either way, but Hyman's argument that Schultze (1850-51) was the "zoologist who first clearly understood the group" may be used as justification for adopting Schultze's name, *Rhynchocoela*, for the phylum.

Acanthocephala. This is another one-class phylum, for which no class names are available. The orders are listed as in Hyman (1951).

Rotifera. The decision made above, not to employ the Aschelminthes for six groups of pseudocoelomate animals, results in elevation of these six groups to phyla. This raises the question of whether the orders of the former class Rotifera should be raised to classes. This has been done by some classifiers, but there is considerable hesitation to doing so here. The Seisonidea appear from Hyman's remarks to be sufficiently distinct to be considered a separate class, but it is not so clear that Bdelloidea and Monogononta can be distinguished by equally fundamental characters. In this dilemma, the three groups are tentatively treated as classes, with the three groups within the Monogononta treated as orders.

Gastrotricha. The differences between the two groups of gastrotrichs, as described by Hyman, including the protonephridia, pharyngeal pores, and the body cavity subdivision, appear to justify the elevation of the two groups to the level of classes. Each then consists of a single order.

Kinorhyncha. Although this group is here considered to be a distinct phylum rather than a class of Aschelminthes, there seems to be no reason for not following Hyman (1951) in considering its subdivisions as of less than ordinal rank. The characters distinguishing the three subdivisions are principally matters of degree, including no fundamental clear-cut distinctions.

As the phylum must contain at least one class, there seems to be no reason for not using the name Echinodera at this level. It remains effectively a synonym of Kinorhyncha.

Priapulioidea. The three known species belong to two genera. There appears to be no basis for separating these at the ordinal level (Hyman, 1951), and therefore there is a single class with one order.

Nematoda. Although the treatment of this group as a phylum differs from Hyman's (1951) treatment of it as a class of Aschelminthes, her view is accepted that there are no subdivisions worthy of rank above the ordinal level. The single class can be distinguished from the phylum by the older but less familiar spelling Nematoida.

Gordioidea. There appears to be little of basic nature in the differences between the Gordioidea and the Nectonematoidea. Hyman (1951) is therefore followed in placing these as orders, although in the status of the group as a whole a different view is adopted (see Aschelminthes, above).

Calysozoa / Endoprocta. A single class and order make up this phylum, and the only questions which arise are about the names to be used. The order has been called Pedicellinida by Boettger (1952), the name Entoprocta or Endoprocta has generally been used for the class, and the first name proposed for the phylum is Calysozoa of Clark (1921). It seems least confusing to accept these rather than duplicate one name at several levels. (The spelling Endoprocta is here preferred over Entoprocta because of its greater difference from Ectoprocta.)

Bryozoa. Hyman's (1959) division of this phylum into two classes with six orders, following many earlier workers, is accepted here, as in most current paleontological works.

The single order of the Phylactolaelmata seems to be without a name. The name first used for the group was Lophopoda, abandoned by later workers in favor of Phylactolaemata. It is here revived for the ordinal level.

The argument for replacing Bryozoa with Ectoprocta because of removal of the Endoprocta has been answered above under Coelenterata. Removal of one group is not considered justification for changing the name of a phylum (or other taxon).

Phoronida. The two genera seem to belong to a single order, for which there is no special name (Hyman, 1959).

Brachiopoda. There appears to be universal agreement as to the division of this

phylum into two classes. Six pairs of names have been proposed for these classes, of which Inarticulata and Articulata are favored in most recent works. The Inarticulata are usually divided into two orders, and the Articulata were formerly divided into two or three orders. There is no general agreement on the orders of Articulata, and the opinion of Hyman (1959) and others that there is no satisfactory classification is accepted here. However, one of the older orders is still acceptable to paleontologists, and there is no satisfactory method for combining the remaining two. The older division into three orders is therefore followed, until a clear alternative is available.

Mollusca. Only one recent American work is known to list seven classes of Mollusca as is done herein. There is difference of opinion among modern workers only as to the status of the groups sometimes referred to as Isopleura. Many texts have omitted the fossil Monoplacophora and treated the Solenogastres as an *incertae sedis* group. This leaves the Amphineura or Placophora as a fifth class. It also leaves the classification of the phylum incomplete and therefore unsatisfactory.

In volume I of the Treatise of Invertebrate Paleontology, Yonge (1960) discusses the features of these groups and concludes that there are seven classes. This arrangement is followed also in the *Traité de Zoologie* and is accepted herein.

Monoplacophora. Until 1957 this class was known only as fossils. Its division into three orders is taken from the Treatise (I, 1960).

Amphineura / Polyplacophora. There are three substantially different classifications of this group among recent works. These are: 1] orders Lepidopleurida and Chitonida, by Thiele (1935), etc.; 2] orders Eoplacophora, Mesoplacophora, Isoplacophora, and Teleoplacophora, by Cotton & Godfrey (1940); and 3] orders Paleoloricata and Neoloricata, by Smith (1960). There seems to be little direct correlation between these systems.

Smith's system is ostensibly based on Pilsbry's early classification, modified by paleontological data. It is unfamiliar to neontologists, but it may be readily understood when it is seen that all living chitons are placed in the order Neoloricata (to which many fossil forms belong as well). It is adopted here as the best available classification of a neglected group.

Aplacophora. There appears to be no

disagreement on the division of this class into two orders. It is sometimes treated as a subclass or even as an order, of Amphineura or Gastropoda.

Gastropoda. Nearly all recent writers agree on the division of this class into three subclasses, following Thiele (1931). The first, Prosobranchia, has been widely divided into three orders, but Cox (1960) in the Treatise (I), has combined two of these under the new name Caenogastropoda. His new arrangement is followed here, although in other respects Thiele's classification is accepted. A recent classification by Taylor & Sohl (1962) is not followed here because it is not accompanied by justification at the ordinal level.

Bivalvia / Pelecypoda. A considerable variety of classifications are in use for this class, with little obvious correlation of groupings. At the present time it appears best to present the more common arrangement of neontologists and also the customary paleontological one (in the footnotes), until a single scheme has been accepted by both groups of workers. The first of these is the scheme of Lankester (1906) and most later textbooks. The second is the scheme of Cotton & Godfrey (1938) with the orders raised to subclasses as by Cox (1960). (Cox's more numerous orders may represent a more natural arrangement, but it is not yet known whether they will be acceptable to other workers.)

Scaphopoda. Apparently no names are available for the single class and the single order. Therefore, Scaphopoda is here used for all three levels, as they are coextensive.

Cephalopoda. There is little agreement among recent workers as to the subdivision of this class, although many of the subgroups are found in all schemes. The arrangement followed here is that of Cotton & Godfrey (1940) and many of the older textbooks. The numerous nautiloid "orders" of Flower & Kümmel (1950) are based largely on relative characters and have not been clearly established as entitled to ordinal rank.

Sipunculoidea. The ten genera of this phylum are not separated into classes or orders. Separate names are not available for the resulting single class and order.

Echiuroidea. This phylum, which has often been placed in or appended to the Annelida, is divided into two classes as in Boettger (1952). The class Echiurida is divided into three orders as in Pearse (1949).

Myzostomida. The two orders are accepted from Prenant in the *Traité de Zoologie* (1959).

Annelida. Many recent books list the Polychaeta and Oligochaeta as separate classes. The differences between the two are largely relative, and the two together can be described in detail with few conflicts. For this reason, the two groups are here combined in the class Chaetopoda, as in many of the older works. Their differences may then be brought out at the subclass level.

No really satisfactory classification of this phylum or its classes has been found.

Polychaeta. The usual division into two orders has been followed, with the addition of one extinct order.

Oligochaeta. There being no generally accepted subdivision of this group, the one given without Latin names by Avel (1959) in the *Traité* (attributed by him to Michaelson, 1930) and without acceptable single names by Pearse (1949) is followed here. The names are emended to conform to custom in Latin nomenclature.

Hirudinea. Division of this class into four orders was proposed by Harant & Grassé (1959) using three orders proposed by Caballero (1952) and adding the "Acanthobdelliformes nom.nov." These names and groupings were not new there, except in ending. Rhynchobdellida dates from Blanchard (1887), Gnathobdellida from Vaillant (1890), and Pharyngobdellida from Johannson (1913). These same four orders were recognized by Lowenstein (1954), using the name Acanthobdellida and using the name Herpobdellida instead of Pharyngobdelliformes.

It is not clear whether these names were independently proposed, but there seems to be no need for the *-iformes* endings here. The four orders are accepted here, the spellings of Caballero and of Harant & Grassé are rejected, and Pharyngobdellida is accepted because of apparent priority.

Archiannelida. There is apparently general agreement that there is only one order in this class. No ordinal name is available.

Tardigrada. The division into three orders in two classes is taken from Pearse (1949), after Richters (1926) and Marcus (1927).

Pentastomida. The orders are from Boettger (1952).

Onychophora. Division of the phylum into two orders is accepted from Boettger (1952) and the *Treatise* (O, 1959), following earlier writers.

Arthropoda. Some recent classifications of this largest of all phyla have been complicated by attempts to include the Pentastomida, Onychophora, and even the Tardigrada. When this is done, the phylum can no longer be defined, because it would include a variety of body cavities, nervous systems, respiratory systems, excretory systems, integuments, etc. With these groups removed, the arthropods can readily be classified into eleven classes, and these can be grouped into three subphyla.

Much of the classification of the Arthropoda above the ordinal level is in an unsettled state. There seems to be no single complete classification that is adequate for both Recent and fossil groups. The one presented here is therefore made up from many sources, most of which are at least in part drawn from earlier sources. Listed below are the recent works that are accepted at each level, but they usually are not the original proposal of the arrangement.

Subphyla are accepted from Pearse (1949), classes in the Trilobitomorpha from the *Treatise* (O, 1959), in the Chelicerata from Pearse (1949) and Moore (1952), and in the Mandibulata from Pearse (1949) with exclusion of superclasses.

Orders in the Trilobitomorpha are from the *Treatise* (O, 1959), in the Mero-stomata from the *Treatise* (P, 1955), in the Pycnogonida from the *Treatise* (P, 1955), in the Arachnida from the *Treatise* (P, 1955) which is the system of Petrunkevitch, in the Crustacea from Waterman & Chace (1960), in the Pauropoda and Symphyla from Brues & Melander (1954), in the Diplopoda from Boettger (1952), in the Chilopoda from Pearse (1949), and in the Insecta from Brues & Melander (1954).

The class Eurypterida consists of a single order, for which the synonym Gigantostroaca can reasonably be used.

Chaetognatha. This is another of the one-class one-order phyla. Boettger (1952) has used the name Sagittoidea for both class and order, but it seems to be more appropriate to restrict this name to the ordinal level and to use the phylum name also at the class level. The other two synonyms seem to be inappropriate as they were

originally employed in somewhat different context.

Pogonophora. This is probably the newest phylum in point of knowledge of the animals themselves, as the first species was described in 1914, and most of the present day knowledge is less than a score of years old. Only one classification has been undertaken, by Ivanov (1955), and his division into two orders is accepted here.

Inasmuch as the synonym *Brachiata* is not well known for these animals, it has not been used for the one class.

Echinodermata. No single satisfactory classification has been found for this varied phylum. The subphyla here accepted (see footnotes) are those of Shrock & Twenhofel (1953). The classes in the *Pelmatozoa*, *Homalozoa*, and *Haplozoa* are those of Shrock & Twenhofel (1953), being extinct except for the *Crinoidea*; in the *Eleutherozoa* the scheme of Shrock & Twenhofel is modified according to the views of Hyman (1955) to omit the *Steleroidea* and treat *Asteroidea* and *Ophiuroidea* as classes. This makes it necessary also to treat as classes the extinct groups *Auluroidea* and *Somasteroidea*. This arrangement is admittedly a compromise with more familiar classifications.

This phylum contains a large number of extinct subgroups, and it is difficult to give full attention to the extinct subgroups without confusing the classification of Recent ones. The orders accepted here are as follows: In *Pelmatozoa*, *Homalozoa*, and *Haplozoa*, from Shrock & Twenhofel (1953); in *Asteroidea*, from Hyman (1955); in *Ophiuroidea*, from Boettger (1952) except for removal of *Auluroidea*; in *Echinoidea*, from Shrock & Twenhofel (1953) for the *Regularia* and from Hyman (1955) for the *Irregularia* (except for removal of *Bothriocidaroida* after Moore

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et al. (1952); and in the *Holothurioidea*, from Shrock & Twenhofel (1953).

Pterobranchia. Many writers agree on dividing the pterobranchs into two groups. The difficulties of describing *Rhabdopleura* and *Cephalodiscus* together leads to skepticism that they should be considered orders rather than classes. In deference to workers in this field, the usual division is adopted, with some misgivings (as in Hyman, 1959).

Enteropneusta. Only one class and one order is known in this group. It is sometimes left without a name, but *Balanoglossida* is available. It is here used for the order, as the phylum name is also familiar at the class level.

Planctosphaeroidea. This phylum consists of a single species of what appear to be larvae.

Tunicata. There appears to be general agreement on the assignment of the tunicates to three major classes. The subclasses and orders accepted here are those of Pearse (1949) and others, with addition to the *Ascidiacea* of an order *Octacnemida* after Harant (1948).

Cephalochordata. This group, which is usually included in the *Chordata*, has at least four available names. Those adopted are the ones most often used at the respective levels.

Vertebrata. The restriction of this phylum to the craniates is explained in a previous section. The classes of *Vertebrata* are taken from Romer (1945) and Colbert (1955). The orders of these classes are taken from these same works, except that Romer is generally followed where he treats as orders the groups which Colbert lists as subclasses or superorders.

Complete List

Subk Series Phylum

ANIMALIA

(Zoa)

EOZOA (*Plastidozoa*)

Protozoa CAM-REC

PARAZOA

Porifera (*Spongiaria, Spongiae*) CAM-REC

Cyathospongia (*Pleospongia, Archaeocyatha*) CAM

AGNOTOZOA

Mesozoa (*Planuloidea, Mionelminthes, Moruloidea*) REC

HISTOZOA (*Metazoa, Eumetazoa*)

Enterocoela (*Enterozoa, Protaxonia*)

Monoblastozoa REC

Graptozoa CAM-MIS

Conularida CAM-TRI

Coelenterata (*Cnidaria, Nematozoa, Nematophora*) CAM-REC

Ctenophora (*Acnidaria, Collaria, Ctenarea, Ctenophoraria*) REC

Acoelomata

Platyhelminthes (*Platodes*) REC

Rhynchocoela (*Nemertinea, Aplocoela, Miocoela*) REC

Pseudocoelomata (*Pseudocoelia, Autoscolecida, Protonephridozoa*)

Acanthocephala REC

Rotifera (*Rotatoria*) REC

Gastrotricha REC

Kinorhyncha (*Echinodera*) REC

Priapulioidea REC

Nematoda (*Nemata*) REC

Gordiacae (*Gordioidea, Nematomorpha*) CAR-REC

Calyssozoa (*Entoprocta, Endoprocta, Kamptozoa*) REC

of Phyla¹

Subk	Series	Phylum	
		Coelomata (<i>Eucoelomata</i>)	
		Bryozoa (<i>Polyzoa, Ectoprocta</i>)	ORD-REC
		Phoronida	REC
		Brachiopoda (<i>Spirobranchia, Palliobranchiopoda</i>)	CAM-REC
		Mollusca (<i>Palliated, Malacozoa, Saccata, Heterogangliata, Otocardia</i>)	CAM-REC
		Sipunculoidea	REC
		Echiuroidea	REC
		Myzostomida	JUR-REC
		Annelida (<i>Annulata, Coelhelminthes</i>)	CAM-REC
		Tardigrada	REC
		Pentastomida (<i>Linguatulida</i>)	REC
		Onychophora (<i>Polypoda, Protracheata, Ceratophora, Malacopoda</i>)	CAM-REC
		Arthropoda (<i>Euarthropoda</i>)	CAM-REC
		Chaetognatha (<i>Homalopterygia, Oesthelminthes</i>)	CAM-REC
		Pogonophora (<i>Brachiata</i>)	REC
		Echinodermata	CAM-REC
		Pterobranchia	ORD-REC
		Enteropneusta (<i>Helminthomorpha</i>)	REC
		Planctosphaeroidea	REC
		Tunicata (<i>Urochordata</i>)	REC
		Cephalochordata (<i>Acrania, Cirrhostomi, Entomocrania, Haplocyemata, Homomeria, Myelozoa, Pharyngobranchii</i>)	REC
		Vertebrata (<i>Euchorda, Craniata</i>)	ORD-REC

¹ For explanations, see preceding section.

Complete List of Classes and Orders

with Synonyms, Subgroups, and Geologic Range

Class Subcl Order

PROTOZOA¹

FLAGELLATA ² (<i>Mastigophora</i>)	SIL-REC
Phytomastigina ³ (<i>Phytomastigophorea</i>)	SIL-REC
Chryomonadina (<i>Silicoflagellata</i> , <i>Chryomonada- ceae</i>)	CRE-REC
Coccolithophorida	SIL-REC
Cryptomonadina (<i>Cryptomonadaceae</i>)	REC
Phytomonadina (<i>Volvocales</i> , <i>Volvocina</i> , <i>Volvocaceae</i>)	EOC-REC
Euglenoidina (<i>Euglenida</i> , <i>Euglenaceae</i>)	EOC-REC
Chloromonadina (<i>Chloromonadaceae</i>)	REC
Dinoflagellata ⁴ (<i>Cilioflagellata</i> , <i>Catenata</i>)	JUR-REC
Zoomastigina ⁵ (<i>Zoomastigophorea</i>)	REC
Rhizomastigina (<i>Pantostomatida</i> , <i>Rhizomastigaceae</i> <i>Rhizoflagellata</i>)	REC
Protomonadina (<i>Protomastigida</i> , <i>Protomastigaceae</i>)	REC
Polymastigina	REC
Hypermastigina (<i>Holomastigina</i>)	REC
SARCODINA	CAM-REC
Rhizopoda ⁶	ORD-REC
Proteomyxa	REC

¹ *Synonyms:* Eozoa, Plastidozoa. *Subphyla:* Plasmodroma (Homokaryota, Gymnomyxa, Cytomorpha) = FLAGELLATA + SARCODINA + SPOROZOA. Ciliophora (Infusoria, Heterokaryota, Cytoidea) = CILIATA + SUCTORIA. *Includes:* Corticata (FLAGELLATA + SPOROZOA + CILIOPHORA).

² *Includes:* Lissoflagellata, Monadidea, Heteromastigina, Chromomonadina, Choanoflagellata, Craspedomonadina, Phalansteriina, Phytoflagellata, Chlamydomonadina, Euflagellata.

³ *Includes:* Heterochlorida.

⁴ *Includes:* Prorocentraceae, Adinida, Peridiniaceae, Gymnodiniaceae, Diniferidea, Cystoflagellata, Rhynchoflagellata.

⁵ *Includes:* Trichomonadida.

⁶ *Includes:* Labyrinthulidea, Lobosa, Filosa.

Class	Subcl	Order	
		Mycetozoa ⁷ (<i>Myxomycetes</i> , <i>Myxogasteres</i>)	REC
		Amoebozoa (<i>Amoebina</i> , <i>Amoebaea</i> , <i>Nuda</i> , <i>Gymna- moebaea</i>)	REC
		Testacea (<i>Thecamoebae</i>)	EOC-REC
		Foraminifera ⁸ (<i>Reticularia</i> , <i>Polythalamia</i> , <i>Thalamo- phora</i>)	ORD-REC
	Actinopoda		CAM-REC
		Heliozoa ⁹	PLE-REC
		Radiolaria ¹⁰ (<i>Polycystina</i> , <i>Cytophora</i> , <i>Echinocystida</i>)	CAM-REC
SPOROZOA ¹¹ (<i>Gregarina</i>)			REC
		Telosporidia ¹² (<i>Cytosporidia</i> , <i>Ectospora</i> , <i>Amoebosporidea</i>)	REC
		Gregarinida ¹³	REC
		Coccidia ¹⁴ (<i>Coccidiomorpha</i>)	REC
		Haemosporidia ¹⁵ (<i>Haemocytozoa</i> , <i>Acystosporidia</i> , <i>Gymnosporidia</i>)	REC
	Cnidosporidia		REC
		Myxosporidia (<i>Amoebogeniae</i>)	REC
		Actinomyxidia	REC
		Microsporidia	REC
		Helicosporidia	REC
	Sarcosporidia (<i>Sarcocystidea</i>)		REC
		Sarcosporidia	REC
		Globidia	REC
	Haplosporidia (<i>Aplosporidia</i>)		REC
		Haplosporidia	REC

⁷ *Includes:* Euplasmodida, Eumycetozoa, Sorophora, Acrasiae, Amaurochaetaceae, Amaurochaetineae, Amaurosporaes, Anemineae, Arcyriaceae, Calcarineae, Calonemineae, Ceratiomyxaceae, Dictyosteliaceae, Didymiaceae, Endosporeae, Exosporae, Guttulinaceae, Heterodermaceae, Lamprosporaes, Liceaceae, Lygogalaceae, Margaritaceae, Physaraceae, Reticulariaceae, Stemonitaceae, Trichiaceae, Tubulinaceae.

⁸ *Includes:* Allogromidiaceae, Astrorhizidea, Cheilostomellaceae, Chilostomellidea, Globigerinidea, Gromiidea, Lagenidea, Lituolidea, Miliolidea, Nummulitidea, Rotalidea, Textularidea, Xenophyphoridae.

⁹ *Includes:* Actinophrydea, Aphrothoraca, Centrohelidia, Chalarothoraca, Chlamydomphora, Desmothoraca, Helioflagellida.

¹⁰ *Includes:* Acantharia, Acanthometrida, Acanthophractida, Actipyloa, Cyrtellaria, Botryoidea, Cyrtoida, Spyroidea, Monopylaria, Nasselaria, Osculosida, Merotrypasta, Peripyloa, Spumellaria, Collodaria, Sphaerellaria, Sphaerozoa, Plectellaria, Plectoidea, Stephoidea, Porulosida, Holotrypasta, Tripylaria, Phaeodaria, Phaeoconchia, Phaeocystina, Tripyloa, Phaeogromia, Phaeosphaeria).

¹¹ Neosporidea (Histosporidia, Endospora) = CNIDOSPORIDIA + SARCOSPORIDIA + HAPLOSPORIDIA. Acnidosporidia = SARCOSPORIDIA + HAPLOSPORIDIA.

Class	Subcl	Order	
CILIATA			JUR-REC
	Protociliata (<i>Ciliatoidea</i>)		REC
	Opalinida		REC
	Euciliata		JUR-REC
	Holotricha ¹⁶ (<i>Aspirigera</i> , <i>Aspirotricha</i>)		REC
	Spirotricha ¹⁷ (<i>Spirigera</i>)		JUR-REC
	Chonotricha		REC
	Peritricha		REC
SUCTORIA (<i>Acineta</i> , <i>Acinetaria</i> , <i>Tentaculifera</i>)			REC
	Suctoria		REC

P O R I F E R A¹⁸

CALCAREA ¹⁹ (<i>Calcispongea</i>)			CAM-REC
	Solenida (<i>Asconosa</i>)		CAM-REC
	Lebetida (<i>Syconosa</i>)		JUR-REC
	Pharetronida		PER-REC
	Thalamida (<i>Sphinctozoa</i>)		PEN-CRE
HYALOSPONGEA ²⁰ (<i>Hexactinellida</i> , <i>Triaxonida</i>)			CAM-REC
	Lyssakina (<i>Lyssacina</i>)		CAM-REC
	Dictyonina (<i>Dictyida</i> , <i>Inermia</i>)		ORD-REC
	Lychniskophora (<i>Lychniskida</i>)		JUR-REC
	Heteractinida		CAM-CAR
DEMOSPONGEA ²¹ (<i>Desmospongea</i>)			CAM-REC
	Myxospongida		REC
	Keratosida ²² (<i>Ceratospongida</i> , <i>Ceratosida</i> , <i>Euceratosida</i>)		CAR-REC

¹² Includes: Rhabdogeniæ, Serosporidia, Exosporidia, Piroplasmidea.

¹³ Includes: Eugregarinida, Schizogregarinida.

¹⁴ Includes: Adeleida, Eimeriida.

¹⁵ Includes: Babesiida, Plasmodiida.

¹⁶ Includes: Apostomina, Aspirotrichaceæ, Astomata, Astomina, Gymnostomata, Hymenostomata, Thigmotrichina, Trichostomata.

¹⁷ Includes: Ctenostomina, Entodiniomorphina, Heterotricha, Hypotricha, Oligotrichina, Polytricha, Tintinnina.

¹⁸ Synonyms: Spongiaria, Spongeæ. Includes: Octactinellida, Heteractinellida. Silicospongiæ (Non-calcareæ) = HEXACTINELLIDA + DEMOSPONGEA. Nidulitida, sometimes included here, is probably a calcareous alga.

¹⁹ Asconosa, Syconosa, Leuconosa are structural types, not groups. Includes: Sycones, Dialytina, Lithonina, Homocoelida, Heterocoelida.

²⁰ Includes: Hexasterophora, Amphidiscophora, Uncinataria.

²¹ Includes: Tetractinellida, Tetraxonida, Desmophora, Monaxonida, Sigmato-monaxonellida, Monactinellida.

²² Considered by some to belong to Hadromerida. Sometimes placed with some others of Demospongea as Cornacuspongia (with orders Protorhabdina, Poikilorhabdina, Phthinorhabdina, Aporhabdina). Includes: Dictyoceratina, Monoceratina, Dendroceratina, Hexaceratina.

Class	Subcl	Order	
		Haplosclerida	CAM-REC
		Poecilosclerida	CAM-REC
		Hadromerida (<i>Astromonaxonellida</i>)	CAM-REC
		Halichondrida	REC
		Epipolasida	CAM-REC
		Choristida (<i>Astrophora, Sigmatophora</i>)	CAR-REC
		Carnosida (<i>Homosclerophora, Microsclerophora</i>)	CAR-REC
		Lithistida	CAM-REC
RECEPTACULITIDA		²³	ORD-DEV
		Receptaculitida	ORD-DEV

CYATHOSPONGIA ²⁴

MONOCYATHA			CAM
		Monocyathida	CAM
		Archaeophyllida	CAM
ARCHAEOCYATHA			CAM
		Ajacyathida	CAM
		Metacyathida	CAM
		Acanthinocyathida	CAM
		Hetairacyathida	CAM
		Syringocnemida	CAM
ANTHOCYATHA			CAM
		Anthomorphida	CAM
		Somphocyathida	CAM

MESOZOA ²⁵

RHOMBOZOA			REC
		Dicyemida	REC
		Heterocyemida	REC
ORTHONECTIDA			REC
		Orthonectida	REC

MONOBLASTOZOA

MONOBLASTOIDEA			REC
		Monoblastidea	REC

²³ *Affinities unknown; may not belong to Porifera.*

²⁴ *Includes: Acanthocyatha, Uranocyatha, Exocyatha. Synonyms: Pleospongia.*

²⁵ *Synonyms: Planuloidea, Mionelminthes, Moruloidea. Catenata are now considered to be parasitic dinoflagellates (Protozoa).*

²⁶ *Includes: Rhabdophora, Retioloidea. Acanthaspida, Acanthistida, Graptoblasti, Graptovermida are groups of uncertain status.*

Class Subcl Order

GRAPTOZOA²⁶

GRAPTOLITHIDA	CAM-MIS
Dendroidea	CAM-MIS
Graptoloidea	ORD-SIL
Tuboidea	ORD-SIL
Camaroidea	ORD
Stolonoidea	ORD

CONULARIDA

CONULATA	CAM-TRI
Conulariida	CAM-TRI

COELENTERATA²⁷

PROTOMEDUSAE	CAM-ORD
Brooksellida	CAM-ORD
DIPLEUROZOA	CAM
Dickinsoniida	CAM
STROMATOPOROIDEA	CAM-CRE
Stromatoporidea	CAM-CRE
Labechioidea	ORD-CRE
Sphaeractinoidea	JUR-CRE
HYDROZOA ²⁸ (<i>Anoecia</i> , <i>Ectocarpus</i> , <i>Aphacellae</i> , <i>Hydrozoaria</i>)	CAM-REC
Trachylinida ²⁹	JUR-REC
Hydroida ³⁰ (<i>Nudibrachiata</i> , <i>Polyparia</i> , <i>Hydrida</i> , <i>Hydrariae</i> , <i>Diplomorpha</i>)	CAM-REC
Spongiomorphida	TRI-JUR
Milleporida (<i>Hydrocorallinae</i>)	CRE-REC
Stylasterina	CRE-REC
Siphonophora ³¹	ORD-REC

²⁷ *Synonyms:* Cnidaria, Nematozoa, Nematophora.²⁸ *Includes:* Eleutheroblastea, Hydromedusae.²⁹ *Includes:* Trachymedusae, Trachomedusae, Narcomedusae.³⁰ *Includes:* Anthomedusae, Athecata, Gymnoblastera, Leptomedusae, Thecata, Thecophora, Calyptoblastea, Leptolinae, Sertularina, Campanulariae, Tubulariae.³¹ *Includes:* Calycophora, Physophora, Chondrophora.

Class	Subcl	Order	
SCYPHOZOA	³²	(<i>Scyphomedusae, Acalephae, Neoscyphozoa, Acraspeda</i>)	JUR-REC
		Stauromedusae (<i>Lucernaria, Lucernariidea, Cyclozoa, Calycozoa</i>)	REC
		Cubomedusae (<i>Carybdeida, Charybdeida, Marsupialia</i>)	JUR-REC
		Coronatae (<i>Peromedusae, Corona, Coronatida</i>)	JUR-REC
		Semaeostomeae (<i>Semostomeae, Semaestomatida</i>)	JUR-REC
		Lithorhizostomeae (<i>Lithorhizostomatida</i>)	JUR
		Rhizostomeae (<i>Rhizostomatida</i>)	JUR-REC
ANTHOZOA		(<i>Endoaria, Actinozoa, Actinoidea, Oecioa, Polycladia, Corallaria, Monocyclica, Coralligena, Coralla, Scyphopolyphi, Anthozoariae</i>)	CAM-REC
		Alcyonaria ³³ (<i>Octocorallia, Octactinia, Zoophytaria</i>)	PER-REC
		Stolonifera	CRE-REC
		Telestacea	REC
		Alcyonacea	JUR-REC
		Trachypsammiacea	PER
		Coenothecalia	CRE-REC
		Gorgonacea	CRE-REC
		Pennatulacea	CRE-REC
		Zoantharia ³⁴ (<i>Hexacorallia, Helianthoidea, Zoanthactiniaria, Actinanthida, Dodecacorallia, Zoantha</i>)	CAM-REC
		Zoanthiniaria (<i>Zoanthidea</i>)	REC
		Corallimorpharia (<i>Stichodactylina, Asclerocorallia</i>)	REC
		Actiniaria (<i>Actiniidea, Malacactiniae, Edwardsiidea</i>)	CAM-REC
		Rugosa (<i>Stauracea, Pterocorallia, Tetrseptata, Tetracoelia, Tetracorallia</i>)	ORD-PER
		Heterocorallia (<i>Dicoelia</i>)	CAR
		Scleractinia (<i>Madreporaria, Polyactinia, Cyclocorallia</i>)	TRI-REC
		Tabulata (<i>Aseptata, Trichocorallia, Tubulosa, Tetradida, Schizocoralla, Heliolitida, Multisolenida, Thallocoralla, Chaetetida</i>)	ORD-PER

³² Discomedusae (Discophora) = CORONATAE + SEMAEOSTOMEAE + RHIZOSTOMEAE.

³³ Includes: Pseudaxonia, Axifera, Stelechotokea, Protalcyonacea, Synalcyonacea.

³⁴ Includes: Paramera, Cryptoparamera, Ptychodactiaria, Proactiniae.

³⁵ Synonyms: Acnidaria, Collaria, Ctenophoraria, Ctenarea.

³⁶ Synonyms: Platodes, Platyelmia, Plathelminthes, Platyhemia. Cestoidea = CESTODA + CESTODARIA.

Class	Subcl	Order	
	Ceriantipatharia		MIO-REC
	Antipatharia	(<i>Hexactinia, Anticorallia, Antipathidea</i>)	MIO-REC
	Ceriantharia	(<i>Paranemata, Tetractiniae, Heterocoralla, Cerianthiae, Cerianthidea</i>)	REC

CTENOPHORA³⁵

TENTACULATA	(<i>Micropharyngea</i>)	REC
	Cydippida (<i>Saccata</i>)	REC
	Lobata (<i>Bolinopsidea</i>)	REC
	Cestida (<i>Cestoidea</i>)	REC
	Platyctenea (<i>Tjalfiellidea, Ctenoplanidea</i>)	REC
NUDA	(<i>Macropharyngea, Atentaculata</i>)	REC
	Beroida	REC

PLATYHELMINTHES³⁶

TURBELLARIA	(<i>Planaria</i>)	REC
	Acoela	REC
	Rhabdoacoela ³⁷	REC
	Alloeoacoela (<i>Alloioacoela</i>)	REC
	Tricladida	REC
	Polycladida (<i>Cryptocoela</i>)	REC
TREMATODA		REC
	Monogenea ³⁸ (<i>Monogenetica, Heterocotylea, Eterocotylea, Herocotylida, Polystomea, Pectobothrii, Cryptocoela, Ectoparasitica</i>)	REC
	Aspidogastrea (<i>Aspidobothria, Aspidocotylea</i>)	REC
	Digenea ³⁹ (<i>Digenetica, Malacocotylea, Distomea, Malacobothrii, Strigeata</i>)	REC
CESTODA ⁴⁰	(<i>Eucestoda, Cestoidea, Merozoa, Polyzoa, Tomiosoma</i>)	REC
	Proteocephala (<i>Proteocephaloidea</i>)	REC
	Tetraphyllidea (<i>Phyllobothrioidea</i>)	REC
	Disculicepitidea	REC
	Lecanicephala (<i>Lecanicephaloidea, Diphyllidea</i>)	REC

³⁷ Includes: Temnocephaloidea, Dactylifera, Catenulida, Macrostomida.

³⁸ Includes: Monopisthocotylea, Polyopisthocotylea.

³⁹ Includes: Gasterostoma, Prosostomata.

⁴⁰ Includes: Aphylles, Monophyllidea, Heterophyllidea, Cystica, Caryophyl-lacea.

Class	Subcl	Order	
		Trypanorhyncha (<i>Tetrarhyncha</i> , <i>Tetrarhynchoidea</i> , <i>Phyllorhyncha</i>)	REC
		Cyclophyllidea (<i>Taenioidea</i> , <i>Tetracotylea</i> , <i>Tetrabothri-</i> <i>diata</i>)	REC
		Aporidea	REC
		Nippotaeniidea	REC
		Caryophyllidea	REC
		Spathebothridea	REC
		Pseudophyllidea (<i>Bothriocephaloidea</i> , <i>Dicestoda</i> , <i>Di-</i> <i>bothridiata</i>)	REC
CESTODARIA		(<i>Monozoa</i> , <i>Atomiosoma</i>)	REC
		Amphiliniidea	REC
		Gyrocotylidea	REC
		Biporophyllidea	REC

R H Y N C H O C O E L A ⁴¹

NEMERTINEA		(<i>Nemertea</i>)	REC
		Palaeonemertea (<i>Paleonemertea</i> , <i>Palaeonemertini</i>)	REC
		Heteronemertea (<i>Schizonemertini</i> , <i>Trimyaria</i> , <i>Eupoli-</i> <i>ida</i>)	REC
		Hoplonemertea (<i>Metanemertini</i>)	REC
		Bdellonemertea (<i>Bdellomorpha</i>)	REC

A C A N T H O C E P H A L A

ACANTHOCEPHALA		⁴³	REC
		Archiacanthocephala	REC
		Palaeacanthocephala	REC
		Eoacanthocephala ⁴⁴	REC

R O T I F E R A ⁴⁵

SEISONIDEA			REC
		Seisonacea	REC
BDELLOIDEA			REC
		Bdellacea (<i>Bdelloidaceae</i>)	REC

⁴¹ Synonyms: Aplocoela, Miocoela.

⁴² Includes: Dimyaria, Protonemertini, Mesonemertini, Anopla, Enopla.

⁴³ Metacanthocephala = ARCHIACANTHOCEPHALA + PALAEACANTHOCEPHALA

⁴⁴ Includes: Gyraacanthocephala, Neoacanthocephala.

⁴⁵ Synonyms: Rotatoria. Digononta = SEISONIDEA + BDELLOIDEA.

⁴⁶ Includes: Rhizota.

Class Subcl Order

MONOGONONTA	⁴⁶	REC
Ploima	⁴⁷ (<i>Ploimoidaceae</i>)	REC
Flosculariacea	⁴⁸	REC
Collothecacea		REC

GASTROTRICHA

MACRODASYOIDEA		REC
Macrodasyidea		REC
CHAETONOTOIDEA		REC
Chaetonotidea		REC

KINORHYNCHA

ECHINODERA		REC
Echinodera	⁴⁹	REC

PRIAPULOIDEA

PRIAPULOIDEA		REC
Priapulida		REC

NEMATODA⁵⁰

NEMATOIDEA		REC
Enoploidea	(<i>Enoplata</i>)	REC
Dorylaimoidea		REC
Mermithoidea		REC
Chromadoroidea	⁵¹	REC
Araeolaimoidea		REC
Monhysteroidea		REC
Desmoscolecoida		REC
Rhabditoidea	(<i>Anguilluloidea</i>)	REC
Rhabdiasoidea		REC

⁴⁷ Includes: Notommatoidea, Brachionoidea, Asplanchnaceae, Loricata, Il-
loricata.

⁴⁸ Includes: Scirtopoda, Trochosphaerida, Melicertida.

⁴⁹ Includes: Cyclorhaga, Conchorhaga, Homalorhaga, as suborders.

⁵⁰ Synonym: Nematata. Includes: Hologonia, Telogonia, Phasmidia, Aphasmidia.

⁵¹ Includes: Chaetosomatida.

Class	Subcl	Order	
		Oxyuroidea	REC
		Ascaroidea	REC
		Strongyloidea	REC
		Spiruroidea (<i>Camallanta</i>)	REC
		Dracunculoidea	REC
		Filarioidea	REC
		Trichuroidea (<i>Trichinelloidea</i>)	REC
		Diectophymoidea	REC

GORDIACEA

NEMATOMORPHA			CAR-REC
		Gordioidea (<i>Gordididea</i>)	CAR-REC
		Nectonematoidea	REC

CALYSSOZOA⁵²

ENDOPROCTA (<i>Entoprocta</i>)			REC
		Pedicellinida	REC

BRYOZOA⁵³

PHYLACTOLAEMATA (<i>Hippocrepia</i>)			CRE-REC
		Lophopoda	CRE-REC
GYMNOLAEMATA ⁵⁴ (<i>Stelmatopoda</i>)			ORD-REC
		Trepostomata (<i>Trepostomata</i> , <i>Monticuliporoidea</i>)	ORD-PER
		Cryptostomata	ORD-PER
		Cyclostomata (<i>Stenostomata</i>)	ORD-REC
		Ctenostomata	ORD-REC
		Cheilostomata (<i>Chilostomata</i>)	CRE-REC

PHORONIDA

PHORONIDA			REC
		Phoronida	REC

⁵² *Synonyms*: Kamptozoa (see also class names).

⁵³ *Synonyms*: Polyzoa, Ectoprocta. Formerly included also Endoprocta; together called also Holobranchia.

⁵⁴ Stenolaemata = TREPOSTOMATA + CYCLOSTOMATA. Cheilostenostoma (Eurytomata) = CTENOSTOMATA + CHEILOSTOMATA.

⁵⁵ *Synonyms*: Spirobranchiopoda, Palliobranchiopoda, Branchiopoda, Branchionopoda, Brachionocéphala, Branchionobranchia, Spirobranchia.

⁵⁶ *Includes*: Orthida, Strophomenida.

⁵⁷ *Includes*: Pentamerida, Rhynchonellida, Spiriferida, Terebratulida, Triplesiida.

⁵⁸ *Synonyms*: Palliata, Malacozoa, Heterogangliata, Otocardia, Saccata. Glos-sophora (Cephalophora) = AMPHINEURA + GASTROPODA + CEPHALOPODA + SCA-

Class Subcl Order

BRACHIOPODA⁵⁵

INARTICULATA (<i>Ecardines, Lyopomata, Pleuropygia, Gastrocaulia, Tretenterata, Sarcobranchiata</i>)	CAM-REC
Atremata	CAM-REC
Neotremata	CAM-REC
ARTICULATA (<i>Testicardines, Arthropomata, Apygia, Pygocaulia, Clistenterata</i>)	CAM-REC
Palaeotremata (<i>Paleotremata</i>)	CAM
Protremata ⁵⁶	CAM-REC
Telotremata ⁵⁷	CAM-REC

MOLLUSCA⁵⁸

MONOPLACOPHORA ⁵⁹ (<i>Protogastropoda, Amphigastropoda</i>)	CAM-REC
Tryblidioidea (<i>Tryblidiacea</i>)	CAM-REC
Archinacelloidea	CAM-SIL
Cambridioidea	CAM
AMPHINEURA ⁶⁰ (<i>Aculifera, Polyplacophora, Loricata, Crepidoda, Polyplakiphora, Polyplaxiphora, Placophora, Polybranchiata, Lamellata, Lepidoglossa</i>)	CAM-REC
Paleoloricata	CAM-CRE
Neoloricata	CAM-REC
APLACOPHORA (<i>Solenogastres, Telobranchia, Scolecomorpha</i>)	REC
Neomeniida (<i>Neomeniomorpha</i>)	REC
Chaetodermatida (<i>Chaetodermomorpha</i>)	REC
GASTROPODA ⁶¹ (<i>Anisopleura, Paracephalophora, Pselaphecephala</i>)	CAM-REC
Prosobranchia (<i>Streptoneura, Cochlides</i>)	CAM-REC
Archaeogastropoda ⁶²	CAM-REC

PHOPODA. Stenolaemata = AMPHINEURA + GASTROPODA + BIVALVIA + SCAPHOPODA. Prorhipidoglossomorpha = GASTROPODA + BIVALVIA + SCAPHOPODA. Isopleura = MONOPLACOPHORA + AMPHINEURA + APLACOPHORA.

⁵⁹ Includes: Cynostraca, Cochliostraca.

⁶⁰ Includes: Lepidopleurida, Chitonida, Eoplacophora, Isoplacophora, Mesoplacophora, Teleoplacophora.

⁶¹ Also spelled: Gasteropoda, Gastraeopoda, Gasteropodophora, Gasterozoa. Includes: Spironotia. Euthyneura (Androgyna, Platymalakia) = OPISTHBRANCHIA + PULMONATA.

⁶² Includes: Scutibranchia, Aspidobranchiata, Diotocardia, Bellerophonacea, Cyclobranchia, Zygobranchia, Docoglossa, Rhipidoglossa.

Class	Subcl	Order	
		Caenogastropoda ⁶³	ORD-REC
	Opisthobranchia ⁶⁴		MIS-REC
		Pleurocoela ⁶⁵ (<i>Tectibranchiata</i> , <i>Tectobranchia</i> , <i>Aplysiacea</i> , <i>Steganobranchia</i>)	MIS-REC
		Pteropoda	CRE-REC
		Sacoglossa	REC
		Acoela ⁶⁶	EOC-REC
	Pulmonata		PEN-REC
		Basommatophora	PEN-REC
		Stylommatophora	PEN-REC
BIVALVIA ⁶⁷		(<i>Pelecypoda</i> , <i>Lamellibranchiata</i> , <i>Aglossa</i> , <i>Lipocephala</i> , <i>Conchifera</i> , <i>Conchophora</i> , <i>Acephala</i>)	ORD-REC
		Protobranchia ⁶⁸	ORD-REC
		Filibranchia ⁶⁹	ORD-REC
		Eulamellibranchia ⁷⁰	SIL-REC
		Septibranchia	JUR-REC
SCAPHOPODA		(<i>Cirrhobranchiata</i> , <i>Solenocoencha</i> , <i>Prosopocoephalia</i> , <i>Lateribranchiata</i>)	DEV-REC
		Scaphopoda	DEV-REC
CEPHALOPODA		(<i>Siphonopoda</i>)	CAM-REC
		Tetrabranchiata (<i>Schizosiphona</i> , <i>Tentaculifera</i>)	CAM-REC
		Nautiloidea ⁷¹	CAM-REC
		Ammonitoidea ⁷²	ORD-CRE
		Dibranchiata (<i>Coleoidea</i> , <i>Acetabulifera</i> , <i>Holosiphona</i>)	MIS-REC
		Decapoda ⁷³ (<i>Decembranchiata</i> , <i>Decabrachia</i>)	JUR-REC

⁶³ Includes: Siphonobranchia, Pectinibranchia, Ctenobranchiata, Hemipomatostoma, Apomatostoma, Monotocardia, Azygobranchia, Mesogastropoda, Stenoglossa, Neogastropoda, Rachiglossa, Toxoglossa, Heteropoda, Taenioglossa, Platypoda, Rhachiglossa.

⁶⁴ Includes: Gymnosomata, Oncidiacea, Acochliidae, Vaginulacea, Anaspidea.

⁶⁵ Includes: Cephalaspidea, Thecosomata, Bullomorpha, Gyrosomata.

⁶⁶ Includes: Notaspidea, Pleurobranchomorpha, Nudibranchiata.

⁶⁷ Includes: Anisomyaria, Anatinacea, Cladocopa, Ambonodonta. Groups sometimes recognized include: Siphonida, Asiphonida, Homomyaria, Macrociliobranchia, Microciliobranchia, Pteriomorpha, Colloconchida, Eutaxodonta, Isofilibranchia, Pterocoencha, Rostroconchida, Heterocoencha, Eudesmodontida, Naidida, Pachyodontida, Pantodontida, Asthenodontida, Schizodontida, Heterodontida, Septibranchida. Also used as orders: Autobranchiata, Dimyaria, Eleutherohabda, Hemibranchia, Heteromya, Heteromyaria, Isedrolotila, Isomya, Laternulacea, Macrotrachia, Monomyaria, Monomya, Neotaxodonta, Palaeobranchia, Palaeolamellibranchia, Parafilibranchia, Pholadacea, Pleuroconcha, Pleurodonta, Praeheterodonta, Synaptorhabda, Veneracea.

Class	Subcl	Order	
		Octopoda (<i>Octobrachiata</i> , <i>Octopoida</i>)	CRE-REC
		Vampyromorpha	REC
		Belemnoida ⁷⁴ (<i>Phragmophora</i>)	MIS-EOC

SIPUNCULOIDEA

SIPUNCULOIDEA		REC
	Sipunculida	REC

ECHIUROIDEA

ECHIURIDA		REC
	Echiuroina	REC
	Xenopneusta	REC
	Heteromyota	REC
SACCOSOMATIDA		REC
	Saccosomatida	REC

MYZOSTOMIDA ⁷⁵

MYZOSTOMIDA		PAL-REC
	Proboscidea	REC
	Pharyngidea	REC

Arrangement preferred by paleontologists:

Subclass Prionodesmacea (orders Paleoconcha, Taxodonta, Schizodonta, Isodonta, Dysodonta).

Subclass Anomalodesmacea (orders Septibranchia, Anomalobranchia).

Subclass Teleodesmacea (orders Pantodonta, Diogenodonta, Cyclodonta, Teleodonta, Asthenodonta, Heterodonta, Pachyodonta, Desmodonta)

⁶⁸ Sometimes a subclass with orders Cryptodonta, Lipodonta, Palaeotaxodonta.

⁶⁹ *Includes:* Pseudolamellibranchia.

⁷⁰ *Includes:* Schizodonta, Heterodonta, Adapedonta, Anomalodesmata, Sinu-palliata, Integripalliata.

⁷¹ Sometimes ranked as a separate subclass with orders Mixochoanites, Schistochoanites, Orthochoanites, Cyrtchoanites; or with orders Ellesmeroceroida, Michelinoceroida, Ascoceroida, Oncoceroida, Endoceroida, Actinoceroida, Discosoroida, Nautilida; or with orders Bassleroceratida, Barrandeoceratida, Centroceratida, Rutoceratida, Solenochilida, Tarphyceratida.

⁷² Sometimes ranked as a separate subclass with order Ammonitida; or with orders Intrasiphonata, Extrasiphonata.

⁷³ *Includes:* Teuthoidea, Sepioidea, Loliginacea, Architeuthacea.

⁷⁴ Sometimes used as subclass in place of Dibranchiata.

⁷⁵ *Synonyms:* Myzostomaria, Myzostoma.

Class Subcl Order

ANNELIDA⁷⁶

CHAETOPODA ⁷⁷	CAM-REC
Polychaeta ⁷⁸	CAM-REC
Errantia (<i>Phanerocephala</i>)	CEN-REC
Sedentaria (<i>Cryptocephala</i> , <i>Tubicola</i>)	ORD-REC
Miskoa	CAM
Oligochaeta ⁷⁹	ORD-REC
Plesiothecata	?-REC
Prosothecata	?-REC
Prosopora	?-REC
Opisthopora	?-REC
HIRUDINEA	REC
Rhynchobdellida (<i>Rhynchobdelliformes</i>)	REC
Gnathobdellida (<i>Gnathobdelliformes</i>)	REC
Pharyngobdellida (<i>Herpobdellida</i> , <i>Erpobdellida</i> , <i>Pharyngobdelliformes</i>)	REC
Acanthobdellida (<i>Acanthobdelliformes</i>)	REC
ARCHIANNELIDA ⁸⁰	REC
Archannelida	REC

TARDIGRADA

HETEROTARDIGRADA	REC
Arthrotardigrada (<i>Prototardigrada</i>)	REC
Echiniscoidea	REC
EUTARDIGRADA	REC
Eutardigrada	REC

⁷⁶ *Synonyms*: Annulata, Coelhelminthes. Clitellata = OLIGOCHAETA + HIRUDINEA.

⁷⁷ *Includes*: Haplodrili, Saccocirrida.

⁷⁸ *Includes*: Nereidiformia, Capitelliformia, Spioniformia, Terebelliformia, Scoleciformia, Archichaetopoda, Poecioidea.

⁷⁹ *Includes*: Aphanaura, Limicolae, Moniligestres, Terricolae, Naidomorpha, Lumbricomorpha. Plesiothecata and Prosothecata have previously been cited as Plesiopora plesiotheca and Plesiopora prosotheca.

⁸⁰ *Includes*: Dinophleia.

⁸¹ *Synonyms*: Polypoda, Protracheata, Ceratophora, Malacopoda.

⁸² *Synonyms*: Euarthropoda. *Subphyla*: Trilobitomorpha (Anomomeristica) = TRILOBITOIDEA + TRILOBITA; Chelicerata (Nomomeristica) = MEROSTOMATA + PYCNOGONIDA + ARACHNIDA; Mandibulata = CRUSTACEA + PAUROPODA + SYM-

Class Subcl Order

PENTASTOMIDA

LINGUATULIDA	REC
Cephalobaenida	REC
Porocephalida (<i>Linguatulodea</i>)	REC

ONYCHOPHORA⁸¹

PERIPATIDEA	CAM-REC
Protonychophora	CAM
Euonychophora	REC

ARTHROPODA⁸²

TRILOBITOIDEA ⁸³	CAM-PEN
Merostomoidea (<i>Xenopoda</i>)	CAM
Limulavida (<i>Prochelicerata</i> , <i>Limulava</i>)	CAM
Emeraldellida	CAM
Nectaspida	CAM
Leanchoiliida (<i>Pseudanostraca</i>)	CAM
Pseudonotostraca (<i>Pseudocrustacea</i>)	CAM
Burgessiida	CAM
Waptiida	CAM
Marrellomorpha ⁸⁴ (<i>Marellomorpha</i>)	CAM
Marrellida	CAM
Hymenocarina	CAM
Hymenocarina	CAM
Arthropleurida	PEN
Arthropleurida	PEN
Cheloniellida	DEV
Cheloniellida	DEV
Opabiniida	CAM
Palaeanostraca	CAM

PHYLA + DIPLOPODA + CHILOPODA + INSECTA. Hyparthropoda was proposed for hypothetical ancestral forms. A separate class Arthrocephala is listed by Boettger in the Chelicerata, but no other reference to such an extinct group has been found. Diantennata = TRILOBITOMORPHA + CRUSTACEA. Branchiata = TRILOBITOMORPHA + CHELICERATA + MANDIBULATA. Acerata = MEROSTOMATA + ARACHNIDA. Arachnomorpha = TRILOBITOMORPHA + CRUSTACEA. Myriapoda = PAUROPODA + SYMPHYLA + DIPLOPODA + CHILOPODA. Progoneata = SYMPHYLA + DIPLOPODA + PAUROPODA. Antennata = PAUROPODA + SYMPHYLA + DIPLOPODA + CHILOPODA + INSECTA. Opisthogoneata = CHILOPODA + INSECTA. *Includes*: Marriocarida, of unknown position.

⁸³ Homopoda = MARRELLINA + PSEUDANOSTRACA + PSEUDONOTOSTRACA + HYMENOCARINA.

⁸⁴ *Includes*: Mimetasterida, Pygaspida, Proarthropoda.

Class	Subcl	Order	
TRILOBITA		⁸⁵	CAM-PER
		Agnostida (<i>Isopygia</i> , <i>Miomera</i>)	CAM-ORD
		Redlichiida (<i>Micropygia</i> , <i>Mesonacida</i>)	CAM
		Corynexochida (<i>Bathyriscidea</i> , <i>Zacanthoidacea</i>)	CAM
		Ptychopariida (<i>Conocoryphida</i> , <i>Trinucleida</i>)	CAM-PER
		Phacopida (<i>Proparia</i>)	ORD-DEV
		Lichida (<i>Lichacea</i>)	ORD-DEV
		Odontopleurida	CAM-DEV
MEROSTOMATA		⁸⁶ (<i>Palaeostraca</i>)	CAM-REC
		Xiphosura (<i>Gnathopoda</i> , <i>Poecilopoda</i>)	CAM-REC
		Aglaspida	CAM-ORD
		Xiphosurida ⁸⁷	SIL-REC
		Eurypterida	ORD-PER
		Gigantostraca	ORD-PER
PYCNOGONIDA		(<i>Pantopoda</i>)	DEV-REC
		Eupantopoda ⁸⁸	REC
		Palaeopantopoda	DEV
ARACHNIDA		⁸⁹ (<i>Embolobranchiata</i> , <i>Aeropneusta</i> , <i>Eu-arachnida</i>)	SIL-REC
		Latigastra	SIL-REC
		Scorpionida (<i>Scorpiones</i> , <i>Pectinifera</i>)	SIL-REC
		Pseudoscorpionida (<i>Chelonethida</i> , <i>Chernetes</i> , <i>Chernetidea</i>)	OLI-REC
		Phalangida (<i>Opiliones</i> , <i>Opilioneida</i>)	PEN-REC
		Architarbida (<i>Architarbi</i> , <i>Phalangiotarbi</i>)	CAR
		Acarida ⁹⁰ (<i>Acari</i> , <i>Acarina</i> , <i>Rhynchostomi</i> , <i>Monomerostomata</i>)	DEV-REC
		Stethostomata	CAR
		Haptopodida (<i>Haptopoda</i>)	CAR
		Anthracomartida (<i>Anthracomarti</i>)	CAR
		Soluta	DEV-CAR
		Trigonotarbida (<i>Trigonotarbi</i>)	DEV-CAR
		Caulogastra ^{91, 92}	CAR-REC

⁸⁵ Includes: Opisthoparia, Hypoparia, Integricephalida, Oligomeria, Pliomeria, Protoparia, Epiparia, Polymera, Eodiscida, Olenellida.

⁸⁶ Delobranchia (Hydropneustea) = MEROSTOMATA (sometimes + TRILOBITOMORPHA).

⁸⁷ Includes: Synxiphosurida, Bunodomorpha, Limulida, Euxiphosura.

⁸⁸ Includes: Colossendeomorpha, Nymphonomorpha, Ascorhynchomorpha, Pycnogonomorpha.

⁸⁹ Epectinata = all ARACHNIDA except SCORPIONIDA. Arachnoidea = class ARACHNIDA OF ARACHNIDA + MEROSTOMATA.

Class	Subcl	Order	
		Palpigradida (<i>Microthelyphonida</i> , <i>Latisterna</i> , <i>Palpigradi</i>)	JUR-REC
		Thelyphonida (<i>Uropygi</i> , <i>Holopeltidia</i>)	CAR-REC
		Schizomida (<i>Tartarides</i> , <i>Schizopeltidia</i> , <i>Colopyga</i> , <i>Schizonotida</i>)	PLI-REC
		Kustarachnida (<i>Kustarachne</i>)	PEN
		Phrynichida (<i>Amblypygi</i> , <i>Phryneides</i>)	CAR-REC
		Araneida (<i>Araneae</i>)	CAR-REC
		Solpugida (<i>Solifugae</i> , <i>Galeodea</i> , <i>Rostrata</i> , <i>Mycetophorae</i>)	CAR-REC
		Ricinuleida (<i>Rhinogastra</i> , <i>Meridogastra</i> , <i>Podogonata</i> , <i>Cucullifera</i> , <i>Rhignogastra</i>)	CAR-REC
CRUSTACEA	⁹³	(<i>Eucrustacea</i>)	CAM-REC
		Branchiopoda ⁹⁴	CAM-REC
		Anostraca (<i>Euanostraca</i>)	EOC-REC
		Lipostraca	DEV
		Notostraca	PER-REC
		Conchostraca	DEV-REC
		Cladocera	REC
		Cephalocarida	REC
		Cephalocarida	REC
		Ostracoda (<i>Ostracopa</i> , <i>Ostrapoda</i>)	CAM-REC
		Archaeocopida ⁹⁵ (<i>Archaeostraca</i>)	CAM-TRI
		Leperditicopida (<i>Leperditiida</i>)	ORD-DEV
		Myodocopida (<i>Myodocopa</i> , <i>Cladocopa</i>)	ORD-REC
		Podocopida (<i>Podocopa</i> , <i>Platycopa</i>)	ORD-REC
		Palaeocopida (<i>Paleocopa</i> , <i>Beyrichiida</i>)	ORD-PER
		Mystacocarida	REC
		Mystacocarida	REC
		Copepoda (<i>Eucopepoda</i>)	REC
		Calanoida	REC
		Harpacticoida	REC
		Cyclopoida	REC

⁹⁰ Includes: Notostigmata, Cryptostigmata, Prostigmata, Stomatostigmata, Heterostigmata, Parastigmata, Mesostigmata, Metastigmata.

⁹¹ Camarostomata = SCHIZOMIDA + THELYPHONIDA + KUSTARACHNIDA. Labelata = PHRYNICHIDA + ARANEIDA.

⁹² Pedipalpida (scorpion-spiders) = SCHIZOMIDA + THELYPHONIDA + PHRYNICHIDA.

⁹³ Entomostraca = BRANCHIOPODA + OSTRACODA + COPEPODA + CIRRIPIEDIA.

⁹⁴ Diplostraca = CONCHOSTRACA + CLADOCERA. Phyllopoda (Euphyllopoda, Onychura) = ANOSTRACA + NOTOSTRACA + CONCHOSTRACA.

⁹⁵ Includes: Bradorina, Discinocarina.

Class	Subcl	Order	
		Notodelphyoida	REC
		Monstrilloida	REC
		Caligoida	REC
		Lernaeopodoida	REC
	Branchiura		REC
		Branchiura	REC
	Cirripedia (<i>Thyrostraca</i> , <i>Eucirripedia</i>)		SIL-REC
		Thoracica	SIL-REC
		Acrothoracica	REC
		Ascothoracica	REC
		Apoda	REC
		Rhizocephala	REC
	Malacostraca ⁹⁶		PER-REC
		Nebaliacea	REC
		Rhinocarina	DEV-PEN
		Ceratiocarina (<i>Ceratocarina</i>)	CAM-PEN
		Nahecarida	DEV
		Anaspidacea (<i>Anomostraca</i> , <i>Syncarida</i>)	PEN-REC
		Mysidacea ⁹⁷	MIS-REC
		Thermosbaenacea	REC
		Spelaeogriphacea	REC
		Lophogastridea	REC
		Cumacea (<i>Sympoda</i>)	REC
		Tanaidacea (<i>Chelifera</i> , <i>Anisopoda</i>)	REC
		Isopoda	DEV-REC
		Amphipoda (<i>Laemodipoda</i>)	TER-REC
		Euphausiacea	REC
		Pygocephalomorpha	PAL
		Decapoda ⁹⁸	TRI-REC
		Stomatopoda (<i>Hoplocarida</i>)	MIS-REC
PAUROPODA			REC
		Heterognatha	REC

⁹⁶ Phyllocarida (Leptostraca) = NEBALIACEA + RHINOCARINA + CERATIOCARINA + HYMENOCARINA. Eumalacostraca = ANASPIDACEA + MYSIDACEA + THERMOSBAENACEA + CUMACEA + TANAIIDACEA + ISOPODA + AMPHIPODA + EUPHAUSIACEA + DECAPODA + STOMATOPODA. Peracarida (Podophthalma, Thoracostraca, Schizopoda, Anaspides) = MYSIDACEA + THERMOSBAENACEA + LOPHOGASTRIDEA + CUMACEA + TANAIIDACEA + ISOPODA + AMPHIPODA. Edriophthalma (Arthrostraca, Tetradecapoda) = ISOPODA + AMPHIPODA. Eucarida = EUPHAUSIACEA + DECAPODA + STOMATOPODA.

⁹⁷ Lophogastridea has sometimes been included here.

⁹⁸ Includes: Macrura, Anomura, Brachyura.

Class Subcl Order

SYMPHYLA	REC
Cephalostigmata	REC
DIPLOPODA ⁹⁹	PEN-REC
Pselaphognatha (<i>Penicillata</i>)	REC
Ancyrotricha	REC
Lophotricha	REC
Chilognatha ¹⁰⁰	TER-REC
Limacomorpha	REC
Oniscomorpha (<i>Armadillomorpha</i>)	TER-REC
Ascospormophora	REC
Colobognatha (<i>Platydesmiiformia</i>)	TER-REC
Nematophora (<i>Merochaeta</i>)	TER-REC
Proterospermophora	REC
Opisthospermophora	REC
Protosyngnatha	PEN
Protosyngnatha	PEN
Archipolypoda	DEV-CAR
Palaeocoxopleura (<i>Macrosterni</i>)	DEV-CAR
CHILOPODA (<i>Syngnatha</i>)	TER-REC
Pleurostigmophora ¹⁰¹ (<i>Pleurostigma</i>)	TER-REC
Geophilomorpha (<i>Geophylomorpha</i>)	TER-REC
Scolopendromorpha	TER-REC
Lithobiomorpha	TER-REC
Craterostigma	REC
Notostigmophora (<i>Notostigma</i>)	TER-REC
Scutigermomorpha	TER-REC
INSECTA ¹⁰² (<i>Hexapoda</i>)	DEV-REC
Apterygota (<i>Synaptera, Apterygogenea, Aptera</i>)	DEV-REC
Protura (<i>Myrientomata, Mirientomata, Prothysanura, Panprotura, Ellipura, Anamerentoma</i>)	REC
Thysanura (<i>Ectotrophi, Ectognatha</i>)	TRI-REC
Entotrophi (<i>Entognatha, Diplura, Campodeoidea, Homomerentoma, Panthysanura, Dicellura</i>)	MIO-REC

⁹⁹ Includes: Eurysterna, Paleomorpha.¹⁰⁰ Includes: Opisthandria, Proterandria, Eugnatha, Polydesmoidea, Juliformia.¹⁰¹ Anamorpha = CRATEROSTIGMA + LITHOBIOMORPHA. Epimorpha = GEOPHILOMORPHA + SCOLOPENDROMORPHA.¹⁰² Includes extinct orders: Sypharopteroidea, Archodonata, Perielytrodea, Protephemerida, Eubleptidodea, Syntonopteroidea, Permoneurodia. Pterygota (Pterygogenea) = EXOPTERYGOTA + ENDOPTERYGOTA. Palaeoptera = PALAEO-DICTYOPTERA + MEGASEOPTERA + PROTOHEMIPTERA + PROTODONATA + ODONATA + EPHEMERIDA. Neoptera = EXOPTERYGOTA (except PALAEOPTERA) + ENDOPTERYGOTA. Euentomata = DIPLURA + ECTOTROPHI + PTERYGOTA.

Class	Subcl	Order	
		Collembola (<i>Oligoentomata</i>)	DEV-REC
	Exopterygota ¹⁰³	(<i>Heterometabola</i>)	DEV-REC
		Palaeodictyoptera ¹⁰⁴ (<i>Eopaleodictyoptera</i>)	PEN-PER
		Megasecoptera ¹⁰⁵ (<i>Megasecopterida</i>)	PEN-PER
		Protephemerida (<i>Protephmeroidea</i>)	PEN
		Ephemerida ¹⁰⁶ (<i>Ephemeroptera, Ephemeroidea, Plec-</i> <i>toptera</i>)	PER-REC
		Protodonata (<i>Meganisoptera</i>)	PEN-PER
		Odonata ¹⁰⁷	PER-REC
		Protohemiptera (<i>Pseudohemiptera</i>)	PEN-PER
		Protoperlaria ¹⁰⁸	PER
		Plecoptera (<i>Perlarides, Perloidea, Perlaria, Nemurae-</i> <i>des</i>)	PER-REC
		Protorthoptera	PEN-PER
		Caloneuroidea	PEN-PER
		Diploglossata (<i>Hemimeroidea, Dermodermaptera</i>)	PAL
		Grylloblattoidea (<i>Notoptera</i>)	REC
		Orthoptera (<i>Saltatoria, Aeroplanoptera</i>)	PEN-REC
		Phasmidia (<i>Phasmoidea, Ambulatoria, Gressoria, Che-</i> <i>leutoptera</i>)	TRI-REC
		Blattaria (<i>Blattaeformia, Oothecaria, Cursoria, Dicty-</i> <i>optera, Neoblattariae</i>)	PEN-REC
		Mantodea (<i>Deratoptera, Dacnostomata, Phylloptera,</i> <i>Exopterygoptera, Pandictyoptera</i>)	PAL-REC
		Glosselytrodea	PER-JUR
		Protelytroptera (<i>Protocoleoptera</i>)	PER
		Dermaptera (<i>Labidura, Euplexoptera</i>)	JUR-REC
		Embioptera (<i>Embiidina, Embioidea, Adenopoda, Oli-</i> <i>goneura, Aetioptera</i>)	OLI-REC
		Isoptera	EOC-REC

¹⁰³ Coleopteroidea = PROTOCOLEOPTERA + COLEOPTERA + STREPSIPTERA. Phthiraptera (Ellipoptera) = MALLOPHAGA + ANOPLURA. Hemiptera (Rhynchota) = HETEROPTERA + HOMOPTERA + PROTOHEMIPTERA + PALAEOHEMIPTERA. Blattoida = PROTOBLATTOIDEA + BLATTARIA + MANTODEA + ISOPTERA + ZORAPTERA + PSOCOPTERA + MALLOPHAGA + ANOPLURA.

¹⁰⁴ Includes: Hemiodonata, Anisaxia, Permodictyoptera, Breyeridea, Archae-hymenoptera.

¹⁰⁵ Includes: Protohymenoptera, Diaphanopteroidea, Palaeohymenoptera.

¹⁰⁶ Includes: Aphelophlebia, Agnatha, Odontota, Anisoptera, Archipterygota.

¹⁰⁷ Includes: Paraneuroptera, Permodonata, Cryptodonata, Cryptodontia, Libellulides, Libelluloidea.

¹⁰⁸ Includes: Protoblattoidea, Pruvostitoptera, Mixotermiotoidea, Synarmogoi-

Class	Subcl	Order	
		Psocoptera (<i>Corrodentia</i> , <i>Copeognatha</i>)	PER-REC
		Zoraptera (<i>Panisoptera</i>)	REC
		Mallophaga (<i>Lipoptera</i>)	REC
		Thysanoptera (<i>Physopoda</i> , <i>Physapida</i> , <i>Thripoides</i> , <i>Thripsites</i>)	PER-REC
		Homoptera	PAL-REC
		Heteroptera ¹⁰⁹	MES-REC
		Anoplura ¹¹⁰ (<i>Siphunculata</i> , <i>Parasita</i> , <i>Pseudorhyn-</i> <i>chota</i>)	PLE-REC
		Endopterygota ¹¹¹ (<i>Holometabola</i>)	PER-REC
		Neuroptera ¹¹²	PER-REC
		Mecoptera (<i>Panorpatae</i> , <i>Panorpina</i> , <i>Mecaptera</i> , <i>Peta-</i> <i>noptera</i> , <i>Paramecoptera</i> , <i>Protomecoptera</i> , <i>Proto-</i> <i>diptera</i>)	PER-REC
		Trichoptera (<i>Phryganoidea</i> , <i>Placipennes</i> , <i>Paratrichop-</i> <i>tera</i> , <i>Agnathes</i>)	JUR-REC
		Lepidoptera (<i>Glossata</i>)	EOC-REC
		Diptera (<i>Antliata</i> , <i>Halterata</i> , <i>Halteriptera</i> , <i>Haustel-</i> <i>lata</i>)	JUR-REC
		Siphonaptera (<i>Suctoria</i> , <i>Aphaniptera</i> , <i>Rophoteira</i> , <i>Medamoptera</i> , <i>Pulicina</i>)	OLI-REC
		Coleoptera ¹¹³ (<i>Eleutherata</i> , <i>Elytroptera</i>)	PER-REC
		Strepsiptera ¹¹⁴ (<i>Rhipiptera</i> , <i>Rhipidoptera</i> , <i>Strepsata</i> , <i>Stylopida</i>)	OLI-REC
		Hymenoptera	JUR-REC

CHAETOGNATHA ¹¹⁵

CHAETOGNATHA	CAM-REC
Sagittoidea	CAM-REC

dea, Hapalopteroidea, Hadentomoidea, Reculoidea, Cnemidolestoidea, Paraplecoptera, Miomoptera, Protocicadida, Protofulgorida.

¹⁰⁹ *Includes:* Palaeohemiptera, Hemipsocoptera.

¹¹⁰ *Includes:* Pediculidea, Polyptera.

¹¹¹ Hymenopteroidea = ARCHAEOHYMENOPTERA + PALAEOHYMENOPTERA + PROTOHYMENOPTERA + HYMENOPTERA. Panorpoidea = TRICHOPTERA + LEPIDOPTERA + DIPTERA + SIPHONAPTERA + MEGASECOPTERA + PANORPATAE.

¹¹² *Includes:* Megaloptera, Raphidioidea, Emmenognatha, Leptophya. (Planipennia sometimes used for all these.)

¹¹³ *Includes:* Paracoleoptera.

¹¹⁴ Sometimes placed in Coleoptera as family Stylopidae.

¹¹⁵ *Synonyms:* Homalopterygia, Oesthelminthes.

¹¹⁶ *Synonyms:* Brachiata, Pogonofora.

Class Subcl Order

POGONOPHORA¹¹⁶

POGONOPHORA	REC
Thecanephria	REC
Atheceanephria	REC

ECHINODERMATA¹¹⁷

CYSTOIDEA	ORD-PER
Hydrophoridea ¹¹⁸ (<i>Cystidea</i>)	ORD-DEV
Rhombifera	ORD-DEV
Diploporita	ORD-DEV
Blastoidea ¹¹⁹	ORD-PER
Eublastoidea	SIL-PER
Coronata	ORD-SIL
Parablastoidea	ORD
CRINOIDEA ¹²⁰ (<i>Brachiata, Actinoidea, Eucrinoidea</i>)	ORD-REC
Inadunata ¹²¹	ORD-TRI
Disparida (<i>Disparata</i>)	ORD-PER
Hybocrinida	ORD-SIL
Cladida (<i>Cladoidea</i>)	ORD-TRI
Flexibilia (<i>Ichthyocrinacea</i>)	ORD-PER
Taxocrinida (<i>Taxocrinoidea</i>)	ORD-PER
Sagenocrinida (<i>Sagenocrinoidea</i>)	SIL-PER
Camerata (<i>Sphaeroidocrinacea, Adunata</i>)	ORD-PER
Diplobathrida (<i>Diplobathra</i>)	ORD-MIS
Monobathrida (<i>Monobathra</i>)	ORD-PER
Articulata ¹²²	TRI-REC
Isocrinida	TRI-REC
Millericrinida	TRI-EOC
Cyrtocrinida	JUR-REC
Uintacrinida	CRE
Roveacrinida	TRI-CRE

¹¹⁷ *Subphyla*: Pelmatozoa = CYSTOIDEA + BLASTOIDEA + CRINOIDEA + EOCRINOIDEA + PARACRINOIDEA + EDRIOASTEROIDEA. Homalozoa = CARPOIDEA + MACHAERIDIA. Haplozoa = single class HAPLOZOA. Eleutherozoa = SOMASTEROIDEA + ASTEROIDEA + OPHIUROIDEA + ECHINOIDEA + BOTHROCIDAROIDEA + OPHIOCYSTOIDEA + HOLOTHURIOIDEA. *Includes*: Heterostelea (CARPOIDEA + Amphoridea), Asterozoa, Stelleroidea, Stelliformia, Hypostoma, Echinozoa, Cystocidaroidea, Apopora.

¹¹⁸ *Includes*: Eucystoidea, Cystechinoidea, Dichoporita, Cystocrinoidea.

¹¹⁹ Sometimes separated into orders Regulares and Irregulares, or orders Eublastoidea and Protoblastoidea. Sometimes as a separate class.

¹²⁰ *Includes*: Palaeocrinoidea, Inarticulata, Coadunata, Costata, Testacea, Mo-

Class	Subcl	Order	
		Comatulida	JUR-REC
EOCRINOIDEA	¹²³		CAM-ORD
		Eocrinoidea	CAM-ORD
PARACRINOIDEA			ORD
		Paracrinoidea	ORD
EDRIOASTEROIDEA		<i>(Thecoidea, Cystasteroidea, Thyroidea, Agelacrinoidea)</i>	CAM-PEN
		Edrioasteroidea	CAM-PEN
CARPOIDEA			CAM-DEV
		Carpoidea	CAM-DEV
MACHAERIDIA	¹²⁴		ORD-DEV
		Machaeridia	ORD-DEV
HAPLOZOA	¹²⁴		CAM
		Cyamoidea	CAM
		Cycloidea	CAM
SOMASTEROIDEA			ORD
		Goniactinida	ORD
ASTEROIDEA	¹²⁵	<i>(Cirrigrada)</i>	ORD-REC
		Hemizonida	ORD-CAR
		Platyasterida	ORD-DEV
		Phanerozoona	ORD-REC
		Spinulosa ¹²⁶	REC
		Forcipulata ¹²⁶	REC
AULUROIDEA			ORD-MIS
		Lysophiuroida (<i>Lysophiuræ, Aegophiurida</i>)	ORD-MIS
		Streptophiuroida (<i>Streptophiuræ</i>)	ORD-MIS
OPHIUROIDEA	¹²⁷	<i>(Spinigrada)</i>	ORD-REC
		Myophiurida	ORD-DEV
		Ophiocystiida	ORD-DEV
		Aganasterida	?-REC
		Phrynophiurida	?-REC
		Laemophiurida	?-REC
		Gnathophiurida	?-REC

nocyclica, Dicyclica, Irregularia, Regularia, Larvata, Tesselata, Canaliculata, Semi-articulata.

¹²¹ Sometimes divided into Larviformia (Haplocrinacea) and Fistulata (Cyathocrinacea).

¹²² *Includes:* Pentacrinoidea, Pentacrinacea, Stomatocrinoidea, Neocrinoidea.

¹²³ Perhaps not a natural group.

¹²⁴ Groups of doubtful relationships,—possibly not even Echinodermata.

¹²⁵ *Includes:* Encrinasteriae, Euasteriae, Cryptozonia.

¹²⁶ Sometimes united as Cryptozonia.

¹²⁷ *Includes:* Ophiureae, Ophiurida, Euryalae, Euryalida, Cladophiuræ, Zygophiuræ. Also sometimes divided into orders Stenurida and Ophiurida.

Class	Subcl	Order	
		Chilophiurida	?-REC
ECHINOIDEA	¹²⁸		ORD-REC
	Regularia	¹²⁹ (<i>Endocyclica</i>)	ORD-REC
		Lepidocentroida	ORD-PER
		Cidaroida	MIS-REC
		Centrechinoidea (<i>Diadematoidea</i> , <i>Diademoida</i>)	CRE-REC
		Exocycloidea (<i>Exocyclica</i>)	JUR-REC
		Plesiocidaroida	TRI
		Echinocystoida	SIL
		Perischoechinoidea	SIL-PER
	Irregularia	¹³⁰	JUR-REC
		Holectypoida	JUR-REC
		Cassiduloidea	JUR-REC
		Conoclypina	CEN
		Clypeastroidea	CRE-REC
		Spatangoida	CRE-REC
BOTHRIOCIDAROIDEA		(<i>Pseudechinoidea</i>)	ORD
		Bothriocidaroida	ORD
OPHIOCYSTIOIDEA		(<i>Ophiocystioidea</i>)	ORD-DEV
		Ophiocystia	ORD-DEV
HOLOTHURIOIDEA	¹³¹	(<i>Holothuroidea</i> , <i>Fistulides</i> , <i>Scytodermata</i> , <i>Ascidia</i> , <i>Stella</i> , <i>Scytactinata</i>)	ORD-REC
		Aspidochirota ¹³² (<i>Aspidochirotida</i>)	JUR-REC
		Elasipoda (<i>Elasipodida</i>)	REC
		Dendrochirota (<i>Cucumariida</i> , <i>Dendrochirotida</i>)	REC
		Molpadonia (<i>Molpadida</i>)	REC
		Apoda (<i>Synaptida</i> , <i>Paractinopoda</i>)	PER-REC
		Megalopoda	ORD

P T E R O B R A N C H I A

PTEROBRANCHIA			ORD-REC
		Rhabdopleurida	CRE-REC
		Cephalodiscidea	ORD-REC

¹²⁸ *Includes:* Palaeo-echinoidea, Paleo-echinoidea, Palechinoidea, Euechinoidea.

¹²⁹ *Includes:* Melonechinoidea, Melonitoida, Stirodonta, Aulodonta, Camarodonta, Endobranchiata, Ectobranchiata.

¹³⁰ *Includes:* Gnathostomata, Atelostomata.

¹³¹ *Includes:* Pedata. Subclasses sometimes accepted: Actinopoda, Apoda, Megalopoda.

Class Subcl Order

ENTEROPNEUSTA¹³³

ENTEROPNEUSTA	REC
Balanoglossida	REC

PLANCTOSPHAEROIDEA

PLANCTOSPHAEROIDEA	REC
Planctosphaeroidea	REC

TUNICATA¹³⁴

LARVACEA (<i>Copelata</i> , <i>Appendicularia</i> , <i>Atremata</i> , <i>Perennichordata</i>)	REC
Larvacea	REC
ASCIDIACEA ¹³⁵ (<i>Tethyodeae</i>)	REC
Stolidobranchiata (<i>Ptychobranchia</i>)	REC
Aspiraculata	REC
Phlebobranchiata (<i>Diktyobranchia</i> , <i>Dictyobranchia</i>)	REC
Aplousobranchiata (<i>Krikobranchia</i>)	REC
Octacnemida	REC
THALIACEA	REC
Pyrosomata	REC
Pyrosomatida (<i>Luciae</i> , <i>Lucida</i>)	REC
Myosomata	REC
Cyclomyaria (<i>Doliolida</i>)	REC
Hemimiyaria (<i>Salpida</i>)	REC
Desmomiyaria	REC

CEPHALOCHORDATA¹³⁶

LEPTOCARDIA	REC
Amphioxi (<i>Branchiostomoidea</i>)	REC

¹³² Includes: Pelagothurida. ¹³³ Synonyms: Helminthomorpha.¹³⁴ Synonyms: Urochordata. Subphyla: Copelata = LARVACEA; Acopa (Caduichordata) = ASCIDIACEA + THALIACEA.¹³⁵ Includes: Enterogona, Pleurogona.¹³⁶ Synonyms: Cirrhostomi, Entomocrania, Haplocyemata, Homomeria, Myelozoa, Pharyngobranchii, Acrania.

Class Subcl Order

VERTEBRATA¹³⁷

AGNATHA ¹³⁸ (<i>Monorhyncha, Monorhina</i>)	ORD-REC
Cephalaspidomorpha	SIL-REC
Cyclostomata ¹³⁹ (<i>Marsipobranchii, Petromyzonoidea</i>)	REC
Cephalaspida ¹⁴⁰ (<i>Osteostraci, Aspidocephali, Osteostracoidea, Cephalaspidiformes</i>)	SIL-DEV
Anaspida ¹⁴¹ (<i>Anaspidoidea</i>)	SIL-DEV
Pteraspidomorpha ¹⁴² (<i>Pteraspides</i>)	ORD-DEV
Pteraspida (<i>Heterostraci, Pteraspidiformes</i>)	ORD-DEV
Coelolepida (<i>Coelolepidoidea, Coelolepiformes</i>)	SIL-DEV
PLACODERMI ¹⁴³ (<i>Aphetohyoidea</i>)	SIL-PER
Acanthodii ¹⁴⁴ (<i>Acanthoglossa, Acanthodioidea</i>)	SIL-PER
Arthrodira ¹⁴⁵ (<i>Euarthrodira, Arthrodiroidea, Phyllolepada, Ptyctodontida</i>)	SIL-DEV
Macropetalichthyida ¹⁴⁶ (<i>Anarthrodira</i>)	DEV
Antiarchi ¹⁴⁷ (<i>Antiarchoidea, Pterichthyes, Pterichthyomorpha</i>)	DEV

¹³⁷ *Synonyms:* Euchorda, Craniata. Superclass Gnathostomata (Amphirhyncha, Amphirhina) = PLACODERMI + all "higher" vertebrates. Ichthyopterygii = PLACODERMI + ELASMOBRANCHII + HOLOCEPHALI + OSTEICHTHYES. Pisces (Ichthya, Eotetrapoda) = AGNATHA + PLACODERMI + CHONDRICHTHYES + OSTEICHTHYES. Haemacryma = PISCES + AMPHIBIA + REPTILIA. Haematherma = AVES + MAMMALIA. Anamnia (Ichthyopsida) = PISCES + AMPHIBIA. Amniota = REPTILIA + AVES + MAMMALIA. Tetrapoda (Cheiropterygia) = AMPHIBIA + REPTILIA + AVES + MAMMALIA. Sauropsida = REPTILIA + AVES. *Includes:* Protichthyes, Ichthyodorulites.

¹³⁸ Ostracodermi (Ostracophori) = CEPHALASPIDA + ANASPIDA + PTERASPIDA + COELOLEPIDA. *Includes:* Euphaneroidea.

¹³⁹ *Includes:* Myxinoidea, Hyperotreti, Myxini, Myxiniformes, Petromyzontia, Petromyzontiformes, Hyperoarti.

¹⁴⁰ *Includes:* Tremataspidiformes, Lasaniiformes, Oligocnemata, Endeiolepidiformes.

¹⁴¹ *Includes:* Birkeniiformes, Phlebolepidiformes.

¹⁴² *Includes:* Astraspiformes, Psammosteiformes, Cyathaspiformes, Amphiaspiformes, Thelodonti.

¹⁴³ Coccostei (Coccosteomorphi) = EUARTHRODIRA + PHYLLOLEPIDA + MACROPETALICHTHYES.

¹⁴⁴ *Includes:* Clamatiiformes, Mesacanthiformes, Ischnacanthiformes, Gyranacanthiformes, Cheiracanthiformes, Acanthodiformes, Acanthoessi, Acanthoessiiformes. Conodontophorida (Conodonta) may belong here (Ord-Tri).

¹⁴⁵ *Includes:* Acanthothoraci, Aretolepidiformes, Acanthaspidomorphi, Acanthaspida, Coccosteiformes, Brachythoraci, Mylostomatiformes, Ptyctodontiformes, Phyllolepidiformes.

¹⁴⁶ *Includes:* Gemuendiniformes, Rhenanida, Petalichthyida.

¹⁴⁷ *Includes:* Remigolepidiformes, Asterolepidiformes.

Class	Subcl	Order	
		Stegoselachii (<i>Stensiöelliformes</i> , <i>Jagoriniiformes</i> , <i>Stensiöellida</i>)	SIL-MIS
		Palaeospondyloidea (<i>Palaeospondyliiformes</i>)	DEV
CHONDRICHTHYES			DEV-REC
	Elasmobranchii ¹⁴⁸		DEV-REC
		Cladoselachii ¹⁴⁹ (<i>Pleuropterygii</i>)	DEV-PER
		Pleuracanthodii (<i>Ichthyotomi</i> , <i>Proselachii</i>)	DEV-TRI
		Selachii ¹⁵⁰ (<i>Euselachii</i> , <i>Plagiostomi</i> , <i>Chondropterygii</i> , <i>Placoidei</i>)	DEV-REC
		Batoidea ¹⁵¹ (<i>Hypotremata</i> , <i>Platosomia</i>)	JUR-REC
	Holocephali ¹⁵²		DEV-REC
		Bradyodonti ¹⁵³ (<i>Bradyodontoidea</i>)	DEV-PER
		Chimaerae ¹⁵⁴ (<i>Chimaeroidea</i>)	JUR-REC
OSTEICHTHYES (<i>Teleostomi</i>)			DEV-REC
	Actinopterygii ¹⁵⁵		DEV-REC
		Chondrostei ¹⁵⁶ (<i>Chondrosteoidea</i> , <i>Palaeopterygii</i>)	DEV-REC
		Holostei ¹⁵⁷	PER-REC
		Teleostei ¹⁵⁸	JUR-REC

¹⁴⁸ *Includes*: Diplodonti, Diplodontiformes, Xenanthi, Xenacanthi, Xenacanthoidea.

¹⁴⁹ *Includes*: Cladodontiformes, Cladoselachoidea, Cladoselachiformes.

¹⁵⁰ *Includes*: Pleurostomata, Pleurotremata, Selachoidea, Heterodontiformes, Heterodontoidea, Hexanchoidea, Hexanchiformes, Notidanoidea, Lamnoidea, Lamniformes, Isuriformes, Galeoidei, Squaloidea, Squaliformes, Tectospondyli, Edestidi.

¹⁵¹ *Includes*: Narcaciantiformes, Torpediniformes, Rajiformes.

¹⁵² *Includes*: Petalodontes, Petalodontiformes.

¹⁵³ *Includes*: Eubradyodonti, Chondrenchelyes, Chondrenchelyiformes.

¹⁵⁴ *Includes*: Chimaeriformes.

¹⁵⁵ Sometimes divided into superorders: CHONDROSTEI, HOLOSTEI, TELEOSTEI. Sometimes divided into infraclasses: Polypterei, CHONDROSTEI, HOLOSTEI, TELEOSTEI. Ganoidi = CHONDROSTEI + HOLOSTEI. Neopterygii = HOLOSTEI + TELEOSTEI.

¹⁵⁶ *Includes*: Tarrasiiformes, Gymnonisciformes, Lugaonoidiiformes, Phanerorhynchiformes, Dorypteriformes, Cephaloxeniformes, Bobasatraniiformes, Redfieldiiformes, Calopteriformes, Perleidiformes, Platysiagiformes, Ospiiformes, Aetheodontiformes, Pholidopleuriformes, Saurichthyiformes, Palaeoniscoidea, Heterocerci, Palaeonisciformes, Polypterini, Brachyopterygii, Polypteriformes, Cladistia, Cladistioidea, Acipenserioidea, Acipenseriformes, Subholostei, Subholosteoida.

¹⁵⁷ *Includes*: Semionotoidea, Lepidostei, Lepisostei, Lepidosteoida, Lepisosteiformes, Ginglymodi, Rhomboganoidei, Pycnodontoidea, Pycnodontiformes, Aspidorhynchoidea, Aspidorhynchiformes, Amioidea, Amiiformes, Pholidophoroidea, Pholidophoriformes, Pachycormoidea, Pachycormiformes, Protospondyli.

¹⁵⁸ *See* p. 66 for footnote 158.

Class	Subcl	Order	
		Choanichthyes (<i>Amphibioidea</i>)	DEV-REC
		Crossopterygii ¹⁵⁹ (<i>Crossopterygioidea</i>)	DEV-REC
		Dipnoi ¹⁶⁰	DEV-REC
AMPHIBIA ¹⁶¹		(<i>Batrachia</i>)	DEV-REC
		Labyrinthodontia ¹⁶² (<i>Stegocephalia</i>)	DEV-TRI
		Ichthyostegalia	DEV-PEN
		Rhachitomi	MIS-TRI
		Embolomeri	MIS-PER
		Trematosauria	MES
		Stereospondyli	TRI
		Salientia ¹⁶³	PEN-REC
		Eoanura	PEN
		Proanura	TRI
		Anura ¹⁶⁴ (<i>Euanura, Ecaudata</i>)	JUR-REC
		Lepospondyli (<i>Urodelloidei, Pseudocentrophori</i>)	MIS-REC
		Aistopoda	PEN
		Nectridia	PEN-PER
		Microsauria (<i>Adelospondyli, Micramphibia</i>)	MIS-PER
		Urodela (<i>Caudata, Gradientia, Saurabatrachia</i>)	CRE-REC
		Apoda (<i>Gymnophiona, Peromela, Caecilia</i>)	REC

¹⁵⁸ *Includes:* Isospondyli, Isospondyloidea, Malacopterygii, Thrissomorphi, Ostariophysi, Ostariophysoidea, Apodes, Heteromi, Heteromoidea, Mesichthyes, Cyprinodontiformes, Acanthopterygii, Symbranchiformes, Physostomi, Physoclysti, Discocephaloidea, Echiniiformes, Echeniiformes, Plectognathoidea, Hypostomosoidea, Cephalacanthoidea, Scleropareioidea, Percomorphoidea, Allotriognathoidea, Anacanthoidea, Apodoidea, Batrachoidea, Batrachoidiformes, Haplodoci, Gobiesociformes, Xenopterygii, Lampridiformes, Lophiiformes, Lyomeroidea, Pediculati, Pediculatiformes, Pegasiformes, Salmopercoidea, Solenichthyoidea, Synentognathoidea, Tetradontiformes, Tetrodontiformes, Thoracostoidea, Thunifformes, Icosteioidea, Icosteiformes, Malacichthyes, Chaudhurioida, Chaudhuriiformes, Mastacembelioidea, Mastacembeliformes, Opisthomi, Synbranchioidea, Perciformes, Dactylopteriformes, Pleuronectoidea, Pleuronectiformes, Heterosomata, Beryciformes, Berycomorphoidea, Zeiformes, Zeomorphaidea, Mugiliformes, Polynemiformes, Ophiocephaliformes, Clupeiformes, Bathyclupeoidea, Bathyclupeiformes, Galaxiiformes, Cypriniformes, Anguilliformes, Halosauriformes, Notacanthiformes, Beloniformes, Myctophiformes, Iniomi, Scopeliformes, Ateleopiformes, Ateleopoidea, Giganturoidea, Giganturiformes, Saccopharyngiformes, Mormyroidea, Mormyriiformes, Gadiformes, Macruriformes, Gasterosteiformes, Syngnathiformes, Cyprinodontoidea, Microcyprini, Phallostethiformes, Percopseiformes, Stephanoberyciformes.

¹⁵⁹ *Includes:* Porolepiformes, Osteolepiformes, Osteolepides, Osteolepidoti, Holoptychiformes, Megalichthyiformes, Rhipidistia, Actinistia, Coelacanthini, Coelacanthiformes.

¹⁶⁰ *Includes:* Dipteri, Dipteriformes, Dipneumona, Dipneusti, Phaneropleuri-

Class	Subcl	Order	
REPTILIA			PEN-REC
	Anapsida ¹⁶⁵	(<i>Parareptilia, Reptiliomorpha</i>)	PEN-REC
		Seymouriamorpha	PEN-PER
		Cotylosauria	PEN-TRI
		Chelonia (<i>Testudinata, Testudines</i>)	PER-REC
	Parapsida	(<i>Ichthyopterygia, Metapsida</i>)	TRI-CRE
		Ichthyosauria	TRI-CRE
	Euryapsida	(<i>Synaptosauria</i>)	PER-CRE
		Protosauria ¹⁶⁶ (<i>Araeoscelida</i>)	PER-TRI
		Sauropterygia ¹⁶⁷	TRI-CRE
	Diapsida ¹⁶⁸		PER-REC
		Eosuchia ¹⁶⁹ (<i>Prolacertiformes</i>)	PER-EOC
		Rhynchocephalia ¹⁷⁰	TRI-REC
		Squamata ¹⁷¹ (<i>Plagiotremata</i>)	JUR-REC
		Thecodontia ¹⁷²	TRI
		Crocodylia ¹⁷³ (<i>Loricata, Emydosauria, Hydrosauria</i>)	TRI-REC
		Pterosauria (<i>Pterodactyli, Ornithosauria</i>)	JUR-CRE

formes, Uronemiformes, Ctenodontiformes, Ceratodontiformes, Lepidosireniformes, Rhynchodipteriformes, Monopneumona, Ctenodipterini, Ceratodonti, Sirenoidi.

¹⁶¹ *Includes*: Pholidota, Monopnoa, Dipnoa, Nuda. Aspidospondyli (Aspidospondyli, Batrachosauria) = LABYRINTHODONTIA + SALIENTIA. Euamphibia = SALIENTIA + LEPOSPONDYLI.

¹⁶² Sometimes treated as the only superorder in subclass Aspidospondyli. *Includes*: Temnospondyli, Anthracomorpha, Anthracosauroida, Anthracosauria, Phyllospondyli. Seymouriamorpha removed to Reptilia.

¹⁶³ Sometimes listed as a superorder of Aspidospondyli.

¹⁶⁴ *Includes*: Amphicoela, Angusticoela, Opisthocoela, Anomocoela, Procoela, Diplasiocoela.

¹⁶⁵ *Includes*: Eunotosauria, Diadecta, Diadectomorpha, Procolophonina, Pareiasauria.

¹⁶⁶ *Includes*: Weigeltisauria, Trachelosauria, Tanysitrachelia.

¹⁶⁷ *Includes*: Nothosauria, Placodontia, Plesiosauria.

¹⁶⁸ Lepidosauria (Archosauromorpha) = EOSUCHIA + SQUAMATA + RHYNCHOCEPHALIA. Archosauria = THECODONTIA + CROCODYLIA + PTEROSAURIA + SAURISCHIA + ORNITHISCHIA. *Includes*: Katapsida, Kathapsida, Neosauromorpha. Dinosauria (Ornithoscelida, Pachypodes) = SAURISCHIA + ORNITHISCHIA.

¹⁶⁹ *Includes*: Thalattosauria, Pleurosauria, Acrosauria.

¹⁷⁰ Sometimes placed in Archosauria.

¹⁷¹ *Includes*: Sauria, Lacertilia, Serpentes, Ophidia, Pythonomorpha, Mosasauria, Rhiptoglossa, Streptostylica.

¹⁷² *Includes*: Pseudosuchia, Phytosauria, Parasuchia.

¹⁷³ *Includes*: Protosuchia, Sebecosuchia, Mesosuchia, Thalattosuchia, Eusuchia.

Class	Subcl	Order	
		Saurischia ¹⁷⁴ (<i>Theropoda, Sauropoda, Compsognatha</i>)	TRI-CRE
		Ornithischia (<i>Orthopoda, Ornithopoda, Predentata</i> <i>Stegosauria</i>)	TRI-CRE
	Synapsida ¹⁷⁵		PEN-JUR
		Pelycosauria	PEN-TRI
		Therapsida ¹⁷⁶	PER-TRI
		Ictidosauria	TRI-JUR
		Mesosauria (<i>Proganosauria</i>)	PER
AVES			JUR-REC
	Archaeornithes (<i>Saururae</i>)		JUR
		Archaeopteryges (<i>Archaeopterygiformes</i>)	JUR
	Neornithes ¹⁷⁷ (<i>Ornithae, Ornithurae</i>)		CRE-REC
		Hesperornithes (<i>Odontolcae, Hesperornithiformes</i>)	CRE-EOC
		Ichthyornithes (<i>Odontormae, Ichthyornes, Ichthyornithiformes, Ichthyorniformes</i>)	CRE
		Sphenisci (<i>Sphenisciformes, Impennes</i>)	OLI-REC
		Caenagnathae (<i>Caenagnathiformes</i>)	CRE
		Struthionces (<i>Struthioniformes</i>)	PLI-REC
		Rheae (<i>Rheiformes</i>)	PLI-REC
		Casuarii (<i>Casuariiformes</i>)	PLE-REC
		Dinornithes (<i>Dinornithiformes</i>)	PLE
		Aepyornithes (<i>Aepyornithiformes</i>)	EOC-PLE
		Apteryges (<i>Apterygiformes</i>)	PLE-REC
		Crypturi (<i>Tinami, Tinamiformes, Crypturiformes</i>)	PLI-REC
		Gaviae (<i>Gaviiformes</i>)	EOC-REC
		Podicipedes (<i>Podicipediformes, Podicipiformes, Colymbae, Colymbiformes, Pygopodes</i>)	OLI-REC
		Procellariae (<i>Procellariiformes, Cecomorphae, Turbinaries, Tubinares</i>)	EOC-REC

¹⁷⁴ *Includes:* Hallopoda.

¹⁷⁵ *Includes:* Promammalia (Protodonta), at one time placed in subclass Prototheria, of Mammalia.

¹⁷⁶ *Includes:* Dromosauria, Deinocephalia, Dicynodontia, Theriodontia, Anomodontia, Theromorpha.

¹⁷⁷ *Includes:* Dromeognathae, Megistanes, Gastornithes, Stereornithes, Carinatae, Colymbomorphae, Pelargomorphae, Alectoromorphae, Coraciomorphae, Limicolae, Pterocletes, Picariae, Musophagi. Neognathae (Euornithes) = all except HESPERORNITHES + ICHTHYORNITHES + IMPENNES. Superorder Odontognathae = HESPERORNITHES (+ ICHTHYORNITHES). Superorder Palaeognathae = CAENAGNATHAE + STRUTHIONES + RHEAE + CASUarii + DINORNITHES + AEPYORNITHES + APTERYGES. Ratitae included STRUTHIONES, RHEAE, CASUarii, DINOR-

Class	Subcl	Order	
		Steganopodes (<i>Pelecani</i> , <i>Pelecaniformes</i> , <i>Pelicaniformes</i>)	CRE-REC
		Ciconiae ¹⁷⁸ (<i>Ciconiiformes</i> , <i>Gressores</i> , <i>Herodiones Herodii</i>)	CRE-REC
		Anseres (<i>Anseriformes</i> , <i>Chenomorphae</i>)	CRE-REC
		Falcones ¹⁷⁹ (<i>Falconiformes</i> , <i>Accipitres</i> , <i>Accipitriformes</i>)	EOC-REC
		Galli ¹⁸⁰ (<i>Galliformes</i> , <i>Gallinae</i>)	EOC-REC
		Grues ¹⁸¹ (<i>Gruiformes</i>)	EOC-REC
		Diatrymae (<i>Diatrymiformes</i>)	EOC
		Charadriacae ¹⁸² (<i>Charadriiformes</i> , <i>Larolimicolae</i>)	EOC-REC
		Columbae (<i>Columbiformes</i>)	MIO-REC
		Psittaci (<i>Psittaciformes</i>)	MIO-REC
		Cuculi (<i>Coccyges</i> , <i>Cuculiformes</i>)	OLI-REC
		Striges (<i>Strigiformes</i>)	EOC-REC
		Caprimulgi (<i>Caprimulgiformes</i>)	PLI-REC
		Macrochires (<i>Macrochiriformes</i> , <i>Apoda</i> , <i>Apodiformes</i> , <i>Micropodi</i> , <i>Micropodiformes</i>)	OLI-REC
		Colii (<i>Colliformes</i>)	REC
		Trogones (<i>Trogoniformes</i>)	OLI-REC
		Coraciae ¹⁸³ (<i>Coraciiformes</i>)	EOC-REC
		Pici (<i>Piciformes</i>)	EOC-REC
		Passeres ¹⁸⁴ (<i>Passeriformes</i>)	EOC-REC
MAMMALIA	¹⁸⁵	(<i>Mammifera</i>)	JUR-REC
		Prototheria	PLE-REC
		Monotremata (<i>Ornithodelphia</i>)	PLE-REC
		Allotheria ¹⁸⁶	JUR-EOC
		Multituberculata	JUR-EOC
		Triconodonta	JUR

NITHES, AEPYORNITHES, APTERYGES, CURSORES, PROCERES, BREVIPENNES, CRYPTURI.

¹⁷⁸ Includes: Phoenicopterii, Phoenicopteriformes, Amphimorphae, Pelargiformes.

¹⁷⁹ Includes: Cathartidiformes.

¹⁸⁰ Includes: Opisthocomi, Opisthocomiformes, Heteromorphae, Grallae.

¹⁸¹ Includes: Ralliformes, Heliornithiformes, Hemipodii, Telmatomorphomes.

¹⁸² Includes: Alciformes, Lariformes.

¹⁸³ Includes: Alcedines, Bucerotes.

¹⁸⁴ Includes: Eurylaemi, Menurae. Scansores = PICI + PSITTACI in part.

¹⁸⁵ Eplacentalia = PROTOTHERIA + ALLOTHERIA + PANTOTHERIA. Theria = PANTOTHERIA + METATHERIA + EUTHERIA. Promammalia transferred to Reptilia (Synaptida).

¹⁸⁶ Includes: Plagiaulacoidea, Tritylodontoidea.

Class	Subcl	Order	
		Pantotheria	JUR
		Trituberculata	JUR
		Symmetrodonata	JUR
		Metatheria ¹⁸⁷	CRE-REC
		Marsupialia (<i>Didelphia</i>)	CRE-REC
		Eutheria ¹⁸⁸ (<i>Monodelphia, Placentalia, Placentaria</i>)	CRE-REC
		Insectivora	CRE-REC
		Dermoptera	EOC-REC
		Chiroptera	EOC-REC
		Primates ¹⁸⁹	EOC-REC
		Tillodontia	EOC
		Taeniodonta (<i>Ganodonta, Stylinodontia</i>)	EOC
		Edentata (<i>Xenarthra, Paratheria, Bruta</i>)	EOC-REC
		Pholidota (<i>Squamata, Nomarthra</i>)	OLI-REC
		Lagomorpha (<i>Duplicidentata</i>)	EOC-REC
		Rodentia ¹⁹⁰	EOC-REC
		Cetacea ¹⁹¹ (<i>Mutica, Cete</i>)	EOC-REC
		Carnivora ¹⁹²	EOC-REC
		Condylarthra	EOC
		Litopterna	EOC-PLE

¹⁸⁷ *Includes:* Polyprotodontia, Caenolestoidea, Diprotodontia, Paucituberculata.

¹⁸⁸ *Includes:* Ancylopoda, Chalicotheria, Taxeopoda, Quadrumana, Daubentomioidea, Subungulata, Pithecoidea, Platyrrhina, Simiae, Toxodontia, Barytheria, Carnivores, Edentates, Ungulates, Bunotheria. Unguiculata = INSECTIVORA + DERMOPTERA + CHIROPTERA + PRIMATES + TILLODONTIA + TAENIODONTA + EDENTATA + PHOLIDOTA. Ungulata = Protungulata (CONDYLARTHRA + LITOPTERNA + NOTOUNGULATA + ASTRAPOTHERIA + TUBULIDENTATA) + Paenungulata (PANTODONTA + DINOCERATA + XENUNGULATA + PYROTHERIA + PROBOSCIDEA + EMBRITHOPODA + HYRACOIDEA + DESMOSTYLIFORMES + SIRENIA + PERISSODACTYLA + ARTIODACTYLA). Glires = LAGOMORPHA + RODENTIA. Mutilata = CETACEA + SIRENIA. Protungulata = CONDYLARTHRA + LITOPTERNA + NOTOUNGULATA + ASTRAPOTHERIA + TUBULIDENTATA. Therictioidea = INSECTIVORA + Ferae. Archonta = Menotyphla + DERMOPTERA + CHIROPTERA + PRIMATES. Paenungulata = PANTODONTA + DINOCERATA + PYROTHERIA + PROBOSCIDEA + EMBRITHOPODA + HYRACOIDEA + SIRENIA. Diplarthra = PERISSODACTYLA + ARTIODACTYLA.

¹⁸⁹ *Includes:* Anthroipoidea, Lemuroidea, Prosimii.

¹⁹⁰ *Includes:* Simplicidentata.

¹⁹¹ *Includes:* Zeuglodontia, Archaeoceti, Odontoceti, Mystacoceti.

¹⁹² *Includes:* Fissipedia, Creodonta, Pinnipedia, Ferungulata, Ferae.

¹⁹³ *Includes:* Taxodontia.

¹⁹⁴ *Includes:* Amblydactyla, Taligrada, Coryphodontia.

¹⁹⁵ *Includes:* Myohyracoidea.

Notoungulata ¹⁹³	EOC-PLE
Astrapotheria	EOC-MIO
Tubulidentata	EOC-REC
Pantodonta ¹⁹⁴ (<i>Amblypoda</i>)	EOC-OLI
Dinocerata (<i>Uintatheria</i>)	EOC
Pyrotheria	EOC-OLI
Proboscidea	EOC-REC
Embrithopoda (<i>Barypoda</i>)	OLI
Hyracoidea ¹⁹⁵ (<i>Hyraces</i>)	OLI-REC
Sirenia	EOC-REC
Perissodactyla (<i>Mesaxonia</i>)	EOC-REC
Artiodactyla (<i>Paraxonia</i>)	EOC-REC

Vertebrata

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MANY BOOKS, pamphlets, and articles have been consulted in the preparation of this classification. A listing of all of these appears to serve no essential purpose here. The list given below therefore contains principally recent works in which a formal classification is presented for the entire animal kingdom or a major part of it. The list is intended merely as background for the present classification. It does not contain references to all authors and works cited in the text.

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The classification of animals is still very much a field in which discovery and revision are continuing, even after two hundred years of study. Yet, the importance of classification in biology increases every year because the experimental and practical fields find increasing need for accurate identification of animals and for understanding of comparative relationships.

Classification of the Animal Kingdom is a completely new classification system. It is designed to promote interest and study, elicit discussion, and provide a usable single classification for reference for zoology students and teachers.

This classification has three principal parts: (1) the complete classification, including lists of the phyla and of the classes and orders of all animals, living and fossil; (2) the justification for unusual features in the classification system; and (3) a simplified classification of Recent animals for student use. A bibliography of major recent classifications and indexes to common and Latin names are also included.

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