“SALINE GIANTS,” COLD CRADLES AND THE GLOBAL PLAYGROUNDS OF EARTH

The Origin of Animalia

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WHAT IS A METAZOAN?

COMMONLY REFERRED TO AS ANIMALS

MULTICELLULAR
so, single-celled animals (Protozoa) do not qualify

MOBILE
at some stage in their life cycle, they move
WHAT IS A METAZOAN?

HETEROTROPHIC

Metazoans are consumers at different levels in the food chain:

- none are capable of generating their own food directly from inorganic materials
- some have, however, cooperated with other species in symbiotic associations with autotrophs (which can generate food from inorganics), such as coral polyps with dinoflagellates
WHAT IS A METAZOAN?

- Most are DIPLOID ORGANISMS with embryonic development that goes through a blastula stage

  diploid = having two sets of chromosomes, one from each “parent” (leading to much greater biodiversity with each generation)

  blastula = early embryonic stage, a hollow, fluid-filled ball of cells one layer thick
WHAT IS A METAZOAN?

MANY, BUT NOT ALL, ARE TRIPLOBLASTIC during development three embryonic layers (endoderm, mesoderm, ectoderm) produce all later structures
WHERE ARE THE OLDEST ANIMALIA FOUND?

- Bangemall Basin, Western Australia (@1.2 billion years old)
- Glacier National Park, Montana, USA (@1.5 billion years old)
- Doushantuo, Yangtze Gorges, China (@580 million years old, perhaps older)
- Newfoundland (575 +/- 1 million years old)
- White Sea Region, Russia (555.3 +/- 1 to 551.1 +/- 0.7 million years old)
- Ural Mountains, Russia
- Siberia
- Ukraine
- Flinders Ranges, South Australia
- Namibia, Southwest Africa (548.8 +/- 1 to 542.6 +/- 0.3 million years old)
NEWFOUNDLAND
(@575 +/- 1 Ma)

- Oldest Truly Macro-Ediacara Biota (Mistaken Point) Dominated by Rangeomorphs, whose relationships are not understood?
- Deep Water Setting
- Excellent Dating Possible Because of Ashes
THE VENDIAN FAUNAS OF THE WHITE SEA REGION, NORTHERN RUSSIA

• **AGE:** over 551-555 or older *million years*, U-Pb radiometric dating of zircon crystals from volcanic ash beds

• **LOCATION:** about 1000 km north from Moscow, S-SE coast of the White Sea

• **GETTING THERE (TRANSPORTATION):**
  
  22 hours by train from Moscow, then sea vessel or helicopter, small boat, sometimes horse cart and then feet
• **FOSSIL SITES:** within 400 km from Onega River to the *Winter Coast* of the White Sea

• **FIELD CONDITIONS:** swamps and taiga, short and cold summer, mosquitoes, midges, *bears*

• **ACCOMODATION:** *tents*

• **ROCKS:** sandstone, siltstone and claystone deposited in shelf or slope marine environments
Site where Kimberella was found
<table>
<thead>
<tr>
<th>SEQUENCE A</th>
<th>SEQUENCE B</th>
<th>SEQUENCE C</th>
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<tbody>
<tr>
<td><em>Anfesta</em></td>
<td><em>Body fossils</em></td>
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<tr>
<td><em>Beltanelloides-like</em></td>
<td><em>Charnia</em></td>
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<tr>
<td><em>structures</em></td>
<td><em>Ovatoscutum</em></td>
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<td><em>Bonata</em></td>
<td><em>Staurinidia</em></td>
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<td><em>Charnia</em></td>
<td><em>Molds of soft</em></td>
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<td><em>Cyclomedusa</em></td>
<td><em>tubular structures;</em></td>
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<td><em>Dickinsonia</em></td>
<td><em>simple circular</em></td>
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<td><em>Ediacaria</em></td>
<td><em>impressions</em></td>
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<td><em>Eoporpita</em></td>
<td><em>Anfesta</em></td>
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<td><em>Hiemalora</em></td>
<td><em>Brachina</em></td>
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<td><em>Inania</em></td>
<td><em>Cyclomedusa</em></td>
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<td><em>Irrininitus</em></td>
<td><em>Rangea</em></td>
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<td><em>Kaisalia</em></td>
<td><em>Charnia</em></td>
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<td><em>Kimberella</em></td>
<td><em>Dickinsonia</em></td>
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<td><em>Nimbia</em></td>
<td><em>Ediacaria</em></td>
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<td><em>Protodipleuroforma</em></td>
<td><em>Eoporpita</em></td>
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<tr>
<td><em>Tribrachidium</em></td>
<td><em>Inania</em></td>
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<td><em>Three-dimensional</em></td>
<td><em>Irrininitus</em></td>
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<tr>
<td><em>molds of tubular</em></td>
<td><em>Kimberella</em></td>
<td></td>
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<tr>
<td><em>structures and others</em></td>
<td><em>Mawsonites</em></td>
<td></td>
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<tr>
<td>Simple radial feeding</td>
<td><em>Nemiana</em></td>
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<tr>
<td>burrows; backfilled</td>
<td><em>Parvancorina</em></td>
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<tr>
<td>burrows with circular</td>
<td><em>Ovatoscutum</em></td>
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<tr>
<td>path behavior; traces</td>
<td><em>Tribachidium</em></td>
<td></td>
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<tr>
<td>of crawling mollusk-like</td>
<td><em>Vendia</em></td>
<td></td>
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<tr>
<td>organism; fan-shaped</td>
<td><em>Yorgia</em></td>
<td></td>
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<tr>
<td>sets of scratch marks</td>
<td>Others, including numerous</td>
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<tr>
<td>Enigmatic biological</td>
<td><em>new forms</em></td>
<td></td>
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<tr>
<td>structures</td>
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**Diverse radial feeding burrows; traces of crawling mollusk-like organism; fan-shaped sets of scratch marks; diverse vertical burrows; simple tunnels**
• **FOSSILIFEROUS BEDS:** clay/sand interface, storm beds (downslope avalanches)

• **FOSSIL TYPES:** body fossils and trace fossils (trails, tracks and burrows)

• **PRESERVATION MODE:** imprints, 3D casts and moulds, pyrite crust ("death masks"), organic material
• **PRESERVATION DETAILS**: external and internal morphology

• **SIZE**: Range from tiny to large: 2-3 mm to 1 meter

• **PALEOECOLOGY**: shallow to deeper marine habitats, relatively cold oceans, abundant plankton and benthic microbial mats
THE VENDIAN FAUNAS OF THE WHITE SEA REGION, NORTHERN RUSSIA

• NATURE OF ANIMALS
  - soft-bodied forms dominate, though some have more resistant “shells” (*Kimberella*)
  - bottom dwellers: attached and mobile, but some may have been active in water column (*Ventogyrus*)

• FAUNAL COMPOSITION
  - a few, well established groups of both diploblastic and triploblastic invertebrates
• **LOCOMOTION STYLE**

  movement possible in some (*Kimberella, Yorgia, Dickinsonia*), perhaps planktonic (*Ventogyrus*)

• **FEEDING HABITS**

  some micropredators or (gardeners) - *Kimberella*; some may have had symbiotic inclusions, some possible filter-feeders, some microbial mat absorbers (“placid vacuum cleaners”)

• **COLONIZATION OF THE SEDIMENTS**

  little *bioturbation* (disturbance of sediment) - animals feeding on the surface of, into or within microbial mats
• **EVOLUTIONARY SIGNIFICANCE**
  close relatives of some Phanerozoic Phyla present (*Kimberella* likely related to the Mollusca), while others leave no progeny

• **BIODIVERSITY**
  increases with time (higher biodiversity in younger rocks)

• **EXTINCTION**
  many weird and odd life forms are abundant but not known from later periods (Seilacher’s vendobionts) - *e.g.* rangeomorphs
EDIACARAN BIOTA OF AUSTRALIA

- GSSP Site, defines the bottom of the Ediacara Period – Reference Section
- Long Sequence of Sediments, but much lacks fossils and no absolute dates
- Coarse-grained Nature, so Preservation not as Detailed as in White Sea or Siberia
- High Biodiversity
- Situated Near Equator
Sunday 31/3/26

After early work Pat & I went working to do some mapping starting about the south workings.

We had a wonderful view of the estuary Sand dunes to west of Lednacaara. The red in the early morning light is wonderful. Later in day they became the "orange" of Albert Namat.

I started following limestone beds & underlying fiddle gravel's near South workings. Basal structure very obvious. I suspect it is in basal marls SS immediately under massive limestones.

Fossil readily visible on E sw. backed by massive gravel Miocene with little wood.

In underlying fiddle SS to SW. I mean think I found some markings very suggestive of jellyfish, also tracks & etc. anything else is entirely blind to collect more later.
under massive limestone. Faults readily visible on E. sw. washed by massive grey & manganese 2 little kn. In underlying fossil 5's to 50's of main drive I found great bunches very suggestive of jellyfish also tracks of etc. suggesting other creatures. I intend to collect more later.
Some Ediacarian animals possessed circular form and were obviously free floating jellyfish. The pennatulids (or sea pens) obviously anchored into the sea-floor. One form exhibited rare triaxial (three way) symmetry, while still others had strongly developed bilateral symmetry, indicative of the development of a creeping habit. Spriggina was once referred to as the World’s lowest worm, but actually it had a well formed head, and as such was probably then the World’s most brainy creature!
*Charnioidiscus arboreus* (555 million years old)

*Sarcopilus grandis* (Port Noarlunga)

Colonial Soft Corals
This stamp issue focuses on the world’s first animals – multicellular organisms, some probably related to worms, jellyfish, and snaís, dating back some 560 million years.

Known as Ediacaran fossils, predating dinosaurs by millions of years, these creatures have a particular connection to Australia. They are named after the Ediacaran Hills of the world heritage Flinders Ranges in South Australia. This is one of the four best places in the world where fossils of these first animals can be found.

Of the 106 to 150 different species which have been discovered worldwide, between 30 and 40 are found in the Flinders Ranges. In 1946, an Australian mining geologist named Reginald C. Sprigg found fossilised imprints. The name “Ediacara” comes from an Aboriginal word meaning “veinlike spring of water”.

**THE STAMPS**

The stamps, presented in a sheetlet format, are illustrated by Melbourne artist, Peter Trusler. Scientific advice was provided by Drs Patricia Vickers-Rich (Monash University), Jim Gehling (Museum of South Australia), and Mikhail A. Fedonkin (Paleontological Institute, Moscow).

- **Tribrachidium (50c)** – which may have lived on the sea floor.
- **Dicksonia (50c)** – a “germ eater” having a very elegant form.
- **Spriggina (50c)** – between an arthropod and a segmented annelid worm.
- **Kimberella (50c)** – probably a soft-shelled mollusc.
- **Hara (35c)** – may be one of the oldest fossils of an animal showing the entire body.
- **Charniodiscus ($1.00)** – a feather-like organism.

Products also include a first day cover, stamp pack, miniature sheet, maximum cards, and an activity book with this issue.

**TECHNICAL DETAILS**

- **Issue date**: 21 April 2005
- **FDI withdrawal date**: 29 May 2005
- **Denominations**: Five x 50c, one x $1.00
- **Designer**: Belinda Marshall, Australia Post Design Studio
- **Illustrator**: Peter Trusler
- **Stamp size**: 35.5mm x 29mm
- **Miniature sheet size**: 170mm x 210mm
- **Reduced miniature sheet**: 170mm x 86.8mm
- **Perforations**: 13.86 x 14.46
- **Printer**: SNP Sprint
- **Paper**: Tullis Russell
- **Printing process**: Lithography
- **Sheet layout**: Module of 50 with two pares of 25
- **Special feature**: Glow in the dark ink used on miniature sheet outer area
- **National postmark**: GPO Sydney NSW 2000

**MAIL ORDER CODES**

- 1445067 Stamps (five x 50c, one x $1.00) $3.50
- 1445124 Miniature sheet $3.50
- 1445001 Set first day covers $3.80
- 1445092 First day cover stamps $3.80
- 1445003 First day cover (reduced miniature sheet) $3.80
- 1445126 Stamp pack $7.45
- 1445020 Maximum cards (set of six) $8.00
- 1445131 Set gutter strips (ten x 50c, ten x $1.00) $15.00
- 1445242 Gutter strip (ten x 50c) $5.00
- 1445243 Gutter strip (ten x $1.00) $10.00
- 1445244 Gutter strip (ten x $1.00) $10.00
- 1445250 Creatures of the Slime activity book $5.95
NAMIBIAN FAUNA

(542.6 +/- 0.3 to 548.8 +/- 1 Ma)

• Some of Youngest Ediacara Animals
• Possibilities of Precise Dating Due to Abundance of Ashes
• Dominated by Pteridinids
• Preservation Exquisite
SOUTH AMERICA

- Puncoviscana Group, Argentina
- Corumburra Group, Brazil
THE CAMBRIAN EXPLOSION?

- Rapid Appearance of Hard Skeletons (but over time - from the Early to Middle Cambrian)
- Appearance of New Body Plans
- Was the Cambrian Explosion Abrupt or Gradual? The Data—
  - Body Impressions or Skeletons/Shells
  - Trace Fossils
  - Molecular
But are the megafossils telling true tales?

Small phosphatized embryos and adult fossils from the Doushantuo Formation in China record metazoans from 580 million years old - not on the same schedule as the megafossils.

Molecular clocks are also not on the same schedule!
MITCHELL ON THE BUDGET

“Departmental Extravagance”

“Ewen Mee”

“Today’s menu: Budget Redux”

“Surplus”

“We seem to be fresh out of money—would you mind paying?”