the mechanisms that generate change, as well as causing the 'noise'. Big data approaches assume that, if one has all the component information defining a physiological change, the key processes will emerge. But this approach assumes that all the data are available (which is rarely the case), the models are correct and the computing power is great enough. Of course, any lack of hypotheses makes such papers very difficult to read and extremely difficult to present. Too often a reliance on big data removes the necessity for biological insight that underpins real advances in the field. I am definitely a 'small science' scientist in this respect, and I believe, somewhat against current thinking, that we still have relevant contributions and insights to make.

What aspect of science, your field or in general, would you wish the general public knew more about? I wish that the general public knew more about the relationship between what they eat and their health. The cynicism of food industries in promoting the consumption of sugar is, at times, jaw-dropping. The activities of Coca-Cola in funding a health group that focused on physical exercise to combat obesity, rather than on the need to reduce sugar in the diet, is just one example, as exposed in *The New York Times* (http://nyti.ms/2zdWA29). The lack of commercial promotion of the consumption of fresh fruit and vegetables to promote health — especially amongst the low paid and in developing countries — is an enormous cause for concern. Even the promotion of personalised medicine seems more a calculated way of helping the wealthy and making money (either personally or through research funding) than helping the general population improve their diets and health, so improving their quality of life and reducing the increasing burdens on health services. I may be an old 'lefty', but I can still dream!

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Quick guide

Placozoa

Bernd Schierwater[1,*] and Rob DeSalle[2]

What are Placozoa? To us, Placozoa are the most unique animals one can think of (Figure 1). The bauplan of these always hungry creatures is by far the simplest of all animals — only some secondarily reduced parasites show a similarly simple morphology. Placozoa are organized in a sandwich-like body plan with a lower epithelium (facing the substrate) and an upper epithelium (facing the open water). Embedded within these two layers is a loose layer of so-called 'fiber cells'. Placozoa lack any kind of apparent symmetry or body axis. They have no discrete organs, no clear nerve or muscle cells, not even any obvious extracellular matrix or a basal membrane. A mere six somatic cell types perform all functions and hold the animal together (even in heavy wave-break zones). Yet, placozoa can feed, digest, smell, see, move, grow and reproduce. They crawl as flat, tiny plates over hard substrates in most oceans.

How did they get their name? The single placozoan species *Trichoplax adhaerens* was discovered in 1883 by the German zoologist Franz Eilhard Schulze, in a seawater aquarium at the Zoological Institute in Graz, Austria. The generic name is derived from the Greek 'thrix' (meaning 'hair') and 'plax' (meaning 'plate'). The specific epithet 'adhaerens' reflects its propensity to stick to the glass slides and pipettes (and indeed the side of glass surface of aquaria) used in its examination. It is therefore affectionately known as the 'sticky hairy plate'. In 1971, Karl Grell following Otto Bütschli's 'placula hypothesis' named the phylum 'Placozoa'. Bütschli's hypothesis was erected to propose a simple benthic animal, the hypothetical 'placula', with an upper and a lower side (epithelium) that serves as an ancestor *bauplan* for sponges and cnidarians, and thus for all higher metazoans.

How many species of placozoa are there? For more than half a century *Trichoplax adhaerens* has been the only formally named species in the phylum Placozoa. Thus, this phylum is the only monotypic animal phylum, consisting of only a single species. In reality though, there are probably some 100 placozoan species out there, and these species may well turn out to occupy several genera and families and perhaps even a few orders.

How do they reproduce? Placozoans use three different modes of reproduction: vegetative budding, vegetative fission and sexual reproduction. Vegetative fission of a parent into two (sometimes three or more) daughter individuals is the dominant mode of reproduction in the lab, where it leads to high propagation rates of clonal lineages. Sexual reproduction has been shown to occur in nature and has been induced in the lab. However, the embryos from such matings develop only to the 128-cell stage and then die.

Where do we find them? Originally, placozoans were thought to only occur in warm subtropical and tropical ocean waters. Now, we predict that they even occur in moderately cool waters and the distribution range stretches as far as 55°N (e.g. coasts of Ireland) and 44°S (e.g. Tasmania). Often we don't even have to take our trousers off to collect them, but we also found them 20 meters deep. Most likely they will not go much deeper because their main diet, photosynthetic algae, would change, but we do not know yet.

Why is there so much interest in placozoa? *Trichoplax* and other placozoans represent novel model organisms with tremendous potential for many areas of biological and biomedical research. This is because they show the simplest (but not secondarily reduced) of all metazoan bauplans, they posses the smallest nuclear genome and the largest mitochondrial animal genome, and they harbor representatives of all major gene families known from humans. They are also one of only five metazoan higher taxa that are involved in one of the most hotly debated phylogenetic questions since genomics came on the scene. Which of the recent groups Cnidaria, Ctenophora,

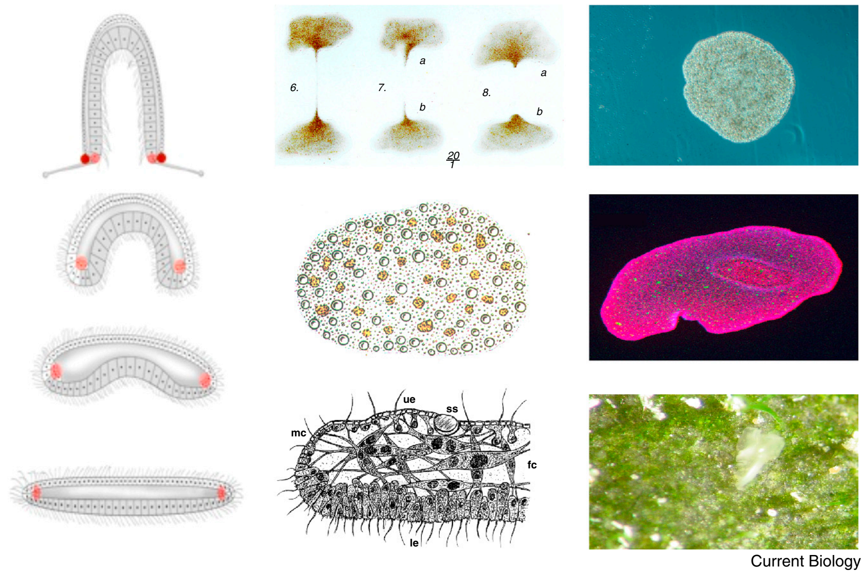

Figure 1. Trichoplax.
Left column: the modern placula hypothesis of Schierwater et al. (2009). Center column: top: drawings of three dividing Trichoplax specimens and a single specimen (middle; from Schulze 1891); bottom: a cross-section showing the sandwich-layer organization of placozoans (drawing by Eckhard Holtorf, from Eitel, M., Osigus, H.-J., DeSalle, R., and Schierwater, B. (2013). Global diversity of the Placozoa. PLoS One *8*, e57131). Right column: A normal growing Trichoplax is shown on the top, an animal with tissue grafted from another — non-Trichoplax — placozoan species is in the middle, below is a feeding placozoon specimen (white glob near middle of picture) on a capture slide from the field (photos by Bernd Schierwater, Karolin Chevallerie and Michael Eitel).

Porifera, Placozoa or Bilatera appeared first on our planet. There are 105 ways that five taxa can be arranged in strictly bifurcating trees and nearly a quarter of these have been offered as hypotheses for the relationships of these five taxa.

Are placozoans the best living surrogate for the ancestor of all animals? Possibly yes. But if so, it would take a while for the community to accept this traditional view. If one only considers comparative organismal evidence and genuine biological knowledge, a basal position of Placozoa seems natural. But recent DNA sequence information contradicts this traditional ‘placula view’ of metazoan evolution. The current, genome-based view of metazoan phylogeny leaves the Placozoa somewhere in the middle of recently constructed trees.

Are placozoans in the field overlooked by researchers? Yes, regularly. For more than a century marine research stations across the world have not reported any placozoan sights, although we now know that different placozoan species are quite abundant near the stations. For the unexperienced eye it is easy to overlook a transparent placozoan specimen camouflaging in the color of its substrate or the color of its diet (*e.g.* green algae in Figure 1, lower right).

What can we learn from them? A lot can be learned from these tiny masters of morphological simplicity. As a rule of thumb, it is often helpful to first learn the basics before you analyze more complex entities. Let’s take cancer research as an example. Placozoans have all major gene families that researchers examine in the context of cancer. So why not first figure out what these genes are doing and how they interact in the simplest metazoan on the planet with just a small number of possible gene interactions instead of going immediately to the unmanageable numbers of possible combinatorial effects in mammals? There are other obvious examples of placozoan research utility. If we want to learn about the evolution and structural organization of genomes, why not start with the smallest and potentially most ancestral animal genome? Or if we want to learn about the development and evolution of nervous systems and other organs, why not first understand the basic genetics underlying neural function or epithelium formation in the least complex system?

Is* Trichoplax adhaerens *the best placozoan species for experimental research? No. The soon to be described new species *Trichoplax* sp. H2 is much more robust, much more abundant and much easier to culture and manipulate.

Any more complications? Yes, despite placozoans being the simplest animals with the smallest of all early branching animal genomes, these animals might still be too complex and morphologically also too different for too simple conclusions. This is what makes comparative zoology so much fun.

Anything else unusual? The oldest PhD student in history, Heinz Wenderoth, worked on *Trichoplax*. At the time of his defense in 2008, he was 97.

Where can I find out more?

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