

Digitized by the Internet Archive
in 2011 with funding from
California Academy of Sciences Library

**A Phylogenetic Tree of the Animal Kingdom
(Including Orders and Higher Categories)**

**L'arbre phylogénétique du règne animal
(groupant les ordres et les catégories
supérieures)**

National Museum of Natural Sciences
Publications in Zoology, No. 8

Published by the
National Museums of Canada

Staff editor
Viviane Appleton

© Crown copyrights reserved

Available by mail
from the
National Museums of Canada
Marketing Division
Ottawa, Ontario
K1A 0M8

Catalogue No. NM95-10/8

National Museum of Natural Sciences
National Museums of Canada
Ottawa, Canada
1973

P0987654321
Y79876543
Printed in Canada

Musée national des Sciences naturelles
Publications de zoologie, n° 8

Publié par les
Musées nationaux du Canada

Rédacteur
Norman J. Boudreau

© Tous droits réservés au nom de la Couronne

L'éditeur remplit
les commandes postales adressées aux
Musées nationaux du Canada
Service de distribution
Ottawa, Ontario
K1A 0M8

N° de catalogue NM95-10/8

Musée national des Sciences naturelles
Musées nationaux du Canada
Ottawa, Canada
1973

T0987654321
A79876543
Imprimé au Canada

**A Phylogenetic Tree of the Animal Kingdom
(Including Orders and Higher Categories)**

**L'arbre phylogénétique du règne animal
(groupant les ordres et les catégories
supérieures)**

Jarmila Kukulová-Peck

Biographical Note

Dr. Jarmila Kukalová-Peck was associate professor in paleontology at Charles University, Prague, from 1966 to 1970. Born in Prague, she received her Ph.D. from Charles University in 1962, specializing in Paleozoic insects. In 1969 she was Alexander Agassiz Lecturer in Zoology at Harvard University, and since 1970 has been associated with the Department of Geology, Carleton University, Ottawa. Dr. Peck has published over thirty scientific papers, including studies on Palaeodictyoptera, Protelytroptera, Ephemeroptera, and other insect orders from localities in Europe, the United States and the U.S.S.R.

Introduction

As part of the program to redesign the public exhibits in the Victoria Memorial Building, Ottawa, Dr. Louis Lemieux, Director of the National Museum of Natural Sciences, and Dr. Arthur H. Clarke, Head of the Invertebrate Zoology Section, decided that a display of the phylogenetic tree of the animal kingdom would be the most effective way of illustrating the diversity of animal life. It was felt that the phylogeny should use the orders and higher categories of classification to show the evolutionary relationship of the groups in time, with as much accuracy as is possible given the present level of knowledge. After the display data had been gathered the decision was made to publish the separate phylogenetic schemes in a manual that could serve as a useful summary of the animal kingdom for college students and higher-level educators in biology and paleontology.

The users of this manual should be aware that phylogeny may be the subject of the most dramatic disagreements between specialists, and may undergo very abrupt changes because of differing interpretations of evolutionary trends. Consequently, there may exist many parallel or even drastically different schemes, and frequently only future investigations can determine which is the more correct. Moreover, the levels of knowledge of the various groups are very uneven. In some, the building of phylogenetic schemes is traditional, for example, in vertebrates. For many groups, however, the graphs presented here are the first ones that cover major categories and their ancestry. Since phylogeny, by definition, expresses the natural relationships of creatures, problematic groups such as conodonts or conulariids could not be included in the charts.

Although there are many compendia that supply data for phylogenetic study, it would not have been possible for one person to cover this vast subject in the time allotted without consulting specialists in many groups. The scientists listed below reviewed the charts and some of them provided me with additional references and information. I am greatly indebted to them for their courtesy and very much appreciate the suggestions they made. This is in no way meant to imply that they are responsible for the schemes published here. Any errors are mine, but I hope they will be considered with generosity in view of the ambitiousness of the project.

Protozoa:

Dr. F.T. Banner

University College of Swansea, Wales

Dr. H. Tappan-Loeblich

University of California, Los Angeles

Dr. V. Pokorný

Charles University, Prague

Porifera:

Dr. R.M. Finks

Queens College, Flushing, N.Y.

Archaeocyatha:

Dr. V.J. Okulitch

University of British Columbia, Vancouver

Coelenterata:

Dr. W.A. Oliver, Jr.

U.S. Geological Survey, Washington, D.C.

Mollusca—Stem Graph, Hyolitha, Scaphopoda, Gastropoda:

Dr. E.L. Yochelson

U.S. Geological Survey, Washington, D.C.

“Amphineura”:

Dr. A.H. Clarke

National Museum of Natural Sciences, Ottawa

Bivalvia:

Dr. J. Pojeta, Jr.

U.S. Geological Survey, Washington, D.C.

Nautiloidea:

Dr. D.H. Collins

University of Toronto

Ammonoidea:

Dr. E.T. Tozer

Geological Survey of Canada, Ottawa

Coleoidea:

Dr. G.A. Jeletzky

Geological Survey of Canada, Ottawa

Dr. M. Gordon

U.S. Geological Survey, Washington, D.C.

Annelida:

Dr. D.G. Cook

National Museum of Natural Sciences, Ottawa

Onychophora, Trilobita:

Dr. W.T. Dean

Geological Survey of Canada, Ottawa

Dr. W.H. Fritz

Geological Survey of Canada, Ottawa

Diplopoda, Chilopoda:

Dr. R.L. Hoffman

Radford College, Virginia

Insecta:

Dr. J. Kukulová-Peck

Carleton University, Ottawa

Dr. F.M. Carpenter

Harvard University

Crustacea:

Dr. E.L. Bousfield

National Museum of Natural Sciences, Ottawa

Dr. M.J. Copeland

Geological Survey of Canada, Ottawa

Dr. V. Pokorný

Charles University, Prague

Dr. P. Tasch

University of Wichita, Kansas

Dr. H.K. Brooks

University of Florida, Gainesville

Chelicerata:

Dr. M.J. Copeland

Geological Survey of Canada, Ottawa

Dr. H.W. Levi

Museum of Comparative Zoology, Harvard University

Bryozoa:

Dr. J.S. Ryland

University College of Swansea, Wales

Dr. N.A. Powell

National Museum of Natural Sciences, Ottawa

Brachiopoda:

Dr. M.J.S. Rudwick

Cambridge University

Echinodermata:

Dr. J.W. Durham

University of California, Berkeley

Hemichordata:

Dr. M.J. Copeland

Geological Survey of Canada, Ottawa

Dr. H. Jaeger

Museum für Naturkunde, Humboldt-Universität, Berlin

“Fishes”:

Dr. A.S. Romer

Museum of Comparative Zoology, Harvard University

Dr. D.E. McAllister

National Museum of Natural Sciences, Ottawa

Dr. B. Schaeffer

American Museum of Natural History, New York

Amphibia:

Dr. R.L. Carroll

McGill University, Montreal

Dr. Z.V. Špínar

Charles University, Prague

Reptilia:

Dr. R.L. Carroll

McGill University, Montreal

Dr. A.S. Romer

Museum of Comparative Zoology, Harvard University

Dr. D.A. Russell

National Museum of Natural Sciences, Ottawa

Mammalia:

Dr. F.R. Parrington

Museum of Comparative Zoology, Harvard
University

Dr. L. Van Valen

University of Chicago

Aves:

Dr. P. Brodkorb

University of Florida, Gainesville

Most of the data on geological occurrence were taken from the *Fossil Record* (Harland, ed., 1967) and the *Treatise on Invertebrate Paleontology* (Moore, ed., 1953-70). The phylogenetic data are based largely on Barnes (1968), Hyman (1940-67), Kaestner (1967; 1970), and the *Treatise on Invertebrate Paleontology*. There are various other smaller works listed in the bibliography that threw light on problems of phylogeny. Since I attempted to synthesize and incorporate the latest knowledge, many of the schemes presented here do not exactly correspond to anything published before. The above-named specialists, who so graciously reviewed parts of the work, contributed some new ideas and arrangements not yet published. By presenting them, however, I am not trying to "claim-jump" or take the credit. Nor should I be considered as a first authority for these schemes. The previously unpublished novelties can become firmly based only when the facts or ideas to substantiate them are presented by the various specialists. Until based on data or presentation of reasons, many portions of the phylogeny are, of course, the author's logical deductions or hypotheses.

The purpose of this report is threefold. It will permit a wider distribution of the data presented in the Hall of Animal Life in the Victoria Memorial Building; for serious zoology students it will serve as an up-to-date and complete synthesis of animal evolution and phylogeny in the higher categories; and, hopefully, it may stimulate further research by the contributing specialists as well as by others interested in these problems.

4 June 1972

Note biographique

Madame Jarmila Kukalová-Peck fut professeur adjoint de paléontologie à l'université Charles de Prague, de 1966 à 1970. Née à Prague, elle reçut son doctorat de l'université Charles en 1962 se spécialisant en entomologie du paléozoïque. En 1969, elle fut conférencière Alexander Agassiz en zoologie à l'université Harvard et depuis 1970, elle est attachée à la faculté de géologie de l'université Carleton d'Ottawa. Madame Peck a publié plus de trente articles scientifiques dont des études sur les paléodictyoptères, les protélytroptères, les éphéméroptères et certains autres ordres d'insectes d'Europe, des États-Unis et de l'U.R.S.S.

Introduction

Dans les cadres du programme de réaménagement des exhibits de l'édifice Victoria Memorial d'Ottawa, Messieurs Louis Lemieux, directeur du Musée national des Sciences naturelles, et Arthur H. Clarke, chef de la Division de la Zoologie des invertébrés, conçurent le projet d'illustrer la diversité de la vie animale en montrant l'arbre phylogénétique du règne animal. Ils retinrent la phylogénèse des ordres et des catégories supérieures pour démontrer le lien évolutif des groupes, à travers le temps, le plus exactement possible étant donné l'état actuel des connaissances. Après avoir recueilli les données de base, on décida de publier séparément les tableaux phylogénétiques en un manuel qui résume les ramifications du règne animal à l'intention des étudiants et des professeurs de biologie et de paléontologie.

Les usagers doivent se rappeler que la phylogénèse est l'objet de nombreux désaccords entre les spécialistes et peut subir des changements brusques par suite d'interprétations divergentes des courants évolutifs. En conséquence, il peut exister plusieurs systèmes parallèles ou même totalement différents et, dans bien des cas, seulement les recherches futures pourront établir la primauté d'un système sur les autres. D'autre part, l'état de nos connaissances des différents groupes est très inégal. Dans certains cas, comme chez les vertébrés, le schéma phylogénétique est traditionnel. Chez d'autres groupes, par ailleurs, les présents tableaux sont les premiers qu'on ait publiés sur leur classification et leur évolution. La phylogénèse traitant par définition des liens naturels des êtres, il était impossible d'inclure dans les tableaux certains groupes problématiques tels que les conodontes ou les conularides.

Même s'il existe un grand nombre d'abrégés qui fournissent les données de base des études phylogénétiques, il eût été impossible pour une seule personne de couvrir un sujet si vaste en si peu de temps sans consulter un grand nombre de spécialistes. Les scientifiques dont les noms apparaissent ci-dessous ont révisé les tableaux et certains d'entre eux m'ont fourni quantité de références et de renseignements. J'ai hautement apprécié leur courtoisie et j'ai largement profité des suggestions qu'ils m'ont faites. Je n'entends pas par là les rendre responsables des tableaux qui apparaissent dans le présent ouvrage. Les erreurs qu'on pourrait y trouver sont les miennes, mais à cause de ma témérité face au projet, j'ose espérer qu'on se montrera clément à mon égard.

Protozoaires:

M. F.T. Banner

University College of Swansea, Pays de Galles

M^{me} H. Tappan-Loeblich

Université de la Californie, Los Angeles

M. V. Pokorný

Université Charles, Prague

Porifères:

M. R.M. Finks

Collège Queens, Flushing, N.Y.

Archéocyathés:

M. V.J. Okulitch

Université de la Colombie-Britannique, Vancouver

Coelentérés:

M. W.A. Oliver, fils

U. S. Geological Survey, Washington, D.C

Tableau principal des mollusques, hyolithes, scaphopodes, gastéropodes

M. E.L. Yochelson

U.S. Geological Survey, Washington, D.C

''Amphineures'':

M. A.H. Clarke

Musée national des Sciences naturelles, Ottawa

Lamellibranches:

M. J. Pojeta, fils

U. S. Geological Survey, Washington, D.C

Nautilidés:

M. D.H. Collins

Université de Toronto

Ammonitidés:

M. E.T. Tozer

Commission géologique du Canada, Ottawa

Coleoïdes:

M. G.A. Jeletzky

Commission géologique du Canada, Ottawa

M. M. Gordon

U.S. Geological Survey, Washington, D.C

Annélides:

M. D.G. Cook

Musée national des Sciences naturelles, Ottawa

Onychophores, trilobites:

M. W.T. Dean

Commission géologique du Canada, Ottawa

M. W.F. Fritz

Commission géologique du Canada, Ottawa

Diplopodes, chilopodes:

M. R.L. Hoffman

Collège de Radford, Virginie

Insectes:

M^{me} J. Kukulová-Peck

Université de Carleton, Ottawa

M. F.M. Carpenter

Université Harvard

Crustacés:

M. E.L. Bousfield

Musée national des Sciences naturelles, Ottawa

M. M.J. Copeland

Commission géologique du Canada, Ottawa

M. V. Pokorný

Université Charles, Prague

M. P. Tasch

Université de Wichita, Kansas

M. H.K. Brooks

Université de la Floride, Gainesville

Chelicérates:

M. M.J. Copeland

Commission géologique du Canada, Ottawa

M. H.W. Levi

Museum of Comparative Zoology, Université Harvard

Bryozoaires:

M. J.S. Ryland

University College of Swansea, Pays de Galles

M. N.A. Powell

Musée national des Sciences naturelles, Ottawa

Brachiopodes:

M. M.J.S. Rudwick

Université de Cambridge

Échinodermes:

M. J.W. Durham

Université de la Californie, Berkeley

Hémicordés:

M. M.J. Copeland

Commission géologique du Canada, Ottawa

M. H. Jaeger

Museum für Naturkunde, Humboldt-Universität, Berlin

Poissons:

M. A.S. Romer

Museum of Comparative Zoology, Université Harvard

M. D.E. McAllister

Musée national des Sciences naturelles, Ottawa

M. B. Schaeffer

American Museum of Natural History, New York

Amphibiens:

M. R.L. Carroll

Université McGill, Montréal

M. Z.V. Špinar

Université Charles, Prague

Reptiles:

M. R.L. Carroll

Université McGill, Montréal

M. A.S. Romer

Museum of Comparative Zoology, Université
Harvard

M. D.A. Russell

Musée national des Sciences naturelles, Ottawa

Mammifères:

M. F.R. Parrington

Museum of Comparative Zoology, Université
Harvard

M. L. Van Valen

Université de Chicago

Oiseaux:

M. P. Brodkorb

Université de la Floride, Gainesville

La plupart des données géologiques locales ou temporelles proviennent de *Fossil Record* (Harland, ed., 1967) et de *Treatise on Invertebrate Paleontology* (Moore, ed., 1953-70). Les renseignements phylogénétiques se fondent en grande partie sur Barnes (1968), Hyman (1940-67), Kaestner (1967, 1970), et sur *Treatise on Invertebrate Paleontology*. La bibliographie mentionne un certain nombre de travaux moins volumineux qui ont cependant servi à éclairer certains problèmes. Puisque le présent ouvrage veut opérer une synthèse et tenir compte des découvertes les plus récentes, plusieurs tableaux diffèrent de tout ce qui a été publié jusqu'ici dans le même domaine. Les spécialistes nommés qui ont si généreusement révisé plusieurs parties du travail ont contribué plusieurs idées nouvelles et suggéré des arrangements qu'on ne saurait retrouver dans aucune autre publication. Loin de moi la pensée d'usurper sur ces personnes ou de m'attribuer le mérite de ces innovations. Il ne faudrait pas non plus me croire l'autorité définitive en ces matières. Les nouveautés inédites que comporte l'ouvrage n'auront de fondement véritable que lorsque les travaux des spécialistes en auront vérifié le contenu. Jusqu'à ce qu'on ait démontré l'application réelle de ces notions, certaines parties de cette phylogénèse ne sont en définitive que les hypothèses et les déductions logiques de l'auteur.

Le présent ouvrage se fixe un triple but. Il veut assurer la dissémination de renseignements contenus dans la galerie de zoologie de l'édifice Victoria Memorial; en ce qui concerne les étudiants, il veut leur présenter une synthèse complète et à jour de l'évolution animale et de la phylogénèse des catégories supérieures; et finalement, il est à espérer qu'il stimule la recherche tant chez les spécialistes qui ont contribué à sa mise au point que chez les autres scientifiques qui s'intéressent au même sujet.

4 juin 1972

Note des éditeurs

Pour des raisons d'économie, les Musées nationaux du Canada n'ont pas cru bon de publier une version française intégrale du présent ouvrage. Les désignations taxonomiques latines ont l'avantage d'être universelles et sont intelligibles pour l'ensemble des scientifiques. Les frais d'édition auraient doublé pour reproduire la série de tableaux avec une nomenclature à terminaisons françaises. Nous avons jugé que la taxonomie latine suffisait, et qu'on ne nous tiendrait pas rigueur des quelques mots anglais qui subsistent, tels que *phylum*, *class*, *order*, etc., auxquels le lecteur pourra facilement substituer les équivalents français.

Au-delà du motif d'économie, l'adaptation d'un ouvrage tel que celui-ci multiplie le risque d'erreurs. L'avantage linguistique offre moins d'attrait si les renseignements sont moins sûrs. Nous nous excusons auprès des lecteurs et les prions de nous accorder leur indulgence.

Les notes et les explications nécessaires à la compréhension de l'ouvrage apparaissent en français et en anglais. Nous n'avons ménagé aucune peine pour assurer la qualité technique de cette publication et nous espérons que tous pourront en tirer profit.

Ottawa, juillet 1972

Bibliography/Bibliographie

Barnes, R.D.

(1968). *Invertebrate zoology*. 2d ed. Saunders, Philadelphia. 743 pp.

Brinkhurst, R.O., and B.G.M. Jamieson

(1971). *Aquatic Oligochaeta of the world*. Oliver and Boyd, London. 860 pp.

Brodkorb, P.

(1963). Catalogue of fossil birds. *Bull. Fla. State Mus. Biol. Sci.* 7: 179-293.

(1964). *Ibid.* 8: 195-335.

(1967). *Ibid.* 11: 99-220.

(1971). *Ibid.* 15: 163-266.

Origin and evolution of birds, pp. 19-55. In D.S. Farmer and J.R. King, eds. *Avian biology*. Academic Press, New York, 1971.

Colbert, E.H.

(1965). *The age of reptiles*. Weidenfeld, London. 228 pp.

Copeland, M.J.

(1957). The arthropod fauna of the Upper Carboniferous rocks of the Maritime Provinces.

Mem. Geol. Surv. Can. 286: 1-110.

Durden, C., et al.

(1969). Gnathostomulida: is there a fossil record? *Science* 164: 855-56.

Filatova, Z.A., and L.A. Zenkevich

(1969). The contemporary distribution of the ancient primitive molluscs Monoplacophora in the oceans and the fossilized Pogonophora in the deposits of the Cambrian seas. *Okeanologia* 9 (1): 162-71.

Gordon, M., Jr.

(1966). Classification of Mississippian coleoid cephalopods. *J. Paleontol.* 40 (2): 449-52.

(1966). An Upper Triassic bactritoid cephalopod from California. *J. Paleontol.* 40 (5): 1220-22.

Harland, W.B., ed.

(1967). *The fossil record*. Geological Society of London. 827 pp.

Hermans, C.O.

(1969). The systematic position of the Archiannelida. *Syst. Zool.* 18 (1): 85-102.

Hopson, J.A.

(1970). The classification of non therian mammals. *J. Mammal.* 51 (1): 1-9.

Horný, R.J.

(1965). *Cyrtolites* Conrad 1838 and its position among the Monoplacophora (Mollusca). *Sb. Nár. Mus. Praze* 21B (2): 57-70.

Huene, F.

(1956). *Palaontologie und Phylogenie der niederen Tetrapoden*. Fischer, Jena. 716 pp.

Hyman, L.H.

(1940-67). *The invertebrates*. McGraw-Hill Publications in the Zoological Sciences. McGraw-Hill, New York.

(1940). Vol. 1: *Protozoa through Ctenophora*. 726 pp.

(1951). Vol. 2: *Platyhelminthes and Rhynchocoela*. 550 pp.

(1951). Vol. 3: *Acanthocephala, Aschelminthes, and Entoprocta*. 572 pp.

(1955). Vol. 4: *Echinodermata, the coelomate bilateria*. 763 pp.

(1959). Vol. 5: *Smaller coelomate groups*. 783 pp.

(1967). Vol. 6: *Mollusca 1*. 792 pp.

Jeletzky, J.A.

(1965). Taxonomy and phylogeny of fossil Coleoidea (=Dibranchiata). *Geol. Surv. Can. Pap.* 65 (2): 72-76.

Kaestner, A.

(1967-70). *Invertebrate zoology*. Trans. and adapted from the German by H.W. Levi and Lorna R. Levi. Interscience, New York.

(1967). Vol. 2: *Arthropod relatives, Chelicerata, Myriapoda*. 472 pp.

(1970). Vol. 3: *Crustacea*. 523 pp.

Loeblich, A.R.

(1970). Ultramicroplankton, pp. 867-929. Part G of *North American Paleontology Convention, Chicago 1969, Proceedings*. Allen Press, Lawrence, Kansas.

Martynov, A.V.

(1940). Outlines of the geological history and phylogeny of insect orders (Pterygota), 1: Palaeoptera and Neoptera-Polyneoptera. *Trans. Paleontol. Inst.* 7 (4): 5-149.

McAllister, D.E.

(1968). Evolution of branchiostegals and associated opercular, gular, and hyoid bones, and the classification of teleostome fishes, living and fossil. *Nat. Mus. Can. Bull.* 221: 1-239.

Moore, R.C., ed.

(1953-70). *Treatise on invertebrate paleontology* Prepared under the guidance of the Joint Committee on Invertebrate Paleontology. Geological Society of America, New York.

(1953). Part G. *Bryozoa*. 253 pp.

(1954). Part D. *Protista 3, Protozoa*. 195 pp.

(1955). Part E. *Archaeocyatha and Porifera*. 122 pp.

Part P. *Arthropoda 2*. 181 pp.

Part V. *Graptolithina*. 101 pp.

(1956). Part F. *Coelenterata*. 498 pp.

(1957). Part L. *Mollusca 4*. 490 pp.

(1959). Part O. *Arthropoda 1*. 560 pp.

(1960). Part I. *Mollusca 1*. 351 pp.

(1961). Part Q. *Arthropoda 3*. 442 pp.

(1962). Part W. *Miscellanea*. 259 pp.

- (1964). Part K. *Mollusca* 3. 519 pp.
Part C. *Protista* 2. 2 vols. 900 pp.
(1965). Part H. *Brachiopoda*. 2 vols. 927 pp.
(1966). Part U. *Echinodermata* 3. 2 vols. 695 pp.
(1967). Part S. *Echinodermata* 1. 2 vols. 650 pp.
(1969). Part N. *Mollusca* 6 (1,2) 2 vols. 952 pp.
Part R. *Arthropoda* 4. 2 vols. 651 pp.
(1970). Part V. *Graptolithina*. 2d ed. 163 pp.

Pearson, R.

- (1964). *Animals and plants of the Cenozoic era; some aspects of the faunal and floral history of the last sixty million years*. Butterworths, London. 236 pp.

Pojeta, J., Jr.

- (1971). Review of Ordovician pelecypods. *Geol. Surv. Prof. Pap.* 695: 1-46
(1972). Rostroconchia: a new class of bivalved mollusks. *Science* 177: 264-67.

Rohdendorf, B.B., ed.

- (1962). *Fundamentals of paleontology Arthropoda, Tracheata and Chelicerata*. Academy of Sciences, Moscow. 560 pp.

Romer, A.S.

- (1941). *Man and the vertebrates*. 3d ed. University of Chicago Press. 405 pp.
(1956). The early evolution of land vertebrates. *Amer. Phil. Soc. Proc.* 100 (3): 157-61
(1959). *The vertebrate story*. 4th rev. ed. University of Chicago Press. 437 pp.
(1966). *Vertebrate paleontology*. 3d ed. University of Chicago Press. 468 pp.
(1968). *The procession of life*. Weidenfeld, London. 323 pp.

Rudwick M.J.S.

- (1970). *Living and fossil brachiopods*. Hutchinson, London. 199 pp.

Ryland, J.S.

- (1970). *Bryozoans*. Hutchinson, London. 175 pp.

Salvini-Plawen, L.

- (1967). Kritische Bemerkungen zum System der Solenogastres (Mollusca, Aculifera). *Z. Zool. Syst. Evolutionsforsch.* 5 (4): 398-444
(1968). Über Lebensbeobachtungen an Caudofoveata (Mollusca, Aculifera), nebst Bemerkungen zum System der Klasse. *Sarsia* 31: 105-26

Schaeffer, B.

- (1969). Adaptive radiation of the fishes and the fish-amphibian transition. *Ann. New York Acad. Sci.* 167: 5-17

Stensio, E.A.

- (1963). *The brain and the cranial nerves in fossil, lower craniate vertebrates*. Universitetsforlaget, Oslo. 120 pp.

Stephenson, J.

- (1930). *The Oligochaeta*. Oxford University Press. 978 pp.

Sterrer, W.

- (1972). Systematics and evolution within the Gnathostomulida. *Syst. Zool.* 21 (2): 151-73.

Tappan, H., and A.R. Loeblich

- (1971). Geobiologic implication of fossil phytoplankton evolution and time-space distribution. Symposium on palynology. *Geol. Soc. Amer. Spec. Pap.* 127: 247-340.

Taylor, D.W., and N.F. Sohl

- (1962). An outline of gastropod classification. *Malacologia* 1 (1): 7-32.

Teichert, C.

- (1967). Major features of cephalopod evolution, pp. 1-210. In Teichert, C., and E.L. Yochelson, eds. *Essays in paleontology and stratigraphy; R.C. Moore commemorative volume*. Univ. Kansas Dept. Geol. Spec. Publ. 2. Lawrence, Kansas. 626 pp.

Van Valen, L.

- (1970). Adaptive zones and the orders of mammals. *Evolution* 25 (2): 420-28.

Whittington, H.B., and W.D.I. Rolfe, eds.

- (1963). *Phylogeny and evolution of Crustacea*. Proceedings of a conference held at Cambridge, Mass., March 6-8, 1962. Harvard Univ. Mus. Comp. Zool. Spec. Publ. Cambridge, Mass. 192 pp.

Yochelson, E.L.

- (1966). Mattheva, a proposed new class of molluscs. *Geol. Surv. Prof. Pap.* 523B: 1-4

Excluded Phyla/Embranchements exclus

List and geological occurrence of phyla so small or poorly known that phylogenetic diagrams have not been prepared.

Les renseignements sur la distribution géologique de certains embranchements sont si minces qu'on n'en a pas fait de tableau phylogénétique. C'est le cas des catégories ci-dessous.

Radiata	
Phylum Ctenophora	Rec
Protostomes Acoelomates	
Phylum Rhynchozoela	JurTith—Rec
Phylum Mesozoa	Rec
Phylum Platyhelminthes	Rec
Phylum Gnathostomulida*	Rec
Protostomes Pseudocoelomates	
Phylum Entoprocta	Rec
Phylum Acanthocephala	Rec
Phylum Nematomorpha	
Order Gordioida	TertEoc—Rec
Phylum Nematoda	
Order Rhabditida	TertOlig—Rec
Phylum Kinorhyncha	Rec
Phylum Gastrotricha	Rec
Phylum Rotifera	Rec
Protostomes Schizocoelomates	
Phylum Priapulida	Rec
Phylum Sipunculida	Camb M.Camb—Rec
Phylum Echiurida	Rec
Phylum Tardigrada	Rec
Phylum Pentastomida	Rec
Protostomes Lophophorate Coelomates	
Phylum Phoronida	Rec
Deuterostomes	
Phylum Chaetognatha	Camb M.Camb—Rec

*Conodontophorida (Camb M.Camb—CretTuron) are possibly an extinct class of Gnathostomulida.

Les conodontophoridés (Camb M.Camb—CretTuron) sont peut-être une classe éteinte de gnathostomulidés.

Abbreviations of Geological Divisions in the Charts

Abréviations des divisions géologiques apparaissant dans les tableaux

Quat	Quaternary	Perm	Permian
Holo	Holocene	Dzhulf	Dzhulfian
Pleist	Pleistocene	Guad	Guadelupian
		Leonard	Leonardian
Tert	Tertiary	Sakm	Sakmarian
Plioc	Pliocene	Assel	Asselian
Mioc	Miocene		
Olig	Oligocene	Carb	Carboniferous*
Eoc	Eocene	U. Carb	Upper Carboniferous
Paleoc	Paleocene	Moscov	Moscovian
Dan	Danian	Bashk	Bashkirian
		Namur	Namurian
Cret	Cretaceous	Viséan	Viséan
Maestr	Maestrichtian	Tourn	Tournaisian
Campan	Campanian		
Santon	Santonian	Dev	Devonian
Coniac	Coniacian	Famen	Famennian
Turon	Turonian	Frasn	Frasnian
Cenom	Cenomanian	Givet	Givetian
Alb	Albian	Eifel	Eifelian
Apt	Aptian	Ems	Emsian
Barrem	Barremian	Siegen	Siegenian
Haut	Hauterivian	Gedinn	Gedinnian
Valang	Valanginian		
Berr	Berriasian	Sil	Silurian
		Ludl	Ludlovian
Jur	Jurassic	Wenl	Wenlockian
"Tith"	"Tithonian"	Lldov	Llandoveryian
Kimm	Kimmeridgian		
Oxf	Oxfordian	Ord	Ordovician
Call	Callovian	Ashg	Ashgillian
Bath	Bathonian	Carad	Caradocian
Bajoc	Bajocian	Lldeil	Llandeilian
Toarc	Toarcian	Llvirn	Llanvirnian
Pliens	Pliensbachian	Arenig	Arenigian
Sinem	Sinemurian	Tremad	Tremadocian
Hett	Hettangian		
		Camb	Cambrian
Trias	Triassic	U. Camb	Upper Cambrian
Rhaet	Rhaetian	M. Camb	Middle Cambrian
Nor	Norian	L. Camb	Lower Cambrian
Carn	Carnian		
Ladin	Ladinian		
Anis	Anisian		
Olenek	Olenekian		
Induan	Induan		

* To relate the phylogenetic charts as closely as possible to the geological divisions used in the *Fossil Record*, European division names have been used for the Carboniferous period. The Tournaisian, Viséan and Namurian "A" of Europe correspond to the Mississippian of American stratigraphy, and the Pennsylvanian of America approximates the Bashkirian, Moscovian and Upper Carboniferous of Europe

* Dans le but de relier les divisions des tableaux phylogénétiques le plus intimement possible à celles de *Fossil Record*, nous avons employé, pour le Carbonifère, les dénominations européennes. Le Tournaisien, le Viséen et le Namurien "A" d'Europe correspondent au Mississippien de la stratigraphie américaine alors que le Pennsylvanien d'Amérique se rapproche du Bashkirien, du Moscovien et du Carbonifère supérieur d'Europe.

List of the Charts/Liste des tableaux

- 1 Phylogenetic tree, as seen from the side
Profil de l'arbre phylogénétique
- 2 Phylogenetic tree, as seen from above
Plan de l'arbre phylogénétique
- 3 Phylum Protozoa
- 4 Phylum Porifera
- 5 Phylum Archaeocyatha
- 6 Phylum Coelenterata
- 7 Phylum Mollusca Stem Graph
Ramifications principales
- 8 Phylum Mollusca Class Hyolitha Class Scaphopoda
- 9 Phylum Mollusca Class Bivalvia
- 10 Phylum Mollusca Class Gastropoda
- 11 Phylum Mollusca Class Cephalopoda
- 12 Phylum Annelida
- 13 Phylum Onychophora
- 14 Phylum Arthropoda Subphylum Trilobitomorpha Stem Graph
Ramifications principales
- 15 Phylum Arthropoda Subphylum Trilobitomorpha Class Trilobita
- 16 Phylum Arthropoda Subphylum Chelicerata
- 17 Phylum Arthropoda Subphylum Pycnogonida
- 18 Phylum Arthropoda Subphylum Crustacea
- 19 Phylum Arthropoda Subphylum Tracheata
- 20 Phylum Arthropoda Subphylum Tracheata Class Insecta
- 21 Phylum Bryozoa
- 22 Phylum Brachiopoda
- 23 Phylum Echinodermata
- 24 Phylum Pogonophora
- 25 Phylum Hemichordata
- 26 Phylum Chordata Stem Graph Fish-like Vertebrates
Ramifications principales Vertébrés pisciformes
- 27 Phylum Chordata Class Amphibia
- 28 Phylum Chordata Class Reptilia
- 29 Phylum Chordata Class Aves
- 30 Phylum Chordata Class Mammalia

Chart 1 / Tableau n° 1

The entire phylogenetic tree, as seen from the side, with the time factor excluded. The categories are a mixture of superphyla, phyla, subphyla, and some classes. It is intended that the position of the categories in reference to each other show general degrees of evolutionary relatedness.

Profil de l'arbre phylogénétique excluant le facteur temporel. Les catégories retenues sont les super-embranchements, les embranchements, les sous-embranchements et certaines classes. La position relative de chaque catégorie traduit le rapport évolutif qui les rattache l'une à l'autre.

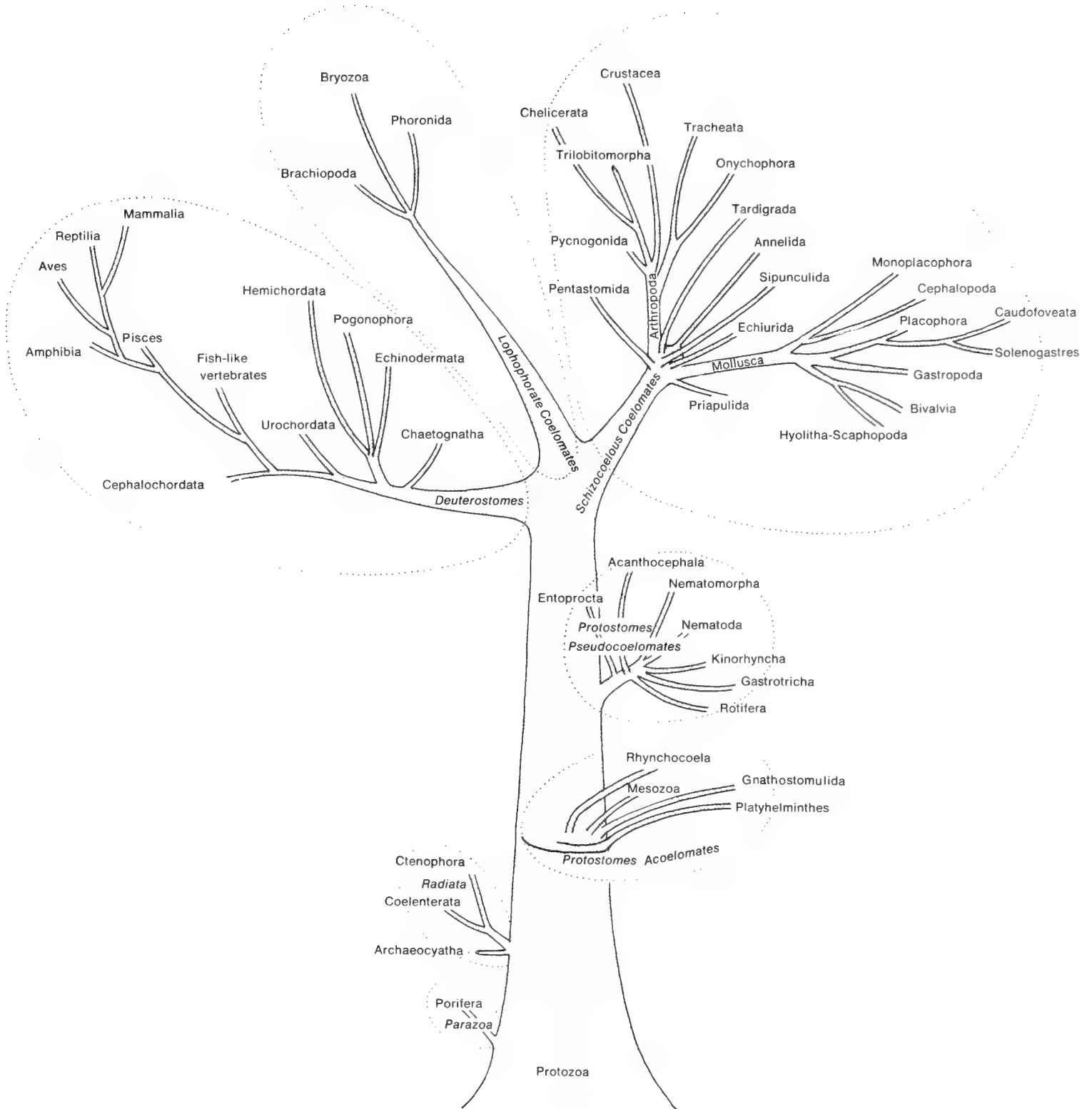


Chart 2 Phylogenetic Tree, as seen from above
Tableau n° 2 Plan de l'arbre phylogénétique

Chart 2/Tableau n° 2

The entire phylogenetic tree, as seen from above, with the time factor excluded. The phyla are mostly in relationship to each other, and are grouped into superphyla. The phylum Gnathostomulida (an acoelous protostome) is not included.

Plan de l'arbre phylogénétique excluant le facteur temporel. Les embranchements sont presque tous en rapport successif et groupés en super-embranchements. L'embranchement des gnathostomulidés (protostomes dépourvus de coelome) est exclu.

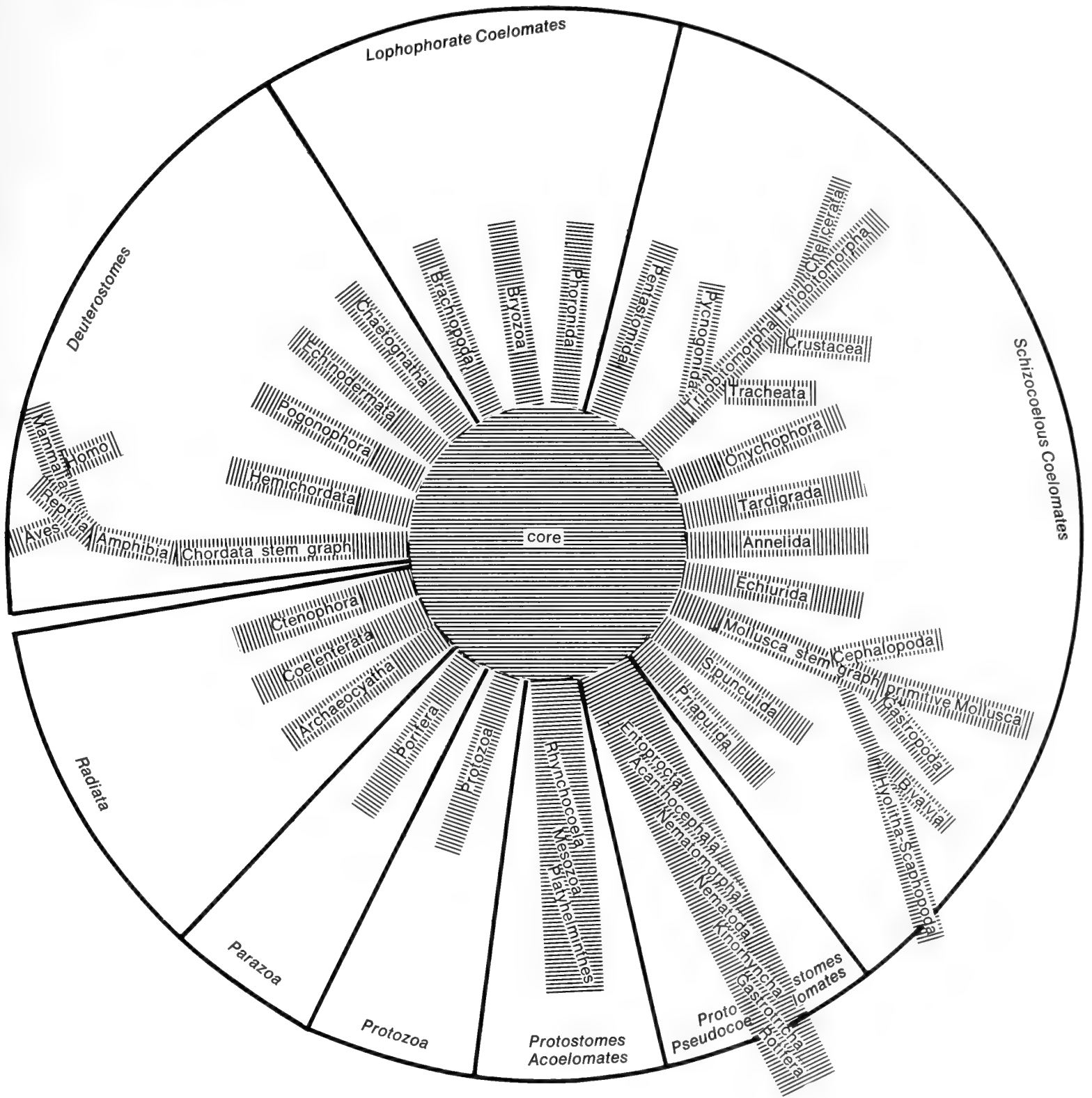


Chart 3/ Tableau n° 3 Phylum Protozoa

Chart 3/ Tableau n° 3

Phylum Protozoa

Subphylum Sarcomastigophora	
Superclass Mastigophora	Rec
Superclass Opalinata <i>(not included/ exclude)</i>	Rec
Superclass Sarcodina	
Class Rhizopodea	
Subclass Lobosia	
Order Amoebida	QuatHolo
Order Arcellinida	CarbNamur—Rec
Subclass Filosia	
Order Aconchulinida <i>(not included/ exclu)</i>	Rec
Order Gromiida	TertEoc—Rec
Subclass Granuloreticulosa	
Order Athalamida	QuatHolo
Order Foraminiferida	
Suborder Allogromiina	Camb U.Camb—Rec
Suborder Textulariina	Camb L.Camb—Rec
Suborder Fusulinina	OrdAshg—TriasRhaet ?JurTith— CretBerr
Suborder Miliolina	SilLudl—Rec
Suborder Rotaliina	?CarbViséan PermGuad—Rec
Class Piroplasma	Rec
Class Radiolaria	
Order Tripylea	TertMioc—Rec
Order Spumellaria	OrdLldeil—Rec
Order Nassellaria	TriasAnis—Rec
Class Acantharia	TertEoc—Rec
Class Heliozoa	QuatPleist—Rec
Class Proteomyxidia <i>(not included/ exclude)</i>	Rec
Subphylum Sporozoa	Rec
Subphylum Cnidospora	Rec
Subphylum Ciliophora	
Class Ciliata	Rec
Subclass Holotrichia	Rec
Subclass Spirotrichia	
Order Heterotrichida	TertDan—Rec
Order Tintinnida	OrdAshg—Rec
Order Hypotrichida <i>(Other orders not included/ Les autres ordres sont exclus)</i>	TertEoc—Rec

Phylum Protozoa

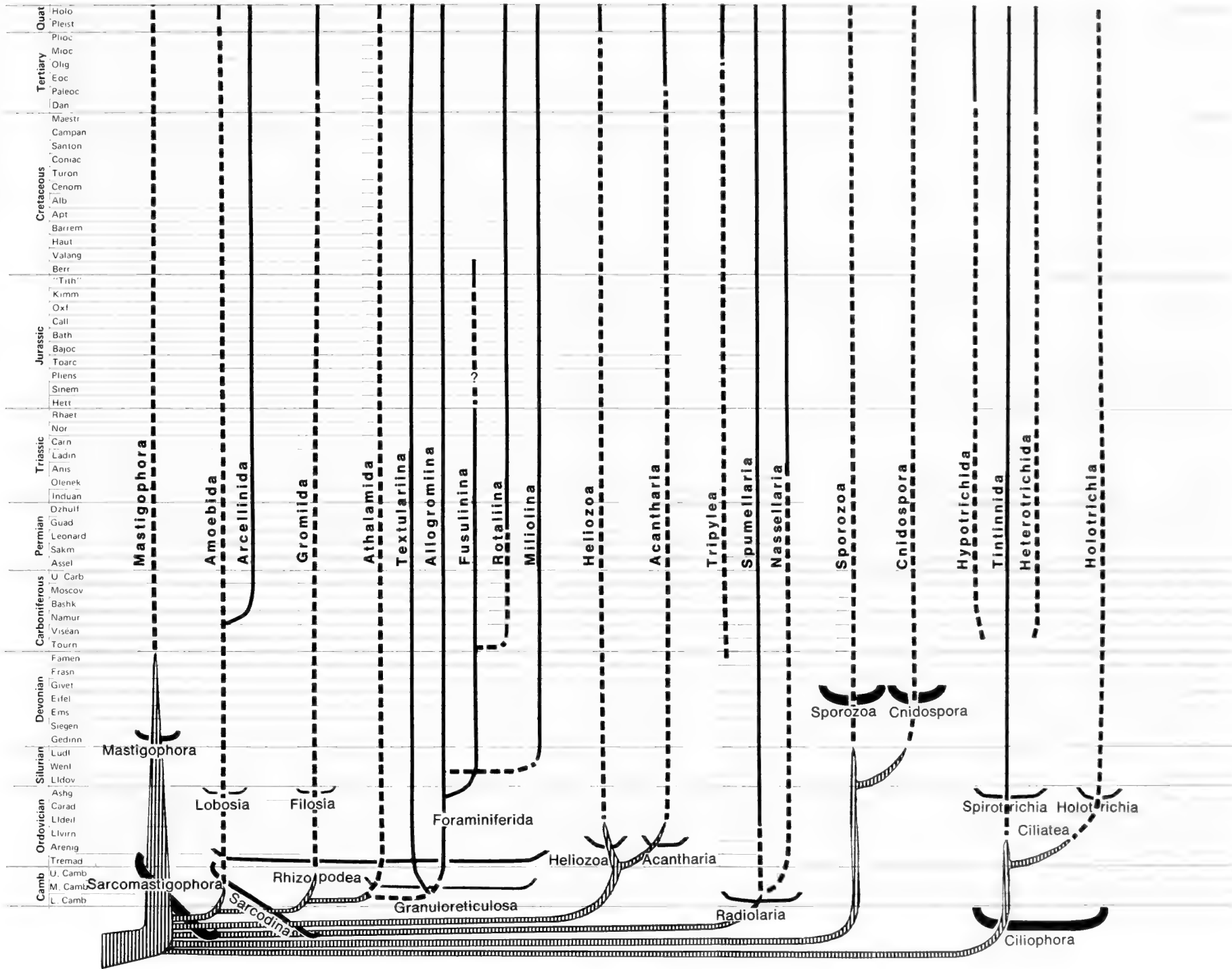


Chart 4/ Tableau n° 4 Phylum Porifera

Chart 4/ Tableau n° 4

Phylum Porifera

Class Hexactinellida	
Order Amphidiscophora	Carb U. Carb—Rec
Order Hexasterophora	Camb L. Camb—Rec
Class Demospongia	
Order Keratosa	Rec
Order Monaxonida	Camb M. Camb—Rec
Order Lithistida	Ord Arenig—Rec
Order Choristida	Carb Viséan—Rec
Class Heteractinida	Camb L. Camb—Perm Leonard
Class Calcarea	
Order Sphinctozoa	Carb Bashk—Cret Maestr
Order Pharetrones	Perm Sakm—Rec
Order Calcinea	Rec
Order Calcaronea	Carb Viséan—Rec

Phylum Porifera

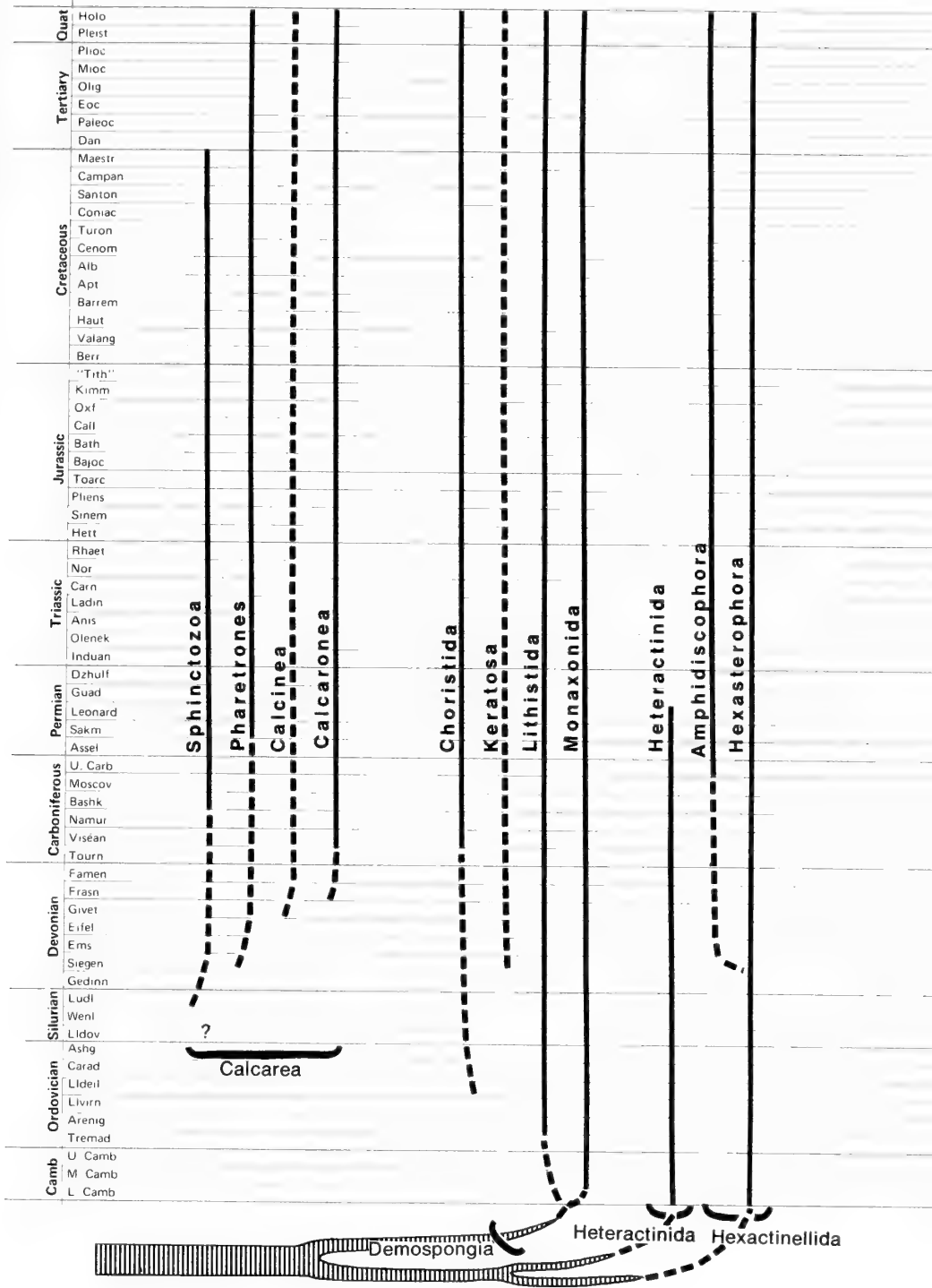


Chart 5/ Tableau n° 5 Phylum Archaeocyatha

Chart 5/Tableau n° 5

Phylum Archaeocyatha

Class Regulares

Order Monocyathida	Camb L.Camb
Order Ajacicyathida	Camb L.Camb
Order Coscinocyathida	Camb L.Camb

Class Irregulares

Order Archaeocyathida	Camb L.Camb
Order Syringocyathida	Camb L.Camb
Order Rhizacyathida	Camb L.Camb

D. Hill (*in* Curt Teichert, ed., *Treatise on invertebrate paleontology*, pt. E, vol. 1: *Archaeocyatha*, rev. ed., 1972, 158 pp.) has recently proposed a different system.

D. Hill (dans Curt Teichert, éd. resp., *Treatise on invertebrate paleontology*, partie E, vol. 1: *Archaeocyatha*, éd. rév., 1972, 158 p.) a récemment proposé un système différent.

Phylum Archaeocyatha



Chart 6/ Tableau n° 6

Phylum Coelenterata

Class Hydrozoa

Order Trachylinida	JurBajoc—Rec
Order Hydroida	Camb M.Camb—Rec
Order Siphonophorida	Precambrian—Rec
Order Spongiomorphida	TriasOlenek—JurTith
Order Milleporina	TertDan—Rec
Order Stylasterina	TertDan—Rec
Order Sphaeractinida	Carb U.Carb—CretCenom
Order Stomatoporoidea	Camb L.Camb—TertEoc

Class Scyphozoa

Subclass Scyphomedusae

Order Stauromedusida	Rec
Order Carybdeida	JurTith—Rec
Order Coronatida	Camb L.Camb—Rec
Order Semaestomatida	JurTith—Rec
Order Lithorhizostomatida	JurTith
Order Rhizostomatida	JurTith—Rec
Order Conchopeltida	OrdCarad

Class Anthozoa

Subclass Ceriantipatharia

Order Antipatharia	TertMioc—Rec
Order Ceriantharia	Rec

Subclass Octocorallia

Order Stolonifera	Cret ?Berr—Rec
Order Telestacea	Rec
Order Alcyonacea	Jur ?Hett—Rec
Order Trachypsammiacea	PermGuad
Order Coenothecalia	Cret ?Berr—Rec
Order Gorgonacea	Cret ?Berr—Rec
Order Pennatulacea	Cret ?Berr—Rec

Subclass Zoantharia

Infraclass Tabulata

Order Favositida	OrdLldeil—PermDzhulf
Order Syringoporida	OrdCarad—PermDzhulf
Order Sarcinulida	OrdCarad—SilWenl
Order Auloporida	OrdAshg—PermDzhulf
Order Lichenariida	OrdArenig—SilLldov
Order Tetradiida	OrdLldeil—OrdAshg
Order Halysitida	OrdCarad—DevEms

Infraclass Heliolitoidea

Order Protaraeida	OrdLldeil—SilLudl
Order Heliolitida	OrdLldeil—DevFrasn
Order Proporida	OrdCarad—SilLudl

Infraclass Rugosa

Order Streptelasmata	OrdCarad—PermDzhulf
Order Columnariida	OrdCarad—PermLeonard
Order Cystiphyllida	OrdCarad—DevGivet
Infraclass Heterocorallia	CarbViséan

Infraclass Scleractinia

Order Astrocoeniida	TriasLadin—Rec
Order Fungiida	TriasAnis—Rec
Order Faviida	TriasAnis—Rec
Order Caryophyllida	JurHett—Rec
Order Dendrophyllida	CretCenom—Rec

Infraclass Corallimorpharia	Rec
Infraclass Zoanthinaria	Rec
Infraclass Actinaria	Rec

Dipleurozoa and Protomedusae were proved not to be coelenterates. Conulariida are referred to Phylum *incertae sedis*.

On a démontré que les dipleurozoaires et les protoméduses ne sont pas des coelentérés. Quant aux conularides, on n'a pas encore réussi à les classer de façon certaine.

Phylum Coelenterata

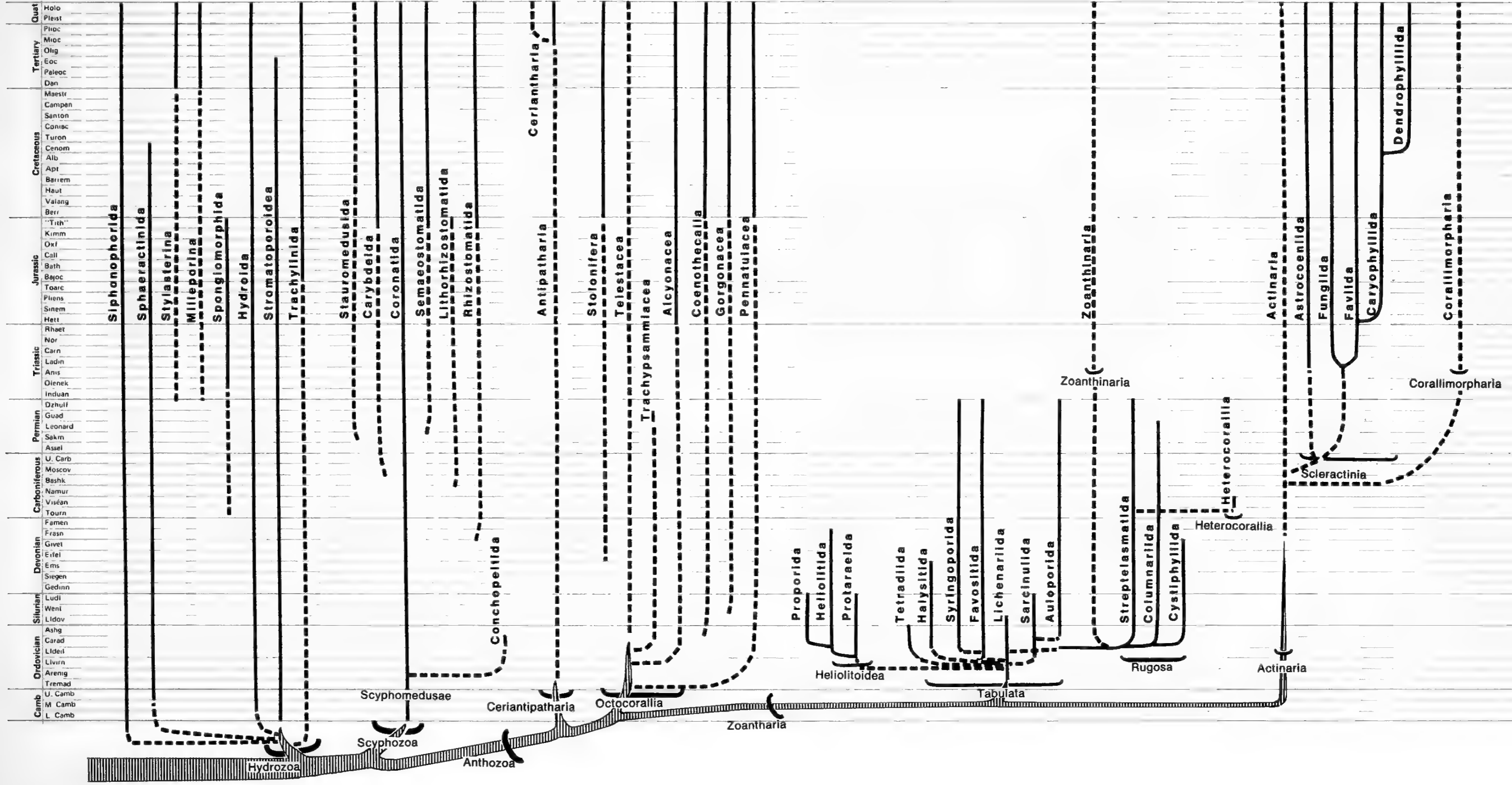


Chart 7 Phylum Mollusca Stem Graph

Tableau n° 7 Phylum Mollusca Ramifications principales

Chart 7/Tableau n° 7

Phylum Mollusca	Stem Graph	
	Ramifications principales	
Class Stenothecoida		
Order Cambridioidea		Camb L.Camb
Class Mattheva		
Order Matthevoida		Camb U.Camb
Class Monoplacophora		
Order Tryblidioidea		Camb L.Camb-DevGivet—Rec
Order Archinacelloidea		Camb U.Camb—SilLldov
Class Placophora		
Order Palaeoloricata		Camb U.Camb—CretCampan
Order Neoloricata		OrdAshg—Rec
Class Caudofoveata		Rec
Class Solenogastres		Rec
Class Rostroconchia		OrdLldeil—PermGuad
<i>(not included; related to and perhaps intermediate between Bivalvia and Scaphopoda / exclue; apparentée aux lamellibranches et aux scaphopodes et peut-être à mi-chemin entre ces deux classes)</i>		
Class Ribeirioda		Camb U.Camb—OrdAshg
<i>(not included; represents the transitional group between an unknown univalve and the Rostroconchia, Bivalvia, and Scaphopoda / exclue; représente le stade de transition entre un univalve inconnu et les classes des rostroconques, des lamellibranches et des scaphopodes)</i>		

Phylum Mollusca stem graph

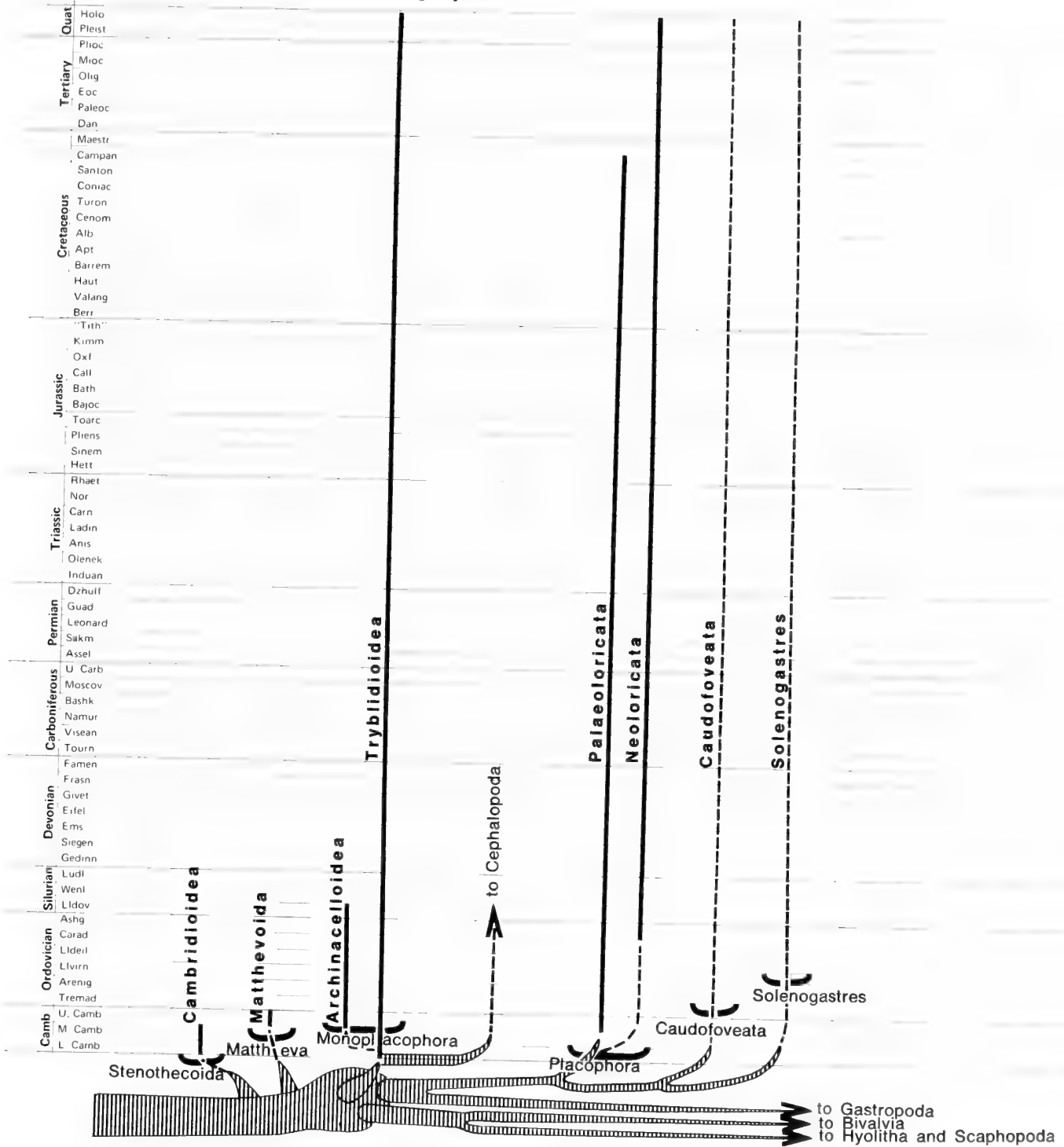


Chart 8/ Tableau n° 8

Phylum Mollusca Class Hyolitha Class Scaphopoda

Chart 8/ Tableau n° 8

Phylum Mollusca Class Hyolitha Class Scaphopoda

Class Hyolitha
 Order Hyolithida

Camb L.Camb—PermGuad

Class Scaphopoda

DevSiegen—Rec

Phylum Mollusca Class Hyolitha Class Scaphopoda

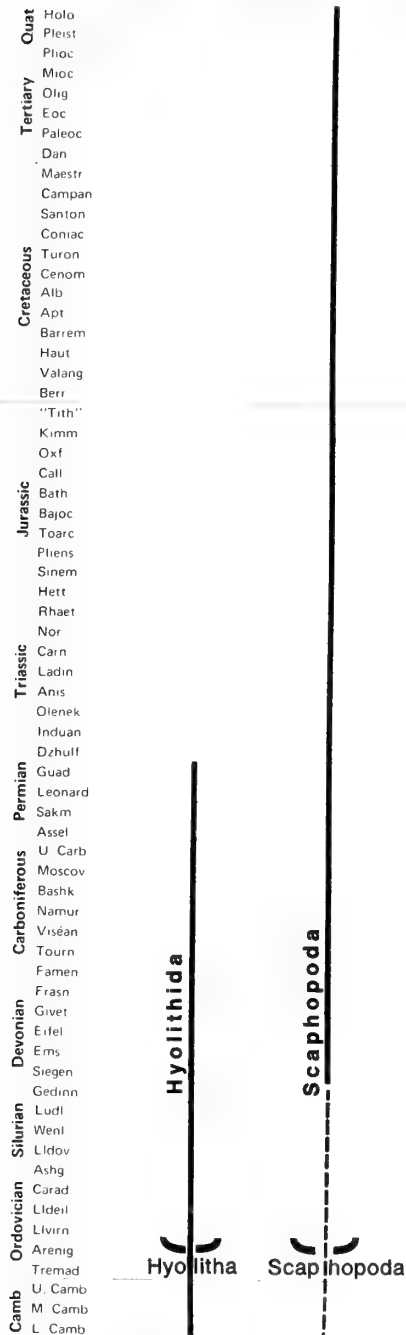


Chart 9/ Tableau n° 9 Phylum Mollusca Class Bivalvia

Chart 9/ Tableau n° 9

Phylum Mollusca Class Bivalvia

Subclass Palaeotaxodonta

Order Solemyoidea

DevSiegen—Rec

Order Nuculoidea

OrdArenig—Rec

Subclass Isofilibranchia

Order Mytiloidea

OrdArenig—Rec

Subclass Pteriomorpha

Order Arcoidea

OrdLldeil—Rec

Order Pterioidea

OrdCarad—Rec

Subclass Heteroconchia

Order Actinodontoida

OrdTremad—OrdAshg—?Rec

Order Unionoida

DevFrasn—Rec

Order Trigonioidea

OrdArenig—Rec

Order Veneroidea

OrdCarad—Rec

Order Myoidea

CarbTourn—Rec

Order Hippuritoidea

SilWenI—CretMaestr

Subclass Anomalodesmata

Order Pholadomyoidea

OrdCarad—Rec

Order Praecardioida is not included.

L'ordre des praecardioida est exclu.

Phylum Mollusca Class Bivalvia

Quat
 Pleist
 Plioc
 Mioc
 Olig
 Eoc
 Paleoc
 Dan
 Maestr
 Campan
 Santon
 Coniac
 Turon
 Cenom
 Alb
 Apt
 Barrem
 Haut
 Valang
 Berr
 "Tith"
 Kimm
 Oxl
 Call
 Bath
 Bajoc
 Toarc
 Pliens
 Sinem
 Hett
 Rhæt
 Nor
 Carn
 Ladin
 Anis
 Olenek
 Inçuan
 Dzhulf
 Guad
 Leonard
 Sakm
 Assel
 U. Carb
 Moscov
 Bashk
 Namur
 Visean
 Tourn
 Famen
 Frasn
 Givet
 Eifel
 Ems
 Siegen
 Gedinn
 Ludf
 Weni
 Lfdov
 Ashg
 Carad
 Lldert
 Livrn
 Arenig
 Tremad
 U. Camb
 M. Camb
 L. Camb

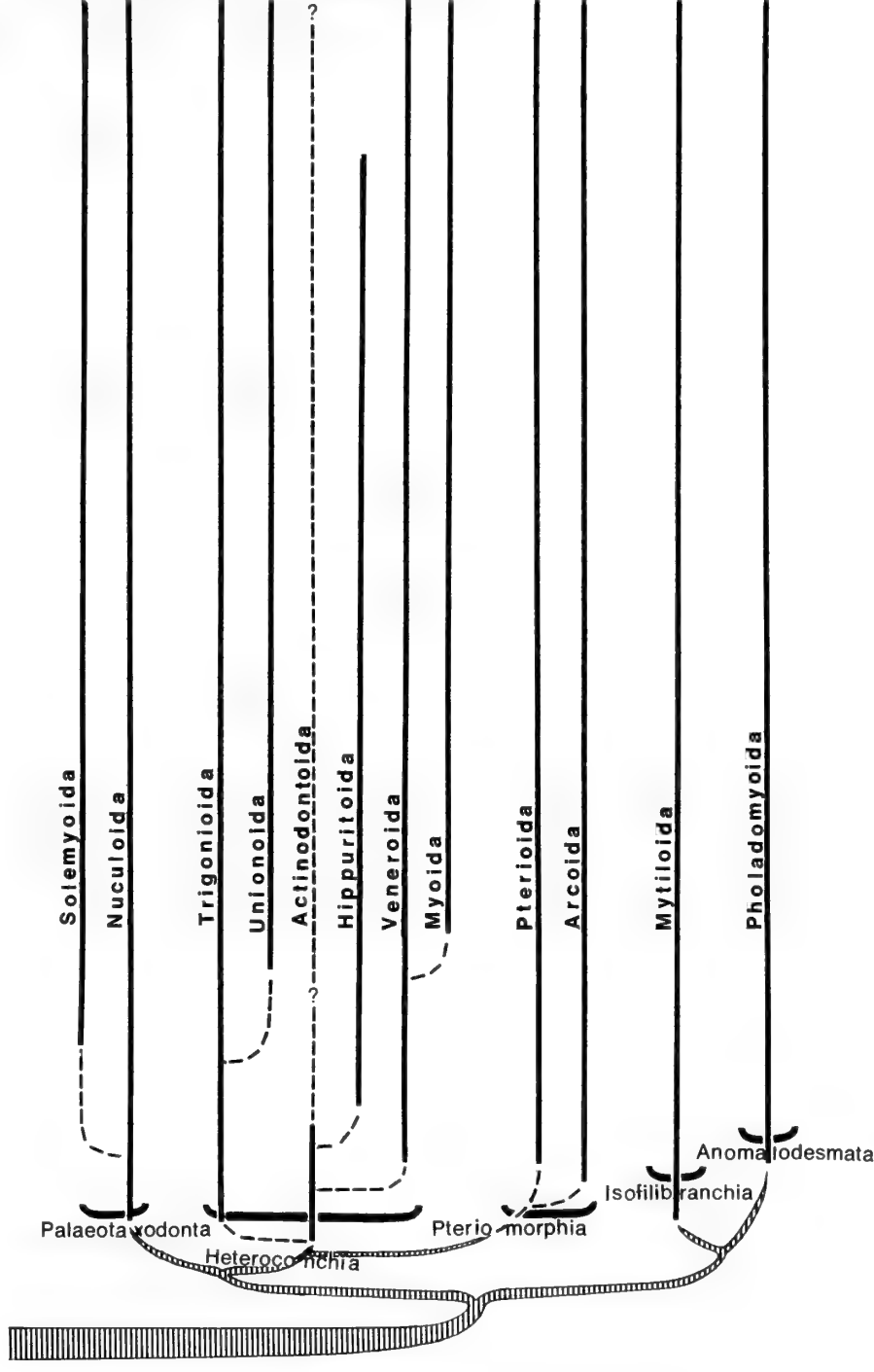


Chart 10/ Tableau n° 10 Phylum Mollusca Class Gastropoda

Chart 10/Tableau n° 10

Phylum Mollusca Class Gastropoda

Subclass Prosobranchia

Order Archaeogastropoda

Camb U.Camb—Rec

Order Mesogastropoda

OrdCarad—Rec

Order Neogastropoda

JurKimm—Rec

Subclass Opisthobranchia

Order Cephalaspidea

CarbViséan—Rec

Order Pyramidellacea

DevGedinn—Rec

Order Philinoglossacea

Rec

Order Anaspidea

Rec

Order Notaspidea

Rec

Order Sacoglossa

Rec

Order Thecosomata

TertEoc—Rec

Order Gymnosomata

Rec

Order Nudibranchia

Rec

Order Rhodopacea

Rec

Order Onchidiacea

Rec

Subclass Pulmonata

Order Basommatophora

Carb U.Carb—Rec

Order Stylommatophora

CretTuron—Rec

Order Systellomatophora is not included.

L'ordre des systellomatophora est exclu.

Phylum Mollusca Class Gastropoda

Quat
Holo
Pleist
Plioc
Mioc
Olig
Eoc
Paleoc
Dan
Maestr
Campan
Santon
Coniac
Turon
Cenom
Alb
Apt
Barrem
Haut
Valang
Berr
"Tith"
Kimm
Oxi
Call
Bath
Bajoc
Toarc
Pliens
Sinem
Hett
Rhaet
Nor
Carn
Ladin
Anis
Olenek
Induan
Dzhulf
Guad
Leonard
Sakm
Assel
U. Carb
Moscov
Bashk
Namur
Visean
Tourn
Famen
Frasn
Givet
Eifel
Ems
Siegen
Gedinn
Ludi
Went
Lidov
Ashg
Carad
Lidell
Llvirn
Areng
Tremad
U. Camb
M Camb
L Camb

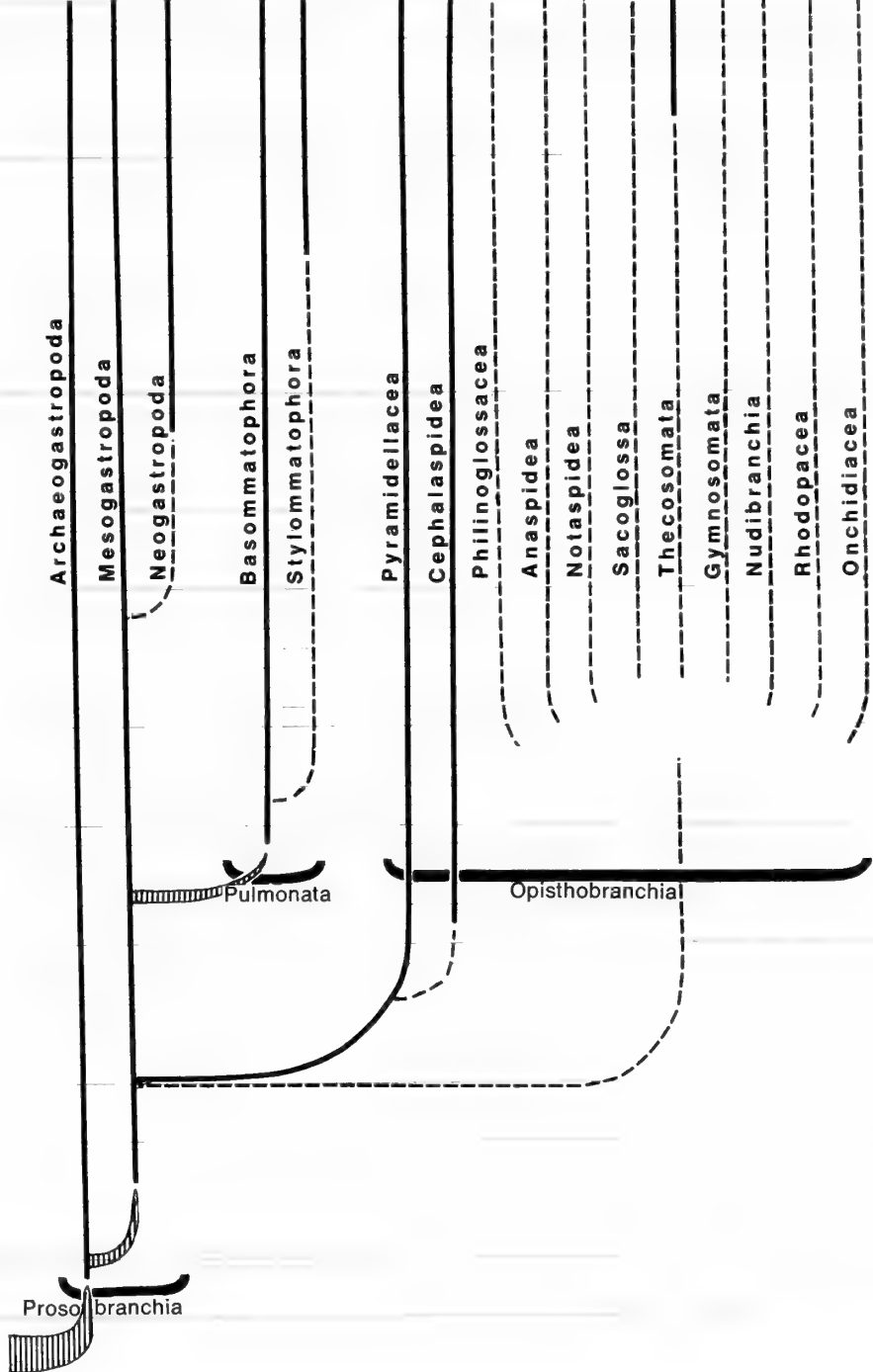


Chart 11/ Tableau n° 11

Phylum Mollusca Class Cephalopoda

Chart 11/ Tableau n° 11

Phylum Mollusca Class Cephalopoda

Subclass Ectocochlia

Superorder Nautiloidea

Order Ellesmerocerida	Camb U.Camb—OrdAshg
Order Orthocerida	OrdArenig—TriasNor
Order Ascocerida	OrdLldeil—SilLudl
Order Actinocerida	OrdLlvirn—CarbNamur
Order Endocerida	OrdArenig—SilWenl
Order Discosorida	OrdLlvirn—DevGivet
Order Oncocerida	OrdLlvirn—CarbNamur
Order Nautilida	DevSiegen—Rec
Order Tarphycerida	OrdArenig—DevGivet

Superorder Ammonoidea

Order Bactritida	OrdArenig—TriasCarn
Order Anarcestida	DevSiegen—DevFamen
Order Clymeniida	DevFamen
Order Goniatitida	DevEifel—TriasInduan
Order Ceratitida	PermLeonard—TriasRhaet
Order Prolecanitida	DevFamen—TriasOlenek
Order Phyllocerida	TriasOlenek—CretMaestr
Order Lytocerida	JurHett—CretMaestr
Order Ammonitida	JurHett—CretMaestr

Subclass Coleoidea

Order Belemnitida	CarbNamur—TertEoc
Order Octopida	CretConiac—Rec
Order Sepiida	CretCenom—Rec
Order Teuthida	PermLeonard—Rec
Order Phragmoteuthida	PermGuad—JurSinem
Order Aulacocerida	DevFrasn—JurOxf

Phylum Mollusca Class Cephalopoda

Quat
Holo
Pleist
Plioc
Mioc
Olig
Eoc
Paleoc
Dan
Maestr
Campan
Santon
Coniac
Turon
Cenom
Alb
Apt
Barrem
Haut
Valang
Berr
Tith
Kimm
Oxf
Call
Bath
Bajoc
Toarc
Pliens
Sinem
Hett
Rhaet
Nor
Carn
Ladin
Anis
Olenek
Induan
Dzhulf
Permian
Leonard
Sakm
Assel
Carboniferous
U. Carb
Moscov
Bashk
Namur
Viséan
Tourn
Famen
Devonian
Frasn
Givet
Eifel
Ems
Siegen
Silurian
Gedinn
Ludi
Wenl
Lldov
Ashg
Ordovician
Carad
Lldeil
Livirn
Arenig
Tremad
Camb
U. Camb
M Camb
L Camb

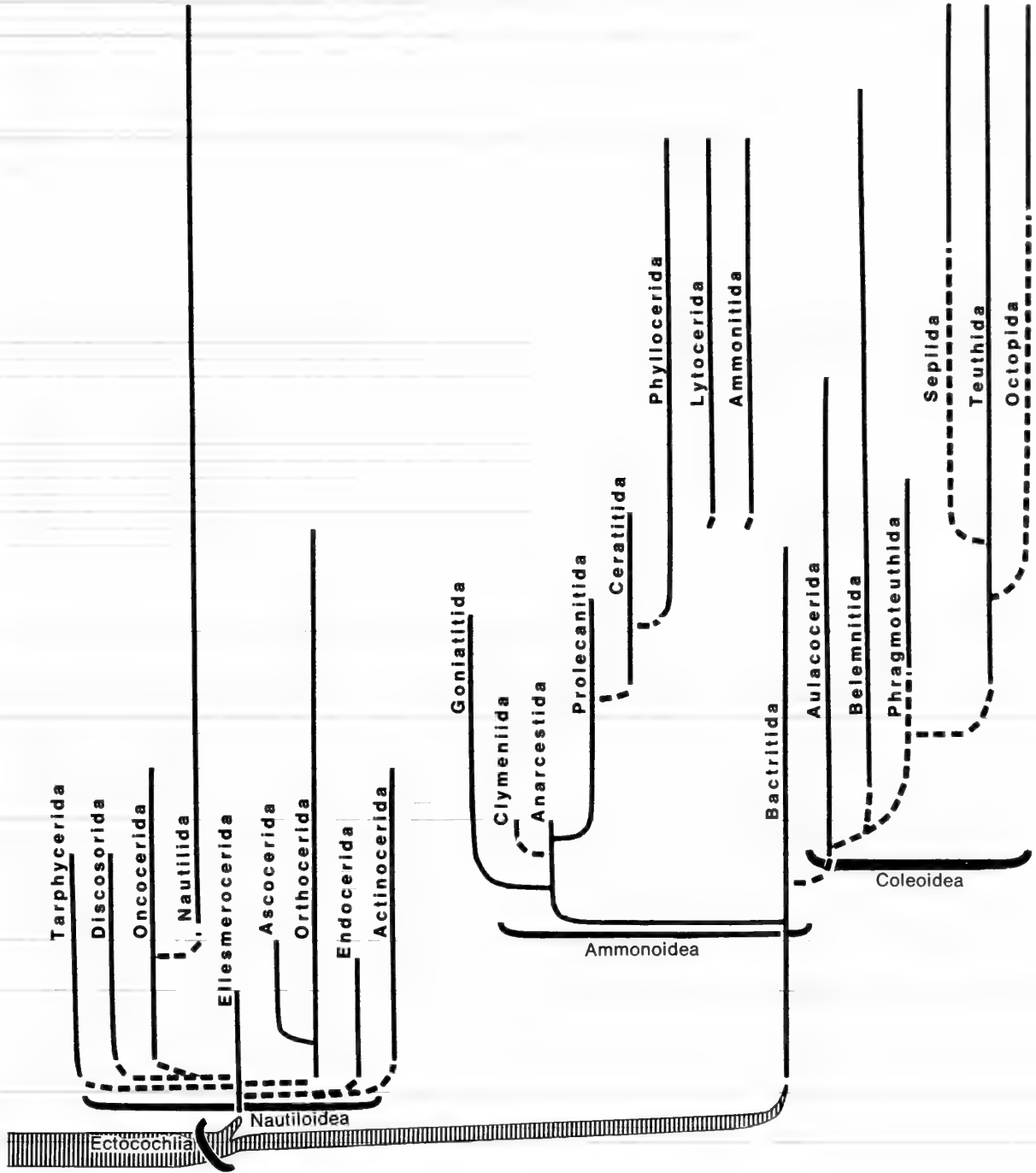


Chart 12/Tableau n° 12 Phylum Annelida

Chart 12/Tableau n° 12

Phylum Annelida

Class Polychaeta

Subclass Errantia

Subclass Sedentaria

Subclass Miskoiida

OrdTremad—Rec

Camb M.Camb—Rec

Camb M.Camb—OrdAshg

?Class Archiannelida

Rec

Class Oligochaeta

Order Plesiopora

Order Prosopora

Order Opisthopora

CarbBashk—Rec

TertOlig—Rec

TertOlig—Rec

?Class Oligochaeta

Aelosomatidae

Brachiobdellidae

Rec

Rec

Class Hirudinea

Order Acanthobdellida

Order Rhynchobdellida

Order Gnathobdellida

Order Pharyngobdellida

JurBajoc—Rec

Rec

Rec

Rec

Phylum Annelida

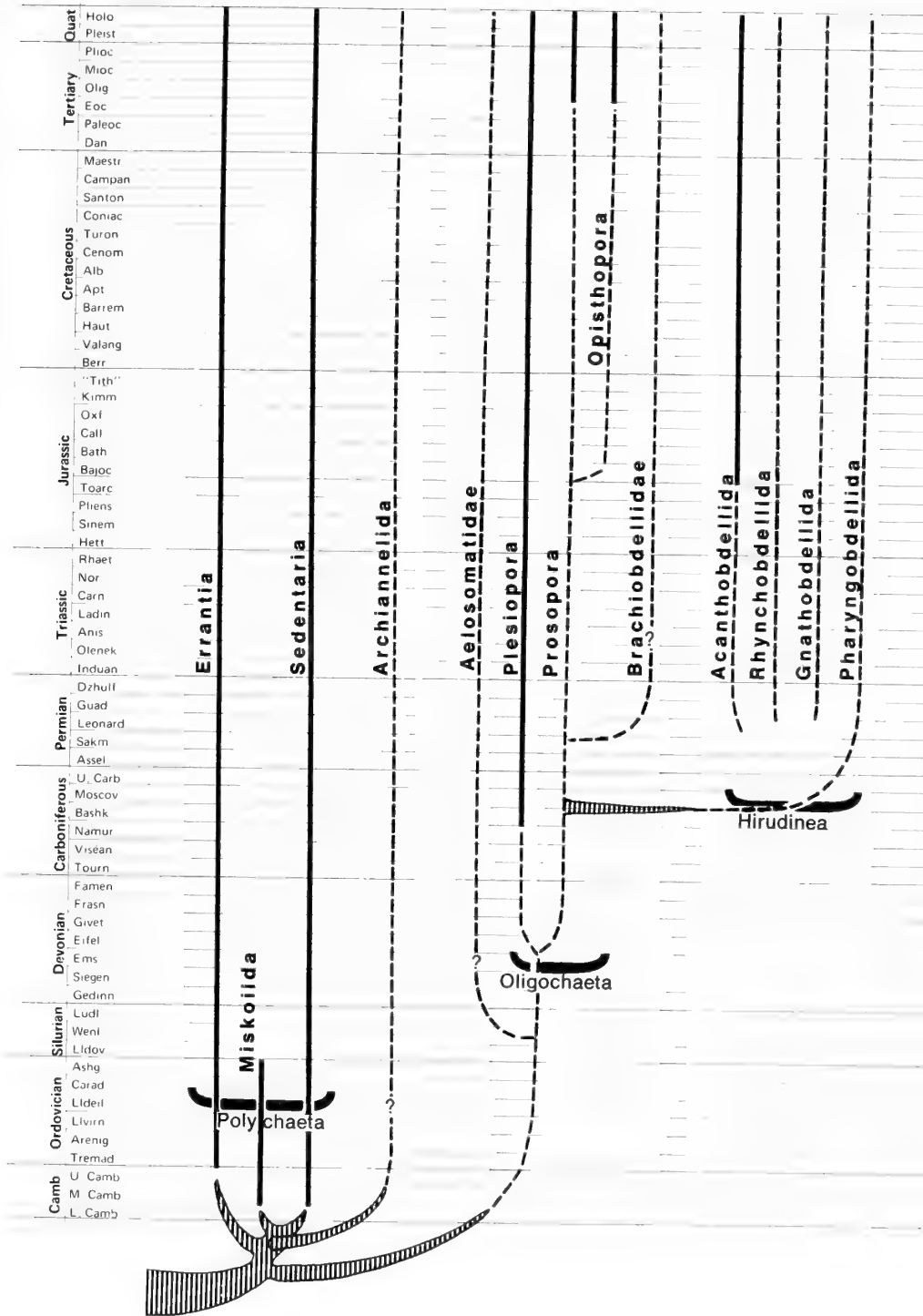


Chart 13/Tableau n° 13 Phylum Onychophora

Chart 13/ Tableau n° 13

Phylum Onychophora

Order Protonychophora

Order Euonychophora

?Order Xenusion

Camb M.Camb

Rec

?Precambrian

Phylum Onychophora

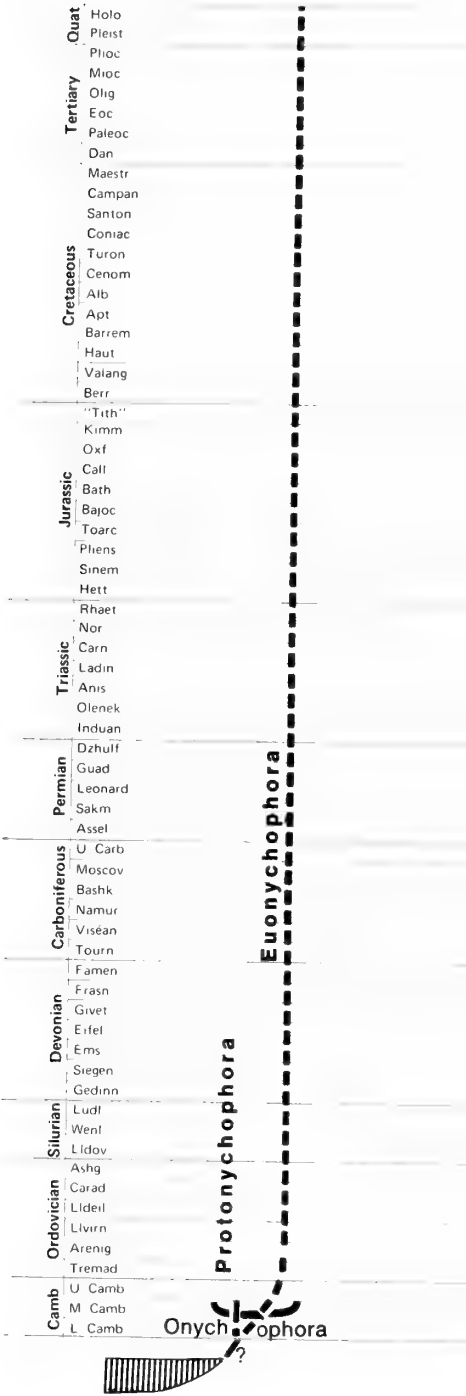


Chart 14 Phylum Arthropoda
Subphylum Trilobitomorpha Stem Graph
Tableau n° 14 Phylum Arthropoda
Subphylum Trilobitomorpha Ramifications principales

Phylum Arthropoda Subphylum Trilobitomorpha

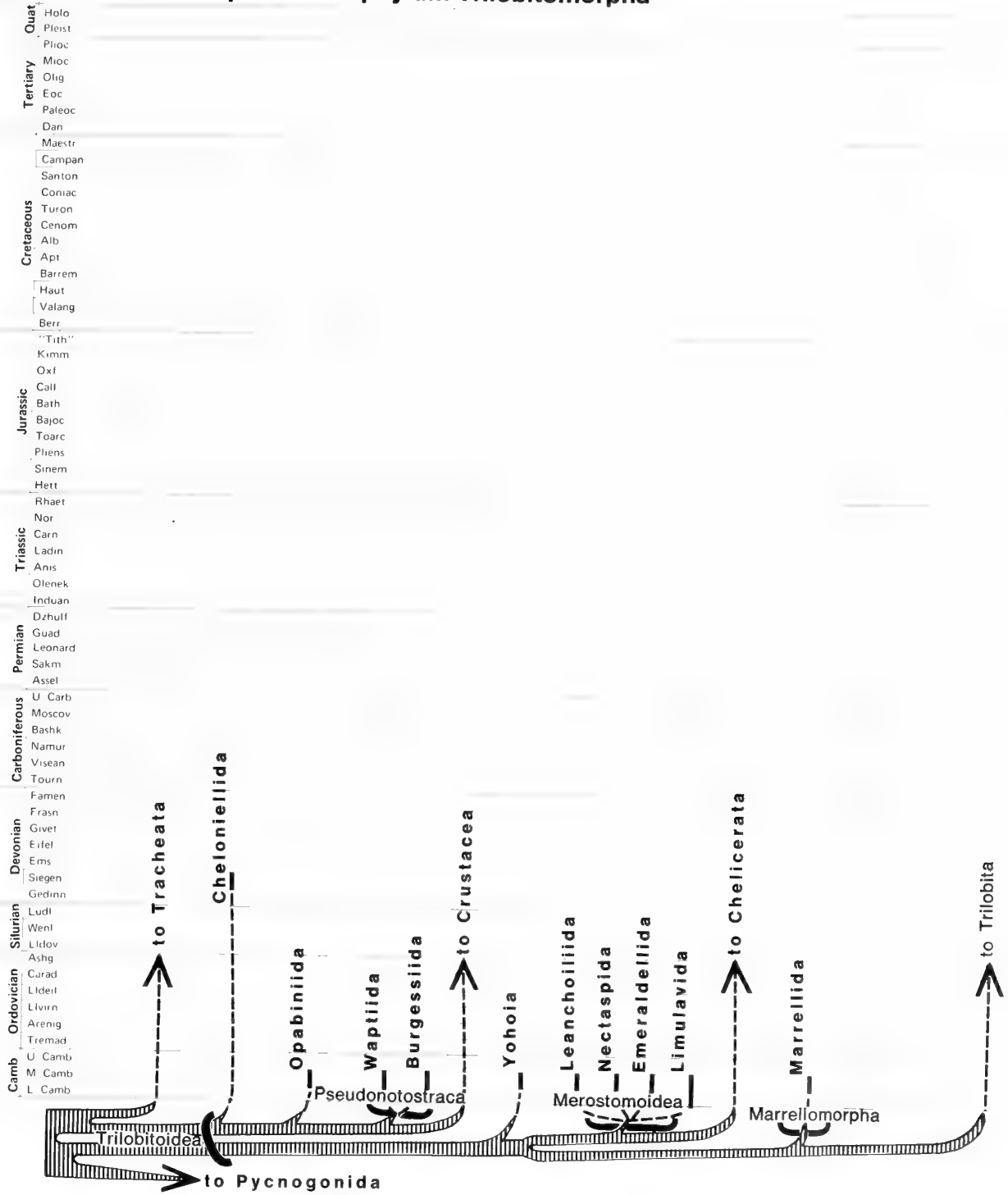




Chart 15/Tableau n° 15

Phylum Arthropoda Subphylum Trilobitomorpha

Chart 15/Tableau n° 15

Phylum Arthropoda Subphylum Trilobitomorpha

Class Trilobita

Order Agnostida

Suborder Agnostina

Camb L.Camb—OrdAshg

Suborder Eodiscina

Camb L.Camb—Camb M.Camb

Order Redlichiida

Suborder Olenellina

Camb L.Camb

Suborder Redlichiina

Camb L.Camb—Camb M.Camb

Suborder Bathynotina

Camb L.Camb—Camb M.Camb

Order Corynexochida

Camb L.Camb—Camb U.Camb

Order Ptychopariida

Suborder Ptychopariina

Camb L.Camb—OrdAshg

Suborder Asaphina

Camb M.Camb—OrdAshg

Suborder Illaenina

Camb U.Camb—PermDzhulf

Suborder Harpina

Camb U.Camb—DevFrasn

Suborder Trinucleina

OrdTremad—SilLudl

Order Phacopina

Suborder Cheirurina

Camb U.Camb—DevEifel

Suborder Calymenina

OrdTremad—DevGivet

Suborder Phacopina

OrdArenig—DevFamen

Order Lichida

OrdTremad—DevFamen

Order Odontopleurida

Camb M.Camb—DevFrasn

Phylum Arthropoda Subphylum Trilobitomorpha Class Trilobita

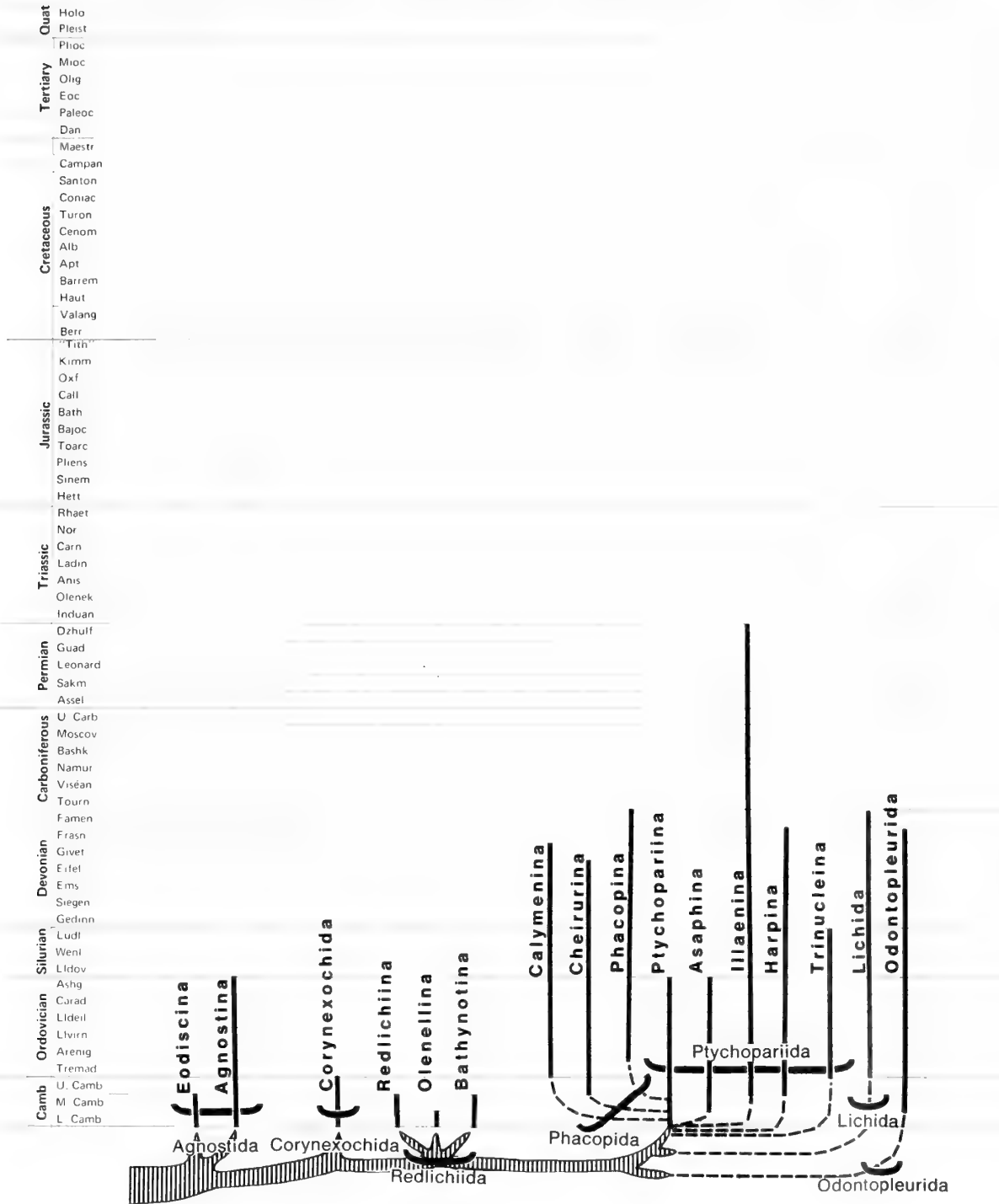


Chart 16/Tableau n° 16

Phylum Arthropoda Subphylum Chelicerata

Chart 16/Tableau n° 16

Phylum Arthropoda Subphylum Chelicerata

Class Merostomata

Subclass Xiphosura

Order Aglaspida

Camb L.Camb—OrdCarad

Order Chasmataspidida

OrdLlvirn

Order Synziphosura

SilWenI—DevSiegen

Order Limulida

DevGedinn—Rec

Subclass Euryptera

Order Eurypterida

OrdArenig—PermLeonard

Class Arachnida

Order Scorpiones

SilWenI—Rec

Order Pseudoscorpiones

TertEoc—Rec

Order Opiliones

CarbMoscov—Rec

Order Architarbi

CarbBashk—CarbMoscov

Order Acari

DevEms—Rec

Order Haptopoda

CarbBashk

Order Anthracomarti

CarbBashk—Carb U.Carb

Order Trigonotarbi

DevEms—Carb U.Carb

Order Palpigradi

JurTith—Rec

Order Uropygi

CarbBashk—Rec

Order Kustarachnida

CarbMoscov

Order Amblypygi

CarbBashk—Rec

Order Araneae

DevEms—Rec

Order Solifugae

CarbMoscov—Rec

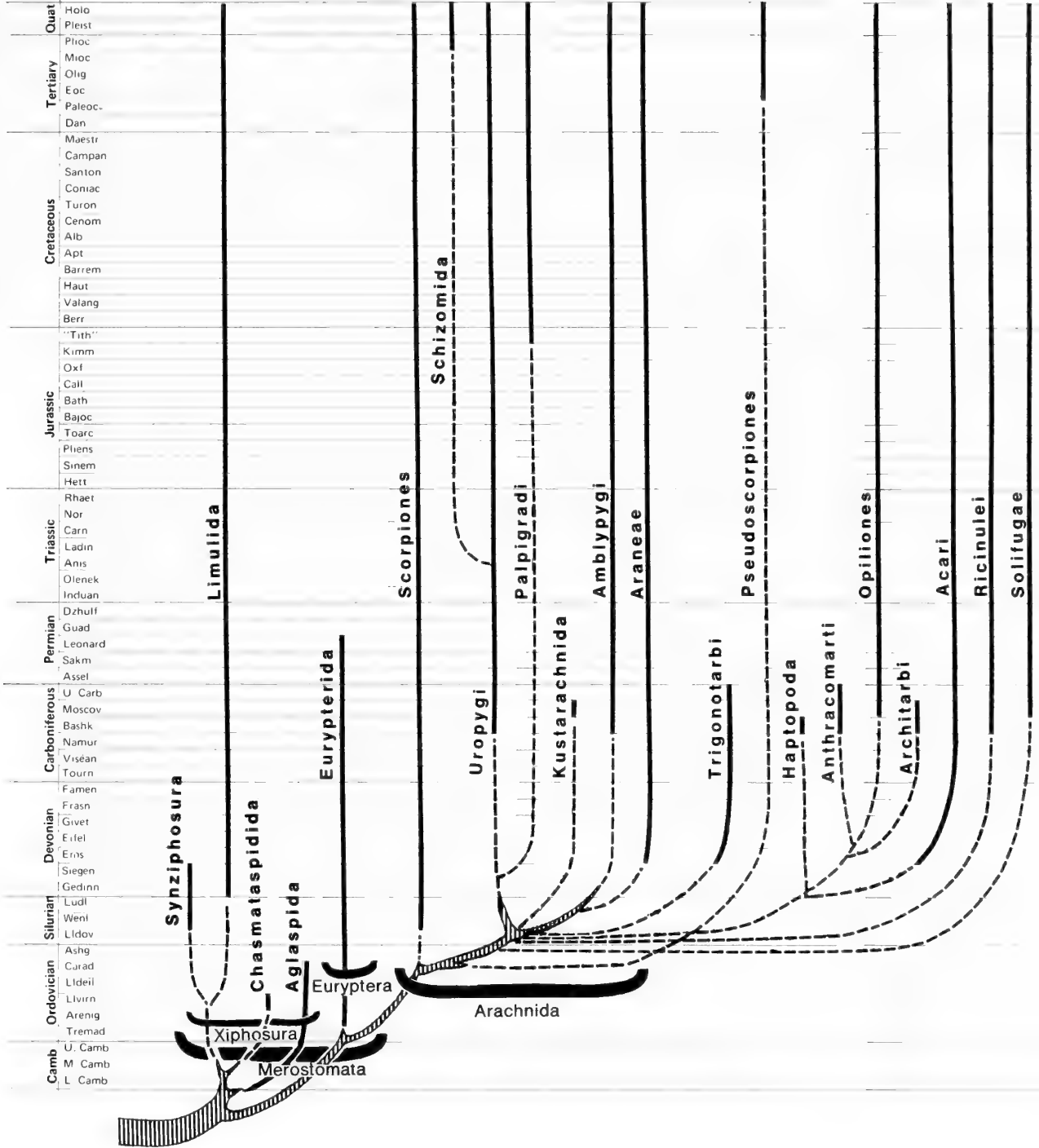
Order Ricinulei

CarbBashk—Rec

Order Schizomida

TertPlioc—Rec

Phylum Arthropoda Subphylum Chelicerata





Phylum Arthropoda Subphylum Chelicerata

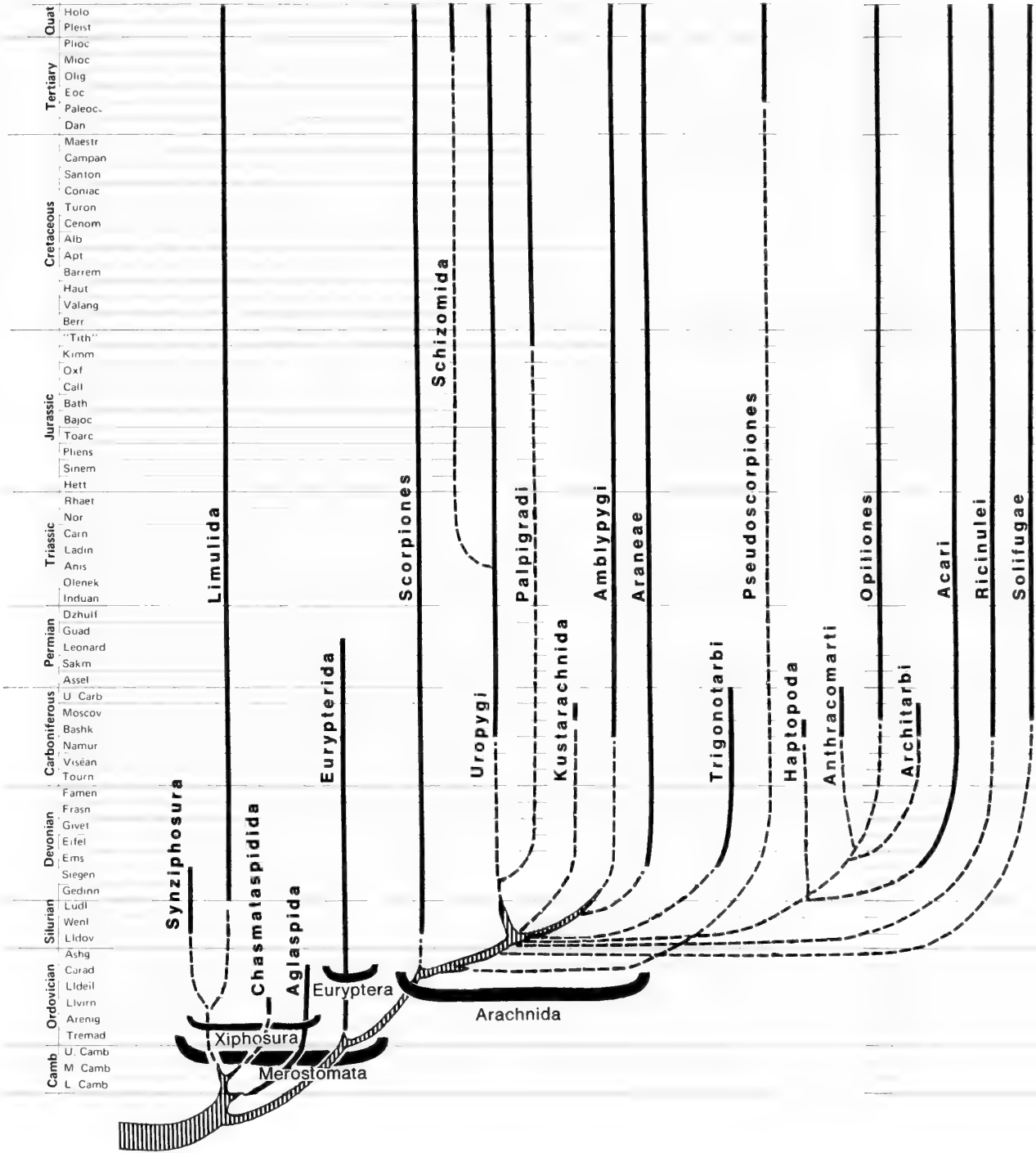




Chart 17/Tableau n° 17

Phylum Arthropoda Subphylum Pycnogonida

Chart 17/Tableau n° 17

Phylum Arthropoda Subphylum Pycnogonida

Order Pantopoda

Rec

Order Palaeopantopoda

DevSiegen

Phylum Arthropoda

Subphylum Pycnogonida

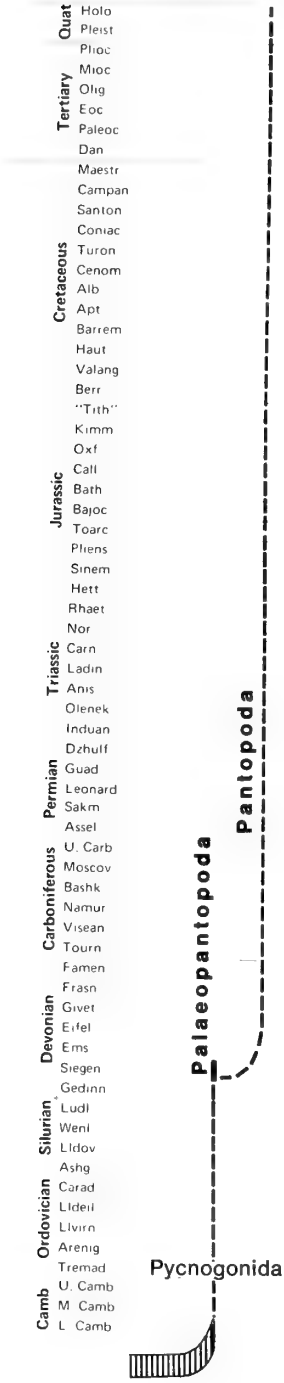


Chart 18/Tableau n° 18

Phylum Arthropoda Subphylum Crustacea

Class Cephalocarida	
Order Brachypoda	Rec
Class Branchiopoda	
Subclass Sarsostraca	
Order Anostraca	DevSiegen—Rec
Order Lipostraca	DevSiegen—DevEifel
Subclass Calmanostraca	
Order Notostraca	CarbNamur—Rec
Order Kazacharthra	JurHett—JurToarc
Order Acerostraca	DevSiegen
Subclass Diplostraca	
Order Conchostraca	DevGedinn—Rec
Order Cladocera	CretCenom—Rec
Class Ostracoda	
Order Archaeocopida	Camb L.Camb—OrdTremad
Order Leperditicopida	OrdTremad—DevFamen
Order Palaeocopida	OrdArenig—PermGuad—?Rec
Order Mydocopida	OrdLlvirn—Rec
Order Podocopida	OrdLldeil—Rec
Class Euthycarinoidea	
Order Euthycarinida	TriasOlenek—Trias ?Ladin
Class Mystacocarida	Rec
Class Copepoda	
Order Calanoida	Rec
Order Harpacticoida	TertMioc—Rec
Order Cyclopoida	TertMioc—Rec
Order Notodelphyoida	Rec
Order Caligoida	Rec
Order Lernaepodoida	Rec
Order Monstrilloida	Rec
Class Cirripedia	
Order Thoracica	SilLudl—Rec
Order Acrothoracica	Carb U.Carb—Rec
Order Ascothoracica	CretTuron—Rec
Order Rhizocephala	Rec
Class Branchiura	
Order Arguloida	Rec
Class Malacostraca	
Subclass Phyllocarida	
Order Archaeostraca	OrdTremad—TriasCarn
Order Leptostraca	PermGuad—Rec.
Order Hymenosthraca	Camb ?L.Camb—Camb M.Camb— OrdArenig

Subclass Eumalacostraca

Superorder Hoplocarida

Order Palaeostomatopoda

DevEifel—CarbNamur

Order Stomatopoda

JurTith—Rec

Superorder Eocarida

Order Eocaridacea

DevGivet—CarbBashk

Order Pygocephalomorpha

CarbTourn—PermLeonard

Superorder Eucarida

Order Euphausiacea

Rec

Order Decapoda

PermGuad—Rec

Superorder Peracarida

Order Anthracocaridacea

CarbTourn—CarbBashk

Order Mysidacea

TriasOlenek—Rec

Order Cumacea

PermGuad—Rec

Order Tanaidacea

PermGuad—Rec

Order Isopoda

CarbBashk—Rec

Order Amphipoda

TertEoc—Rec

Order Spelaeogriphacea

Rec

Order Thermosbaenacea

Rec

Superorder Syncarida

Order Anaspidacea

Trias ?Olenek—Rec

Order Stygocaridacea

Perm ?Assel—Rec

Order Bathynellacea

Rec

Order Palaeocaridacea

CarbViséan—Perm ?Dzhulf

?Class

Order Bostrichopodida

Carb ?Tourn

(not included / exclu)

?Class

?Order Cycloidea

CarbTourn—TriasNor

(not included / exclu)

Phylum Arthropoda

Subphylum Crustacea

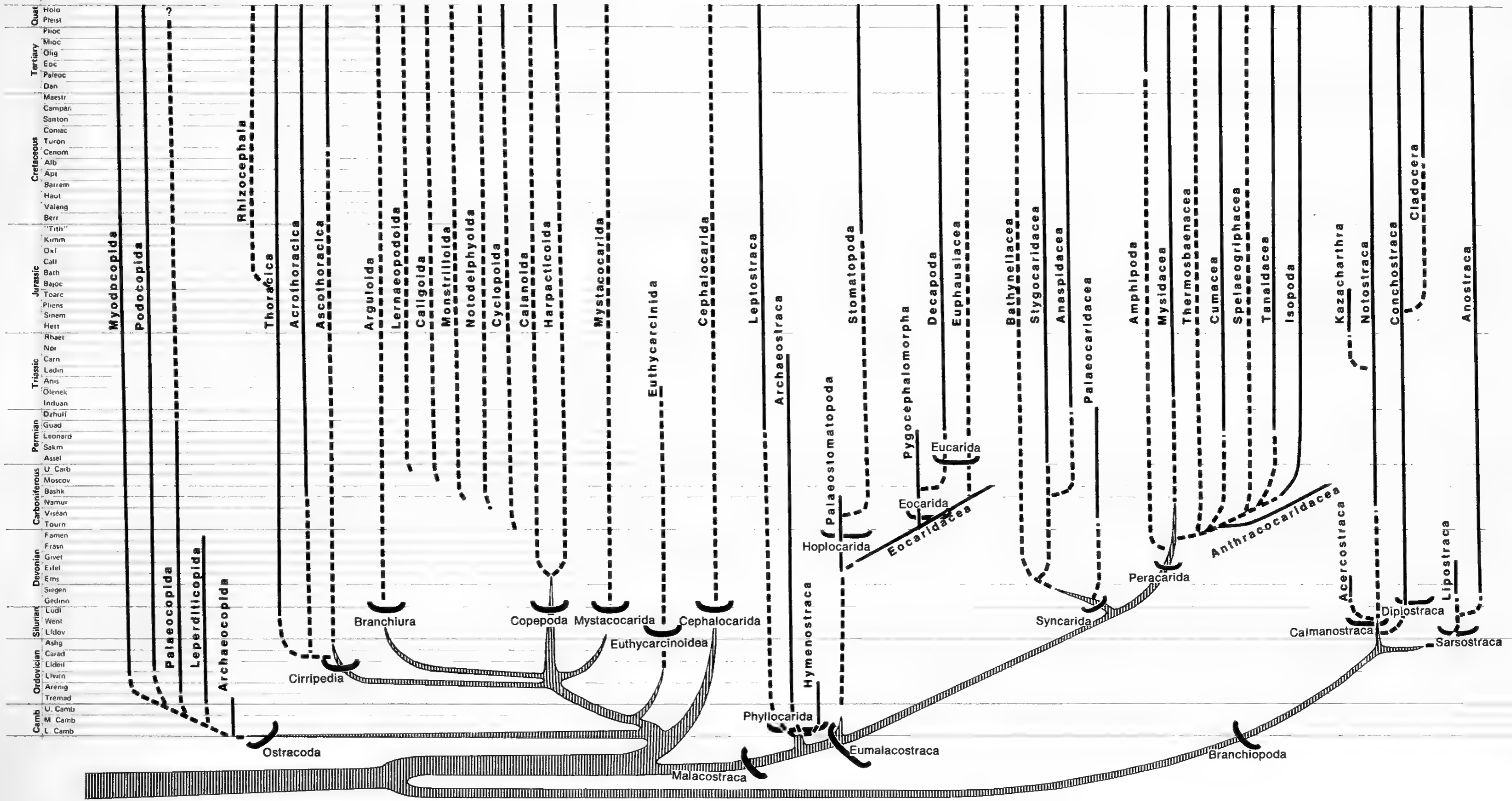


Chart 19/ Tableau n° 19

Phylum Arthropoda Subphylum Tracheata

Chart 19/Tableau n° 19

Phylum Arthropoda Subphylum Tracheata

Class Pauropoda	
Order Hexamerocerata	Rec
Order Tetramerocerata	Rec
Class Arthropleurida	CarbBashk—Carb U.Carb
Class Archipolypoda	
Order Euphoberiida	SilLudl—Carb U.Carb
Class Diplopoda	
Subclass Penicellata	
Order Polyxenida	TertOlig—Rec
Subclass Pentazonia	
Order Glomerida	TertOlig—Rec
Order Sphaerotherida	Rec
Order Glomeridesmida	Rec
Order Amynilyspedida	CarbBashk—Carb U.Carb
Subclass Helminthomorpha	
Order Stemmiulida	Rec
Order Julida	TertOlig—Rec
Order Spirostreptida	CarbMoscov—Rec
Order Spirobolida	Carb U.Carb—Rec
Order Polyzoniida	TertOlig—Rec
Order Siphonophorida	Rec
Order Platydesmida	Rec
Order Chordeumida	TertOlig—Rec
Order Callipodida	TertOlig—Rec
Order Polydesmida	TertOlig—Rec
Class Chilopoda	
Subclass Epimorpha	
Order Geophilida	CretBerr—Rec
Order Scolopendrida	TertOlig—Rec
Subclass Anamorpha	
Order Lithobiida	TertOlig—Rec
Order Scutigera	TertOlig—Rec
Class Symphyla	
Order Scolopendrellida	TertOlig—Rec
Class Protura	Rec
Class Collembola	DevEifel—Rec
Class Diplura	TertOlig—Rec
Class Insecta	
<i>(see next graph / voir le tableau suivant)</i>	

Phylum Arthropoda Subphylum Tracheata

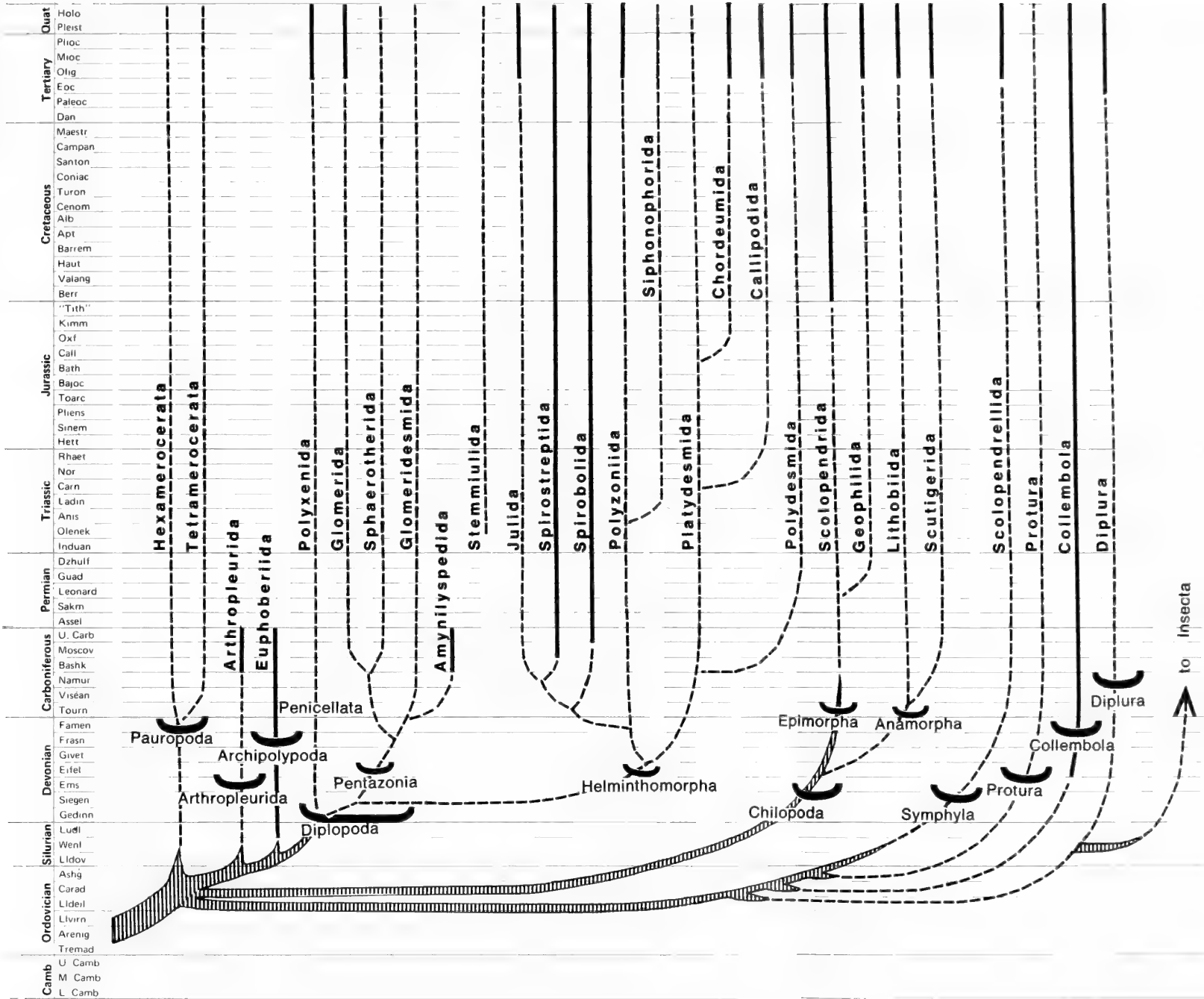


Chart 20/Tableau n° 20

Phylum Arthropoda Subphylum Tracheata Class Insecta

Chart 20/Tableau n° 20

Phylum Arthropoda Subphylum Tracheata Class Insecta

Subclass Apterygota

Order Thysanura

Carb U.Carb—Rec

Subclass Pterygota

Divisio Hemimetabola

Palaeoptera

Order Ephemeroptera

Carb U.Carb—Rec

Order Odonata

CarbBashk—Rec

Order Palaeodictyoptera

CarbBashk—PermGuad

Order Diaphanopteroidea

CarbMoscov—PermGuad

Order Protodonata

CarbBashk—PermGuad

Neoptera

Infraclass Polyneoptera

Order Plecoptera

PermLeonard—Rec

Order Grylloblattodea

Rec

Order Orthoptera

CarbMoscov—Rec

Order Phasmida

Trias ?Ladin—Rec

Order Dermaptera

JurCall—Rec

Order Embioptera

TertOlig—Rec

Order Blattodea

CarbBashk—Rec

Order Mantodea

TertOlig—Rec

Order Isoptera

CretCenom—Rec

Order Protorthoptera

CarbNamur—PermDzhulf

Order Miomoptera

CarbNamur—PermGuad

Order Protelytroptera

PermLeonard—PermDzhulf

Order Caloneuroidea

CarbMoscov—PermGuad

Infraclass Paraneoptera

Order Zoraptera

Rec

Order Psocoptera

PermLeonard—Rec

Order Anoplura

QuatPleist—Rec

Order Mallophaga

Rec

Order Homoptera

PermLeonard—Rec

Order Heteroptera

PermDzhulf—Rec

Order Thysanoptera

PermLeonard—Rec

Divisio Holometabola

Infraclass Oligoneoptera

Order Glosselytroidea

PermLeonard—TriasRhaet

Order Neuroptera

PermLeonard—Rec

Order Megaloptera

PermLeonard—Rec

Order Raphidioptera

PermLeonard—Rec

Order Mecoptera

PermLeonard—Rec

Order Lepidoptera

CretCampan—Rec

Order Trichoptera

PermLeonard—Rec

Order Diptera

TriasRhaet—Rec

Order Siphonaptera

TertOlig—Rec

Order Hymenoptera

Trias ?Olenek—Rec

Order Coleoptera

PermLeonard—Rec

Order Strepsiptera

TertOlig—Rec

Phylum Arthropoda Subphylum Tracheata Class Insecta

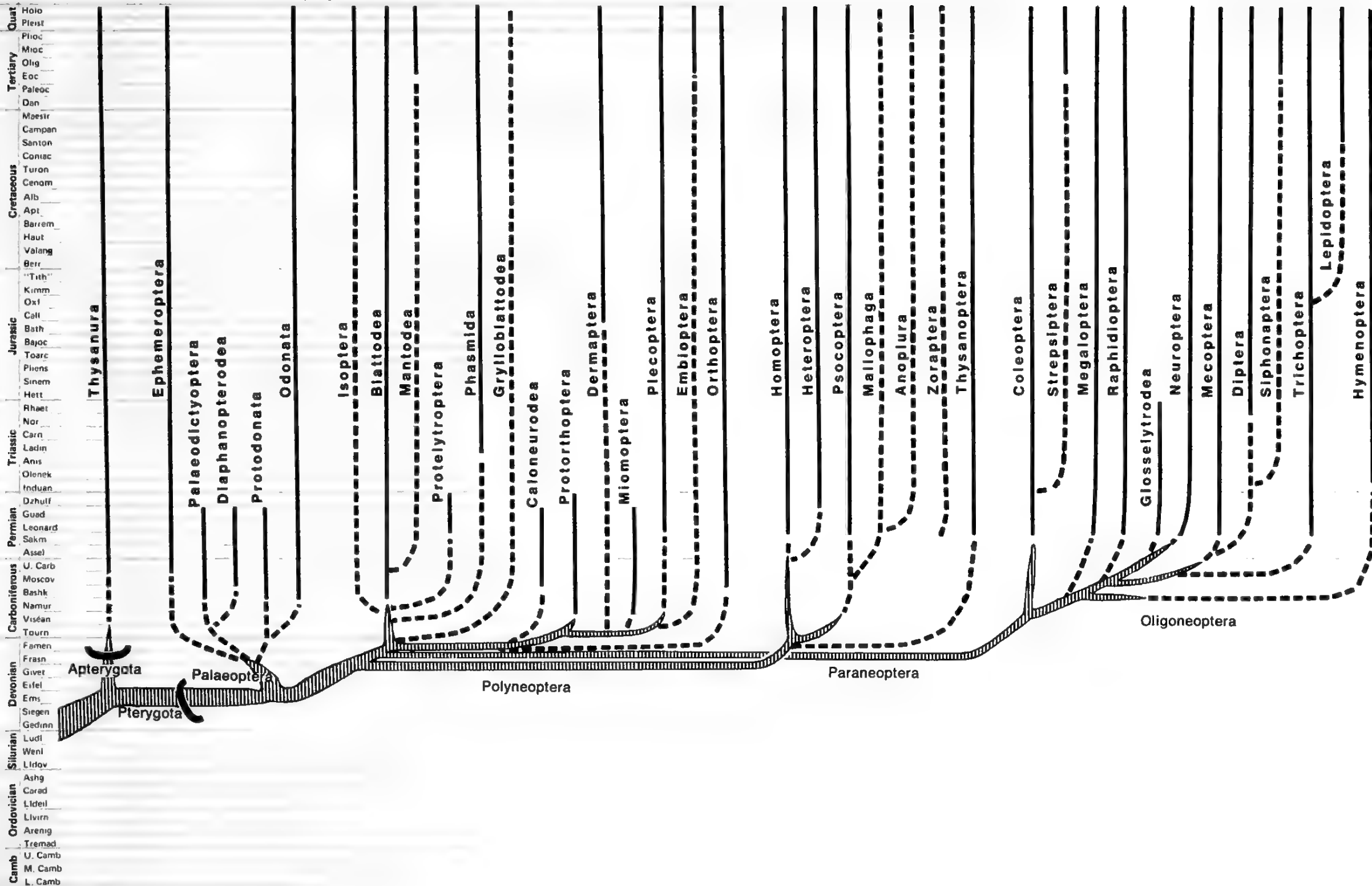


Chart 21/Tableau n° 21 Phylum Bryozoa

Chart 21 / Tableau n° 21

Phylum Bryozoa

Class Stenolaemata

Order Cyclostomata

Order Cystoporata

Order Trepostomata

Order Cryptostomata

OrdCarad—Rec

Camb U. Camb—PermDzhulf

OrdArenig—PermDzhulf

OrdLlvirn—TriasOlenek

Class Gymnolaemata

Order Ctenostomata

Order Cheilostomata

OrdArenig—Rec

CretApt—Rec

Class Phylactolaemata

Rec

Phylum Bryozoa

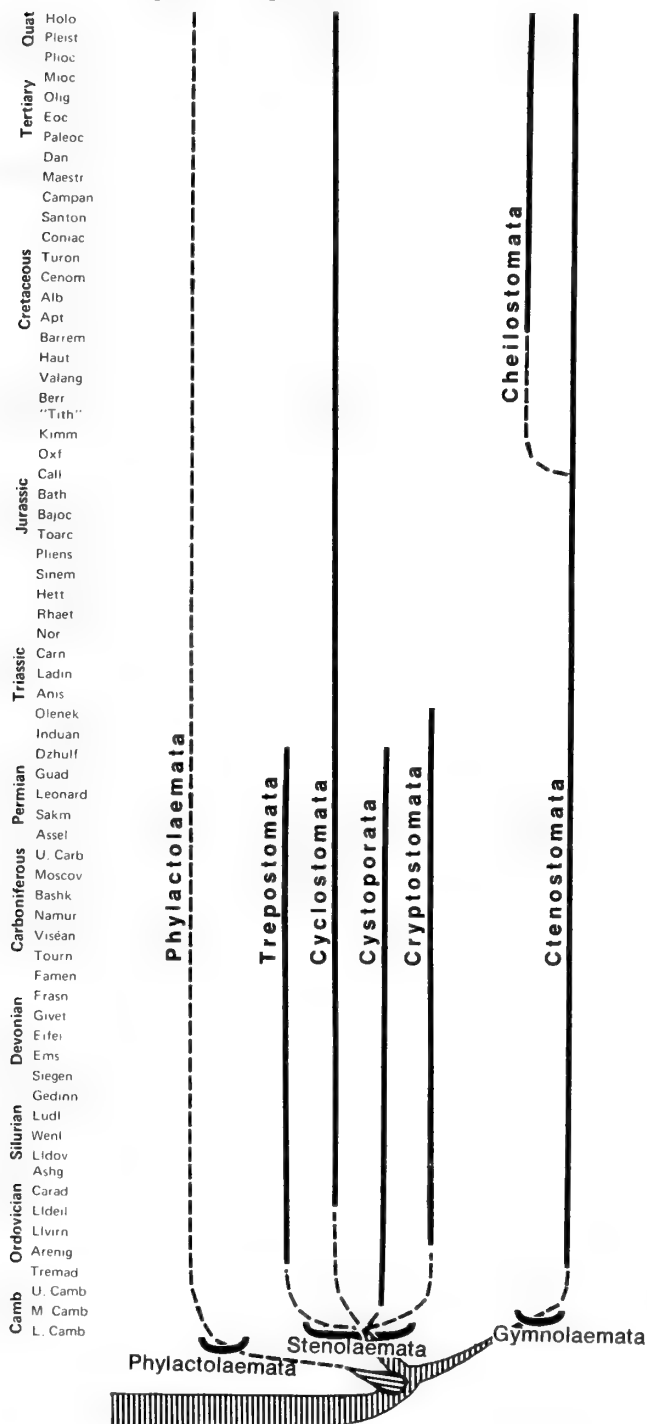


Chart 22/Tableau n° 22 Phylum Brachiopoda

Chart 22/ Tableau n° 22

Phylum Brachiopoda

Class Inarticulata

Order Lingulida

Camb L. Camb—Rec

Order Acrotretida

Camb L. Camb—Rec

Order Obolellida

Camb L. Camb—Camb M. Camb

Order Paterinida

Camb L. Camb—OrdLldeil

Order Kutorginida

Camb L. Camb—Camb M. Camb

Class Articulata

Order Orthida

Camb L. Camb—PermDzhulf

Order Strophomenida

OrdArenig—Rec

Order Pentamerida

Camb M. Camb—PermDzhulf

Order Rhynchonellida

OrdLlvirn—Rec

Order Spiriferida

SiLLldov—JurBajoc

Order Atrypida

OrdLldeil—TriasRhaet

Order Terebratulida

DevGedinn—Rec

Phylum Brachiopoda

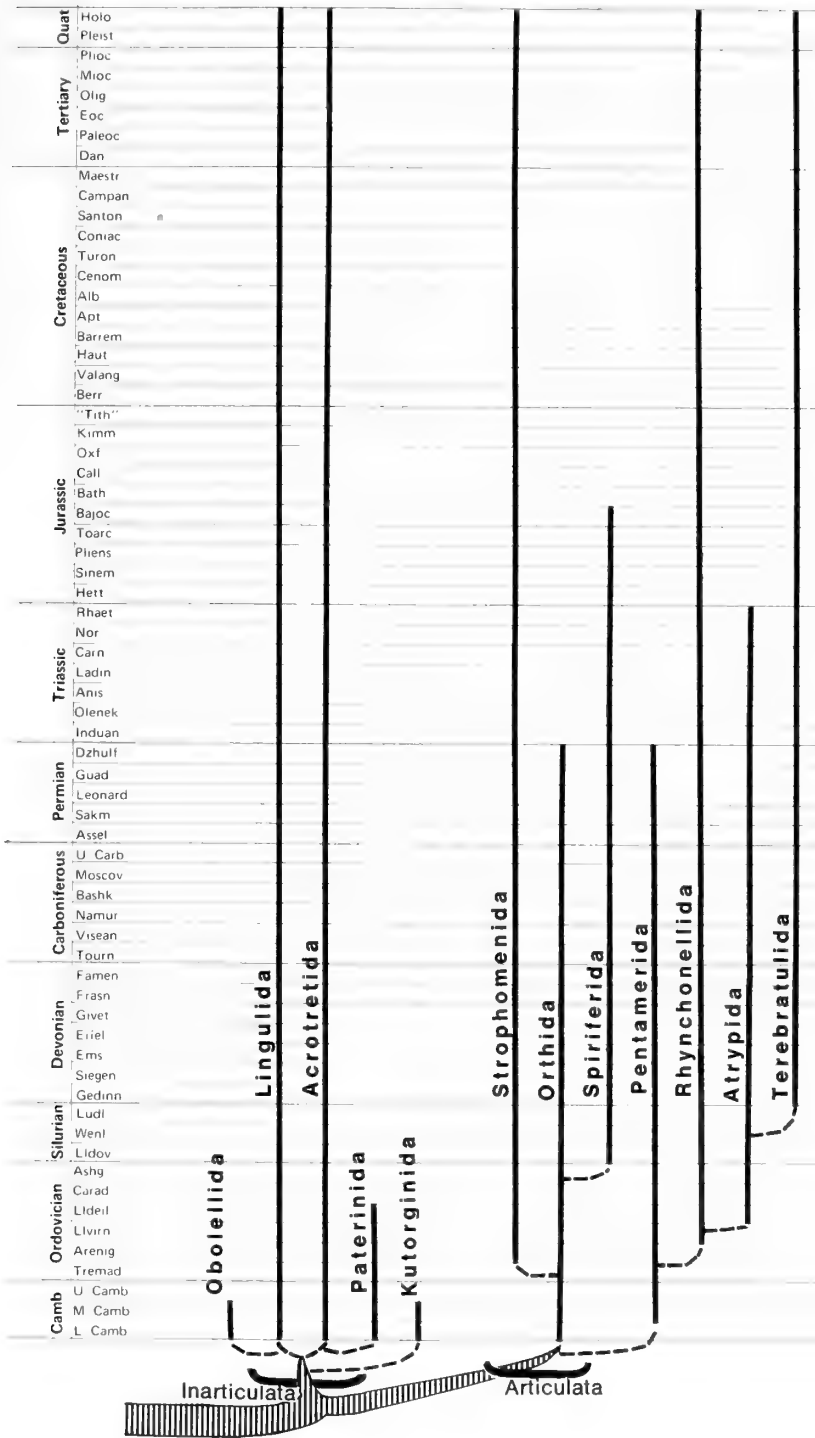


Chart 23/Tableau n° 23 Phylum Echinodermata

Chart 23/Tableau n° 23

Phylum Echinodermata

Subphylum Homalozoa

Class Ctenocystoidea	Camb M.Camb
Class Homoiostelea	
Order Soluta	Camb U.Camb—DevGedinn
Class Homostelea	
Order Cincta	Camb M.Camb
Class Stylophora	
Order Cornuta	Camb M.Camb—OrdAshg
Order Mitrata	OrdTremad—DevGivet

Subphylum Haplozoa

Class Cycloidea	Camb M.Camb
Class Cyamoidea	Camb M.Camb

Subphylum Crinozoa

Class Blastoidea	
Order Fissiculata	SilWenI—PermGuad
Order Spiraculata	SilWenI—PermGuad
Class Crinoidea	Camb M.Camb—Rec
Order Coronata	OrdLldeil—SilLudl
Subclass Inadunata	
Order Hybocrinida	OrdLlvirn—SilLudl
Order Disparida	OrdArenig—PermGuad
Order Cladida	OrdLldeil—TriasRhaet
Subclass Flexibilia	
Order Taxocrinida	OrdCarad—CarbNamur
Order Sagenocrinitida	SilLldov—PermGuad
Subclass Camerata	
Order Diplobathrida	OrdLldeil—CarbViséan
Order Monobathrida	OrdCarad—PermGuad
Subclass Articulata	
Order Isocrinida	TriasInduan—Rec
Order Comatulida	JurBajoc—Rec
Order Millecrinida	Trias ?Olenek—Rec
Order Uintacrinida	CretSanton
Order Roveacrinida	TriasCarn—CretCampan
Order Cyrtocrinida	JurHett—Rec
Class Cystoidea	
Order Rhombifera	OrdArenig—DevFrasn
Order Diploporita	OrdTremad—DevEifel
Class Edrioblastoidea	
Order Pentacystida	Ord ?Llvirn
Class Eocrinoidea	Camb L.Camb—SilWenI
Class Parablastoidea	OrdArenig—OrdLldeil
Class Paracrinoidea	
Order Varicata	OrdLlvirn
Order Brachiata	OrdLlvirn
Class Lepidocystoidea	Camb L.Camb

Subphylum Asterozoa

Class Stelleroidea

Subclass Somasteroidea

Order Goniactinida

OrdTremad—Rec

Subclass Asteroidea

Order Platyasterida

OrdCarad—Rec

Order Paxillosida

OrdArenig—Rec

Order Valvatida

OrdLlvirn—Rec

Order Spinulosida

OrdCarad—Rec

Order Forcipulatida

OrdLlvirn—Rec

Subclass Ophiuroidea

Order Stenurida

OrdArenig—DevFrasn

Order Oegophiurida

OrdArenig—Rec

Order Phrynophiurida

DevSiegen—Rec

Order Ophiurida

SilLudl—Rec

Subphylum Echinozoa

Class Cyclocystoidea

OrdArenig—DevEifel

Class Helicoplacoidea

Camb L.Camb

Class Edrioasteroidea

Camb L.Camb—CarbNamur

Class Ophiocistoidea

OrdArenig—DevEifel

Class Echinoidea

Subclass Perischoechinoidea

Order Bothriocidaroida

OrdCarad—OrdAshg

Order Echinocystitoida

OrdAshg—PermAssel

Order Palaechinoidea

SilWenl—PermAssel

Order Cidaroida

DevEifel—Rec

Subclass Euechinoidea

Superorder Diadematacea

Order Echinothurioida

JurOxf—Rec

Order Diadematoidea

Trias ?Nor—Rec

Order Pedinoida

TriasRhaet—Rec

Order Pygasteroida

Jur ?Pliens—Cret ?Cenom

Superorder Echinacea

Order Salenioida

JurHett—Rec

Order Hemicidaroida

Trias ?Nor—Cret ?Maestr

Order Phymosomatoida

Jur ?Hett—Rec

Order Arbacioida

JurBath—Rec

Order Temnopleuroida

Jur ?Pliens—Rec

Order Echinoida

CretCenom—Rec

Order Plesiocidaroida

TriasCarn

Superorder Echinacea ? or Diadematacea ?

Order Orthopsida

Jur ?Bajoc—Cret ?Maestr

Superorder Gnathostomata

Order Holectypoida

JurPliens—Rec

Order Clypeasteroida

CretMaestr—Rec

Superorder Atelostomata

Order Cassiduloida

JurToarc—Rec

Order Holasteroida

Jur ?Sinem—Rec

Order Spatangoida

CretBerr—Rec

Order Neolampadoida

TertEoc—Rec

Class Holothuroidea	
Subclass Dendrochirotea	
Order Dendrochirotida	Ord ?Tremad—Rec
Order Dactylochirotida	Rec
Subclass Aspidochirotea	
Order Aspidochirotida	Jur ?Hett—Rec
Order Elaspodida	Camb M.Camb—Rec
Subclass Apodacea	
Order Apodida	Carb ?Tourn—Rec
Order Molpadiida	Jur ?Hett—Rec
?Subclass	
?Order Arthrochirotida	Dev ?Gedinn
Class Camptostromatoidea	Camb L.Camb

Phylum Echinodermata

Quat
 Tertiary
 Cretaceous
 Jurassic
 Triassic
 Permian
 Carboniferous
 Devonian
 Silurian
 Ordovician
 Camb

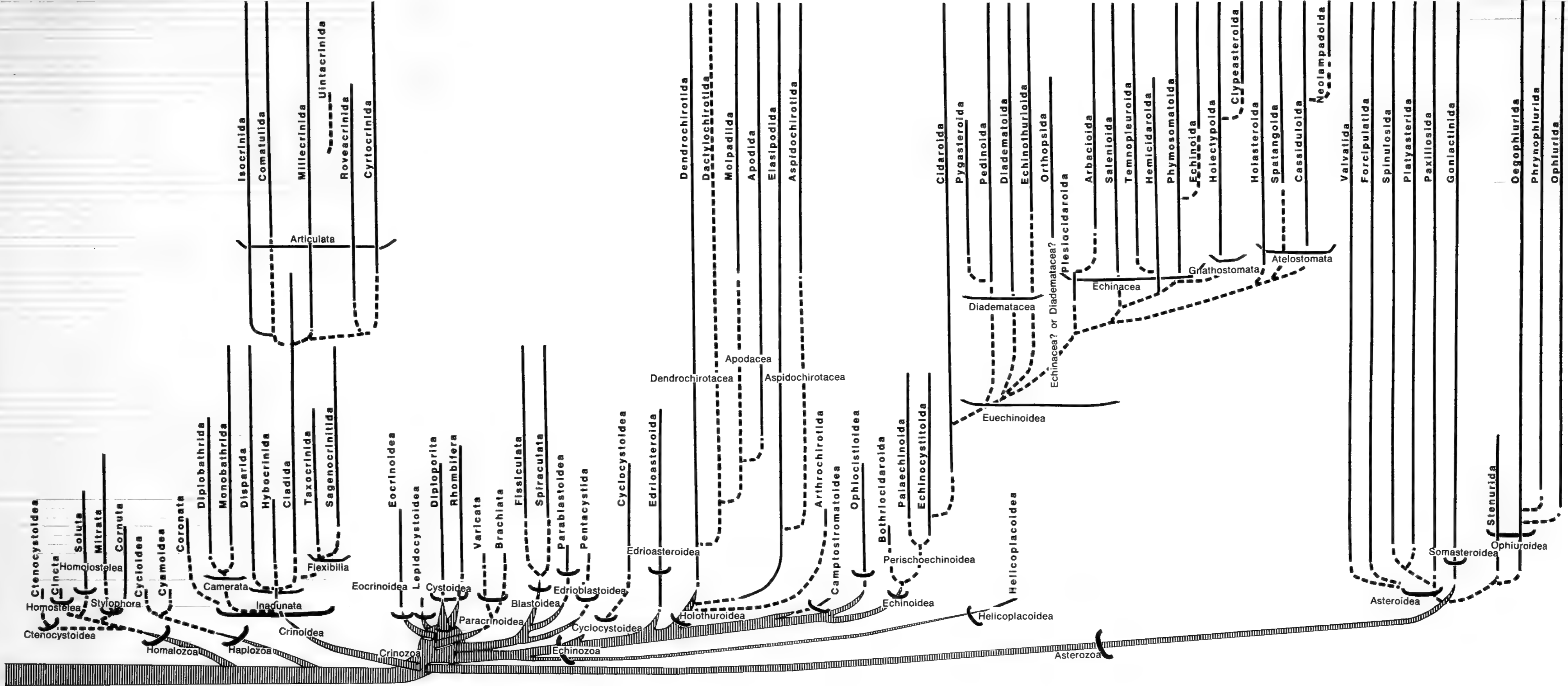


Chart 24/ Tableau n° 24 Phylum Pogonophora

Chart 24/Tableau n° 24

Phylum Pogonophora

Order Sabelliditida

Order Hyolithelminthes

Order Thecanephria

Order Athecanephria

Camb L.Camb

Camb L.Camb—Camb M.Camb

Rec

Rec

Phylum Pogonophora

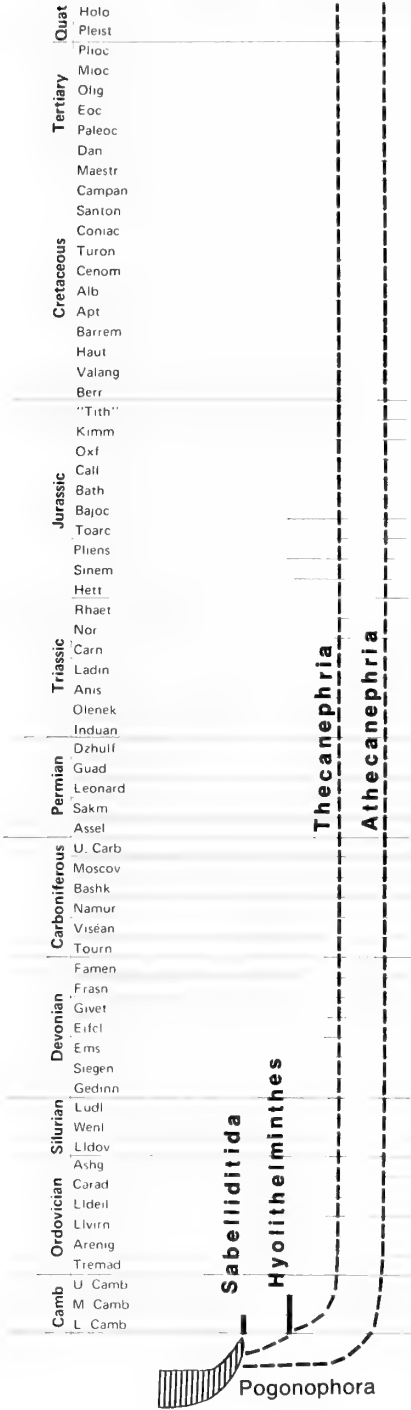


Chart 25/Tableau n° 25 Phylum Hemichordata

Chart 25/Tableau n° 25

Phylum Hemichordata

Class Graptolithina

Order Dendroidea

Camb ?M.Camb—Camb U.Camb—
CarbNamur

Order Tuboidea

Camb ?U.Camb—OrdTremad—
SilWenI

Order Camaroidea

OrdTremad

Order Stolonioidea

OrdTremad—OrdCarad

Order Crustoidea

OrdArenig—OrdLideil

Order Graptoloidea

OrdArenig—DevEms

Suborder Didymograptina

OrdArenig—OrdAshg

Suborder Glossograptina

OrdLlvirn—OrdAshg

Suborder Diplograptina

OrdLlvirn—SilLudl

Suborder Monograptina

SilLldov—DevEms

Class Graptolithina Incertae Sedis

(not included / exclue)

Group Graptoblasti

OrdTremad—OrdLldeil

Group Acanthastida

OrdTremad

Group Graptovermida

OrdTremad

Class Pterobranchia

Order Rhabdopleurida

OrdTremad—Rec

Order Cephalodiscida

OrdTremad—Rec

Class Enteropneusta

Rec

Class Planctosphaeroidea

Rec

(not included / exclue)

Phylum Hemichordata

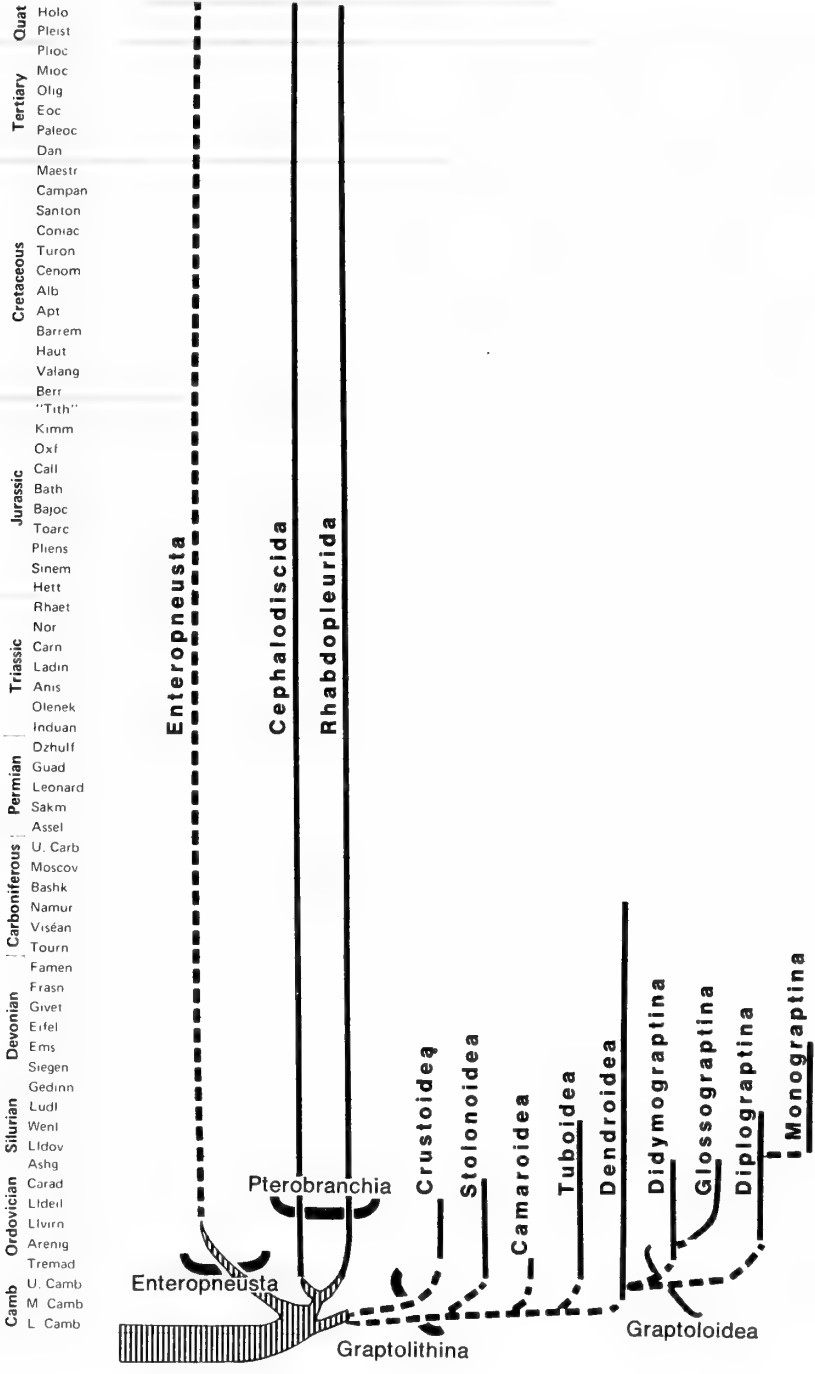


Chart 26 Phylum Chordata Stem Graph Fish-like Vertebrates
Tableau n° 26 Phylum Chordata Ramifications principales
Vertébrés pisciformes

Chart 26 / Tableau n° 26

Phylum Chordata Stem Graph Fish-like Vertebrates
 Ramifications principales Vertébrés pisciformes

Subphylum Urochordata	Rec
Subphylum Cephalochordata (Acrania)	Rec
Subphylum Craniata (Vertebrata)	
Divisio Agnatha	
Class Monorhina	
Superorder Mixini	Rec
Superorder Petromyzonida	CarbBashk—Rec
Superorder Anaspida	SilWenI—DevFrasn
Superorder Osteostraci	SilLldov—DevFrasn
Superorder Galeaspida	DevSiegen
Class Diplorhina	
Superorder Heterostraci	OrdCarad—DevFrasn
Superorder Thelodonti	SilLudI—DevEifel
Divisio Gnathostomata	
Class Placodermi	DevGedinn—CarbTourn
Class Acanthodii	SilLldov—PermLeonard
Class Holocephali	CarbTourn—Rec
Class Elasmobranchii	DevEms—Rec
Superclass Osteichthyes	
Class Actinopterygii	
Subclass Chondrostei	DevGivet—Rec
Subclass Holostei	PermDzhulf—Rec
Subclass Teleostei	JurTith—Rec
Class Dipneusti	DevSiegen—Rec
Class Crossopterygii	
Subclass Coelacanthi	DevGivet—Rec
Subclass Rhipidistia	DevSiegen—PermAssel

Phylum Chordata stem graph—Fish-like vertebrates

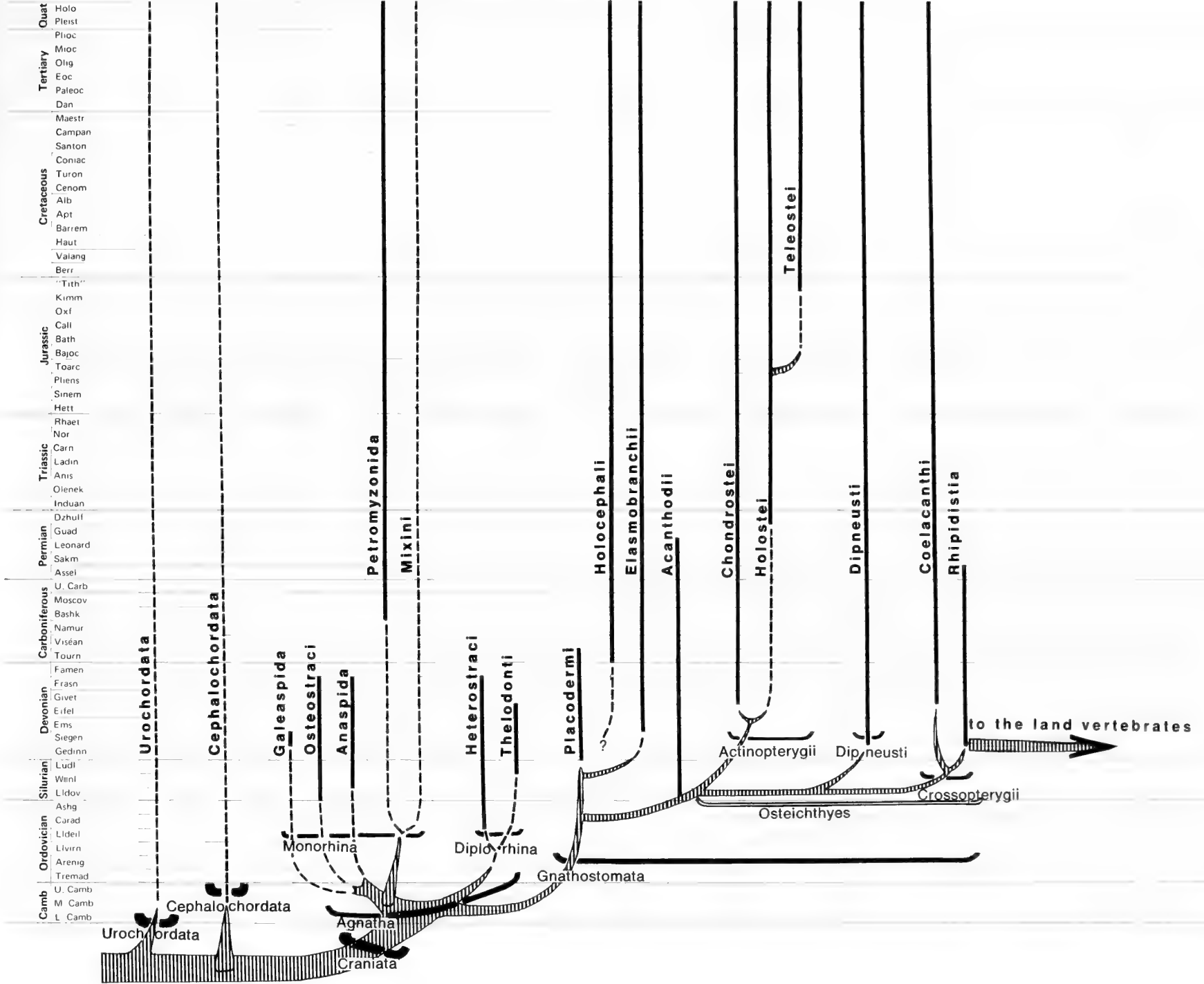


Chart 27/ Tableau n° 27 Phylum Chordata Class Amphibia

Chart 27/ Tableau n° 27

Phylum Chordata Class Amphibia

Subclass Labyrinthodontia

Order Ichthyostegalia

Order Temnospondyli

Order Plagiosauria

Order Anthracosauria

DevFamen—CarbTourn

CarbViséan—TriasRhaet

PermDzhulf—TriasRhaet

CarbViséan—PermDzhulf

Subclass Lemospondyli

Order Aistopoda

Order Nectridia

Order Microsauria

Order Lysorophia

CarbViséan—PermLeonard

CarbBashk—PermLeonard

CarbViséan—PermLeonard

CarbMoscov—PermLeonard

Subclass Lissamphibia

Order Anura

Order Urodela

Order Apoda

TriasInduan—Rec

CretBerr—Rec

TertPaleoc—Rec

Phylum Chordata Class Amphibia

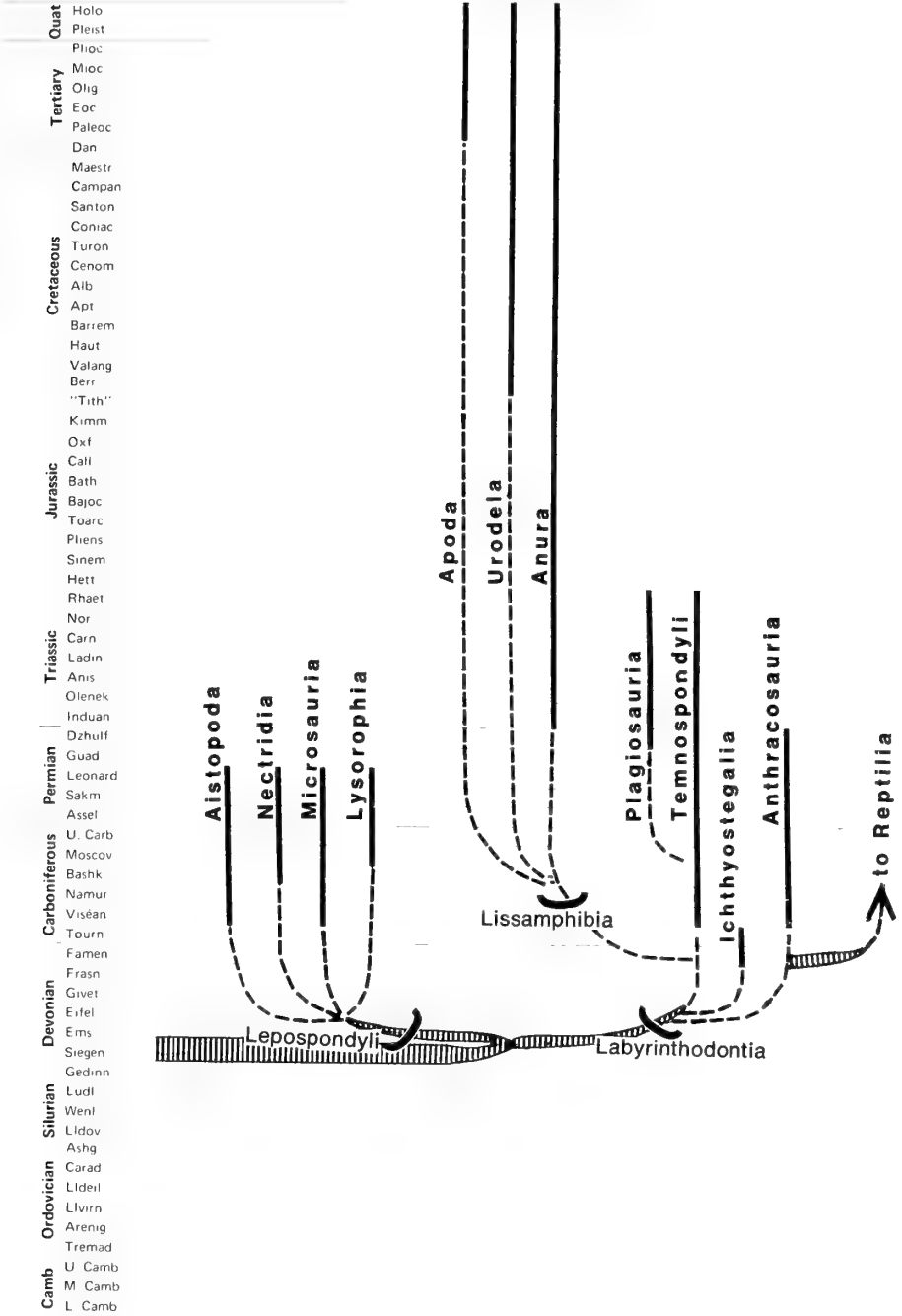


Chart 28/ Tableau n° 28 Phylum Chordata Class Reptilia

Chart 28/ Tableau n° 28

Phylum Chordata Class Reptilia

Subclass Anapsida

Order Captorhinomorpha

Order Chelonida

CarbBashk—PermLeonard

TriasNor—Rec

Subclass Archosauria

Order Thecodontia

Order Crocodylia

Order Saurischia

Order Ornithischia

Order Pterosauria

PermDzhulf—TriasRhaet

TriasCarn—Rec

TriasLadin—CretMaestr

TriasCarn—CretMaestr

JurSinem—CretSanton

Subclass Lepidosauria

Order Eosuchia

Order Rhynchocephalia

Order Squamata

PermGuad—TriasLadin

TriasInduan—Rec

TriasNor—Rec

Subclass Synapsida

Order Pelycosauria

Order Therapsida

CarbBashk—PermGuad

PermGuad—JurBath

Subclass Sauropterygia

Order Nothosauria

Order Plesiosauria

TriasInduan—TriasCarn

TriasLadin—CretMaestr

Subclass Placodontia

Order Placodontia

TriasOlenek—TriasRhaet

Subclass Ichthyopterygia

Order Ichthyosauria

TriasOlenek—CretMaestr

Subclass?

Order Procolophonida

PermGuad—TriasNor

Phylum Chordata Class Reptilia

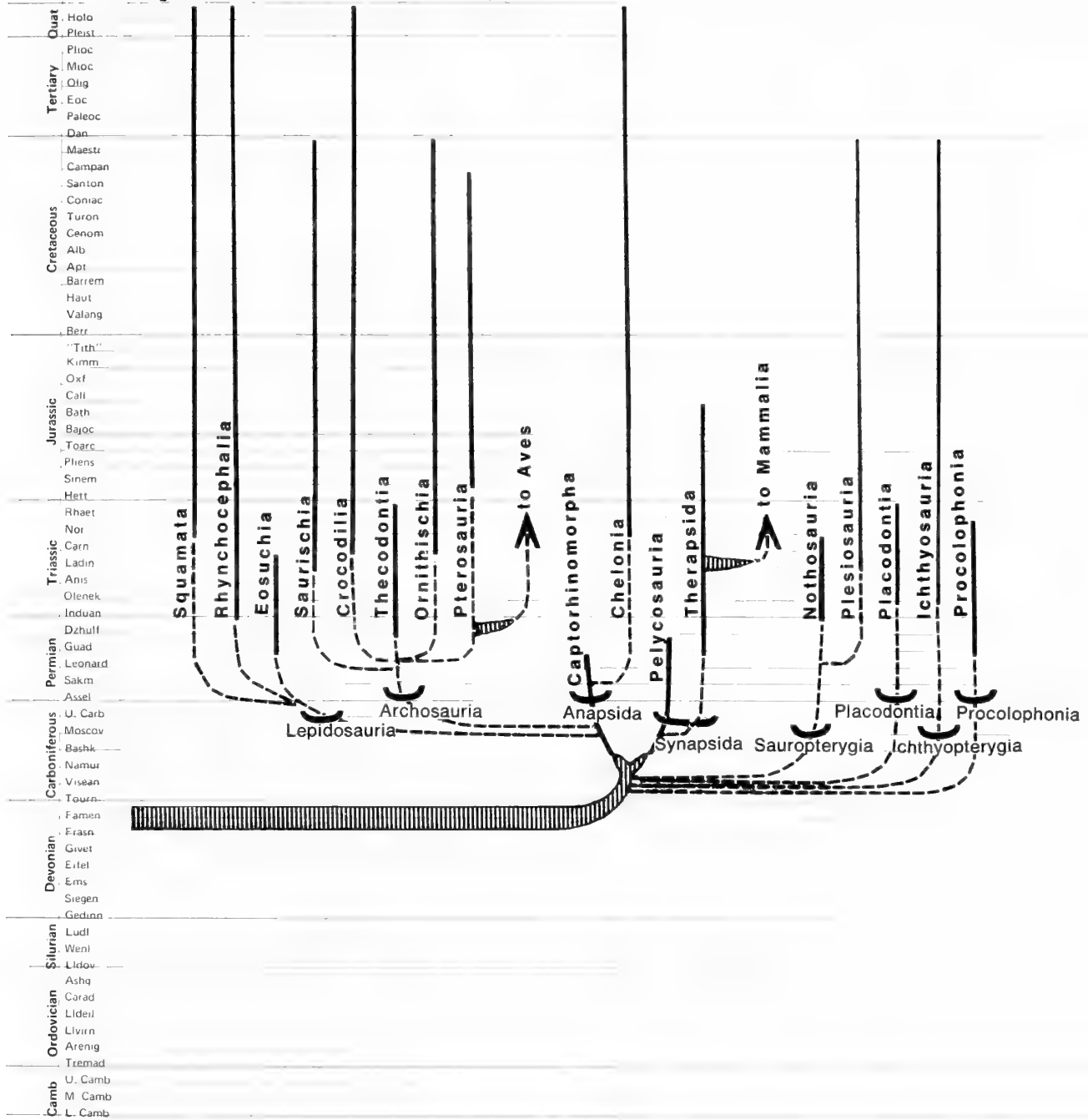


Chart 29/Tableau n° 29 Phylum Chordata Class Aves

Chart 29/ Tableau n° 29

Phylum Chordata Class Aves

Subclass Sauriurae

Order Archaeopterygiformes JurTith

Subclass Odontoholcae

Order Hesperornithiformes CretConiac—CretCampan

Subclass Ornithurae

Superorder Ratitae

Order Rheiformes TertEoc—Rec

Order Struthioniformes TertEoc—Rec

Order Aepyornithiformes TertEoc—Rec

Order Casuariiformes TertPlioc—Rec

Order Dinornithiformes TertPlioc—Rec

Order Apterygiformes QuatPleist—Rec

Superorder Dromaeognathae

Order Tinamiformes TertPlioc—Rec

Superorder Carinatae

Order Gaviiformes CretAlb—Rec

Order Podicipediformes CretConiac—Rec

Order Sphenisciformes TertEoc—Rec

Order Procellariiformes TertEoc—Rec

Order Pelecaniformes CretMaestr—Rec

Order Ardeiformes CretValang—Rec

Order Anseriformes TertEoc—Rec

Order Accipitriformes TertDan—Rec

Order Ichthyornithiformes CretConiac

Order Galliformes TertEoc—Rec

Order Ralliformes CretMaestr—Rec

Order Charadriiformes CretMaestr—Rec

Order Columbiformes TertEoc—Rec

Order Cuculiformes TertEoc—Rec

Order Psittaciformes TertMioc—Rec

Order Strigiformes TertEoc—Rec

Order Caprimulgiformes TertEoc—Rec

Order Coraciiformes TertEoc—Rec

Order Trogoniformes TertEoc—Rec

Order Coliiformes TertMioc—Rec

Order Apodiformes TertEoc—Rec

Order Piciformes TertEoc—Rec

Order Passeriformes TertEoc—Rec

This graph was prepared by Dr. P. Brodkorb in May 1972.

M. P. Brodkorb a préparé ce tableau, en mai 1972.

Phylum Chordata Class Aves

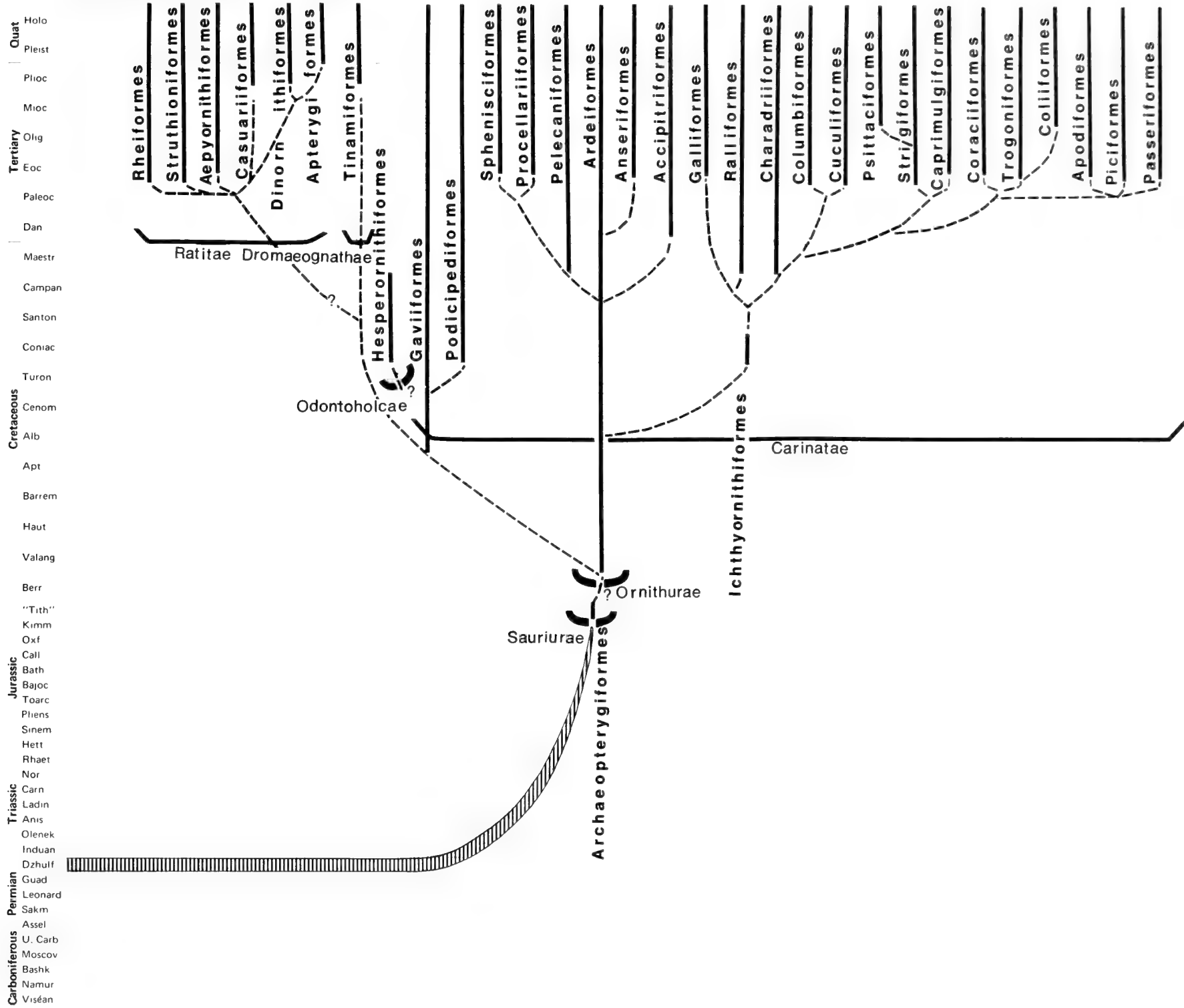


Chart 30/ Tableau n° 30 Phylum Chordata Class Mammalia

Chart 30/ Tableau n° 30

Phylum Chordata Class Mammalia

Subclass Prototheria

Infraclass Eotheria

Order Triconodonta

Order Docodonta

Infraclass Ornithodelphia

Order Monotremata

Infraclass Allotheria

Order Multituberculata

TriasRhaet—CretCampan

JurKimm—JurTith

TertPlioc—Rec

JurKimm—TertEoc

Subclass Theria

Infraclass Trituberculata

Order Symmetrodonta

Order Pantotheria

Infraclass Metatheria

Order Marsupialia

Infraclass Eutheria

Order Insectivora

Order Primates

Order Rodentia

Order Chiroptera

Order Edentata

Order Pholidota

Order Lagomorpha

Order Taeniodonta

Order Hyaenodonta

Order Carnivora

Order Condylarthra

Order Cetacea

Order Tubulidentata

Order Pantodonta

Order Artiodactyla

Order Dinocerata

Order Litopterna

Order Astrapotheria

Order Pyrotheria

Order Notoungulata

Order Perissodactyla

Order Proboscidea

Order Sirenia

Order Desmostylia

Order Embrithopoda

Order Hyracoidea

TriasRhaet—CretCampan

JurBajoc—CretBerr

CretAlb—Rec

CretAlb—Rec

CretMaestr—Rec

TertPaleoc—Rec

TertEoc—Rec

TertPaleoc—Rec

TertPaleoc—Rec

TertPaleoc—Rec

TertDan—TertEoc

TertPaleoc—TertPlioc

TertPaleoc—Rec

CretMaestr—TertMioc

TertEoc—Rec

TertEoc—Rec

TertPaleoc—TertOlig

TertEoc—Rec

TertPaleoc—TertEoc

TertPaleoc—QuatPleist

TertEoc—TertMioc

TertPaleoc—TertOlig

TertPaleoc—QuatPleist

TertEoc—Rec

TertEoc—Rec

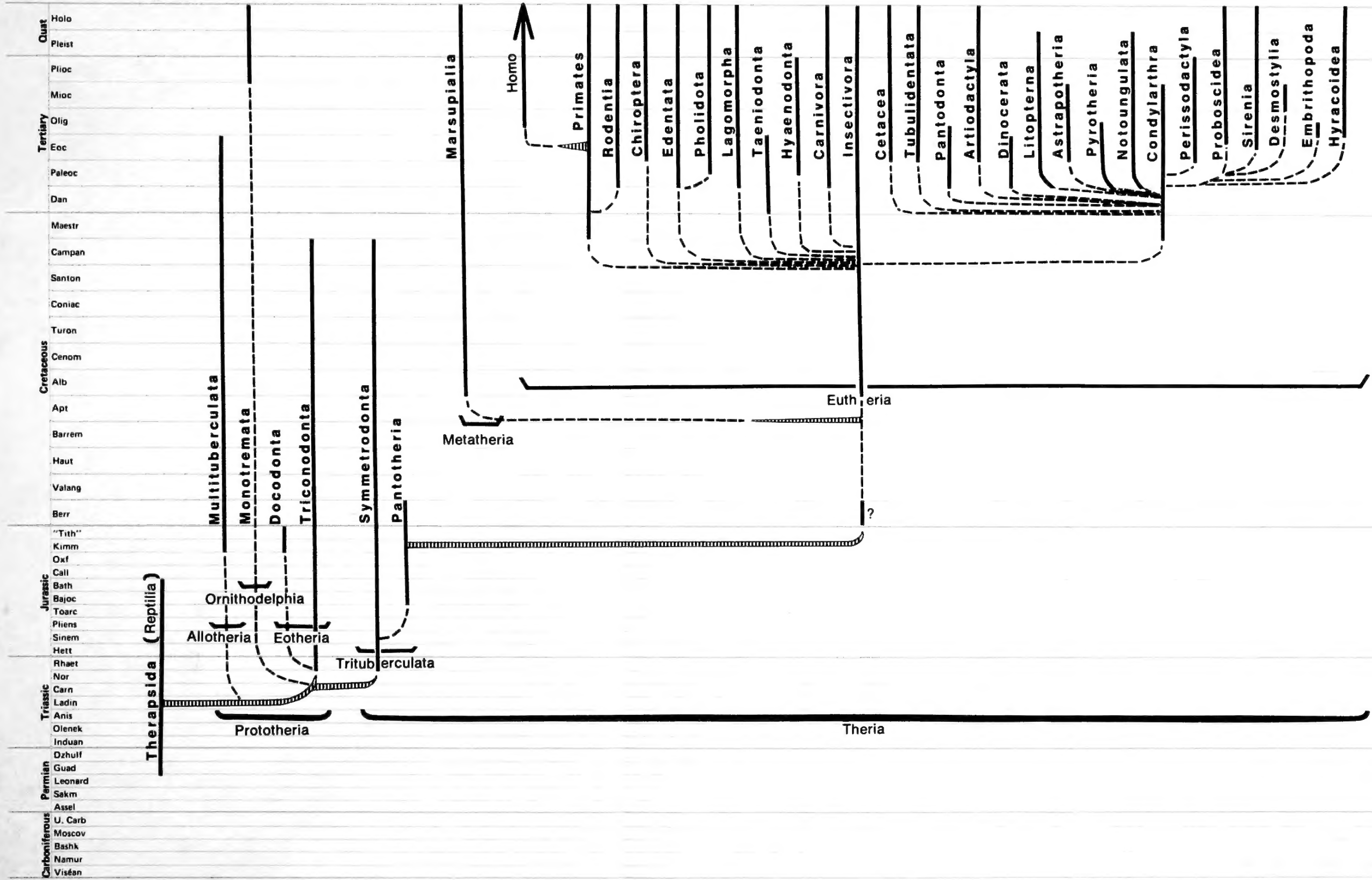
TertEoc—Rec

TertMioc

TertOlig

TertOlig—Rec

Phylum Chordata Class Mammalia



CALIF ACAD OF SCIENCES LIBRARY



3 1853 10004 6114