AIDS: Long research road still looms ahead

Three basic research reports provide useful insights into the AIDS-causing virus (HIV), but the news that emerges is not all heartening. In particular, one study suggests that an experimental drug called soluble CD4 appears less promising than once thought. Taken together, the three studies – detailed in the Dec. 14 SCIENCE – serve as a reminder that despite remarkable gains made by AIDS researchers in the past few years, the deadly virus they seek to understand remains insidiously difficult to manage.

In an encouraging report, molecular biologists describe isolating a piece of HIV's genetic code they hope to use in an AIDS vaccine. Scientists have had difficulty developing a vaccine that protects against all HIV strains because vaccine-induced antibodies that attack some strains prove useless against others.

With seven others, Kashi Javaherian of Repligen Corp. in Cambridge, Mass., vaccinated guinea pigs with a six-amino-acid sequence found on the outer coats of about 60 percent of HIV strains. The animals made antibodies that "neutralized," or rendered noninfectious, widely divergent strains of HIV bearing the key sequence on their viral coats. In earlier efforts, the researchers vaccinated animals with larger proteins that included the six crucial amino acids. But the surrounding amino acids apparently diverted much of the animals' antibody-making machinery away from the six key targets, says study coauthor Dani P. Bolognesi of Duke University Medical School in Durham, N.C.

The new work suggests that a vaccine containing the six-amino-acid sequence and other proteins common to other HIV strains might provide broad protection against HIV infection in humans, Bolognesi says. However, he adds, it remains unclear just what or how many ingredients such a vaccine would require.

In a separate report, Dana Giulian and his colleagues at the Baylor College of Medicine in Houston describe an *in vitro* system that mimics the environment of an AIDS-infected brain and may help scientists identify new treatments for AIDS-related neurologic damage. Researchers remain baffled by AIDS' central nervous system complications, which range from mild weakness to paralysis and dementia. HIV seems not to infect neurons directly. But the infection triggers an accumulation of white blood cells in the brain, leading some to suggest that these cells, called macrophages, may be inadvertent culprits.

The new *in vitro* system helps identify compounds secreted by HIV-infected white blood cells, and tests the effects of those compounds on cultured neurons. Using the system, the Baylor team has identified a previously unrecognized neurotoxin secreted by HIV-infected macrophages. Moreover, Giulian says, their findings indicate that at least some AIDS-induced neuronal destruction occurs via one of the same biochemical mechanisms that cause brain damage during a stroke, suggesting that drugs useful for limiting the effects of stroke may someday play a role in minimizing the neurologic complications of AIDS.

In perhaps the most disappointing AIDS finding reported this week, researchers at the Columbia University College of Physicians and Surgeons in New York City showed that some viruses undergo mutations that enable them to circumvent an otherwise promising antiviral strategy. Researchers had hoped they could prevent HIV infection in humans by flooding the bloodstream with engineered receptor molecules, called soluble CD4, that mimic the docking sites through which HIV enters cells. But Vincent B. Racaniello and his co-workers find that polioviruses can mutate in ways that prevent them from binding to soluble receptors while leaving them perfectly capable of infecting living cells. It's unclear how polioviruses manage this trick, or whether HIV can do the same, but the researchers say the findings "temper enthusiasm for the use of soluble receptors as antiviral compounds." – *R. Weiss*

College classes spur lifelong math memory

People who take college mathematics courses at or above the level of calculus retain most of their knowledge of high school algebra or geometry up to 50 years later, while those who take no college mathematics courses suffer steep declines in algebra and geometry knowledge during adulthood, a psychologist reported last week at an American Psychological Association seminar in Washington, D.C.

The findings, combined with previous investigations, suggest that people remember more mathematics and other high school material when learning occurs in sessions spaced out over several years and when each subsequent session involves broader applications of previously learned information, says study director Harry P. Bahrick of Ohio Wesleyan University in Delaware, Ohio. Thus, he argues, basic changes in educational techniques could spur dramatic increases in the knowledge retained by high school students throughout their lives.

Bahrick and Ohio Wesleyan colleague Lynda K. Hall administered an algebra or geometry test to 1,743 volunteers; 270 took both tests. A total of 1,534 participants had taken their last high school algebra or geometry course from several months to 50 years before the study. The rest – junior high students and adults who had not taken an algebra or geometry course – served as controls.

The researchers constructed their algebra and geometry tests from problems consistently used in textbooks and standardized examinations from 1937 to 1986. The two tests included multiple-choice questions and problems requiring recall of specific facts and principles. Participants also reported the number of mathematics courses they had taken, the grades received and the ways in which they used mathematics at work and at home. Searches of school records for one-third of the sample verified that these self-reports were largely accurate.

Most volunteers, including those who took college mathematics courses, used negligible amounts of algebra or geometry in daily life. Nevertheless, those who took three or more college mathematics courses, with the highest-level course extending beyond calculus, performed almost flawlessly on the algebra test up to 50 years after their high school classes.

Participants who took no math beyond college calculus answered nearly 90 percent of the algebra questions correctly. Even those who took calculus and had been out of high school for 50 years managed to score 80 percent on the test.

But those who took no college mathematics showed steep declines in algebra knowledge. Fifty years after high school, they answered about 30 percent of the algebra questions correctly, scoring only slightly higher than the controls.

Memory gains associated with taking college mathematics courses were slightly stronger on the geometry test.

The results, scheduled for publication in the March JOURNAL OF EXPERIMENTAL PSYCHOLOGY: GENERAL, confirm other findings obtained by Bahrick. In one study, for example, he found that people who got good grades in high school Spanish classes remembered much of the Spanish vocabulary up to 50 years after taking their last course (SN: 3/10/84, p.149). Moreover, memory for Spanish vocabulary improved when practice sessions occurred at 30-day intervals rather than daily (SN: 4/18/87, p.244).

Bahrick says the data suggest that specific educational approaches can promote information retention. For the same number of instructional hours, a semester schedule appears superior to a quarter schedule, and final exams should cover material from the entire course, he contends. Classes might even convene weekly for one or two years rather than daily for a few months, he adds.

"The educational establishment needs to look at the longevity of knowledge imparted by different teaching techniques," Bahrick maintains. – *B. Bower*