

# SEED

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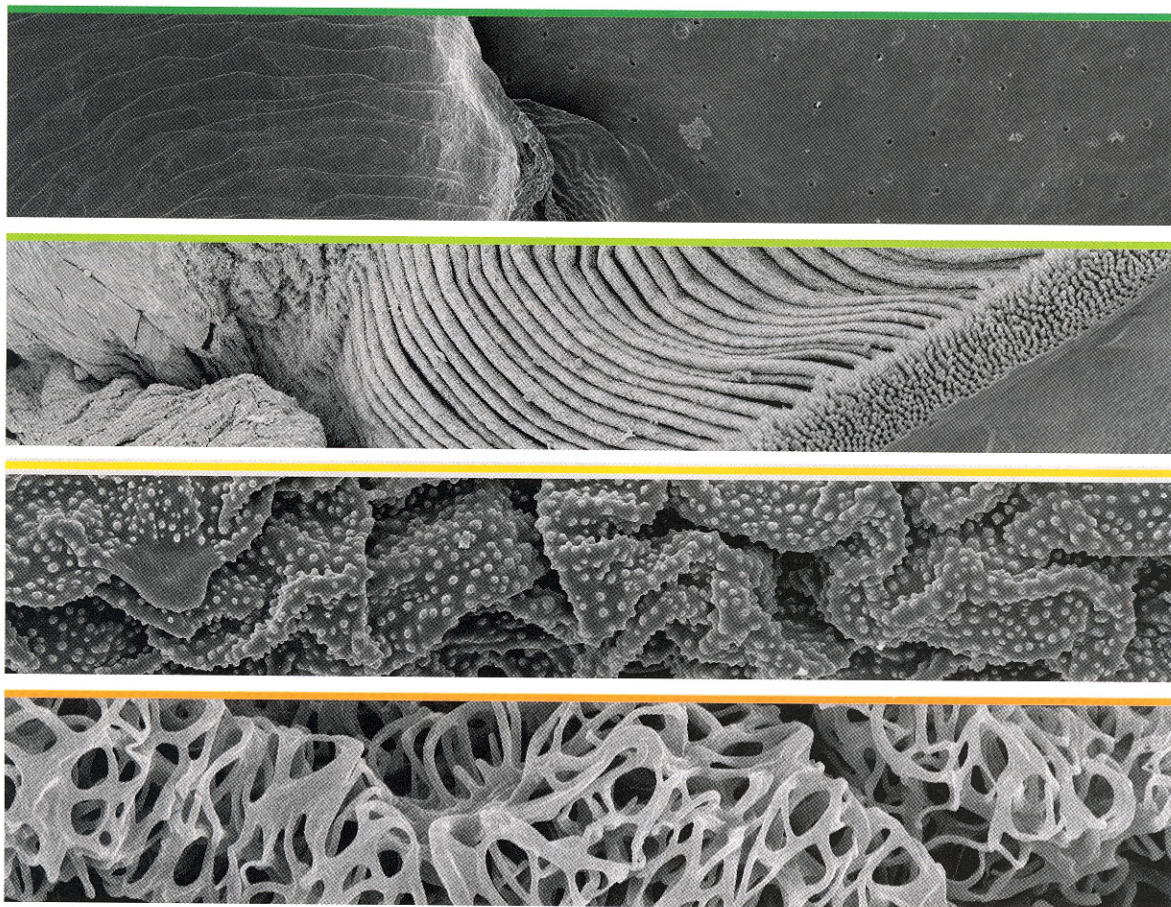
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No one had studied arachnid “book lungs” in depth for more than 75 years when Carsten Kamenz of the Humboldt University of Berlin, then a master’s student, turned his electron microscope on the miniature caverns in 2003. What he found was a landscape of sere, alien beauty—canyons and beaches of chitin that, at higher magnifications, split into thin pages fringed with lacy arches and carpeted with mushroom-like structures. The slender pages, or lamellae, protruded from the walls of their chamber in a stack, like a dictionary left lying open on a table.

The scorpion book lungs Kamenz saw are the remnants of book gills that retreated into sheltered cavities to escape the sucking dryness of air. Resolving a longstanding conflict, Kamenz’s studies confirmed three years ago that book lungs evolved from gills only a single time in the ancestors of arachnids. As in book gills, the lungs’ pages are full of scorpion blood—hemolymph—which circulates freely throughout the body and picks up oxygen through the thin walls of the lamellae. To keep air circulat-

ing, thick veins or rods prop the fragile pages apart. Even a grain of sand could damage them—their frilled edges likely catch such particles before they can get wedged between the pages. At the chamber’s opening, a maze of chitin may serve a similar purpose, keeping debris out when the hatches are battened down against blowing sand.

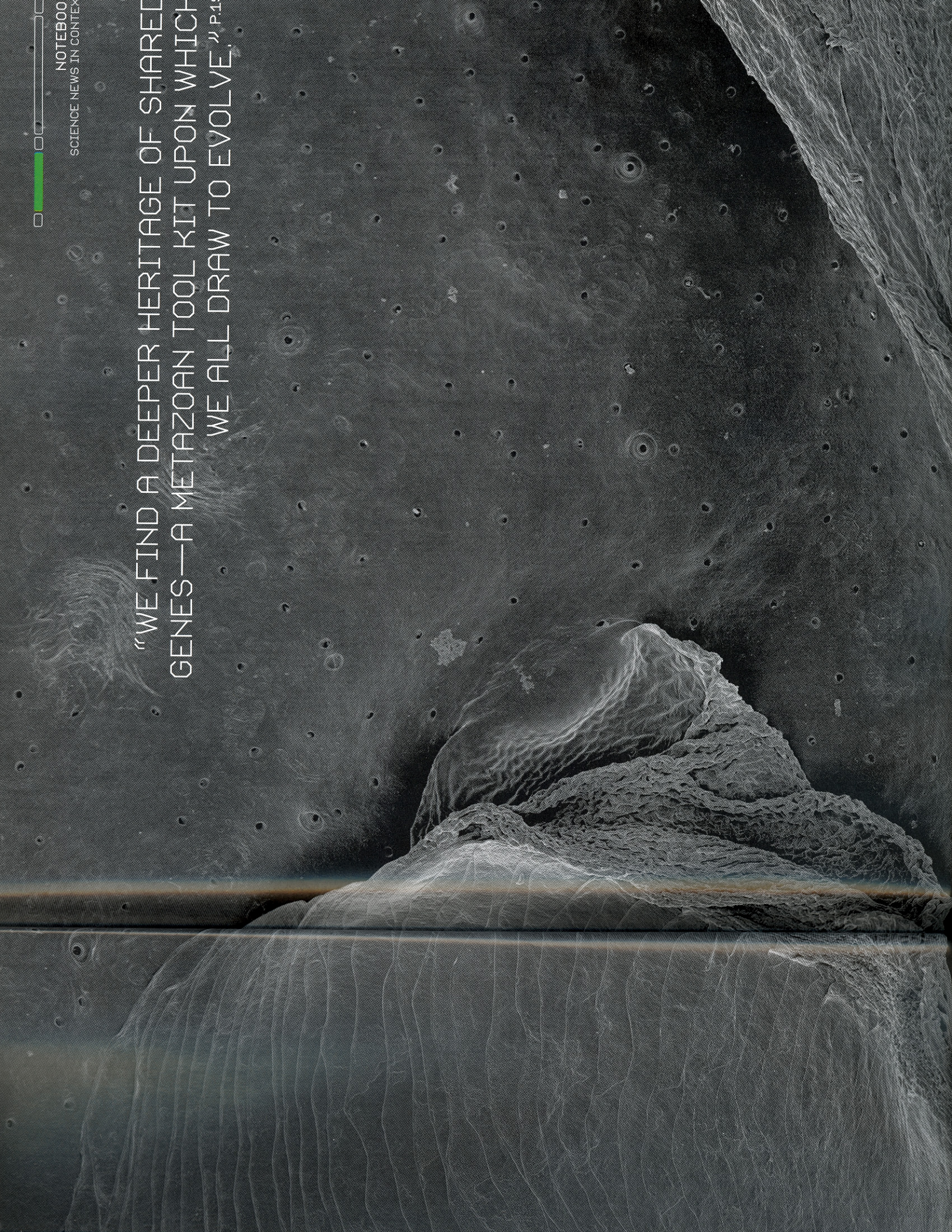
**A LIBRARY OF LUNGS** Scorpion “book lungs” are revealed in a series of scanning electron micrographs.

The immense variety of forms Kamenz uncovered with his microscope will enable scientists to trace the evolution of book lungs—and through them, the relationships among more than a thousand scorpion species. With Lorenzo Prendini of the American Museum of Natural

History, Kamenz surveyed lung structures across the entire Scorpiones order. He now seeks to uncover what the lungs of arachnids’ common ancestor looked like—thin bridges may have connected the edges of the lamellae, joining them as that primordial creature would have bridged water and land.



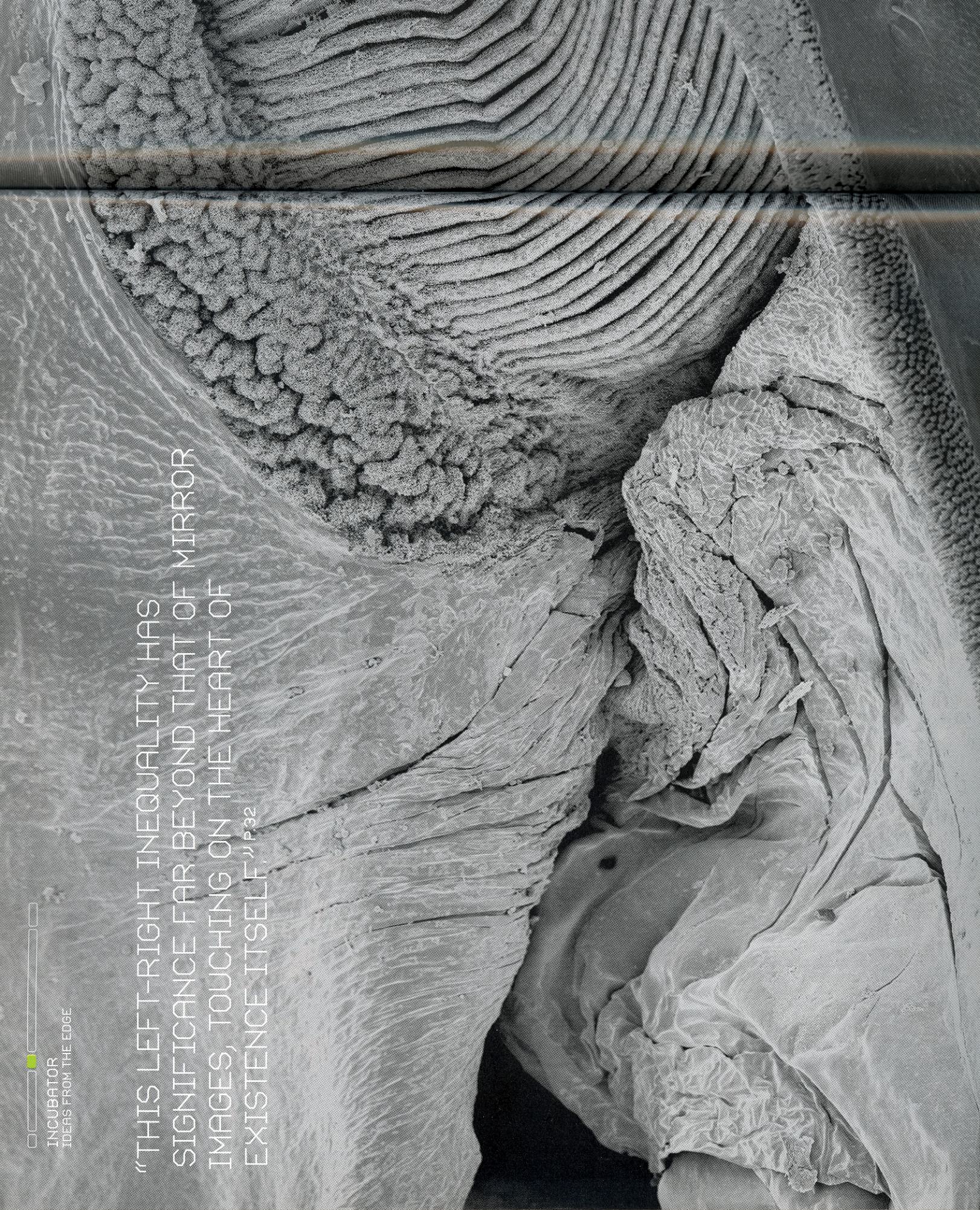
"WE FIND A DEEPER HERITAGE OF SHARED GENES—A METAZOAN TOOL KIT UPON WHICH WE ALL DRAW TO EVOLVE." P.11



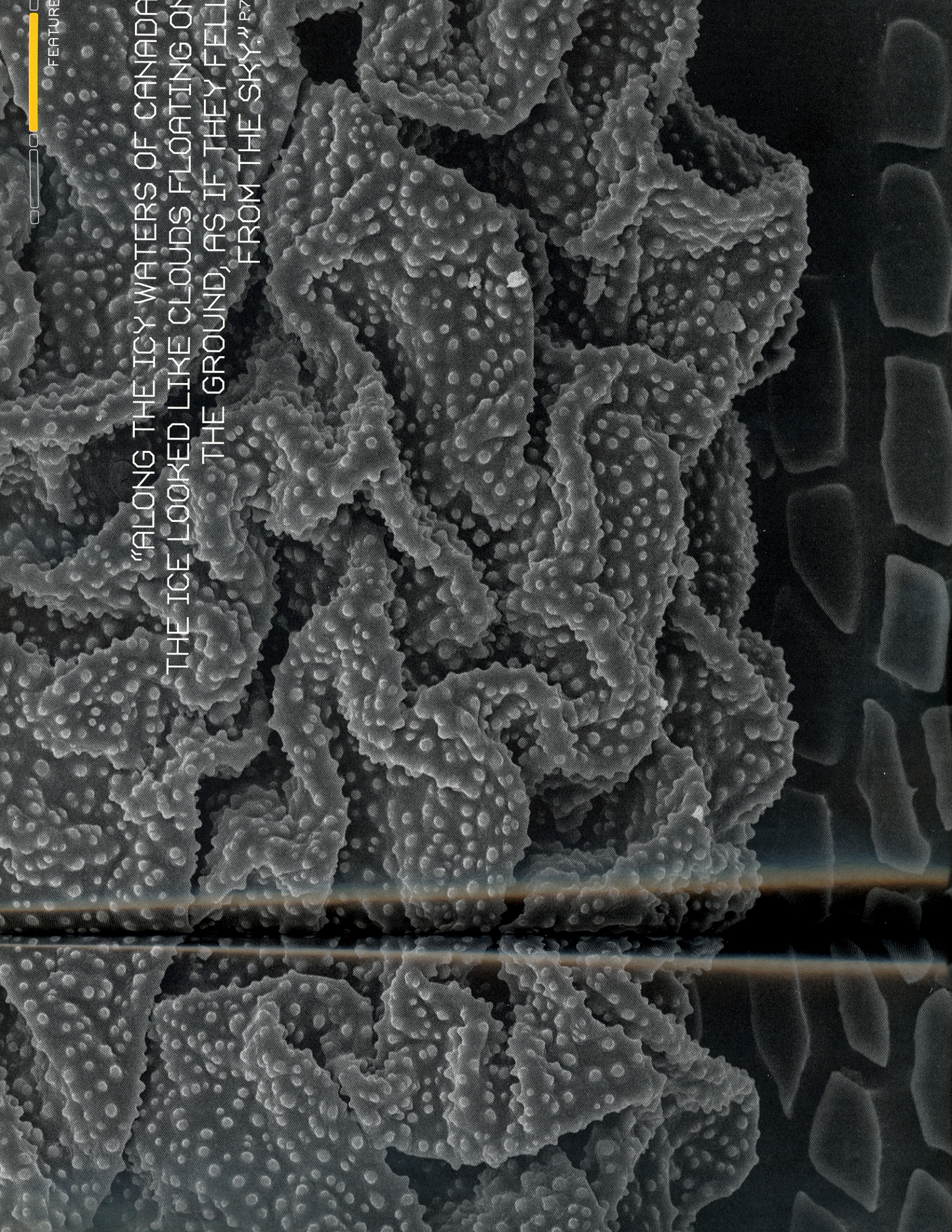


INCUBATOR  
IDEAS FROM THE EDGE

“THIS LEFT-RIGHT INEQUALITY HAS  
SIGNIFICANCE FAR BEYOND THAT OF MIRROR  
IMAGES, TOUCHING ON THE HEART OF  
EXISTENCE ITSELF.” P32



"ALONG THE ICY WATERS OF CANADA  
THE ICE LOOKED LIKE CLOUDS FLOATING ON  
THE GROUND, AS IF THEY FELL  
FROM THE SKY."<sup>R27</sup>



NUMERISM IS THE SEA OF MODERN  
E AND WE ARE THE PLANKTON—  
PLESSLY TUMBLED AND SWIRLED  
FORCES WE CAN FEEL BUT  
IT UNDERSTAND.” P.76

