splits up, there's a good chance that the fates of the "extra" copies in the two resulting groups will diverge. In one group, one copy might jump to a new chromosome, while in the other, the copy might move to a different spot in the genome. If the populations merge again, these gene shifts will have made their genomes incompatible. Individuals from the two groups could still mate, but this incompatibility would likely make their offspring less fit.

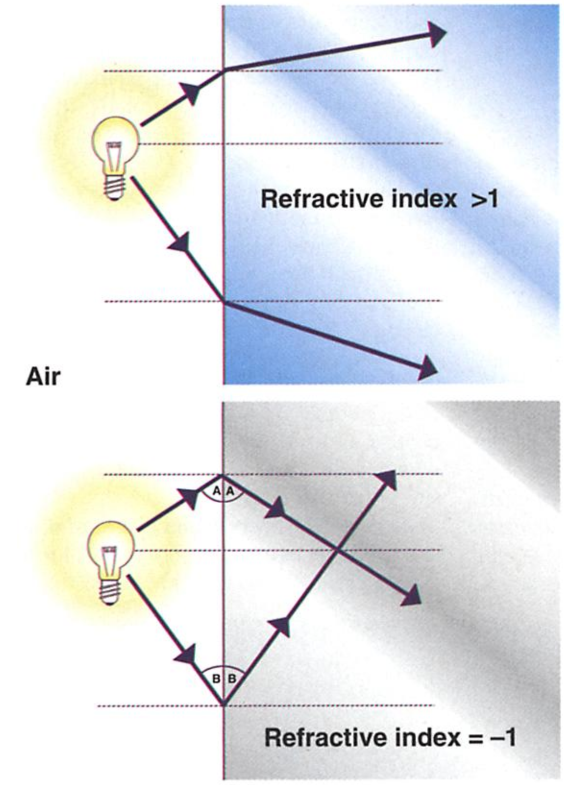
But several researchers question how Lynch and Conery came up with their duplicate genes and worry about some of the resulting estimates. Manyuan Long, an evolutionary biologist at the University of Chicago, thinks that their analysis doesn't adequately take into account the long-lived gene copies, many of which also exist in these genomes.

Even if the estimates are rough, counters Wagner, "for my work, they are very, very relevant." And he expects that others will take these results as starting points for their own work: "We can plug these estimates into models [to study] the evolution of many interesting things."

—ELIZABETH PENNISI

THEORETICAL PHYSICS

Offbeat Lenses Promise Perfect Fidelity



Sharper image. Negatively refractive materials that bend light in exotic ways *(bottom)* could make perfect lenses, calculations show.

A battleship spied by periscope, a kestrel watched with binoculars, a nebula under the Hubble Space Telescope's gaze: What do these images have in common? None faithfully represents the real thing. A seemingly ineluctable property of any lens is that it cannot focus all wavelengths of light shed by a distant object. What's viewed, therefore, is to some degree a washed out, grainy version of the original. But now a British physicist has found an ingenious solution that lights the way to building a perfect "superlens." That notion has set other experts abuzz. "This is kind of amazing," says Eli Yablonovitch, a physicist at the University of California (UC), Los Angeles. "It's a real theoretical breakthrough."

Most of the time, light travels in an arrow-straight line. But when a beam passes from one material into another, its speed changes, causing it to veer in a slightly different direction. The amount of bending depends on the refractive indexes of the two materials—roughly speaking, measures of light's speed in those materials. By shaping a lens just right, opticians can exploit this bending to make rays converge at a point beyond the lens. But even the best conventional lenses are unable to focus all the light rays; some wavelengths are inevitably lost.

Some deft calculations, however, point to the surprising conclusion that it doesn't have to be that way. Physicist John Pendry of Imperial College, London, used Maxwell's equations—the basic laws governing electromagnetic waves—to examine the behavior of individual wavelengths of light as they pass through a lens. A distant object is blurry because various wavelengths get out of step, like a collection of metronomes, once in sync, that start beating at different tempos. "The function of the lens is to correct that phase difference," says Pendry. It's as if the lens selectively slows each metronome so that the assembly can again sound off in lockstep: When the metronomes synchronize, the image comes into focus. But not all wavelengths can be salvaged. According to the equations, some waves evanesce before reaching the focal point. That means the reconstructed image is missing some of the reflection's original components. Even with the best lens, details are lost.

But Pendry discovered a loophole in the equations. His insight was inspired by work described at a meeting of the American Physical Society last March by Sheldon Schultz and colleagues at UC San Diego. Most materials have a positive refractive index; the bigger the index, the slower light moves. The refractive index of air, for example, is 1; that of water, 1.33. Schultz's group found a way to make a material with a negative refractive index—one in which light bends in the opposite direction from the way it bends on entering a glass lens.

Pendry calculated that evanescent waves are not lost when passing through a hypothetical material with a refractive index of –1. "It's a very strange property," he says. "The slab of material grabs hold of the evanescent waves and removes their decay" by shoring up the waves. "It is almost as if it acts as an amplifier," adds Yablonovitch. "It's a feat that is hard to believe." As a result, all the light waves passing through a negative refractive lens reach the focal point intact, preventing any loss of resolution and creating an image that perfectly duplicates the original. Pendry's calculations appear in the 30 October *Physical Review Letters*.

More conventional materials might also make perfect lenses if other electromagnetic properties of theirs were tuned just right, Pendry says. He thinks a very thin film of silver could do the trick. But whatever its composition, a superlens would have drawbacks. For instance, to capture evanescent waves, the lens must be placed only nanometers away from the object being observed and would focus the image roughly the same distance from the lens. That scale isn't useful for naval warfare or bird-watching—let alone astronomy—but Pendry hopes that tiny superlenses will find uses in such pursuits as lithography and medical imaging.

—CHARLES SEIFE

CELL BIOLOGY

New Clues to How Genes Are Controlled

The transformation of a single cell into a complex organism requires an exact system for regulating gene expression. It wouldn't do, say, to have hormone-secreting cells make liver proteins, or even the wrong hormone. Cell biologists don't know exactly how developing cells achieve this precision, but they do know it involves so-called transcription factors—proteins that can turn genes on or off. Now, researchers have intriguing new information about how the transcription factor called Pit-1 works.

Pit-1 is needed to activate the genes for three hormones—growth hormone, prolactin, and thyrotropin—each of which is made by a different type of cell in the pituitary gland. But how Pit-1 turns on the right gene in each cell type without activating the other two has been a mystery. Work described on page 1127 by Kathleen Scully and Michael G.

ILLUSTRATION: CAMERON SLAYDEN