

## Editorial

### *Living Communication*

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# Tributes to pioneers in bioenergetics - wandering in the garden of memories

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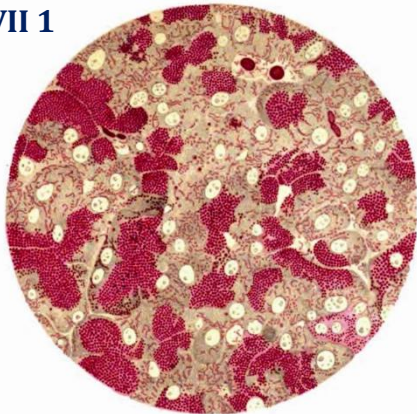
Renowned scientists are invited to contribute to the BEC Series on *Tributes to pioneers in bioenergetics*. Scientists and students should be alert to the intellectual and experimental legacies that shape our contemporary ways of thinking. *Tributes to pioneers in bioenergetics* offer a fresh perspective on concepts in a state of flux, contrasting with fixed paradigms that often distort when ignored. Unlike traditional Special Issues with finite closure dates, the BEC Series extends a perpetual invitation for authors to contribute their manuscripts to the 'garden of memories' - *Living Communications*. This unique series serves as an enduring educational resource, offering profound insights into the minds and lives of bioenergetics pioneers. Thus, *wandering in the garden of memories* becomes an essential journey for all who seek to navigate the ever-changing landscape of scientific discovery.

Who qualifies as 'pioneer'? A documentary record reflects bias in scientific history: lack of compensation for unequal gender opportunities, science networks centered on Europe and North America. How do we define the field of bioenergetics? Bacteria, mitochondria, and chloroplasts: energy transformation by *bioblasts* is the core of bioenergetics.

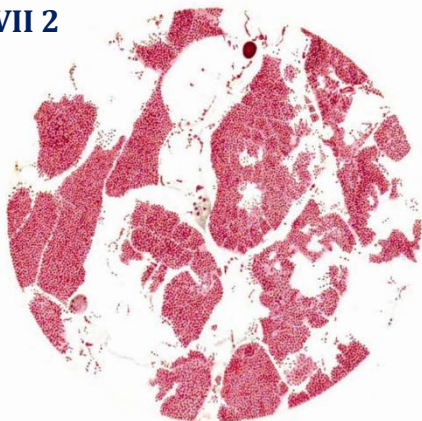
Richard Altmann may be recognized as a true pioneer who proposed the bioblasts as the '*morphological unit of living matter*' - the taxonomic unit of bioenergetics, including the mitochondria as they were called later (Benda 1898). Altmann (1894) observed osmium-fixed 'granula' in prokaryotes and eukaryotes, compared them to symbiotic and free-living bacteria, and described them as: '*The protoplasm is a colony of bioblasts. Microorganisms and granula are at an equivalent level and represent elementary organisms, which are found wherever living forces are acting, thus we want to describe them by the common term bioblasts. In the bioblast, that morphological unit of living matter*

appears to be found' (Figure 1). Endosymbiotic theories (Margulis 1970; Martin, Kowallik 1999; Baedke et al 2020) link the mitochondria and plastids to their free-living ancestors. Consequently, the mitochondrial and chloroplast identity is organismic, distinct from an organelle (Gnaiger 2022): they are bioblasts, they '*represent elementary organisms*'. Nick Lane takes the historical record on the endosymbiotic theory even further with reference to Leewenhoek (1677): '*Leeuwenhoek's comparison with bacteria leaves open the tantalizing possibility that he had even seen organelles such as mitochondria, which with a diameter of 0.5–1  $\mu\text{m}$  would have pushed his microscopical resolution to the limits*' (Lane 2015).

VII 1



VII 2



**Figure 1. Richard Altmann (1894): Tafel VII 1 Pankreas der Maus. VII 2 Wurzelknöllchen von *Coronilla glauca*.** - Panel VII 1: Pancreas of the mouse, osmium mixtures. Panel VII 2: Intracellular symbiotic bacteria in root nodules of *Coronilla glauca* (leguminous plant). This introduces a phenomenological link between intracellular symbiotic bacteria and the mitochondria '*at an equivalent level*'.

Renowned scientists pay 'Tributes to pioneers in bioenergetics', to properly expand the recognition of pioneers and their vital contributions to science and humanity.

Books have been written with historical records of the lives and achievements of eminent scientists, such as Peter Mitchell (Prebble, Weber 2003), Lynn Margulis (Sagan 2012), or Hans Krebs (Lane 2022). To broaden the historical account and beyond memorials honoring the scientific legacy of bioenergeticists, *Tributes to pioneers in bioenergetics* will present a variety of articles that link personal memories to current research, with reference to published retrospectives (e.g., Azzi A, Kresge 2011; Dutton 2010). This may make a *Tribute* act as a crystallization point and as such attract brief recollections, comments and anecdotes. Sentences, short stories, anecdotes, and recollections may result in the creation of a mosaic that best illustrates the personality to whom a tribute is due.

The BEC Series *Tributes to pioneers in bioenergetics* is at its beginning - [https://www.bioblast.at/index.php/Tributes to pioneers in bioenergetics](https://www.bioblast.at/index.php/Tributes%20to%20pioneers%20in%20bioenergetics) (retrieved 2024-05-12). This is a call to scientists, to elect your 'pioneer' and join us *wandering in the garden of memories*. This Editorial is a *Living Communication* (Gnaiger 2021), which will be updated periodically to summarize the newest contributions to *Tributes to pioneers in bioenergetics*.

Meandering down diverse paths by different persons has the potential to weave together an unparalleled tapestry of memories, forming a mosaic of anecdotes, narratives, and phrases that enrich the overarching story and infuse it with a deeply human essence.

## References

- Altmann R (1894) Die Elementarorganismen und ihre Beziehungen zu den Zellen. Zweite vermehrte Auflage (The Elementary Organisms and Their Relationships to the Cells. Second Extended Edition). Verlag Von Veit & Comp, Leipzig:160 pp.
- Azzi A, Kresge N (2011) Retrospective: Britton Chance (1913 – 2010). *Free Rad Biol Med* 59:1019-20. <https://doi.org/10.1016/j.freeradbiomed.2011.02.009>
- Baedke J, Fábregas-Tejeda A, Nieves Delgado A (2020) The holobiont concept before Margulis. <https://doi.org/10.1002/jez.b.22931>
- Benda C (1898) Weitere Mitteilungen über die Mitochondria. *Verh Dtsch Physiol Ges*:376-83.
- Dutton PL (2010) Retrospective. Britton Chance (1913-2010). *Science* 330:1641. <https://doi.org/10.1126/science.1200976>
- Gnaiger E (2021) Beyond counting papers – a mission and vision for scientific publication. *Bioenerg Commun* 2021.5. <https://doi.org/10.26124/bec:2021-0005>
- Gnaiger E (2022) Bioblasts - the taxonomic unit of bioenergetics: mitochondria, aerobic bacteria, chloroplasts. *Bioblast 2022: BEC Inaugural Conference*. In: <https://doi.org/10.26124/bec:2022-0001>
- Lane N (2015) The unseen world: reflections on Leeuwenhoek (1677) 'Concerning little animals'. *Phil Trans R Soc B* 370:20140344. <https://doi.org/10.1098/rstb.2014.0344>
- Lane Nick (2022) *Transformer: the deep chemistry of life and death*. Profile Books:400 pp.
- Leewenhoek A (1677) Observation, communicated to the publisher by Mr. Antony van Leewenhoek, in a Dutch letter of the 9 Octob. 1676 here English'd: concerning little animals by him observed in rain-well-sea and snow water; as also in water wherein pepper had lain infused. *Phil Trans* 12:821–31. <https://doi.org/10.1098/rstl.1677.0003>
- Margulis L (1970) *Origin of eukaryotic cells*. Yale University Press New Haven.
- Martin W, Kowallik K (1999) Annotated English translation of Mereschkowsky's 1905 paper 'Über Natur und Ursprung der Chromatophoren im Pflanzenreiche'. <https://doi.org/10.1080/09670269910001736342>
- Prebble J, Weber B (2003) *Wandering in the gardens of the mind. Peter Mitchell and the making of Glynn*. Oxford Univ Press.
- Sagan D (2012) *Lynn Margulis: the life and legacy of a scientific rebel*. Chelsea Green Publishing:205 pp.

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