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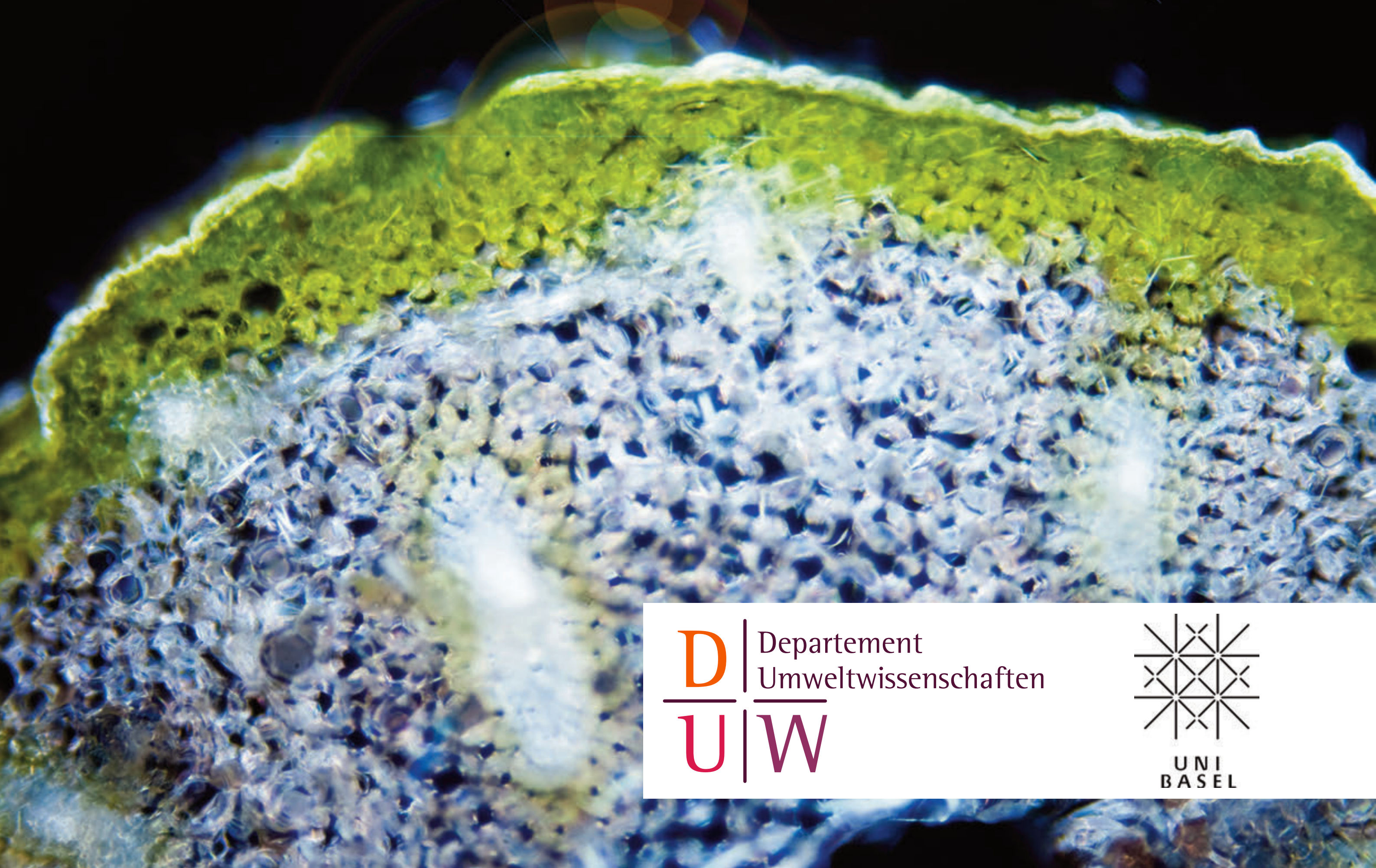
FIELDS OF THE CELL

Discover the future



Departement Umweltwissenschaften

UNI BASEL

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Discover the Future

Definition

The term 'fields of the cell' refers to the fact that electrodynamic fields surround every cell and cellular organelle. It includes fields belonging to all charged cell components, i.e. ions and polar molecules, as well as those components generated by cell chemistry. This further refers to the model of cavity resonance, and can also be defined as the sum of all electrodynamic cell activity taking part in intracellular and extracellular processes.

Past and Present

The discovery of electrodynamics in the 19th Century boosted not only material sciences but also Bioengineers, developing devices to affect biological systems in plants, animals and man. For example, devices that emit low-frequency electromagnetic fields were constructed for that purpose. Even though successful treatments were reported, the upcoming chemical industry had no interest in devices that give desired effects with lowest costs, and nothing more to sell than a technical device. Additionally, in the early 20th Century a theory was developed – based on observation – that cells emit electromagnetic waves, in particular that they radiate in UV. While this was studied in many countries in Europe, some claimed the experiments were non-repeatable. Even though many could repeat and contribute, the general attention got distracted. Without a greater context, it remains fully speculative why these early approaches to the fields of the cell had only marginal continuity up to today. Reasons among others were probably the key-locker principle that offered a good model to understand molecular cascades in living systems and the lack of technical devices to measure fields generated by cells.

Today we understand and can describe electrodynamic phenomena far better than for decades. We now have devices that can measure the lowest intensities of electromagnetic energy emitted by cells. We also have an increasing number of scientists exploring the quantum world of life. Currently the key-locker principle is in the company of systems explained by electromagnetic resonance, true for cell phones and found for cells.

External – Internal

Being interested in understanding the fields of the cells will lead to 2 approaches. One, is applying fields from an exterior source, while the other is studying the interior (endogenous) fields.

The application from outside falls under non-invasive therapy and is branching from empirical research as well as from measuring the electromagnetic emissions of cells. Despite technical devices, natural fields, such as sunlight and the Earth's magnetic field, can essentially influence life from outside, too. Cells do have receptors for these fields, yet many of them are still unknown demanding us to look at the interior of the cells. Today we know that the cell interior is an ensemble of polar molecules structurally organised in ways that allow oscillations in low as well as the highest frequencies (i.e. from kHz to THz). ROS-induced chemical reactions, i.e. other than those related to bioluminescence, are known to result in cellular emission of visible light. An increasing number of studies give evidence that these (ultra-weak) light emissions are signals that belong to a non-chemical cellular communication system. While cells function as senders and receivers of such cellular photon emissions, it remains a major working hypothesis that the sources of these fields may partly function as receiving structures.

The Network

The exploration of the fields of the cell is mainly performed by scientists from Medicine, Physics, Biology, and/or Engineering working both practically and theoretically. We currently have a European network of scientists investigating the fields of the cell connecting with research groups around the world (Figure 1), and we see a slow but steadily increasing number of new researchers joining this

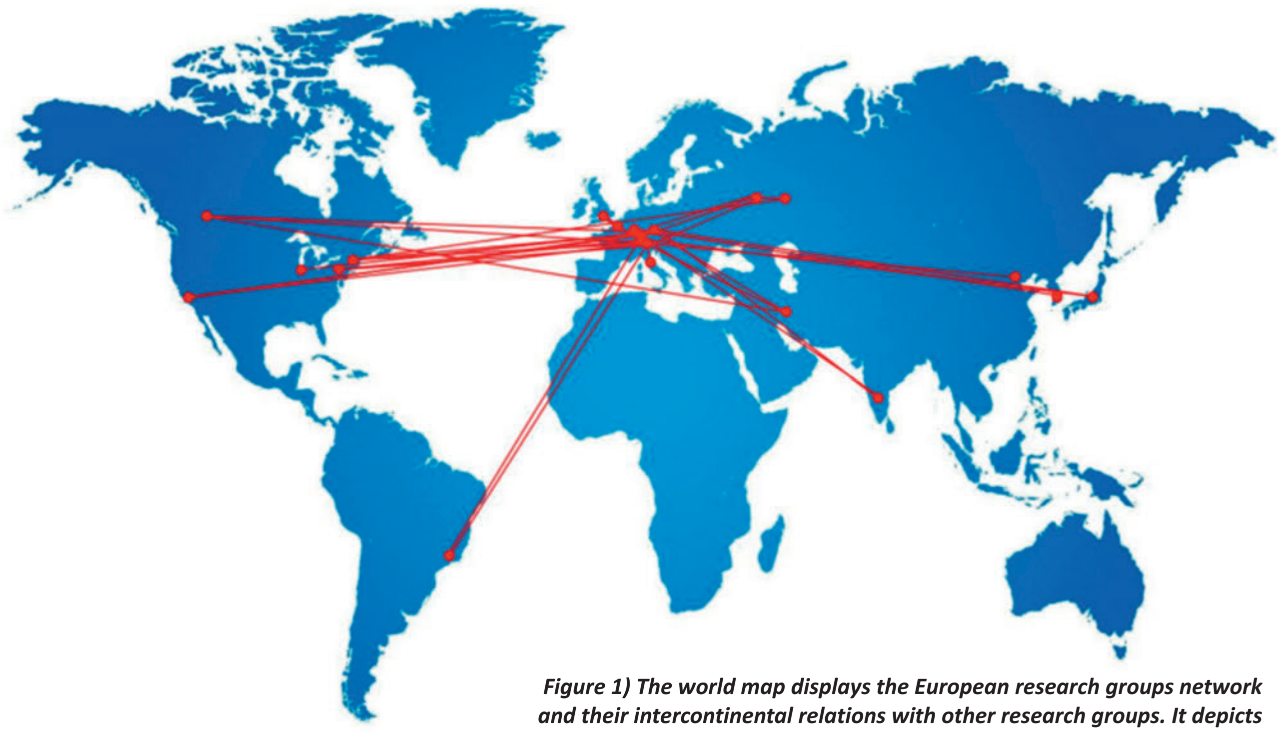

Figure 1) The world map displays the European research groups network and their intercontinental relations with other research groups. It depicts relationships of cooperation and scientific dialogue.

network. Some can give these young students full-time projects; others dig into the unknown with prudence. Yet, over recent years, publications were reaching impacting journals, international conferences were organised, and projects were started across country borders. The networking is reaching a new dimension, e.g. websites are going live, and journals are being created to directly address the issue to governments and politicians. The goal of the latter is to inform people in decision-making positions about the state of knowledge, with the aim to affect funding decisions but moreover to declare that revolutionary discoveries are being made in respect to cell water, molecular interactions, non-chemical cell interactions, and the role of endogenous electrodynamic fields involved in fundamental biological processes. The upcoming website <fieldsofthecell> will deliver information on these subjects from late 2014 onwards. It will also include publications, details and dates of conferences, and short essays to introduce the topics of papers. Furthermore, the open-access eBook Fields of the Cell (online end-summer 2014) will deliver an introduction that allows any interested student to read about empirical data, theory, history and new perspectives.

The Coupling with Life Sciences

In a nutshell, there are 2 fundamental aspects one should be aware of when talking about the fields of the cell. The first is the building of the field. Cells cannot avoid building fields because they are filled with charged particles, which by definition have an electrostatic field around them. The other is that fields are either static or oscillating – the latter allows them to resonate in frequencies applied from the exterior being either technical (electroceutical is a new term in this context) or natural, i.e. Earth's magnetic field, sunlight and other cells. Research on effects of cells across chemical separators indicated that cells could non-chemically influence other cells on several levels, one of which being biochemistry where cells were found to induce the production of cell components. This hints directly on the gene level as well as gene regulation (genetics and epigenetics). Other studies show effects on cell division rates and cell population regulation, the latter being a topic in cancer research. Cells and organisms may also have non-chemical means by which they couple with each other across the species border; hence, ecosystems may also be organised by fields (models for this come

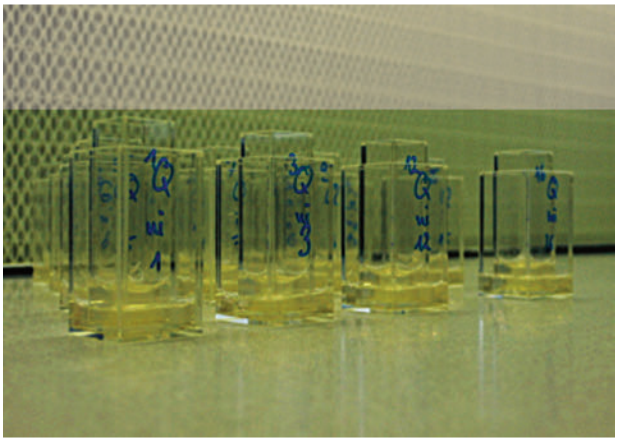

Figure 2a) The photo shows chemical separation of two media containing cells used to test for electro-dynamic, i.e. non-chemical cell communication.

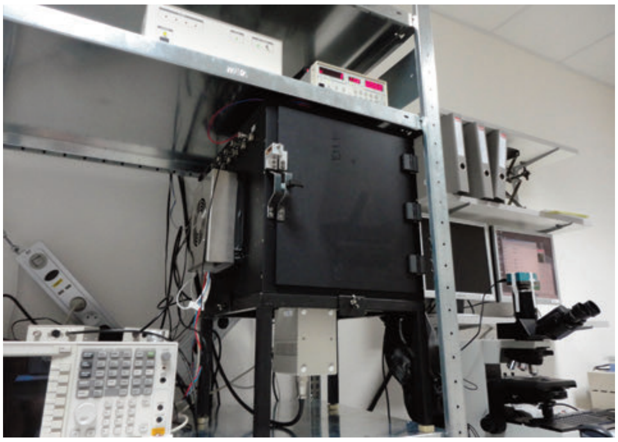

Figure 2b) In the center one can see a lightproof photo-multiplier, into which probes are placed for counting emitted photons/sec×cm².

from quantum field theory). Finally, we may ask from an evolutionary perspective whether the fields are inherited. If so, then it is not only DNA that is passed from generation to generation but also a field that interacts with the DNA. Any investment in the research of the electrodynamics of cells brings us closer to non-invasive therapies, potentially resulting in much lower costs than traditional methods.

Methods

Non-chemical cell signaling is a very important area of research, for here we learn more about *how* cells communicate and more importantly *what* they communicate. There are 2 major methods of investigation. One is measuring the emitted fields (e.g. the ultra-weak photons) with photomultipliers; the other is to have a barrier between cell cultures that separates these cultures chemically but not electromagnetically – this is achieved with transparent material. The best situation is when a laboratory can use both of these methods to complement each other (Figures 2a and 2b). Other approaches refer to sophisticated devices for low-frequency measurement of cell material, measuring cell membrane potentials, or technologies for reaching the gene level.

11 Great – Yet unanswered – Questions

Biology and Medicine, and Life Sciences in general, are constantly discovering new facets of life. While some old questions remain unanswered, new questions also arise.

- How could life, that game between order and chaos, start?
- Why do cells replicate themselves?
- Are cells intelligent?
- How can cells regulate 20,000 and more genes?
- What in the cell organises the switching on and off of genes in accordance to environmental stimuli?
- Epigenetics hints on Lamarckian evolution, mutation on Darwinian; is life evolving in a rather Lamarcko-Darwinian way?
- What induces functional and structural unity in a multicellular organism?
- What gives form e.g. to a flower, a fish, or an ear?
- Do we sufficiently describe how enzymes find their substrates when about 10,000 different enzymes are at the same time 'looking' for their substrate?
- Are the fields of the cell inherited?
- What is the role of the field of the cell, e.g. for wound healing, neuronal signal processing, tumor formation and cell transformation?

A model of life that (i) considers cells only as a kind of random beakers where molecules bang into each other, and (ii) assumes random mutations on the DNA-level may probably never have the potential to answer these questions. Evidence for this being true is that the hundreds of years old question of what is giving form to life has still not been answered so far. Why this might be so is suggested with an analogy. If we were assuming any solar system to exist without gravitational and electrodynamic fields, such a solar system with its dynamic form could not exist. What gravity and electrodynamic fields are to solar systems, the fields are to the cells. These fields play a significant role in life and hence are part of the answer. We know that fields (i) can influence chemical reactions, (ii) affect gene expression, (iii) play a role in cell migration and positioning, (iv) regulate cell division rates, (v) induce epigenetic alterations, (vi) play triggering roles in regenerative processes, (vii) can induce long-distant interactions among molecules, (viii) and – last but not least – are assumed to play an essential role in form giving processes. Here, the term 'field' is mainly used in singular form. However, e.g. electrostatic membrane potential, ROS-induced reactions, cytoskeleton vibrations are all expressions of what is summarised with the term electrodynamic field, shortly ascribed here as the field(s) (see definition above).

The Hurdles

The biggest hurdle to explain why there is not already much investment in the research of the fields of the cell is seen in the models. They explain life mainly as random events of probability from molecules to organisms. Seeing a cell as more than a bartender's shaking beaker demands you to incorporate the discoveries in bioelectromagnetics and photobiology into the concept. This is not easy! It demands many hours of investment, hours which only young scientists might be able to find, for any established group cannot afford to change the so far successful model. It needs courage to reject or enlarge, in respect to an old model. It is more comfortable to back the old, (which is still a winning horse) – the prize however, is that we can only pretend to look for the answers to some of the great questions. In other words, we must invest in research without the immediate pay-off. It is about life. It is about us.

The Significance and the Potential

Studying the fields of the cell is of the highest significance. First of all, it is not a variation of what we do already but is adding what we may call the essence of matter. Such research can be undertaken today with tremendous insight into the potential of cells. The fields can also be seen as the potential of what leads to observable cell kinetics.

Once we understand how cells electrodynamically interact and what the effects are, we can develop devices that copy the signals and affect cells in similar ways. This will add to existing non-invasive devices where people experience an improvement in their state of health, in ways we may not yet comprehend.

Once we start teaching quantum biology, i.e. describing life as a vibrating phenomenon it will become easier to collate and unify alternative explanations and principles. Such thoughts are far from being trivial as they bare a socio-political component: the unification of all of us. Yet this is not because of wishful thinking, but because we can learn from life with very pragmatic approaches – investigating the fields of the cell – how life creates unity among trillions of cells that belong to a single being like man for example.

We may learn that cells need their fields in their decision making processes and start seeing them as quantum computers that are already realised by nature. In combination with devices we may sooner or later literally communicate with cells.

In summary, the current models of life are still in the 19th Century. When people had to communicate with each other they used matter (a letter). Nowadays, we are in the early stages of harnessing electrodynamics (with smartphones) to inform each other by sending electromagnetic waves. Cells have always done this. Why not learn from them?

Addendum: There are not as many students studying Natural Sciences as we would like. Maybe this is because the thinking models of Natural Sciences do not relate with how the younger generation experience the world: wireless. However, we believe that studying the fields of the cell can be so attractive that in the near future we will find many more enthusiastic young people wanting to join.

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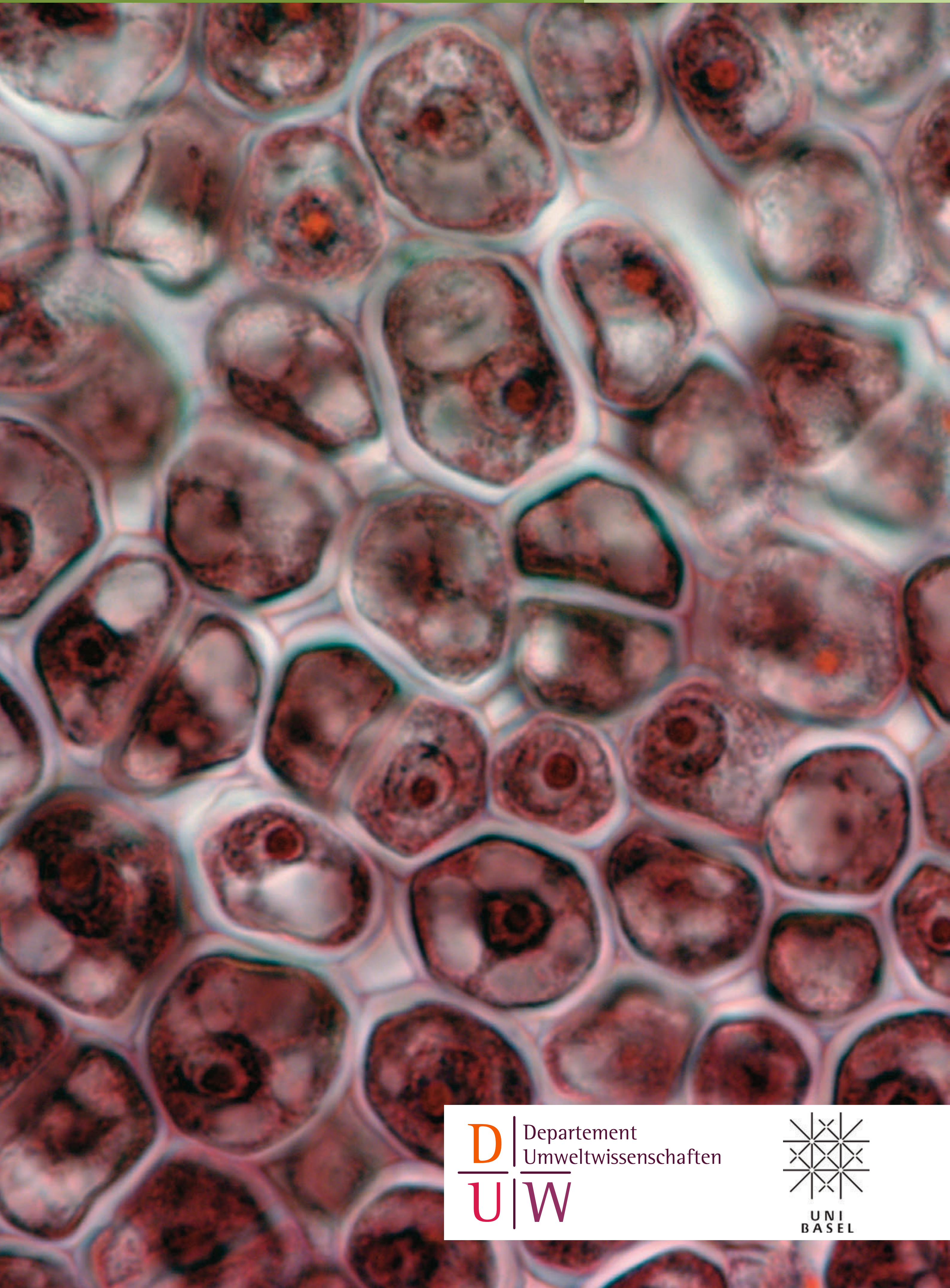

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