

Schierwater (2005)

Notes:

- *Trichoplax adhaerens* is a small marine animal and probably the most simple organized metazoa
- It is the only species in the phylum of Placozoa
- There are just three cell-layer and four cell-types (upper and lower epithelium, gland and fiber cells)
- The epithelia are ciliated, so *Trichoplax* can stick to surfaces
- There is no regular body shape or symmetry, also there is nothing like oral and aboral
- *Trichoplax a.* multiplies by binary fission
- Developed gametes are observed, but not far developed zygotes
- The full sexual cycle has not been observed
- Very little is known about the ecology of the Placozoan
- Scientific work with this animal could be a good insight to the minimal requirements of multicellular life
- The bauplan of *Trichoplax a.* is a evidence for the „urmetazoan“-hypothesis
- Different hypothesis from Haeckel (gastrea hypothesis) and Bütschli (placula hypothesis) are based on this urmetazoan-hypothesis
- First hints for high biodiversity are genetically shown
- Developmental genes, comparable to higher metazoan ones, were found (Proto-Hox gene named *Trox2*)
- In 2005 the whole genome is sequenced

Summary:

Trichoplax a. is maybe the most simple organized metazoan organism. Because of the basal position in the Tree of Life this animal could be the mother of all metazoa. There are just four cell-types and three cell-layer. The first description of this animal is in 1883 by F.E. Schulze. After the first description it falls into oblivion. In the 1970s it was rediscovered and was used as evidence for different hypothesis, based on the „urmetazoan“-hypothesis. Thus the metazoan evolved from a ancestor comparable to *Trichoplax*. Genetic work with the genome of *Trichoplax* could be a good insight in function of basal metazoan organization and life.

Srivastava et al. (2008)

Notes:

- *Trichoplax a.* is the most primitive metazoa, nevertheless the knowledge about this animal is still very small
- Although both germs has been observed, the sexual cycle is completely unknown (under culture conditions the zygote never reaches the 256-cell stage)
- Allelic variation suggests of sexual interbreeding in wilderness
- in 2005 the whole genome was sequenced, since this point lots of genetically work has been done
- Whole-genom analysis shows the possible position in the Tree of Life
- The phylogenetic position is presumable more basal than porifera
- Hox-genes comparable to higher metazoa was identified (ANTP-class)
- The theory, that *Trichoplax a.* are reduced cnidarian can be refused by genetics (no extensive intron loss, which is associated with secondary reduction)
- With 98 million basepairs *Trichoplax a.* has the smallst metazoan genome
- Lots of highly conserved genome structures (e.g. transciption factor and signalling pathway genes) has been estimated, comparable to higher diploblasta and triploblasta
- Metazoan signalling pathways and potential neuroendocrine proteins are found, e.g. analogs to vesicle fusion proteins for synapes
- Also genes were found, which are involved in cnidarian axis-defining
- about 14.500 ESTs were estimated

Summary:

Having the most primitiv bauplan and the smallest genome of all metazoa. The genome shows lots of genes, which are comparable to higher and lower metazoan animals. With only 98 million basepairs it is completely sequenced and extensive genetic work has been done. The analysis showed, that *Trichoplax a.* is maybe more basal than porifera. Hox-gene activity, comparable to cnidarian, was also observed. It is not much known about ecology and natural behavior, yet. Also the sexual cycle has not been observed. *Trichoplax a.* is predestinated to be the model organism for basal parts of the Tree of Life, because it indicates that this animal is a living fossil, which could show new aspects in the early evolution in multicellular life.

Schierwater et al. (2009, Com. & int. Biology)

Notes:

- The Diploblasta-Bilateria Sister hypothesis is generally declared as improbable, because the idea, that Nervous systems evolved twice is refused by many scientists
- A nervous system is an aggregate of nerve cells
- Neither Placozoa nor Porifera have a nervous system (or nerv-cells), but they show behaviour
- Both taxa have a kind of protonerv-cells (Placozoa even have a complex fiber-cell network)
- It is not possible to make a clear definition for nervous systems, because they can be so variable
- The last common ancestor of all metazoa must have a kind of protonervous system
- The Diploblasta-Bilateria Sister hypothesis includes different scenarios
 1. Coelenterata and Bilateria gained specialized nerve cells independently
 2. A common ancestor gains spec. nerve cells, Porifera and Placozoa lost this feature

Summary:

The Diploblasta-Bilateria Sister hypothesis is today not general approved. Many scientists refuse this hypothesis, because the main idea of this theory is, that nervous systems evolved twice. Today two phyla are estimated to be a potential „urmetazoa“. On the one hand the Porifera and on the other hand the Placozoa. Both of them have primitive nerve cells, so it is to discover if one of these phyla is the „mother of all metazoa“. Genetics show that *Trichoplax* is the more presumable candidate for being the most basal metazoa.

Schierwater et al. (2009, PLoS biol.)

Notes:

- Long time the origin of metazoa was discussed and many hypotheses were released
- One possible hypothesis is the theory of an „urmetazoa“
- A derivative of this theory is the placula hypothesis, thus an amoeba-like animal is the origin of all metazoan
- This amoeba-like animal could be *Trichoplax adhaerens*, genetically it is shown, that this animal is maybe the most basal multicellular organism

- To resolve this part in the Tree of Life could bring clarity to very important inventions of metazoa like head-foot axis, symmetry and ceolom
- It is advantageous to use multidisciplinary tools, to solve this enigma
- In this paper different tools were used: Morphological evidence, secondary structure of ribosomal RNA, sequence of mitochondrial and nuclear genes. Additional Hox-like gene expression patterns were compared
- Using this bandwidth of tools a phylogenetic tree can be reconstructed:
 - Bilateria-Diploblasta are sistergroups
 - Porifera and Coelenterata are sistergroups
 - Placozoa are most basal Diploblasta
- This tree provides a modern version of the placula hypothesis
- The expression patterns of Hox-like genes in *Trichoplax* shows a similarity to the ones of lower cnidarian (e.g. *Eleuthera dichotoma*)
- Thus a potential transition from a non-symmetric and axis-lacking amoeba-like animal into a radially symmetric animal, which has an oral-aboral axis.

Summary:

Bringing clarity in the basal parts of the Tree of Life helps to understand the early evolution of multicellular organisms. To get highest resolution and maximum likelihood for the basal tree a great bandwidth of multi-disciplinary tools are used. The created tree shows a Bilateria-Diploblasta Sister group and a basal position of Placozoa in Diploblasts. From this one can infer that the common ancestor of all metazoan life could be a *Trichoplax*-like organism. The modern placula hypothesis, provides by multi-disciplinary analysis.

Schierwater et al. (2010)

Notes:

- Placozoa is traditionally a monophyletic taxon, which contains only one species named *Trichoplax adhaerens*
- 16S ribosomal RNA-analysis shows a high variation and suggests a high diversity
- Two ways of sampling are constituted
 - 'Rock sampling' – Rocks were collected

- 'Slide-sampling – Microscope slides were fixed in water
- Sampling all over the world and subsequent analysis of 16S rRNA show the phylogeographically distribution
- 78 isolates from 23 field-sampling sites were collected, additionally 8 isolates from 2 samples were collected in aquariums
- 16 Haplotypes were found, which can arrange in 7 clades
- The clades show different distribution-bandwidth in latitude
 - Clade II: a very small range of (northern) latitudes between 15° and 30°
 - Clade III: a range of (northern) latitudes between 0° and 30°
 - Clade V: a range between 45° northern and 10° southern latitudes
 - Clade I: nearly ubiquitairy, range between 75° northern and 30° southern latitudes
- From this one can infer that the clades have different ecological potency. E.g. clade II is stenoecious and clade I is euryoecious

Summary:

Traditional the Placozoan contains just one species named *Trichoplax adhaerens*. In the last few years this paradigm changes. Sampling all over the world shows a complex phylogeography. At 25 spots all over the world 16 Haplotypes were collected. They can arrange in 7 clades, which shows a difference in latitudinal distribution. This suggests a variation in ecological potency, which is a argument to define different species.

Vocabulary:

English	German	Context
marine	marin, im Meer lebend	<i>Trichoplax a.</i> is a tiny marine animal
ancestral state	Stadium eines Vorfahren	It represents the ancestral state of life
gastric cavity	gastrischer Hohlraum	How could a cnidarian give up its gastric cavity?
Unique	einzigartig	This is a unique bauplan
to float	schweben	It floats in the ocean for up to a week
specimens	Exemplare	Some specimens were collected in the Red Sea
distributed	verteilt	The animal is distributed all over the world
latitudes	Breiten	It was collected in subtropical latitudes
vermiform	Wurmförmig	<i>Trichoplax a.</i> did not fit the pattern of vermiform phyla

English	German	Context
primitive bauplan	einfacher Bauplan	<i>Trichoplax a.</i> shows a primitive bauplan
benthic	im Benthal lebend (auf dem Boden der flachen See)	The evolutionary scenario led to a benthic animal
genealogical	genealogisch (Ahnenforschung)	I.e. Assigning taxonomic levels to genealogical branching patterns
eumetazoa	Gewebetiere	Placozoa and Porifera are no eumetazoa
fibre cells	Faser-Zellen	The fiber cells are located between the two epithelia
fission	Teilung	Im culture, <i>Trichoplax</i> reproduces by fission
allelic variation	Variation, die sich wie Allele verhalten	Also allelic variation were observed
axis-defining	Bestimmend in der Achsenbildung	A similar axis-defining role proposed in cnidarian
neuroendocrine	Neuroendokrin	Elements associated with neuroendocrine function
signalling pathway	Signaltransduktion	Metazoan signalling pathway and biological process genes in the <i>Trichoplax</i> genome
living fossil	lebendes Fossil	It has been suggested that <i>Trichoplax</i> is a living fossil
common ancestor	gemeinsamer Vorfahre	Many ancestral features of its last common ancestor
orthologous	Orthologisch (Proteine, die eine gleiche Abstammung haben)	82% of human introns have orthologous counterparts
counterparts	Gegenstücke	
branch	Zweig (phylogenetische Einheit)	On the basis of nuclear genes is less susceptible to long-branch attraction factors
tantamount	gleichbedeutend	tantamount to reconciling the parallel evolution of the nervous system
to reconcil	schlichten	
parsimony	Sparsamkeit (eine Methode einen Stammbaum zu erstellen)	support for both parsimony and maximum likelihood analyses
likelihood	Wahrscheinlich	
spatio-temporally	räumlich-zeitlich	functional synapses organizing intracellular and extracellular signalling processes spatio-temporally
expression patterns	Expressionsmuster	Hox-like gene expression patterns
Diploblasta	Diploblasta (Zweikeimblättrige)	Bilateria and diploblasts are sister groups
Bilateria (Triploblasta)	Bilateria (Dreikeimblättrige, Axialsymmetrische)	

English	German	Context
Coelenterata	Coelenterata (Aggregat aus Cnidaria und Ctenophora)	Placozoa are strongly excluded from a Porifera-Coelenterata monophyletic group
crucial	entscheidend	Tree-building procedures are highly crucial
to resurrect	wiederaufstehen	Resurrecting the „Placula“
transition	Übergang	a potential transition from a non-symmetric organized cnidarian
cosmopolitan	kosmopolitisch (überall in der Welt vorkommend)	sequencing of the mitochondrial large ribosomal subunit (16S) reveals a cosmopolitan distribution
to sample	Proben nehmen	We sampled a total of 39 tropical and subtropical locations
clade	Klade (phylogenetische Einheit)	phylogenetic branching patterns between clades
disc-shaped	plattenförmig	<i>Trichoplax</i> is a disc-shaped animal
somatic cell	Körperzelle	with only five somatic cell types
squamous	schuppenartig	Its made up ip of a squamous epithelium
lineage	Abstammungslinie	Voigt et al. Were able to identify eight different genetic lineages
(microscope glass) slide	Objekträger (für das Mikroskop)	As a second method, standard microscopic glass slides were placed
rack	Gestell (in diesem Fall eine Plastikbox, die Objekträger beinhaltet und fixiert)	Each rack contained five evenly spaced glass slides
artificial seawater	Künstliches Seewasser	Dishes were pre-filled with sterile artifical seawater
distinct	deutlich	Species that must group into several distinct higher taxonomic units
euryoecious	euryök (große ökologische Potenz)	Thus can be termed a euryoecious clade
stenoecious	stenök (kleine ökologische Potenz)	An example of the opposite, taht is, a stenoecious lineage, is H13
endemic	endemisch	this is an endemic taxon

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