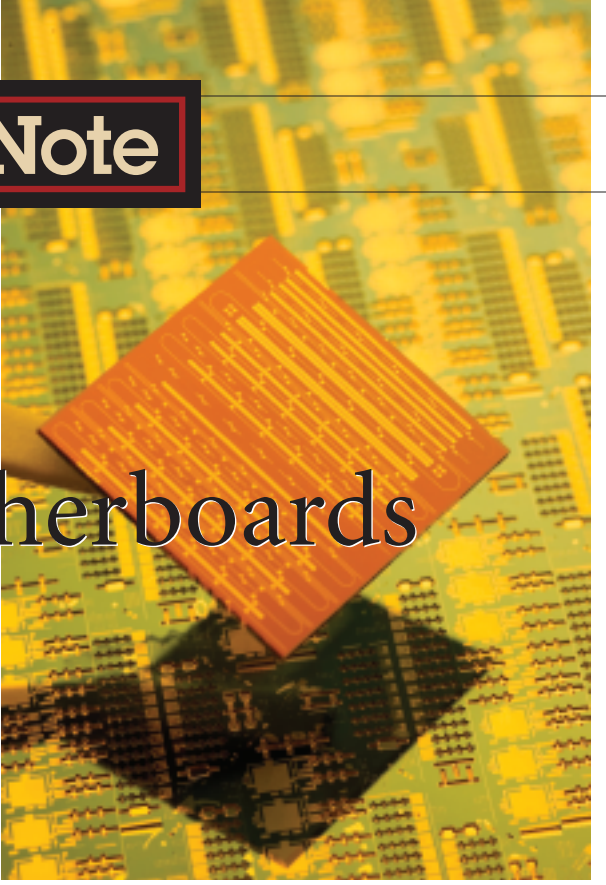

Twinkling Motherboards

The announcement in September from Intel and the University of California, Santa Barbara was seriously opaque: The chip maker and the university had "built the world's first electrically powered hybrid silicon laser using standard silicon manufacturing processes." The new chip removed "one of the last major barriers to producing high-bandwidth silicon photonics devices for use inside and around future computers and data centers." "Well, that's nice," you might imagine hearing as newsprint pages turned.

But this is worth a second look. Photonic computing uses light in place of electrons (electricity) and is faster by a factor of thousands. And it could change, even replace, computing as we know it.

Intel's new chip is revolutionary for two reasons. First, it combines Indium Phosphide, a material that emits light when you apply current to it, with silicon, which has the ability to see, route, and amplify light. This combination brings source and conductor together on the same chip. And because it's silicon-based, the chip can be mass-produced.

Understanding how the team created this hybrid almost requires a willful suspension of disbelief. The engineers used a "glass-glue" to fuse the two elements together to form a sandwich with a laser cavity. They started with electrically charged oxygen gas. They applied this low-temperature oxygen plasma as a layer on the surface of both elements. It's an impossibly thin layer, only 25 atoms thick, but when it's heated and pressed, it will bond (glass-glue) the two elements into a hybrid silicon laser.

Now if you could train light to do what electron flows can do (switch on and off for the 0s and 1s of computer logic), you might really have something for this chip to do—like store and compute.

Our conventional electronic computers are approaching end limits as power consumption demands increase and higher processing speeds cause problems with heat and accuracy. Photonic computing, on the other hand, uses photons, or light particles generated by lasers. Photons are faster than electrons. And there's a device that was created in 1989 at the Rocky Mountain Research Center that uses one light beam to turn another light beam on and off. It's called the photonic transistor, and it has inspired research in photonic computing.

John Bowers of UC Santa Barbara has been working with Indium Phosphide-based materials for decades, and he has achieved data transfer rates as high as 160GBs per second. Some believe optical switching will enable 100 terabit-per-second rates in the next 10 years. And just as today's computers use 64- and 128-bit position logic, researchers point out that visible light could permit 35 billion-bit positions. The horizon widens.

But before you turn the page here with a sigh and a "that's nice," just remember there are lasers running your CD and DVD players, printers, and barcode sensors. It might not be long before computers start taking some long steps in a landscape fashioned with similar lighted circuits on your computers. With the new laser chip, researchers now have all the parts. ■

PHOTOGRAPH: INTEL CORPORATION