systems of the Ugandans faced many more assaults from diseases such as tuberculosis, malaria, and helminthic infections. "When the patients become infected, in a sense they're already behind the eight ball."

A growing cadre of HIV researchers now working on a cure presented some of the most intriguing—if early stage—results. The only cured person, Timothy Brown, had his immune system destroyed to combat leukemia and then replaced with bone marrow transplants from a donor who had blood cells that were naturally resistant to the virus. Brown stopped taking ARVs more than 5 years ago, and the virus—if it's even in his body—remains at bay. Timothy Henrich of Beth Israel Deaconess Medical Center in Boston reported two patients who could mimic Brown but for now fall short of being cured.

Henrich's patients both had Hodgkin's lymphoma and received bone marrow transplants from donors. Unlike Brown, the donors did not have HIV-resistant immune systems, but since the transplants, neither patient has had detectable levels of HIV on the most sensitive blood tests available. Henrich cautioned that the patients are still on ARVs and that they have not had their tissues analyzed for the virus, which often can harbor HIV when it's undetectable in blood. Transplants are not a widely applicable intervention, but they bolster the field because they prove that cures are possible.

At the closing ceremony, former U.S. President Bill Clinton stressed that many difficult questions remain, but he encouraged those in the field to keep their aspirations high. "All of you have created the possibility that we could have an AIDS-free generation," Clinton said. "You may think this is naïve, but I've seen it over and over again: If you build it, they will come. If you scale it up and it works, the money will be there to fund it."

**–JON COHEN**

DEVELOPMENTAL BIOLOGY

# Multicellularity Driven by Bacteria

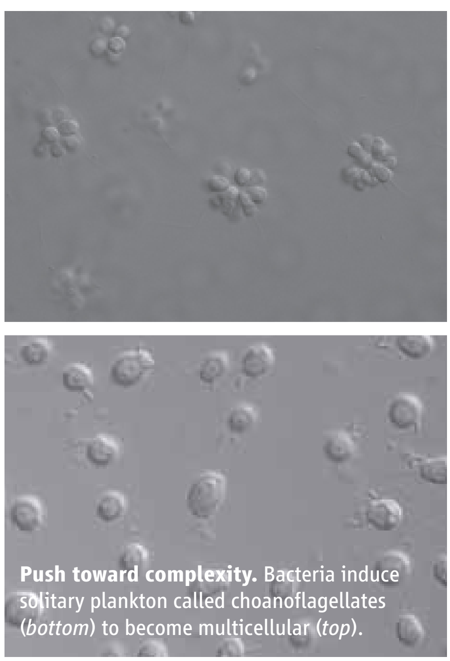
**MONTREAL, CANADA—**When taking a dip this summer you will probably swallow tens, possibly hundreds, of microscopic plankton called choanoflagellates. These common organisms have led to an uncommon insight into how multicellular organisms might have evolved. Bacteria can prompt single-celled choanoflagellates to divide into multicellular versions of themselves, University of California (UC), Berkeley, biologist Nicole King reported last week here at the 71st annual meeting of the Society for Developmental Biology. King hopes the work will prompt biologists to look more closely at the role of microorganisms in the evolution of multicellularity.

To the untrained eye, choanoflagellates look like animals. But they are less complex—the closest living relatives of animals but on an older branch of the tree of life. As such, these organisms can provide clues about what early animals looked like and can help reconstruct the events from more than 600 million years ago that led to the incredible diversity of the animal kingdom.

Choanoflagellates exist as solitary cells or rosette-shaped colonies. King had shown in 2010 that colonies are not simply aggregates of single-cell choanoflagellates but an interacting cluster that forms after a single cell divides. This finding convinced many biologists that the mechanisms for making multicellular organisms existed before the origin of animals.

To investigate the transition to colony life, King decided to sequence the genome of a colony-forming choanoflagellate and compare it to the genome of a unicellular individual. But before sequencing, she asked undergraduate Richard Zuzow to purge the sample of everything but the plankton itself. When Zuzow added antibiotics to get rid of any bacteria, the choanoflagellate colonies disappeared. At first, "I didn't believe him," King recalls. But with repeated tests, she became convinced that "the bacteria are the important part of the [multicellular] story," she says.

She investigated further. Of the 60 bacteria cultured from the original choanoflagellate sample, only one—a bacterium called *Algoriphagus machipongonensis*—induced colony-forming behavior. Focusing on this species, and enlisting the help of chemist Jon Clardy's lab at Harvard Medical School in Boston, King cleaved the bacterium into its constitutive parts—membrane, cytoplasm, cell envelope—and exposed the choanoflagellates to each one. "The cell envelope was highly potent" in inducing colonies, King reported. Within the envelope, she and her colleagues homed in on a molecule called RIF-1, identified as a colony-inducing molecule. It belongs to a class of molecules called sulfonolipids, which typically regulate cell differentiation and migration, among other processes.



**Push toward complexity.** Bacteria induce solitary plankton called choanoflagellates (*bottom*) to become multicellular (*top*).

King plans to see if RIF-1 plays a similar role in other animals, such as sponges, that closely resemble early animals. "The transition to [studying] sponges will be a tough one," says developmental biologist William McGinnis of UC San Diego. There are few molecular tools to study choanoflagellates, fewer still in sponges. Yet, as simple animals, sponges are the next obvious place to look for evidence that bacteria played a role in the evolution of animal multicellularity.

"[Multicellularity was] a critical step in the evolution of animals because it allowed the division of different cell [functions]," which ultimately led to more complex life forms, McGinnis says. But whether bacteria are responsible for similar development in animals "remains to be seen."

McGinnis says he was "astonished" that bacteria would trigger a developmental switch to multicellularity at all. He, like King, suspects that the choanoflagellates have evolved to sense the presence of the bacteria because the microbes are their main source of food. By forming a colony, the plankton make themselves more efficient predators, he notes.

**–JENNIFER CARPENTER**

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