TRILOBITES -- I Know What Trilobites Ate.

by Terrance M. Allen, S.C.E.
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How Trilobites Fit Into the Animal Kingdom

In the Animal Kingdom trilobites are identified and placed into the Phylum: Arthropoda (Greek: arthro= joint, pod= foot). Of the three Subphylums of arthropods, including 1) Trilobita, 2) Chelicerata (i.e. horseshoe crabs, spiders, and scorpions), and 3) Mandibulata (i.e. insects, crustaceans, and crabs), trilobites, the time-forgotten paleozoic arthropods, alone constitute this Trilobita or Trilobitamorpha group of extinct animals.

General Characteristics of Trilobites and Their Geological Time On Earth

Trilobites (Greek: tri= 3, lobos= lobe; Latin: ites= fossil), known only from fossil remains, existed hundreds of millions of years before the archaic arachnids and insects, ammonites (extinct marine molluska) and nautiluses, and the ancient fish, amphibians, reptiles, dinosaurs, birds, mammals and humans. Like today's insects, the trilobites' chitinous exoskeleton, which was molted or shed at intervals for growth and possibly regeneration, formed a jointed body and limbs. They usually possessed multifaceted compound eyes and antennae, and many had external spines and/or projections. The segments of the trilobite body were divided by longitudinal furrows on the dorsal (top) surface into three lobes. Depending on each individual species, their size ranged from less than one-mm (1/32-inch) to one-meter (39-inches) or more.

Trilobites made their grand entrance into the Cambrian seas during the "Cambrian Explosion" of life on Earth; no life existed on the terrestrial lands as yet. These primitive arthropods dominated the oceans during the Paleozoic Era living from the Early Cambrian Period to the Late Permian Period (544 to 250 MYA/million years ago). They disappeared from the planet Earth at the time of the great "Permian-Extinction." To date, fossils of nearly 15,000 different species of trilobites have been identified. Trilobites too, like all life on Earth, evolved from more primitive arthropod ancestors which also are preserved in the fossil record (see "Relatives and/or Ancestors of Trilobitamorpha").

Trilobites were marine or sealiving invertebrate animals. They are more closely related to insects, crustaceans (including pill bugs and sow bugs, shrimps, lobsters, crayfish, sea and land crabs, barnacles, and others), and horseshoe crabs, including

Limulus sp., "the living fossils." Some could roll up into a ball like a pill bug (a crustacean) or an armadillo (a mammal), concealing their soft underbody and appendages. Their hardened exoskeleton, sometimes armored with sharp defensive spines, provided protection against predators such as Anomalocaris canadensis(*) and Eurypterids (aka: sea scorpions), or even each other including close relatives of their own species. Large, now extinct, Nautiloids up to 30-meters or 90-feet in length, related to today's surviving cephalopod mollusk Nautilus, also would have fed on trilobites. In the latter period of their earthly reign, the sometimes outlandish spines or outgrowths that evolved over time also provided them protection from the huge predatory fish that flourished in the Devonian seas.

(*)Note: The 2-meter or 6-foot long Anomalocaris predator fed on trilobites in the Cambrian seas. But for unknown reasons they disappeared at the end of the Cambrian Period.

Trilobites Were The First Organisms to Develop Eyes

Although the earliest trilobites were blind as they swam in the darkness on the sea floor, via evolutionary law, mutations and/or adaptation, these aquatic bilateral animals were the earliest life forms or organisms on Earth to develop eyes and possess vision for detecting movement. These visionary miracles may have developed from a single crystalline lense made of calcite over light receptive cells such as those found in flat worms, earth worms, and sea stars(*) (aka: star fish).

(*)Note: Trilobites lived alongside of sea stars. [Direct fossil evidence of fossil rock containing brittle sea stars, Protaster salteri, and the trilobite Paychopyge sp. from Morocco, Africa, 510-439 MYO (million years old); in personal collection of T.M. Allen, September 25, 2007.]

Resembling something between a rivulose "sunflower-seed-like" arrangement or "honeycomb-like" pattern, these calcite crystalline lenses formed into a set or pair of eyes. Through adaptation and genetic modifications and the reproduction of the dominate keen-sighted survivors, the opposing eyes situated on opposite sides of the median lobe of the trilobite body evolved over time on the cephalon (head) of the early trilobites. Although the eyes became characteristically different for individual species, sometimes placed at the ends of stalks or turret-like extensions(*), the trilobites set the standard for the compound eyes found on almost all arthropods.

(*)Note: The compound eyes and antennae found at the ends of tubular extensions from the head of the currently living "Stalk-Eyed Flies," (Cyrtodiopsis dalmanni, Family: Diopsidae, Order: Diptera), may be considered as an example of recurrent evolution or atavism of genetic traits carried down from their trilobite ancestors dating back over millions of years.

The ancient trilobite Xanderella sp. had bilateral symmetric prominent eyes probably brought on through visually-guided predation and/or foreseeable evasion from other predators. The eyes of the trilobite Phacops were of the same design as today's extant insects, especially those of the Strepsipteran, Xenos peckii, Order: Strepsiptera (strepsi= twisted, ptera= wings), a small beetle-like insect known as a Twisted-Winged Parasite. The "bug-eyed" trilobites were now also able to scuttle over the sea floor looking for something to eat.

Today, the majority of all arthropods, like the trilobites, possess bilateral compound eyes, including all insects, except for the primitive proturans along with a small number of species of other primitive groups and some cave dwelling insects. Some insects, including the advanced honey bees, Apis mellifera spp. of the Family: Apidae and the Order: Hymenoptera, and their relatives, have three additional "simple" single-lense eyes arranged in the form of a triangle in between the pair of compound eyes, giving them a total of five eyes.

What Trilobites Ate

Foraging or scavenging in the sand or silt of the sea floor, trilobites probably fed on smaller organisms and plankton and other sea plants. New evidence suggests they even fed on brachiopods(*), aka: "lamp shells." [New fossil evidence: two brachiopods being eaten by a trilobite, Flexicalymene meeki (Foerste), discovered and extracted and identified by T.M. Allen (February 2008); from rock collected in Cincinnati, Ohio, U.S., from the Upper Ordovician, 443-441 MYO.] Or, like modern day insects, spiders, and other arthropods, trilobites sometimes probably preyed upon and ate others of their own kind.

(*)Note: from the Cambrian Period to Recent times, brachiopods were, and are, marine invertebrates with bivalve shells. Although barely surviving the "Permian-Extinction," today, living or extant species of brachiopods are rare.

Descendants(?) of Trilobites

Usually oblong and flattened, trilobites were shaped more like today's cockroaches, which too have fossil records dating back over 300 million years B.P. (Before Present). But unlike their extinct relatives the trilobites, today cockroaches successfully continue living on Earth in almost every environment. Scientists have discovered fossilized remains of insects dating back to 392 to 420 million years B.P. Hence, insects, crustaceans, and other arthropods may have evolved from early forms of trilobites. Insects, including cockroaches, would have lived concurrently during the trilobites' prevalence for 170 million years.

Cockroaches belong to the Subphylum: Mandibulata (with mandibles or biting jaws, Latin: mandere= to chew) and the Class: Hexapoda (Greek: hexa= 6, pod= foot). All insects are classified and placed into the Hexapod Class (aka: the Class: Insecta). Although all of the trilobites and some groups or orders of insects have since disappeared, cockroaches lived on; a living example manifesting the "perpetual longevity of a species" [ref: NetaGuide Magazines, Tucson Guide, T.M. Allen, 2013].

Another living example exhibiting trilobite ancestry is the "Deep-Water Giant Isopod," Bathynomus giganteus. It belongs to the Subphylum: Mandibulata and the Class: Crustacea (Latin: crusta= crustlike exoskeleton or hard shell). Residing in the abyssal sediment of ice cold waters in the bathyal zone up to 7,000 feet below sea level off the coast of Queensland, Australia, this giant arthropod with extremely large bilateral compound eyes, resembling an ancient trilobite, grows up to 19-inches in length and can weigh in at 3 pounds! [See example of a specimen, 10-1/2 inches long in personal collection of T.M. Allen.]

Conclusion

Mass extinctions, including the "Permian," 250 million years ago (when trilobites disappeared), and the "Cretaceous-Tertiary" (aka: The K-T Boundary), 65 million years ago (when dinosaurs, flying pterosaurs, belemnites and most nautiluses disappeared), have caused major disruptions yet advancements of life on Earth. Through the aeons of time, of life and death and life again, in reference to the extinctions and rebirth of animals and plants, life on Earth has been ever-changing and evolving.

Along with their numerous uncountable relations, including all insect, arachnid, myriapod, and crustacean kindred, all similar yet divergent from their ancestors in the Phylum of Arthropoda, creatures like the cockroaches, deep-water giant isopods, and horseshoe crabs unwittingly survived the mass extinctions that trilobites and other marine and terrestrial species of animal and plant life could not.

Like pieces of a puzzle, fossils and their associations are valuable scientific specimens and are indicators and direct evidence as to the history and evolution of life on Earth.

Terrance M. Allen

Relatives and/or Ancestors of Trilobitamorphs

There were many types of Trilobitamorphs, arthropods related to or pre-evolutionary to the trilobites, during the Paleozoic Era. These four animals are from the Cambrian Period, 544-510 MYA (million years ago). All are from the Burgess clays, in British Columbia, Canada, North America.

* Phylum : ARTHROPODA

  * Subphylum : CRUSTACEA (hard shell/crusta)
    (1) Waptia fieldensis

  * Subphylum : MARELLOMORPHA (the lace crabs)
    Class : TRILOBITOIDEA(?)
    Order : MARRELLIDA
    Family : MARRELLIDAE
    (2) Marrella splendens (also Marella)
    (from Middle Cambrian, 530 million years ago)

  * Subphylum : ARACHNOMORPHA
    (trilobites, arachnids, & relatives)
    Superclass: EMERALDELLIDA (=Order?)
    (3) Emeraldella brooki (also E. brocki)

    Superclass: SIDNEYIIDA
    Class : TRILOBITOIDEA
    Order : LIMULAVIDA
    Family : SIDNEYIIDAE
    (4) Sidneya inexpectans (also Sidneyia)
    (from Middle Cambrian, 530 million years ago)

Another recent fossil find includes an arthropod, Kootenichela deppi, (Depp Sea Creature, named after actor Johnny Depp), said to be the ancestor of all arthropods; found in British Columbia's Kootenay National Park, 2014.

Paleoentomologically yours,

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Trilobites Full Report
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History Summary for Terrance M. Allen includes:
- Northwestern School of Taxidermy
  Certificate & Diploma in completion of the Study of Taxidermy
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- California State University, Long Beach
  Bachelor of Arts, with a Major in Entomology
- State of California Department of Health
  Certified Technician in Mosquito Control
- California State Department of Food and Agriculture
  Certified as Economic Entomologist
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- Inventor: - Insect Collecting Allen Aspirator
  - Fruit Fly (Medfly) Fruit Collection/Detection
    Stacking Bucket
  - Intense-Biased-Survey Medfly Detection Program

Digital Photograph of Trilobite Fossil "Eating" Two Brachiopods:
Caption: Trilobite "Flexicalymene meeki" feeding
on two Brachiopods (only one visible).
Note: white arrow points to remnants
of trilobite's antenna. T.M.Allen
Photo by Linda D. Henderson, 2014.

Digital Photograph of Terrance M. Allen
Caption: Terrance M. Allen, Sacramento, California
Entomologist, Arachnologist, Practicing
Paleoentomologist, and Factotum Naturalist.
In his home laboratory with 50,000 insects,
spiders and related arthropods,
and over two-thousand fossils.
Photo by Don Meuchel, May 21, 2014

References and Sources:

Animal Eyes
by Michael F. Land and Dan-Eric Nilsson
Oxford University Press, c-2012, pages 3 & 189.

Arthropod Fossils and Phylogeny
by Gregory D. Edgecombe
c-1998, pages 71 & 87.

Australia's First 4-Billion Years
PBS Television Series / NOVA
c-2014.

Deep Sea Creature
by Catherine Zuckerman
National Geographic (Magazine), August 2014.

Encyclopedia Prehistorica, Sharks and Other Sea Monsters
by Robert Sabuda and Matthew Reinhart
c-2006.

Evolution of the Insects
by David Grimaldi and Michael S. Engel
c-2005, pages 1, 98, 99, 111.

Insects, Spiders and Other Terrestrial Arthropods
a Dorling Kindersley Handbook
by George C. McGavin
c-2000, page 145.

Just One Bite and Life Took Off
by Laura Wright
Discover (Magazine), February 2004.

Simon and Schuster's Guide to Fossils
by Paolo Arduini and Georgio Teruzzi
c-1986, pages 117 & 119.

The Prehistoric World
by Giorgio P. Panini
c-1982, 1987, page 24.

The Trilobite Book, A Visual Journey, (In Color)
by Riccardo Levi-Setti
c-2014, pages 141, 142, 248, incl. plates 132 & 133.

The World Encyclopedia of Fossils & Fossil Collecting
by Steve Parker
c-2007, 2009, pages 128-133.

Trilobites of New York, An Illustrated Guide
by Thomas E. Whitely, Gerald J. Kloc, and Carlton E. Brett
c-2002, Plate 66, Flexicalymene weeki.

Additional Sources Consulted:

An Introduction to the Study of Entomology, Third Edition
by Donald J. Borror and Dwight M. DeLong
c-1964 and 1971.

Eyes of an Ancient Predator Had 16,000 Lenses / Anomalocaris
The New York Times, Observatory / from the journal "Nature"
by Sindya N. Bhanoo
December 13, 2011

General Zoology
by Tracy I. Storer
c-1943, page 439.

"Giants-2"
Cable Television Science Channel # 272
c-2009, Aired June 8, 2013; "Deep-Water Giant Isopod."

Integrated Principles of Zoology
by Cleveland P. Hickman, Ph.D.
c-1970.

Mystery Predator of the Cambrian,
Searching Ancient Seas for Anomalocaris
by Jan Roach
c-2007.

Treatise On Invertebrate Paleontology
Part O: Arthropoda 1
Arthropoda - General Features, Protarthropoda
Euarthropoda - General Features, Trilobitomorpha
Directed by Raymond C. Moore
Geological Society of America and University of Kansas Press
c-1959.

Trilobite! Eyewitness to Evolution
by Richard Fortey
c-2000.

Trilobites, Second Edition
by Riccardo Levi-Setti
c-1975, 1993.