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1-1-2011

## Phylum arthropoda, subphylum trilobitomorpha: trilobites

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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

### Publication Details

Wright, A. J. & Cooper, R. A. (2011). Phylum arthropoda, subphylum trilobitomorpha: trilobites. In D. P. Gordon (Eds.), *New Zealand Inventory of Biodiversity - Volume Two: Kingdom Animalia* (pp. 45-49). Christchurch, New Zealand: Canterbury University Press.

## FIVE

# Phylum ARTHROPODA TRILOBITOMORPHA trilobites

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ANTHONY J. WRIGHT, ROGER A. COOPER

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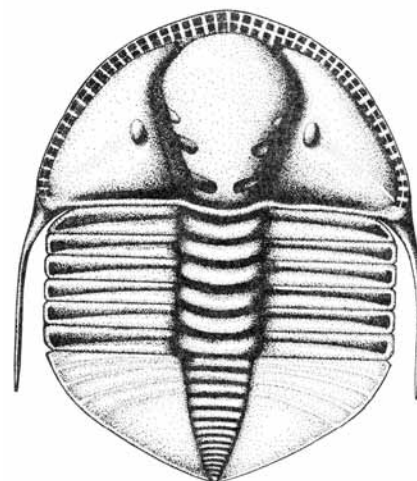
**T**rilobites are an extinct group of marine arthropods with calcareous exoskeletons. They were extremely abundant in the Cambrian and Ordovician periods, becoming extinct at the end of the Paleozoic during the devastating Permo-Triassic extinction event. They had a flattened oval body divided into 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.

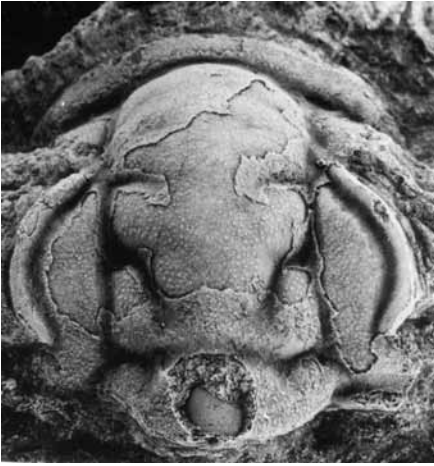
The New Zealand trilobite fossil record is very limited, largely owing to the small amount and highly deformed nature of Early Paleozoic strata. Elsewhere in the world, rich and diverse trilobite faunas are found in platform strata or shallow shelf strata. Paleozoic developments of such environments 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 nepheids 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 Cambrian 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.

### 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.

### Authors

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

Roger Cooper

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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 Munker & Cooper 1999 CB

*Nepea* sp. Cooper & Bradshaw 1986 CB  
 POPYRIASPIDIDAE  
*Pianaspis* sp. Cooper 1979 CB  
 PROASAPHISCIDAE  
*Koptura* sp. Cooper & Bradshaw 1986 CB (= kopturids of Cooper in Shergold et al. 1985)  
*Sudanomocarina* sp. Munker & 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)  
 SOLENOLEURIDAE  
*Hystericurus?* 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. Munker & Cooper 1999 CB  
*Neoagnostus* sp. Wright et al. 1994 OT  
*Oidagnostus* 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 Munker & Cooper 1999 CB  
*Hypagnostus of parvifrons* type Munker & Cooper 1999 CB  
*Peronopsis of elkedraensis-longiqua* type Munker & 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. Munker & 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  
*Asaphosoides* 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. Munker & 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  
 PHILLIPSIDAE  
 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