few sounds, indicating a preoccupation with the way words sound.

Overall, the data suggest that no matter what their reading level, dyslexics do not easily connect letters to appropriate sounds within words, as good readers of all ages do, Bruck asserts. This deficit slows down reading and renders word comprehension more laborious, she says.

Dyslexics may harbor an inability to learn the associations between sounds and spellings, Bruck notes. Or they may learn these associations but fail to integrate sound and spelling knowledge rapidly while reading.

Dyslexics also displayed persistent problems with attaching letters to corresponding sounds in an unpublished study directed by pediatrician Sally E. Shaywitz of Yale University School of Medicine. But Shaywitz remains optimistic.

"Dyslexics can learn to compensate for this difficulty," she maintains. "We see remarkable progress in many adults who have been dyslexic since childhood and who are willing to work hard at becoming better readers." *— B. Bower*

Dimmer lasers brighten the photon's future

In efforts to create useful gadgets from the semiconductor layer cakes called multiple quantum well structures, researchers have already fashioned miniature lasers and optical switches that route information riding on light beams.

Now, in a significant advance, scientists at Purdue University in Lafayette, Ind., have decreased the intensity of laser light at which one such material allows light itself to change the rate at which it travels through the layers.

These so-called photorefractive materials have the ability to store holograms internally as a pattern of electrical charges. The patterns can hold a tremendous amount of information about an image projected into the crystal with laser light. This makes photorefractive materials ideal for use in the emerging technology of optical computing — controlling light with light.

Previous photorefractive materials required laser intensities 10 times greater than those demanded by the Purdue device. The new material's higher sensitivity to light bodes well for the use of photorefractive materials in optical computing, says physicist David D. Nolte, co-investigator on the Purdue project. "It means that the power requirements are way down, that you can use very low-power, low-cost, safe, compact laser diodes," he says.

Alastair Glass, a researcher at AT&T Bell Laboratories in Murray Hill, N.J., and co-holder of the patent on the material, characterizes the improvement in sensitivity as a welcome, though not unexpected, advance. These multilayer crystals, he says, "look like they're going to be the material of choice for image processing."

This is the first time researchers have demonstrated experimentally the low power requirements of the material, Nolte says. The Purdue team describes its results in the September Journal of the Optical Society of America.

In an ordinary material — glass, for example — intersecting beams of photons pass right through each other unperturbed. Photorefractive materials, however, allow researchers to modulate one light beam with another. In the device tested at Purdue, ultrathin semiconductor layers — the multiple quantum wells — confine photons, enhancing certain optical properties of the material.

The Purdue researchers demonstrated significant modulation at intensities comparable to the illumination in a dimly lit room. Moreover, the device redirects an unprecedented 10 percent of one beam's energy into the other. Nolte says this dual result — a high degree of modulation at a relatively low laser intensity — is a "world record" for photorefractive materials.

In their experiments, the researchers place the device at the intersection of two laser beams. The beams interfere with each other, generating a pattern of bright and dark fringes. Electric charges move into these fringes and form a holographic impression of the information projected in the laser beams.

The laser beams also interact with the hologram. This allows one beam to control another: A change in the light entering the crystal changes its optical properties, which in turn affect the behavior of the other beam.

Nolte says these photorefractive materials — whose applications include holographic memories and robot vision — are drawing the attention of other researchers. He cites well-attended sessions on the subject at last week's meeting of the Optical Society of America, held in Albuquerque, N.M. "More and more people are getting interested in these devices," he says. *— D. Pendick*

Protein identified in dinosaur fossils

A team of molecular biologists and paleontologists has identified a protein preserved in dinosaur bones, opening up the possibility of using ancient molecules to help sort out the controversial relationships among dinosaurs and other vertebrates.

Scientists have long considered it highly unlikely that they would find proteins in material more than a few million years old, because such organic molecules usually decay far sooner. Yet several research teams in the past few years have reported detecting proteins in very old fossils, including dinosaur bones (SN: 5/4/91, p.277). In the dinosaur case, however, the researchers did not know which proteins they had detected, and many scientists wondered whether the proteins had come from bacteria or other sources of contamination.

Now, Gerard Muyzer of Leiden University in the Netherlands and his colleagues report using immunological tests to identify a specific bone protein called osteocalcin in several dinosaur fossils that date back 75 million and 150 million years. They discuss their work in the October Geology.

"If it is indigenous, then it is the oldest protein," says Lisa Robbins, a micropaleontologist at the University of South Florida in Tampa.

Muyzer's group identified the dinosaur protein through an antibody that binds to osteocalcin, a small molecule present in the bones of vertebrate animals. The antibody test found osteocalcin in the bones of hadrosaurs, a ceratopsian, and a sauropod dinosaur. It also detected the protein in several mammal fossils and an ancient turtle bone.

The researchers believe the osteocalcin is indigenous to these fossils because invertebrates and bacteria do not produce this protein. Their tests did not show any osteocalcin present in fossilized seashells. Another procedure showed that the dinosaur fossils contained relatively high concentrations of gamma-carboxy glutamic acid (Gla), an amino acid absent in invertebrates and microbes, say the researchers.

Other researchers, however, remain skeptical about the possibility of finding proteins from so far back. Jeffrey L. Bada from the Scripps Institution of Oceanography in La Jolla, Calif., says a study he did on Gla shows that it doesn't last more than 100,000 years. "I worry greatly about the stability of Gla. Why would it remain unaltered over tens of millions of years?" he wonders.

Muyzer and his colleagues had hoped to isolate the osteocalcin and then determine its amino acid sequence. By comparing that with osteocalcin sequences from birds and crocodiles, the researchers could address the long-standing question of how closely birds and dinosaurs are related. At present, paleontologists can only use dinosaur bones to make comparisons.

Muyzer's group did not succeed in isolating the protein. But advances in laboratory procedures may soon make the job easier. "The techniques are improving daily. It's just a matter of the techniques catching up with what we want to do," Robbins says. *— R. Monastersky*