Fields of the Cell:

At a turning point

Departement Umweltwissenschaften

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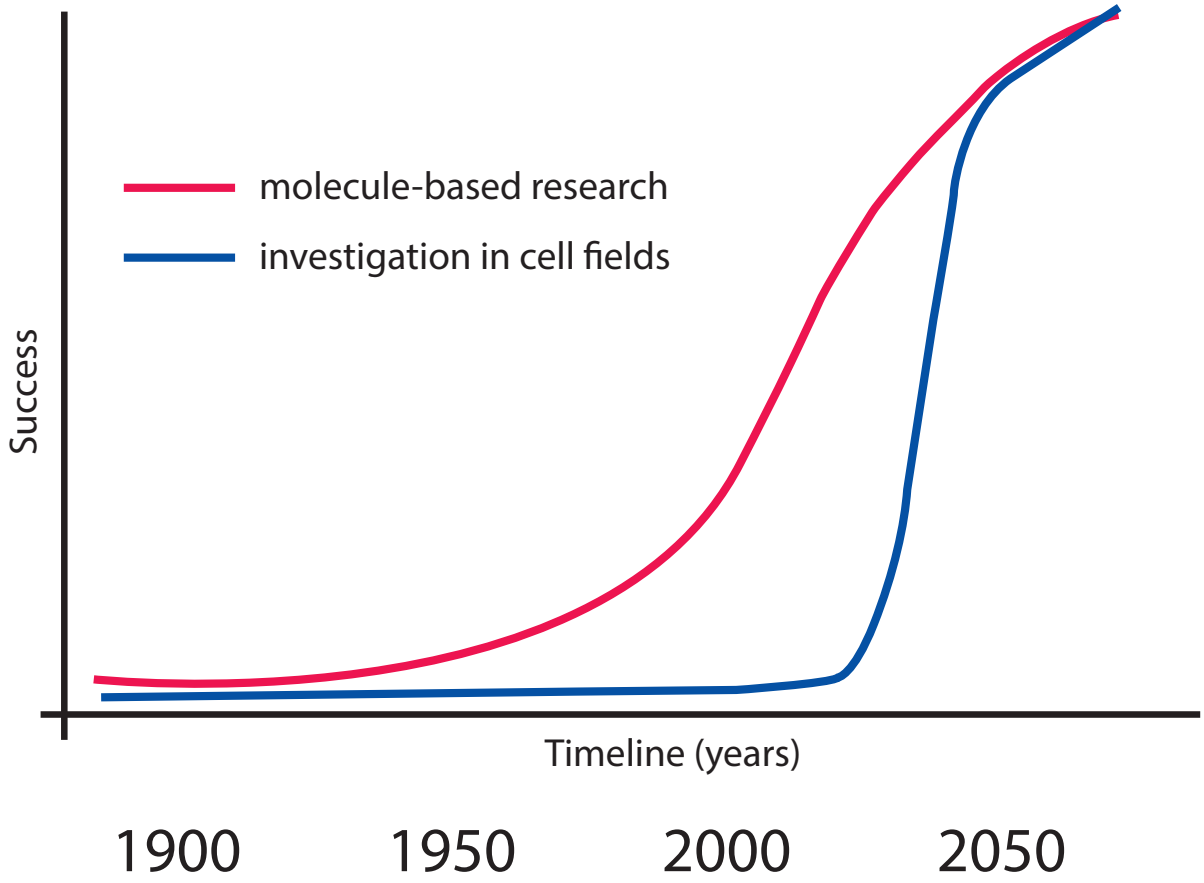
Fields of the Cell: At a turning point

While progress is based on development, a revolution is associated with turning points and a phase-transition (speaking in the terms of physics). Over the last 10 years a tremendous progress could be observed within the network of researchers studying functional cell components that have no weight but nevertheless induce effects: the fields of the cell. This development is mainly due to advances in technology and in networking. The latter leading to and sprouting of international conferences, workshops and cooperation between research groups. In summa this bears the potential to revolutionise classical concepts that explain life basically as random encounters of molecules.

It is evident that within a cell the material components, i.e. (polar) molecules, ions as well as chemical reactions exist together with the electric currents and electromagnetic fields they induce. And yet, the deep research of that kind of cell physics appears like a satellite orbiting around tremendous investment packages for molecular biology, or Life Sciences in general.



Molecular and electromagnetic components are part of a mutually dependent system of reciprocal causality leading to observed complex cell dynamics. This is, for example, well recognised in neurobiology in case of membrane potential switches and tunnel proteins in the context of information flow along axons. So, there we do look at the intricate relationship between molecules and electromagnetic components. We claim that there are much more effects emerging from more endogenous electrostatic and electrodynamic fields with accumulated evidence found in the newly released online book 'Fields of the Cell' (Fels, Cifra & Scholkmann, 2015, Research Signpost).

We claim that in the near future molecular and electromagnetic biology will merge (see graph) with an incredible power for emergent phenomena to study.

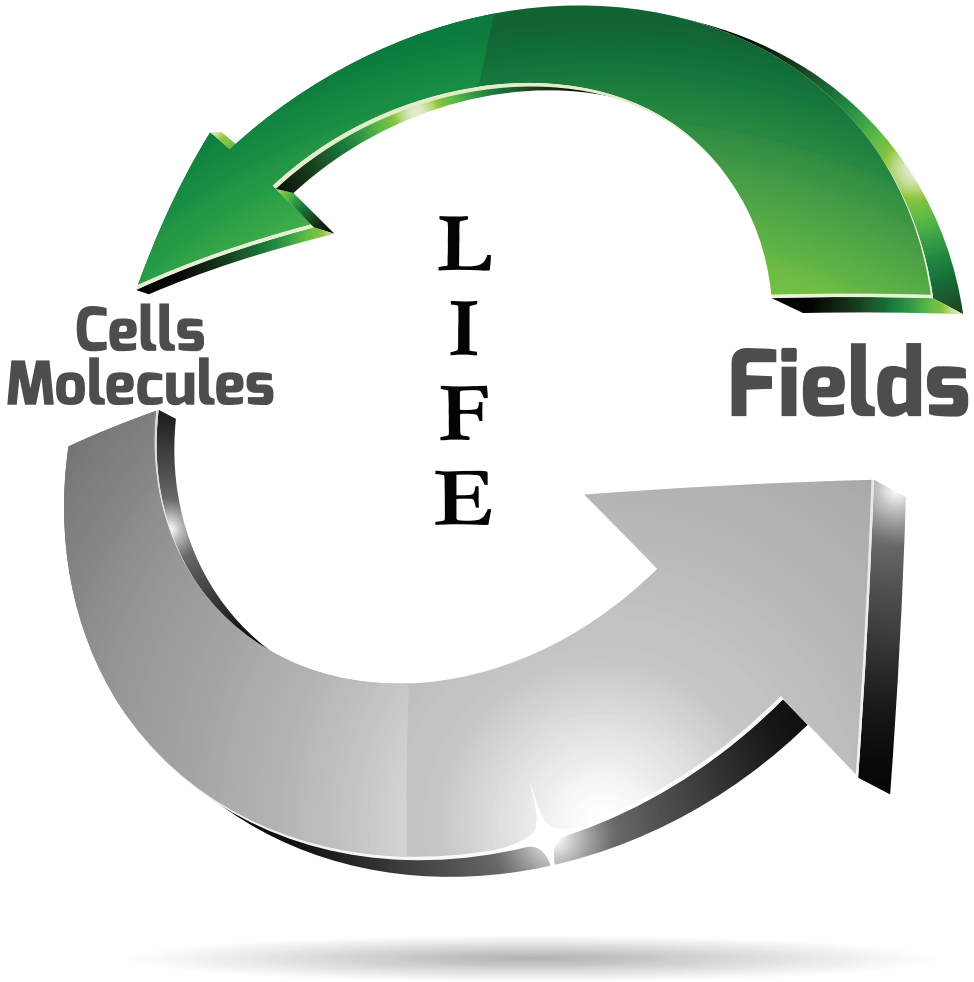
This qualitative graph describes the evolution of molecule-based research (red) as increasingly successful (y-axis) over time (x-axis) regarding financing and manpower. Investigation in cell fields (blue) is considered as inevitable and hence, the two curves are predicted to approach each other (sooner or later).

Questions and assumptions

Molecule-based research brought us a tremendous insight into life and being interested in the components of a cell one will – interesting for basic and applied research – certainly look for and find molecules. What else? Cell fields. Being interested in the non-material components of a cell one will – interesting for basic and applied research – certainly look for and find fields.

When it comes to functions we may be locked looking at molecules only. Are, e.g. substrate and enzyme within a cell really banging randomly into each other both of which being (hopefully) in the right cell space? Are cell fields playing an organising role in cell space and encounter organisation? The latter is a question that would never arise from a classical cell description but does so from a field- and molecule-based theory about life! We would like to give a few examples that show how a field- and molecule-based theory of life can give rise to new questions and can answer some old questions.

'Development': What gives an organism its form? Sensu Richard Lewontin (The Triple Helix) classical biology has no answer and skipped the



The figure describes the reciprocal causality between the polar matter of the cell and the fields of the cell. Together they establish the kind of self-organisation which we call life

question over to: Which gene(s) is (are) required during development. This however, does not explain the development of form! Now we know that e.g. embryos produce a field as a result from charged cells and that this field has a form into which cells migrate by which the form of the field is altered and so on.

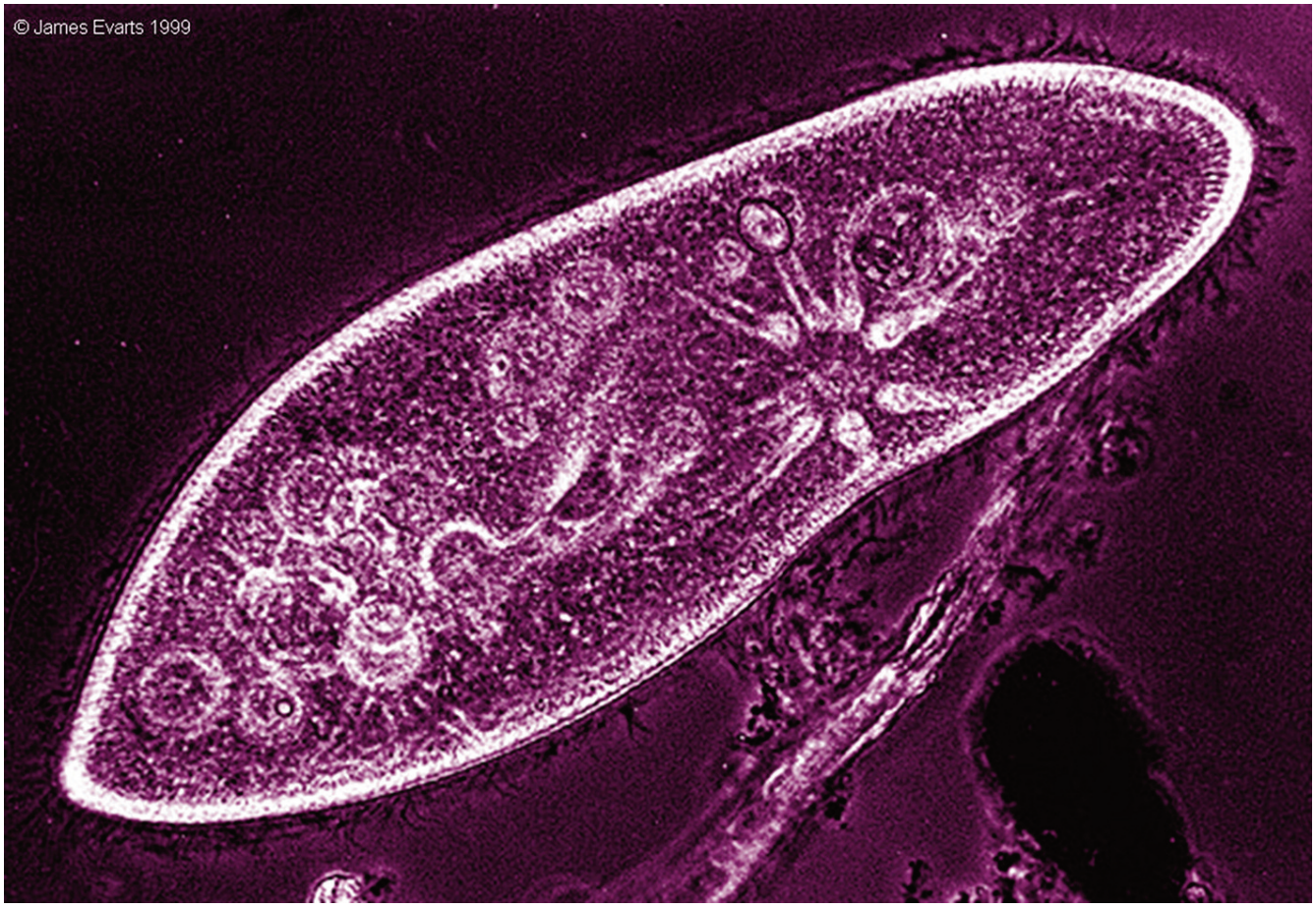
'Mitosis and meiosis': How do the microtubules find the chromosomes and why does the spindelapparatus resemble in form an electric field?

'Random': We say random when something occurs in a system, which we do not know. The critical question is, whether there is always such a system (if so, there would be no real random, which we do not discuss here). Quantum biology perceives a molecule as a vibrating entity. This implies phenomena like resonance and can, further, lead to attraction or distraction of similarly vibrating molecules (confer chapter 11 in Fields of the Cell, Preto et al).

'Inheritance': What is inherited (sensu textbooks) are genes and within egg cells a lot of additional molecules (leading also to so called maternal effects). Yet, if a cell is also a cavity resonator (confer chapter 16 in Fields of the Cell, Pietak) or more general, bears its fields (with their organising powers) we must ask whether fields are inherited as well.

'Natural selection': Order and structure may have occurred due to a process of small random events followed by natural selection. Yet if fields lead to order and structure and if life can follow these field forces, we may learn that not all order and structure follows from natural selection but probably also from life intrinsic fields.

'Exogenous fields': Fields (either from space or Earth or technology induced ones) surround us. It remains an open question how the exogenous



This is the cell (Paramecium caudatum) the author is working with. The results of the experiments are published in PLoS (2009) and Axiomathes (2012)

fields interact with the endogenous fields; assuming such interaction cannot exist appears highly improbable (think of electrotechnology).

'Reciprocal causality': While evidence is accumulating there is still research necessary to elaborate the mechanisms by which the fields due to polar molecules, ions, and chemical reactions feed back on polar molecules, ions, and chemical reactions thereby leading to the reciprocal causality between material and non-material cell components enabling complex cybernetic regulation in organisms.

Once better understood we will become able to interfere with fields into the process of cell dynamics. Another great responsibility we must prepare ourselves for.

Conclusion

The Fields of the Cell allow us to understand how self-organisation functions. Independent from human reactions (territorial, psychological), textbooks will include many more pages on the fields of the cell than so far because fields and molecules (therefore cells and organisms, too) belong together like mass and gravitation. For some this appears like an opinion. But the fields of the cell are about the truth of life and not about opinion. We believe that we are on a turning point in the Science about Life where the courage to allow the revolution will bring unforeseen fruits emerging from the tree of knowledge.

Outlook

Over the years we became increasingly aware that the book project Fields of the Cell was overdue. Without such an introduction one may not undertake the effort of reading into the topic. For granting a continuation we intend to launch a website (Fields of the Cell) informing about research groups, conferences and relating to recent research.

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