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Phylum arthropoda, subphylum trilobitomorpha: trilobites

Abstract

This volume is the second of three that provide a complete review and inventory of New Zealand's entire living and fossil biodiversity - an international effort involving more than 220 New Zealand and overseas specialists and the most comprehensive of its kind in the world. Together, the three volumes will list every one of the almost 55,000 known species of New Zealand's animals, plants, fungi and micro-organisms. Volume 2 mostly deals with the major branch of the animal kingdom known as Ecdysozoa (moulting animals), which includes arachnids, centipedes and millipedes, crustaceans and insects. It also includes the enigmatic phylum Chaetognatha (arrow worms) and concludes with a chapter on the fossil traces - ichnofossils - of ancient animal activities. All three volumes are affiliated with Species 2000, an international scientific project with the long-term goal of enumerating all known species on Earth into one seamless list - the Catalogue of Life, a kind of online biological telephone directory.To date, only New Zealand has compiled a checklist of its entire biota. Approximately 52% of this country's species are endemic - found only in New Zealand's freshwater, marine, and land environments. We have a responsibility to the global community to preserve this unique heritage or taonga. But further than that, all of our species - including many of the naturalised aliens included in the survey - are important to New Zealand's economy, ecology and well-being. Written for the advanced high-school and tertiary-level reader, these volumes are intended to be a kind of 'Cooks Tour' of the kingdoms and phyla of life that will, it is hoped, provide an appreciation of the wondrous diversity of nature.

Keywords

trilobitomorpha, phylum, subphylum, arthropoda, trilobites, GeoQUEST

Disciplines

Life Sciences | Physical Sciences and Mathematics | Social and Behavioral Sciences

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FIVE

Phylum ARTHROPODA

TRILOBITOMORPHA

trilobites

ANTHONY J. WRIGHT, ROGER A. COOPER

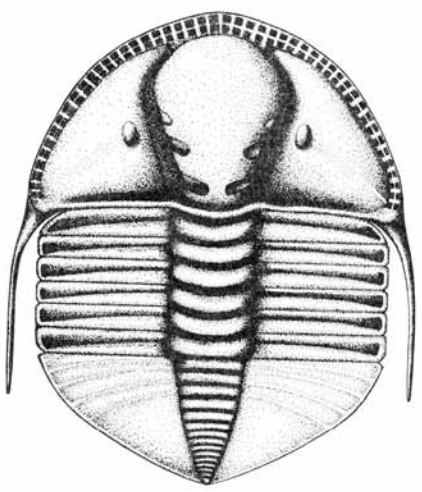
Trilobites are an extinct group of marine arthropods with calcareous exoskeletons. They were extremely abundant in the Cambrian and Ordovician periods, becoming extinct at the end of the Paleozoic during the devastating Permo-Triassic extinction event. They had a flattened oval body divided into a head-shield (cephalon) with a pair of antennae, compound eyes, and biramous appendages; a trunk (thorax) bearing paired biramous limbs, and a terminal segment (pygidium). Most of the known species ranged in length from one millimetre to 10 centimetres, but some giants achieved 76 centimetres. The name trilobite alludes to the three longitudinal lobes of the body, namely a central axial lobe flanked to left and right by a pleural (side) lobe.

The group diversified extensively during its more than 300-million-year duration in those ancient seas, both in body form and numbers of species, such that specialists recognise 10 orders, more than 150 families, about 5000 genera, and over 17,000 described species. While most were wide-bodied, some were narrow-bodied and streamlined. Trilobite fossils are often found enrolled like modern pillbugs or woodlice for protection. Some species were extremely spiny, while others were smooth. Some had huge compound eyes, while others were eyeless. While uncertainty remains concerning the function and ecological role of some of the body shapes, it is clear that trilobites were extremely successful, found in a very wide variety of habitats, and probably occupied many, if not all, of the ecological niches that marine crustaceans do today, including planktonic, free-swimming, benthic, burrowing, and reef-dwelling, but possibly not parasitic. An excellent website for information about all aspects of trilobites is http://www.trilobites.info/.

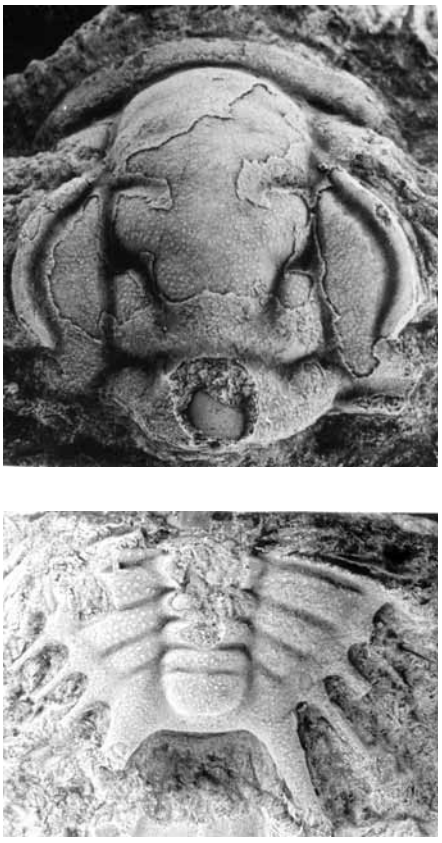
There were two main groups. Agnostids were characterised by small skeletons and two thoracic segments; many authorities have interpreted them as planktonic, and they have great significance for intercontinental correlation of Cambrian strata, in which they are best developed. The larger, mostly seafloor-dwelling, trilobites had more than two thoracic segments. Known as 'polymerids', they are mostly useful for intrabasinal correlation.

The New Zealand trilobite fossil record is very limited, largely owing to the small amount and highly deformed nature of Early Paleozoic strata. Elsewhere in the world, rich and diverse trilobite faunas are found in platform strata or shallow shelf strata. Paleozoic developments of such environments were widespread in Australia but not in New Zealand.

Some 80 species-level taxa have been recorded from New Zealand, of which the most important trilobite faunas are from the Cambrian, Ordovician, and Devonian. Silurian trilobites (with the exception of an indeterminate specimen



The Late Ordovician trilobite *Incaia bishopi* (order Asaphida), from the Paturau River area of northwest Nelson.
Anthony Wright



The cephalon (upper photo) and pygidium (lower photo) of an undetermined genus and species of dolichometopid trilobite (order Corynexochida) from the Middle Cambrian of the Cobb Valley area of northwest Nelson.

Roger Cooper

from the possibly latest Silurian *Notoconchidium* fauna from the Wangapeka River) and Carboniferous trilobites are as yet unknown. There are two reported Permian trilobite occurrences. Occurrences of trilobites in the New Zealand Paleozoic sedimentary record are patchy in the sense that there are no sequences of trilobite-bearing strata. All records are from the northwest Nelson district of the South Island, with the exception of rare Permian occurrences from Southland.

Stratigraphic distribution

Cambrian

All identified Cambrian trilobites are from the Takaka Terrane of northwest Nelson. The Kootenia-Peronopsis fauna in the Heath Creek Beds represents the oldest New Zealand fossils, of middle Middle Cambrian (probably Floran) age, about 508 million years ago (Münker & Cooper 1999). In the Middle Cambrian Tasman Formation, allochthonous limestone lenses, derived from a carbonate shelf or platform of which no other trace remains, contain a varied fauna of large polymerid trilobites including *Dorypyge*, *Koptura*, *Pianaspis*, '*Solenoparia*', and thick-shelled agnostids (Henderson & MacKinnon 1981). The best-known lens is 'Trilobite Rock' in Cobb Valley, first reported by Benson (1956) and from which 15 species have been recorded (Cooper 1979). The enclosing shales represent an off-shelf environment and contain agnostids and small polymerids such as nepeids preserved in in situ concretionary bands. The in situ trilobites in the lower part of the Tasman Formation are of probable Undillan (Drumduan) age and those from the top represent the following Boomerangian (Guzhangian) age (Münker & Cooper 1999), both in Epoch 3 of the Global Geochronological Scale (equivalent to the late Middle Cambian in the traditional scale). The Cambrian trilobites, which have not yet been formally described, are most closely related to those of Australia and Antarctica (Cooper 1979; Cooper & Shergold 1991).

Cambrian–Ordovician

The next youngest important occurrence of trilobites is that in the Mount Patriarch area, also in northwest Nelson. Trilobites were first collected here in the 1920s by members of the Geological Survey of New Zealand; on the basis of the initial poor material, Reed (1926) described one species from near Mount Patriarch as *Dionide hectori* (now placed in *Hysterolenus*).

A large fauna (some 40 species including *H. hectori*) was described by Wright et al. (1994) from the sequence at Mount Patriarch. This succession spans the Cambrian–Ordovician boundary, with the bulk of the fauna from the Patriarch Formation considered latest Cambrian (late Furongian) to earliest Ordovician (Tremadocian). A smaller, post-Tremadoc fauna occurs in the overlying Summit Limestone. A few taxa are endemic but the fauna is largely cosmopolitan at the genus level. Several genera and species (e.g. *Kainella meridionalis*, *Onychopyge* cf. *riojana*) highlight a close relationship with South American (Argentina, Bolivia) faunas.

Ordovician

One of the two common species of Gisbornian (early Late Ordovician) age from the Paturau Formation on the Paturau River in northwest Nelson was described by Reed (1926) as *Ogygites collingwoodensis*, an asaphid now assigned to *Basiliella* following Wright (2009). A second species was described from this locality by Hughes and Wright (1970) as *Incaia bishopi*, the only trinucleid yet known from New Zealand. The finding of this genus is of some paleogeographic interest, as its only other occurrences are in Peru, Bolivia, and China.

Cocks and Cooper (2004) reported several trilobite taxa characteristic of the cosmopolitan *Hirnantia* (latest Ordovician, Hirnantian) faunal assemblage, based on a poorly preserved shelly fauna from the Wangapeka Formation collected

from the Wangapeka River area. The fauna includes *Eoleonaspis*? sp., *Mucronaspis mucronata*, a possible aulacopleurid, and a possible panderid.

Silurian
One generically indeterminate trilobite specimen has been collected from *Notoconchidium*-bearing sandstones (Wright & Garratt 1991) that outcrop near the junction of the Rolling and Wangapeka Rivers in Nelson Province. The most recent assessment of the age of this distinctive faunal assemblage from New Zealand, Tasmania, and Victoria is latest Silurian (Wright & Garratt 1991).

Devonian
Low-diversity Early Devonian trilobite faunas have been described from the Reefton region and the older Baton Formation in northwest Nelson. The fauna from the latter area, of Pragian (early Early Devonian) age, was described by Shirley (1938) and Wright (1990). This fauna strongly resembles coeval eastern Australian faunas. Typical trilobite genera include *Acaste*, *Acastella* and *Calymene*. Trilobites from the Emsian (late Early Devonian) Reefton sequence were described by Hector (1876) and Allan (1935). These belong mostly to cosmopolitan genera, but the Reefton fauna is of much greater biogeographic interest than the 'Old World' Baton River fauna, as the brachiopod fauna at Reefton includes coldwater 'Malvinokaffric' elements. The Reefton fauna includes the somewhat unexpected trilobite *Dechenella* (*Eudechenella*) *mackayi*, which is clearly anomalous, as no dechenellids are known from the Devonian of eastern Australia. Other genera described by Allan (1935) were assigned to *Digonus*. Sandford (2005) clarified the status of *Wenndorfia expansa* (and its synonyms) from Reefton.

Permian
Rare, undescribed Late Permian trilobites are known from two localities in Southland, one from near Mossburn within the Countess Formation of the Dun Mountain–Maitai Terrane (Hyden et al. 1982; H. J. Campbell pers. comm.), and the other from Pleasant Creek, a tributary of Aparima River, eastern Takitimu Mountains, within a faulted outlier of the Productus Creek Group of Brook Street Terrane (Begg 1981; H. J. Campbell pers. comm.). Permian trilobites from southeastern Australia are similarly very rare.

The cephalon of an undescribed species of *Nepea* (order Ptychopariida) from the Middle Cambrian of the Cobb Valley area of northwest Nelson.

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Future work

The only major undescribed faunas are the above-mentioned Cambrian ones; it is likely that further species will be found in Cambrian rocks, which so far have been investigated in detail only in the Cobb Valley area. In younger strata, apart from any further revision of the Devonian faunas and the description of the Permian faunas, there appears to be little prospect of major finds. Acid leaching of Cambrian and Ordovician limestones could produce further important phosphatised or silicified material as described by Wright et al. (1994) and Percival et al. (2009). As far as detailed correlation value is concerned, the Cambrian agnostids are globally important such fossils and offer the greatest potential for improving the correlation of New Zealand rocks with those of adjacent continents.

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Checklist of New Zealand Trilobita

In the following list, taxonomic order of suprageneric taxa is as given by Fortey (1997: *Treatise on Invertebrate Paleontology, Part O, revised*). Age assignments, abbreviations, and localities for the relatively few trilobite-bearing levels are as follows: CB, Undillan to Boomerangian (Drumduan to Guzhangian), Epoch 3 of the Global Geochronological Scale (equivalent to late Middle Cambrian of the traditional scale), Cobb Valley; CP, latest Cambrian (Payntonian) and OT, earliest Ordovician (Tremadoc), Mount Patriarch; OD, Middle Ordovician, Thompson Creek; OG, early Late Ordovician (Gisbornian), Paturau River; OH, Hirnantian (latest Ordovician), Wangapeka River; DP, Early Devonian (Pragian), Baton River; DE, late Early Devonian (early Emsian), Reefton; and PL, Late Permian, Southland. E indicates an endemic species or genus.

PHYLUM ARTHROPODA
SUBPHYLUM TRILOBITOMORPHA
Class TRILOBITA
Order PTYCHOPARIIDA
Suborder PTYCHOPARIINA
ACROCEPHALITIDAE
Ketyna? sp. indet. Wright et al. 1994 CP-OT
CATILLICEPHALIDAE
Onchonotellus sp. indet. Wright et al. 1994 CP?
CONOKEPHALINIDAE
Suludella? sp. Cooper 1979 C
EULOMIDAE
Amzasskiella kupenga Wright, 1994 CP E
Proteuloma ahu Wright, 1994 CP E
NEPEIDAE
Nepea cf. *avara* Opik, 1970 Münker & Cooper 1999 CB
Nepea sp. Cooper & Bradshaw 1986 CB
PAPYRIASPIDIDAE
Pianaspis sp. Cooper 1979 CB
PROASAPHISCIDAE
Koptura sp. Cooper & Bradshaw 1986 CB (= kopturids of Cooper *in* Shergold et al. 1985)
Sudanomocarina sp. Münker & Cooper 1999 CB
SHUMARDIIDAE
Shumardia (*Conophrys*) *tauwhena* Wright, 1994 CP E
Shumardia (*Conophrys*) *wrighti* Waisfeld et al., 2001 OT E (= *S.* (C.) sp. indet. of Wright et al. 1994)
SOLENOPLEURIDAE
Hystricurus? sp. indet. Wright et al. 1994 OT
'*Solenoparia*' sp. Cooper 1979 CB

Suborder OLENINA
OLENIDAE
Leptoplastides grindleyi Wright, 1994 OT E
Parabolinella sp. indet. A Wright et al. 1994 OT
Parabolinella sp. indet. B Wright et al. 1994 OT
Plicatolina sp. indet. Wright et al. 1994 OT

Order AGNOSTIDA
AGNOSTIDAE
Lotagnostus (*Lotagnostus*) cf. *asiaticus* (Troedsson, 1937) Wright et al. 1994 CP
DIPLAGNOSTIDAE
Diplagnostus sp. Münker & Cooper 1999 CB
Neoagnostus sp. Wright et al. 1994 OT
Oidalagnostus n. sp. Cooper 1979 CB
Pseudagnostus (*Pseudagnostus*) sp. indet. Wright et al. 1994 CP
Tasagnostus sp. Cooper *in* Shergold et al. 1985 CB
METAGNOSTIDAE

Geragnostus? sp. indet. A Wright et al. 1994 CP
Geragnostus? sp. indet. B Wright et al. 1994 OT
PERONOPSIDAE
Hypagnostus of *clipeus* type Münker & Cooper 1999 CB
Hypagnostus of *parvifrons* type Münker & Cooper 1999 CB
Peronopsis of *elkedraensis-longiqua* type Münker & Cooper 1999 CB
PTYCHAGNOSTIDAE
Goniagnostus aculeatus Angelin, 1851 Cooper *in* Shergold et al. 1985 CB
Goniagnostus cf. *nathorsti* (Brögger, 1878) Cooper 1979 CB
INCERTAE SEDIS
Grandagnostus sp. Cooper in Shergold et al. 1985 CB
Valenagnostus sp. Münker & Cooper 1999 CB

Order ASAPHIDA
ALSATASPIDIDAE
Hapalopleura? sp. indet. Wright et al. 1994 CP-OT
Skjarella sp. indet. Wright et al. 1994 OT
ASAPHIDAE
cf. *Niobella* sp. indet. Wright et al. 1994 CP
Basiliella collingwoodensis (Reed, 1926) OG E
CERATOPYGIDAE
Hedinaspis regalis Troedsson, 1937 Wright et al. 1994 CP
Hysterolenus hectori (Reed, 1926) Wright et al. 1994 CP
Onychopyge aff. *riojana* Harrington, 1938 Wright et al. 1994 OT
cf. *Onychopyge* sp. indet. A Wright et al. 1994 CP
Onychopyge? sp. indet. B Wright et al. 1994 OT
Pianaspis sp. Cooper *in* Shergold et al. 1985 CB
Gen. et sp. indet. A Wright et al. 1994 OT
Gen. et sp. Indet. B Wright et al. 1994 CP
HUNGAIIDAE
Asaphopsoides sp. indet. Wright et al. 1994 CP
NILEIDAE
Ordosaspis? sp. indet. Wright et al. 1994 CP
REMOPLEURIDIDAE
Apatokephalops sp. Wright et al. 1994 OT
Apatokephalus cf. *tibicen* Pribyl & Vanék, 1980 Wright et al. 1994 OT
Apatokephalus? sp. indet. A Wright et al. 1994 OT
Apatokephalus? sp. indet. B Wright et al. 1994 OT
Eorobergia? sp. indet. Wright et al. 1994 OT
Kainella meridionalis Kobayashi, 1935 Wright et al. 1994 OT
Kainella cf. *conica* Kobayashi, 1935 Wright et al. 1994 OT
Pseudokainella lata (Kobayashi, 1935) Wright et al. 1994 CP
TRINUCLEIDAE
Incaia bishopi Hughes & Wright, 1970 OG E

Order CORYNEXOCHIDA
Suborder CORYNEXOCHINA
DOKIMOCEPHALIDAE
Wuhuia sp. indet. Wright et al. 1994 OT
DOLICHOMETOPIDAE
Gen. et sp. indet. Cooper 1979 CB
DORYPYGIDAE
Dorypyge sp. Cooper 1979 CB
Kootenia sp. Münker & Cooper 1999 CB
Olenoides sp. Cooper 1979 CB

Suborder ILLAENINA
PANDERIIDAE
Panderiidae? gen. et sp. indet. Cocks & Cooper 2004 OH
STYGINIDAE
Scutellum sp. (as *Goldius* sp.) Shirley 1938 DP

Order PHACOPIDA
Suborder CALYMENINA
CALYMENIDAE
Calymene (*Gravicalymene*) ?*angustior* Chapman, 1915 Shirley 1938 DP
HOMALONOTIDAE
Homalonotus sp. Shirley 1938 DP
Wenndorfia expanda (Hector, 1876) DE E

Suborder CHEIRURINA
PILEKIIDAE
Gogoella sp. indet. OD
cf. *Metapilekia bilirata* Harrington, 1938 Wright et al. 1994 OT
Gen. et sp. indet. A Wright et al. 1994 CP
Gen. et sp. indet. B Wright et al. 1994 CP
?Pilekiidae gen. et sp. indet. Wright et al. 1994 CP

Suborder PHACOPINA
ACASTIDAE
Acaste sp. indet. Wright 1990 DP
Acastella sp. indet. Wright 1990 DP
DALMANITIDAE
Mucronaspis mucronata (Brongniart, 1822) Cocks & Cooper 2004 OH
PHACOPIDAE
?*Phacops* sp. Willis 1965 DP

Order PROETIDA
AULACOPLEURIDAE?
Gen. et sp. indet. Cocks & Cooper 2004 OH
Dechenella (*Eudechenella*) *mackayi* Allan, 1935 DE E
PHILLIPSIIDAE
Gen. et sp. indet. A Begg 1981 PL
Gen. et sp. indet. B Hyden et al. 1982 PL

Order ODONTOPLEURIDA
ODONTOPLEURIDAE
Eoleonaspis? sp. Cocks & Cooper 2004 OH