Beauty is (not) only skin deep: Ecobiology explained

If you met some ecobiologists, what would they tell you about the field? Would they point to its interdisciplinary approach, or to a focus on the health of the whole organism, or perhaps to its ultimate goal, advancing human well-being?

Such were the questions—from the nitty-gritty of research to the philosophical—that consumed scientists gathered at the ecobiology summit, held April 18–19 in Split, Croatia. They were meeting to thrash out a definition for ecobiology and to assess the impact it could have on human health. Ecobiology, say its proponents, is an approach that investigates the interconnections and communication between cells, and between cells and their external environment.

For Errol Friedberg, emeritus professor of pathology at University of Texas Southwestern Medical Center in Dallas, that raises the question, “Why don’t we just stick with integrative biology, with what is axiomatic of all biology?”

Molecular biologist Miroslav Radman, one of the conference organizers, sees ecobiology as “more a vision, a movement. Do we even need a sharp definition?” he asks. “Results and new knowledge will eventually arrive independent of the buzzwords used.”

Skin in the game: Skincare teams up with cancer research

Radman’s collaborator, Jean-Noël Thorel, a pharmacist and founder of the skincare group NAOS, has been talking about an ecobiology—or holistic—approach for several years. His philosophy is centered on human well-being, and on an ethical approach to business. “I see so many new products that have absolutely no use,” he says. “The skincare industry should strive to innovate to be useful.”

He wants ecobiologists “to create new products that will allow us to help the skin to adapt to our environment,” he insists.

Whether a science or not, could ecobiology be a useful approach to tackling some of the big issues in human health, beginning with aging? Radman comments that much research has been focused on diseases of aging as opposed to the aging process itself. Too much of the science is concerned with treating the consequences rather than trying to understand the causes, he asserts.

The body has many mechanisms to repair and maintain cells, and yet aging still occurs. The key to unlocking treatments to extend healthy life may come from extensive research on mechanisms that provide protection against protein damage, which are being studied in fields such as cancer research.

The conference heard from Peter Karran, a former principal scientist at the Francis Crick Institute in the United Kingdom, whose focus has been on skin cancer. Karran points out that because the skin provides a barrier between us and our environment, it is “exposed to threats not seen by other cells in the body—the most obvious example is sunlight. This is in addition to the internal threats [of] water and highly damaging oxygen that affect all cells.” Humans have sophisticated mechanisms that recognize and repair DNA in order to prevent mutations. But repair is imperfect and mutations accumulate with age, occasionally leading to skin cancer.

Proteins, which carry out all cellular processes, are also vulnerable to damage from oxygen. Earlier research by Radman and others suggests that some proteins, including those expressed from mutated genes, are particularly vulnerable to misfolding and oxidative damage. Karran’s work with cells from patients displaying accelerated photoaging builds on this finding. He posits that mutations accumulated over time, which fuel the inevitably growing burden of oxidized proteins, contribute to the functional decline seen in aging.

“If the chemistry of the biological clock is damaging to proteins, then there is no reason we cannot control this—it’s just a matter of time,” says Radman. “Diseases are the weak links that determine whether you die of cancer or a heart attack. [There’s] no reason not to have hope that we can identify these weak points.”

Working out how to stimulate and protect these repair mechanisms will have broad application. But within NAOS, the focus is on the skin: The goal is to find molecules that can be used in skin treatments that will stimulate the natural repair and protection mechanisms cells have evolved. The ideal product will help the skin function better.
Meeting of minds

The complexity of the skin ecosystem and its interaction with the skin microbiome is what drives Thorel to argue for a multidisciplinary approach to skin care. His quest to have science inform product development—a philosophy shared with Radman—has prompted him to invest in Radman’s Mediterranean Institute for Life Sciences (MedILS), located in Split, Croatia. Set up more than 10 years ago, the institute was the first in continental Europe dedicated to the biology of aging and age-related diseases, says Radman. Now the two hope to attract young scientists to this very practical challenge, and Thorel plans to launch a scholarship in ecobiology. MedILS currently has around 20 scientists engaged in understanding the role of protein stability in longevity, and how the biological “robustness” of bacterial species that survive extreme environments could be applied to improve human health.

Thorel’s investment funds both pure and applied research. François-Xavier Pellay is the researcher charged with identifying commercial prospects for new molecules. Pellay—with his background in biology, chemistry, biochemistry, and bioinformatics—embodies the multidisciplinary approach Radman and Thorel advocate.

“Our goal is to turn brilliant ideas into something that can be applied to the skin ... we know the targets are proteins, so [our approach is] ‘how do we protect these proteins?’” explains Pellay.

One strand of research is particularly promising. Pellay has been exploring the mechanisms that a species of cold- and ultraviolet (UV)-resistant bacteria uses to protect its proteins from oxidation.

His team tested very specific molecules belonging to the carotenoid family, isolated from the bacteria. Carotenoids, which originally evolved in plants, are very good at capturing reactive oxygen species. Pellay’s unpublished research suggests that the isolated carotenoid molecules he tested bind to proteins, functioning as antioxidants while also protecting the proteome of human skin cells against stress such as UV light and pollutants.

It may be many years before this avenue of research delivers advances in skincare or even helps push back the ravages of aging. Will ecobiology then be recognized as a science? For Radman and Thorel, the answer is perhaps not that important, as the field already provides a methodological approach, both to the acquisition of knowledge through the cross-fertilization of scientific research, and to commercial applications aimed at advancing human well-being.

This approach was evident when Thorel launched his first product—for sun protection—in the late 1970s. While most cosmetics companies were working on products with high sun protection factors (SPFs) or oils to help tanning, Thorel chose a molecule that would trigger the skin to produce the pigment melanin. Melanin gives some protection against damage from sunlight.

Under the skin: Reexamining ingredients and investigating microbiomes

NAOS’s three brands—Bioderma, Institut Esthederm, and Etat Pur—are billed as ecobiology in the service of dermatology, aesthetics, and personalized skincare, respectively.

“We consider the skin as an ecosystem because it is composed of different kinds of cells, each with their own specific environment. They continually interact with each other, and with our environment,” explains Aurélie Guyoux, director of R&D for NAOS.

With that in mind, NAOS carefully selected just 600 of the more than 30,000 ingredients frequently used in modern cosmetics. “We looked at the structure of these ingredients, [and asked:] are they identical to molecules already found in the skin? If the skin recognizes them, they will be better tolerated and help to restore skin health,” asserts Guyoux. Moreover, with skin sensitivity on the rise, NAOS wants to reduce skin “pollutants,” she explains.

NAOS has plans for some relaunches of its products, especially those designed for sensitive skin, in light of new discoveries about interaction and communication between skin cells as well as the interaction of skin cells with the skin microbiome. Eric Perrier, Innovation director for NAOS, points out that “cell-to-cell interactions are complicated enough, but we now have another layer of communication between the skin cells and microbiome as well as between the bacteria in the microbiome themselves.” Changes in the environment (such as pollution) cause alterations in the microbiome, as will drugs used to treat skin conditions, explains dermatologist Brigitte Dréno. She heads the Department of Dermatology at the University Hospital of Nantes. Dréno anticipates that the concept of stratified medicine will inform the development of personalized probiotics that will help to maintain the health and function of the skin microbiome.
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