MEETING BRIEFS

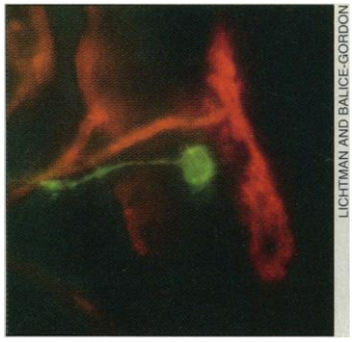
AAAS Provides Its Own San Francisco Quake

The annual meeting of the American Association for the Advancement of Science (AAAS, which is the publisher of *Science* magazine) was a seismic event: 4148 attendees, 650 members of the press, 157 exhibitors. There was lots of press coverage of the meeting—even a discussion on Rush Limbaugh's TV show (of a session on population growth). Here, we offer a sampling of some of the interesting sessions that didn't get a lot of national media attention, ranging from AIDS to zebra mussels.

How the Brain Weeds Its Garden

When it comes to forming connections between neurons, the brain is like a gardener who sows more seeds than he needs, then thins out all but the strongest plants. In the brain, it's not green shoots that are weeded out, but the connections between neurons known as synapses. This process of synapse elimination goes on not only between neurons but also at the neuromuscular junctions where nerves connect with muscles, and it's crucial to the proper functioning of the nervous system. But those who study it have never known just what causes the rejected synapses to dissolve.

At the AAAS meeting, Jeff Lichtman of Washington University in St. Louis reported new results that suggest a possible answer. Studying synapses at the neuromuscular junction (because they are more accessible than those between neurons), Lichtman's group found that the weeding-out is apparently triggered, not by direct combat between incoming neurons, as some researchers have thought, but by the cell at the receiving end of the synapse—in this case, the muscle fiber. "It listens to the activity of the neurons," says Lichtman, "and decides which synapses it wishes to maintain, and which it wishes to lose."


LICHTMAN AND BALICE-GORDON

Stop and go. One neuron (*green*) withdraws from muscle fiber; the other (*red*) stays.

Lichtman and postdoc Rita Balice-Gordon, now an assistant professor at the University of Pennsylvania, focused on a neck muscle in newborn mice, which they could easily expose and view under the microscope in living mice. They used dyes to mark the neurons and the muscle surface, and by returning the mouse to the microscope every day or so, they could watch the changes in specific muscle fibers.

In each case, as they expected, muscle fibers started out with inputs from several neurons, all but one of which withdrew within 2 weeks of birth. What was unexpected was that the victorious neuron did not fill in the sites vacated by the vanquished. Indeed, those sites not only remained empty, but the muscle surface in those areas lost its receptors for the neurotransmitter acetylcholine. "We were quite surprised," says Lichtman. "If you came in at any one time and saw a hole in the receptor pattern, you probably would not assume that it was previously occupied by receptors." But because the researchers watched the same muscle fiber day after day, they knew those holes had once contained receptors for signals from the losing neurons.

If neurons aren't elbowing each other out of the away, what makes the losers withdraw? When the researchers examined the timing of the events, they found that the receptors on the muscle fiber disappear before the neuron actually pulls back. And that, says Lichtman, may mean that the withdrawal of the receptors by the muscle fiber triggers the retreat. But since each neuron makes many synapses on a particular muscle fiber, how can the muscle know which synapses belong to the nerve cell it has decided to keep? One cue is the fact that all synapses from any one neuron fire off signals at the same time, while those from competing neurons fire at other times.

To test whether this synchrony influences the muscle's decision, the researchers spritzed a neurotoxin called bungarotoxin onto just part of the surface of individual muscle fibers in adult mice. In mature muscle fibers, all the synapses come from just one neuron, but by shutting down some synapses and not others, the toxin fooled the muscle into treating the synapses as if they belonged to different neurons. At the toxin-treated synapses, receptors disappeared and the neuron withdrew its connections, just as in natural synapse elimination.

Neuroscientists in the audience definitely had their synapses stimulated by Lichtman's results. "This is fantastic," says Duke University neuroscientist Larry Katz. "Everybody talks about competition," he adds, "but nobody really knows what that means." Katz and other neuroscientists are optimistic that because synapses between neurons are similar to those between nerve and muscle fibers, Lichtman's findings may shed new light on the mechanism of synapse elimination throughout the nervous system.

–Marcia Barinaga

Biomedicine: Americans Don't Get It

From testing for the AIDS virus to use of fetal tissue in research to choosing the best treatment for breast cancer, Americans are constantly confronted with public and private decisions about issues rooted in biomedical research. But how well prepared is the public to understand and make these decisions? Not very, according to a large new study by the Chicago Academy of Sciences (CAS).

As part of a 1993 telephone survey of more than 3000 Americans, the academy tested people on two biomedical concepts: DNA and bacteria. When asked to give a definition of DNA in their own words, 20% of respondents knew DNA was involved in genetic inheritance, while an additional 21% knew the molecule has something to do with genes. That means "41% of Americans have some type of minimal notion of what the word DNA is about, and I stress the word 'minimal,' " says Linda Pifer, associate director of the International Center for the Advancement of Scientific Literacy at CAS, and a coauthor of the study.

When it came to bacteria, the tally was less impressive. Only 10% of respondents correctly defined them as tiny organisms, some but not all of which cause disease. More than 40% equated bacteria solely with harmful "germs."

The scores were worse yet on understanding the process of science. Only 2% understood that science involves forming and testing hypotheses. Another 13% got passing grades by linking science to experimentation. That, says Jon Miller, the study's director, means a mere 15% of Americans have a basic understanding of how science works. The rest were either clueless or equated science with no more than taking precise measurements.

Beyond testing respondents' knowledge of science, the survey questioned them about where they get their information. Television was the main source, with newspapers, doctors, and magazines trailing in that order. But

while Americans get their information from TV, they don't necessarily trust that medium: They place the highest trust in doctors, articles by scientists, and reports from the National Institutes of Health, and descending levels of trust in newsmagazines, TV news, newspapers, and TV talk shows.

Not surprisingly, the single most powerful influence on scientific literacy was education. Ranking second was regular reading of magazines and newspapers. Age showed up as an independent influence: People over 65 had a poorer grasp of biomedicine than younger people, even when other factors such as education were held constant. That is "problematic," says Pifer, since older people are more likely to need biomedical knowledge to deal with their own health problems.

The overwhelming message of the study, says Miller, is that "education drives the system" of understanding science. He adds that "in order to change...the proportion of Americans who understand scientific inquiry, we must do it in our schools. If we miss that boat, we aren't going to change very much."

–M.B.

Flood Flexes Its Mussels

A new and unlikely item has been added to the list of problems stemming from the Great Flood of 1993, which soaked the midwestern United States: zebra mussels. As climatologist Stanley Changnon of the Illinois State Water Survey explained at the AAAS meeting, the flood moved great numbers of these destructive mollusks down the Illinois River almost to the point where it joins the Mississippi. And while the impact of the mussel migration may pale in comparison to 50 lives lost, 17 million acres submerged, and transportation systems crippled, Changnon warned that the spread of the zebras isn't a trivial problem. "This may turn out to be truly an ecological disaster," he said.

This disaster is one aquatic biologists have feared, though they didn't expect it so soon. The tiny, striped European Zebra mussels (*Dreissena polymorpha*) were first found on U.S. shores in 1988, probably hitchhiking into Lake St. Claire on a ship from Europe. The problem with the invaders is that they breed quickly and live in dense clumps, clogging pipes that carry water to cool ship engines and power plant condensers. In addition, they glom onto and destroy native mussels, clams, and snails—and deplete water oxygen levels, threatening all the marine life in areas they infest.

Until recently, the zebra invasion hadn't advanced all that far: The zebras have largely been confined to the Great Lakes and been found mostly in baseball-sized clumps. But in August 1993, divers for the Illinois Natural History Survey (INHS), a state-run sister agency of Changnon's Water Survey, found them carpeting the Illinois River 300 miles downstream of Chicago, 5 miles from where the river merges with the Mississippi. The carpet was 2 inches thick and contained an estimated 94,000 mussels per square meter—in a spot where fewer than 1000 per square meter had been found the year before. "There hasn't been an explosion like this yet, even upstream," says INHS's Richard Sparks, an aquatic ecologist. This means that the critters are now poised to overrun the Mississippi itself.

A few lines of evidence lead Changnon and Sparks to believe that the masses of foreign shellfish were washed downstream by the flood. For one thing, populations found in the Illinois River closer to Chicago's Lake Michigan, the likely source, were not as dense as the populations downstream near the confluence of the Illinois and the Mississippi. This suggests that heavy rains carried a "pulse of larvae" downstream, where they settled on the bottom. In keeping with this theory, the mussels found downstream were smaller than the ones found upstream.

Preliminary evidence gathered by INHS suggests the zebras may already be depleting oxygen levels in the Illinois River. Sparks says aquatic life is stressed when oxygen levels fall to less than 5 parts per million, and already levels as low as 3.2 have been found in areas heavily infested with zebras. "One of the most dramatic effects is they could wipe out native species of mussels and snails," says Sparks. The oxygen depletion, Sparks argues, could also have "drastic" effects on sewage treatment plants that are permitted to dump oxygen-depleting organic wastes into the river. If these plants are forced to cut back on the wastes they can discard, he reasons, the increased costs will be passed on to consumers.

Water sign. The Great Flood of 1993 seems to have spread the zebra mussels downstream.

To prevent such consequences, INHS has proposed a scheme to slow zebra mussel migration. If larvae do not float downstream and repopulate the mats of mussels now in the Illinois River, they will naturally die out in 4 to 5 years. One way larvae could be exterminated upstream is by warming the water in the canal system that links the Great Lakes to the Illinois River at Chicago. INHS proposes heating the water in the canal system with waste heat from municipal and industrial sources. Though this strategy will not prevent existing populations from sending larvae further downstream in the Illinois and into the Mississippi, INHS believes the overall damage could be significantly lowered by breaking the chain.

If nothing is done to slow the zebra mussel migration, INHS predicts hordes of larvae will float downstream in the next 2 years, carpeting much of the Illinois River and some of the Mississippi. And if that happens, the Great Flood of 1993 will become greater still, as it continues to wreak havoc in the unlikely form of a striped freshwater invader that displaces everything in its path.

–Jon Cohen

Quantum Baseball With Lasers

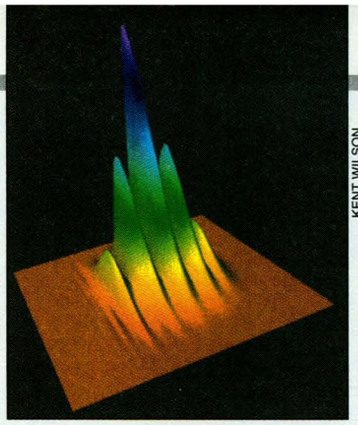
Physical chemist Kent Wilson of the University of California, San Diego, refers to his work as "controlling the future of matter." In his talk at the AAAS meeting, he used a photo of Babe Ruth to explain this enigmatic phrase, saying that when the baseball star wanted to control the future of the baseball—say, to make it clear the right field fence at Yankee Stadium—he applied just the right driving force with the bat. Wilson is trying to do something similar, not with baseballs but with the denizens of the microworld: atoms and molecules. And his tool is nothing as crude as 36 ounces of hickory or ash—it's a laser system producing precisely crafted pulses.

Ever since the invention of lasers, 30 years ago, researchers have wanted to use them to control chemistry. But all attempts so far have failed, because energy applied to a particular bond would leak to other bonds in a molecule, explains Wilson's Princeton colleague, chemical physicist Warren Warren. It didn't matter how finely tuned the laser pulses were, says Warren, "we couldn't do anything that can't be done with an ordinary bunsen burner." As a result, many people still consider laser-controlled chemistry a pipe dream or a joke, he adds.

But several recent advances have made this idea seem less whimsical. The first came in the mid-1980s, when scientists learned to create laser pulses short enough to deal with chemical reactions on their own time scale—a quadrillionth of a second or less. But since then, people have only used laser pulses to observe—not to control chemistry. Now, says Wilson, he is learning to use high-speed computers to calculate a laser pulse with just the right frequency-versus-time profile to achieve a specific goal, such as stretching a bond or controlling an electron's position.

"You tell the computer what you want to create," he says, and it designs a laser pulse.

Wilson hasn't yet put these calculations to the test, but in his AAAS talk he outlined two of his group's recent computations: one for a pulse that would stretch the two atoms of an iodine molecule a specifically chosen distance, the other for a pulse that would take a hydrogen atom and force its single electron into a narrow orbit at a chosen distance 5000 times as far from the nucleus as the electron is typically found.



KENT WILSON

Laser jail. Computer model shows an electron "confined" by lasers.

The next step will be to put theory into practice. Wilson is now gearing up his laser-shaping equipment, as are Warren at Princeton and a handful of other investigators and their groups. If these pioneers succeed, he says, they will be able to do some previously impossible chemistry, for example breaking only the strongest bonds in a molecule and leaving the weakest ones intact and synthesizing molecules that are otherwise impossible to make.

Beyond that lie even more fantastic applications, or "late night dreaming of people in the lab at 3:00 A.M.," as Wilson puts it. In those wee hours, researchers have thought, such as, of using sculpted laser pulses for "nanofabrication" by building specific chemical structures atom by atom. In spite of the still-dreamlike character of some of these applications, the field has good, solid reasons to be excited. As Warren puts it: "These new calculations show that (laser control) is no joke—that it works."

–Faye Flam

Concerns Raised in AIDS Trials

Three months ago, the World Health Organization (WHO) decided for the first time that one company's AIDS vaccine is ready for real-world tests in developing countries. But as these tests approach, a Norwegian bioethicist told the AAAS meeting he believes a key ethical guideline laid down by WHO consultants for such trials may not be met. Reidar Lie of the University of Oslo told attendees at a session on the ethics of HIV vaccine trials that consultants had insisted that a vaccine, if effective, should be made available—at affordable prices—to the people of the country where it was tested. Lie contends, however, that although WHO cannot assure this will happen, the organization has given the "impression that this has been solved."

Researchers have long been concerned about protecting the interests of people in developing countries who take part in trials of AIDS vaccines. In 1989, 39 scientists and ethicists from 17 countries convened at WHO's request to sort out the issues. One criterion they agreed on was that "justice requires equitable sharing" of risks and benefits: If the people of a developing country take the risks of vaccine trials, they should get benefits, too. And though they did not demand that manufacturers offer vaccines at deep discounts or for free, they advised WHO that the organization has "a special role to play in securing the cooperation of industry" to ensure vaccine availability to the global poor "at affordable prices."

Lie pointed out that, in the 5 years since the WHO consultants made their recommendation, little progress has been made in establishing procedures for providing a future vaccine at affordable prices. Furthermore, he says, the language of the WHO recommendation seems to constitute a "guarantee" that the people of developing countries would receive vaccine—a guarantee that he believes is unrealistic. And the idea of a guarantee in itself could create false hopes, and missed opportunities, he argues. "By giving the impression that vaccine will be made available in these countries, we may be bypassing a chance to set realistic goals."

Both WHO officials and officers of vaccine companies deny that Lie is on target. Jose Esparza, WHO's head of AIDS vaccine development, counters that the guidelines are carefully written to avoid creating false hopes. Wayne Koff, head of HIV vaccine development at United Biomedical Inc. (UBI) of New York State, stresses that his company "will endeavor to make vaccines available at an affordable price to countries that we have evaluated them in." In this context, Koff is not just another vaccine maker: A WHO steering committee recently recommended his company's product to the governments of Rwanda, Uganda, Brazil, and Thailand for large-scale trials.

This week, Esparza says, UBI, WHO, and representatives from the four countries will meet in Geneva to discuss details of forthcoming trials. Esparza adds that before WHO endorses a trial, there must be a memorandum of agreement between WHO and the company addressing future access to vaccines. UBI's Koff believes these details will be worked out to everyone's satisfaction and that trials will begin in the four countries within a few months. By then, observers of AIDS vaccine trials should have a clearer sense of whether ethicist Lie's concerns are justified.

–J.C.

University–Industry Collaboration: Huge

As competition for research funds has tightened in recent years, U.S. universities have turned to one effective way of stretching their research dollars: setting up joint research centers with industry. In a session at the AAAS meeting, Richard Florida of Carnegie Mellon University released results from the first large-scale study of academia-industry collaborations. The findings surprised even Florida and his colleagues: "The magnitude of the university-industry research center effort is large," said Florida. "It shocked us."

Florida and his colleague Wesley Cohen surveyed the 1058 university-industry ventures with research budgets of more than $100,000 that existed on 203 campuses in 1990. Forty-eight percent responded to the survey. (Telephone calls by the researchers were made to be sure the 48% were representative.) Florida's shock is justified by the fact that the total spending by all the centers in 1990 was $4.29 billion, and, of that, the researchers estimate that $2.66 billion was spent specifically on R&D—a total that overshadows that year's National Science Foundation research budget of $1.69 billion. Moreover, these university-private sector ventures employed 12,000 faculty and 22,300 other doctoral-level research scientists, or 15% of the nation's academic science and engineering labor force.

Florida noted in his talk that the commercial expansion he depicted does not come entirely without a price. "We do see a weakening of academic norms about the flow of information," he said. More than half the university-industry research centers that responded said participating companies can delay scientific publication; 35% said companies can require that specific commercially important information be deleted from a scholarly report; 42% said communication with the public on their research can be restricted.

Robert P. Morgan of Washington University called the study "a first probe of an important area" for research universities. Morgan said Florida's findings are similar to what he found in his own survey, carried out last year, of engineering research at U.S. universities. If these initial surveys are borne out, it would appear that universities are already heeding calls for making research more applied than it has been in the recent past. Indeed, at the AAAS session, Florida said: "We think that (the universities) are already doing a great deal of what these policies are calling for."

–Christine Mlot

Christine Mlot has a Knight Science Writing Fellowship at MIT this year.