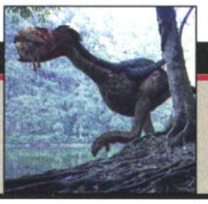


and Germany issued a joint statement calling for an international ban on human reproductive cloning, while their legislatures are debating whether to allow work on embryonic stem cells. In the U.K., which has the most tolerant rules in Europe on the use of human embryos in research, legislators approved research on nuclear transfer to derive stem cells early this year. The House of Commons is planning to debate a bill that would explicitly outlaw the implantation of such an embryo. Lawmakers say ACT's announcement adds urgency to the debate.

The U.S. Senate, which is divided on the subject, has not yet voted on human cloning, although the House passed a bill in July that would make it illegal. If the House bill were in effect today, ACT might be prosecuted. The main effect of ACT's announcement, stem cell researcher John Gearhart of Johns Hopkins University told Reuters, was to scuttle backstage talks among congressional staffers on how to reach a compromise on the use of embryos in research. ACT's announcement, one House aide says, "has made everyone a little queasy."

–ELIOT MARSHALL AND GRETCHEN VOGEL

MOLECULAR IMAGING

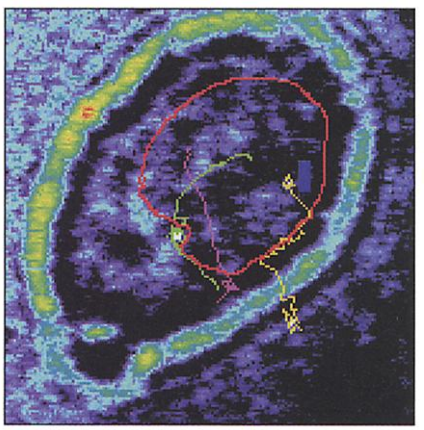
Virus Infects Cell: Live and Uncut

Reality TV has never been this good: After several brief kisses for its unwitting victim, a dazzling virus pushes inside the recumbent cell, while another radiant virus, unsuccessful in its flirtation, floats out of view. The camera pans to the cell interior, where glowing viruses glide along protein rails to the nucleus. There, some slip through nuclear pores, and others cruise through tunnels within the cell center.

Cut to laboratory: For the first time, researchers have viewed live scenes of viral infection. Their lens is an imaging technique that may open up gene therapy and antiviral research to highly detailed, blow-by-blow analysis.

On page 1929, a cadre of researchers led by physical chemist Christoph Bräuchle of Ludwig Maximilian University in Munich, Germany, reports having imaged—in real time—single adeno-associated virus (AAV) particles entering cells and moving into the nucleus. The closeup view was provided by a technique called single-molecule fluorescence spectroscopy, which until now had been used to view chemical reactions such as the enzymatic breakdown of adenosine triphosphate.

Although single-molecule imaging techniques have advanced significantly in the last few years (*Science*, 1 June, p. 1671), the technique had never before been used to watch a viral infection, says molecular virologist R. Jude Samulski, director of the University of North Carolina Gene Therapy Center in Chapel Hill. "This technique will be significant for helping us understand how the virus enters the cell," he says. "We're usually taking a picture after the event happened, but this is real time, the live story."



Caught in the act. Three viruses (yellow, green, and pink lines) infect one cell (outlined in yellow) and head straight to the nucleus (outlined in red).

The documentary approach revealed new information about the small virus, which gene therapy researchers are hotly pursuing as a gene delivery vector. Among their findings: AAV poked through the cell membrane in about 64 milliseconds, much faster than expected, and reached the nucleus in about 15 minutes. That's about an eighth of the time in which conventional cell culture methods, which rely on viral gene expression, can detect infection. Also, the researchers were surprised to see that some particles, after floating toward the nucleus, hopped aboard microtubule-based "tracks" on the nuclear surface and began to move in a straight line. Other viruses followed along the same tracks. Bräuchle suggests that the tracks are tube-shaped invaginations of the nuclear membrane, recently discovered structures never before known to ferry viruses.

Bräuchle's team pieced together its imaging system from commercially available equipment and customized it to circumvent obstacles such as a cell's inconvenient habit of autofluorescing, which would outshine the virus's signal. Bräuchle says conventional methods of measuring and imaging viral entry average the properties of a population and may introduce artifacts that affect infection in unpredictable ways. For example, to see where viruses are concentrated, scientists have had to coat each particle with more than 300 fluorescent molecules, which may get in the way of the virus's activities.

To minimize such interference, the researchers tagged individual viruses with one or two fluorescent molecules, each of which is about 1/25 the size of the virus. After using light microscopy to get a good picture of the mammalian cells lying on a microscope slide, the researchers infected each cell with 10 to 1000 viral particles, which Bräuchle says is much closer than typical cell cultures to normal conditions in the body. The molecules' glow lasted 1 to 10 seconds before it bleached out. This gave the researchers ample time to capture the movement of individual viral particles with snapshots every 40 milliseconds. "Because they're carrying little flashlights around, we can see where the virus is," says physical chemist Anne Myers Kelley of Kansas State University in Manhattan, an expert in single-molecule imaging who was not part of Bräuchle's team.

Bräuchle expects the technique to illuminate virus-host cell interactions for other types of viruses, as well as help screen antiviral drugs. "We can really see how drugs affect the uptake of virus into the living cell, at what stage of the infection pathway the drugs work, and to what extent [they interfere with infection]," Bräuchle says. The ability to view viral infection close up will ratchet up efforts to understand viral processes, says Samulski. "If we can understand processes at this level of detail, then we have to. When somebody breaks the mile record, it challenges everybody to run faster."

–MARY BECKMAN

Mary Beckman is a writer based in southeast Idaho.

RESEARCH COLLABORATIONS

Asian Astronomers Build Closer Ties

TOKYO—The vastness of space is bringing Asian astronomers a little closer together. Meeting earlier this month in Taipei, astronomers from China, Japan, Korea, and Taiwan moved ahead with cooperative plans on both regional and international projects.

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