There, bioinformatics leader Lincoln Stein will double-check the data and run a computerized scan against previously banked human genome sequence data, looking for matches. Wherever the computers find a "hit," they will note the genomic location—a process Stein calls "mapping in silico."

At present, only a fraction of the human genome is available for this kind of SNP mapping. As genome centers release more DNA sequence over the next year, Stein says, in silico mapping will become more powerful. Meanwhile, as insurance, researchers at Stanford University and the Sanger Centre will use a "radiation hybrid" marker system based on cloned fragments of the genome to fix the approximate location of SNPs until they can be located more precisely. Holden, TSC's chief executive, says the mapped SNPs will then be sent to a law firm, which will file patent applications but convert them to simple registrations of invention to prevent others from claiming priority. Every quarter, starting on 15 July, Cold Spring Harbor Lab will release the data on a public Web site. No one—not even key sponsors like Glaxo Wellcome (GW)—will get an early peek.

Allen Roses, GW's worldwide director of genetic research, says the organizers didn't set out to create this public resource; it just grew naturally. Glaxo got interested in SNPs about 18 months ago, Roses says, when an in-house experiment demonstrated that they could be used to speed up the search for disease susceptibility genes. Glaxo suggested to other companies that they jointly fund a collection of SNPs and a map of the human genome, dubbed "Atlas." The cost estimate was high, though: $150 million. "We didn't think that anybody's board would go along if it was a public sort of thing," Roses says, so Glaxo considered creating a private venture that would not release all the data. But when the partners insisted on public release, all agreed.

Last summer, according to Roses, there came "a critical point that made it seem like [a public consortium] was going to work" after all. The academic centers leading the human genome sequencing project expressed a willingness to collaborate. The Wellcome Trust helped in negotiations with academic centers. At the same time, Celera Genomics Inc. of Rockville, Maryland, and NHGRI announced that they were going to speed up the pace at which the human genome will be sequenced (*Science*, 18 September 1998, p. 1774). If Celera and NHGRI produced a whole genome, it would be easier to conduct in silico mapping of SNPs, the consortium leaders realized. The cost estimate for the SNP project dropped sharply—to about $40 million. By the end of 1998, the goals were set. And in January 1999, the Wellcome Trust funded SNP-hunting pilot projects at the three big sequencing centers. Soon, the project was on its way.

Will it really be possible to find 300,000 SNPs and map half of them in 2 years? Perhaps so, if indications from the pilot projects hold up. "They have come in with more SNPs than we had anticipated finding," says Lander. Bentley and Mardis echo his optimism. As new sequencing technology gets installed, Roses concludes, "I think we're going to exceed the goals." **–ELIOT MARSHALL**

CREDITS: (LEFT TO RIGHT) UNIVERSITY OF MALAYA; ANDY WONG/AP

EPIDEMIOLOGY

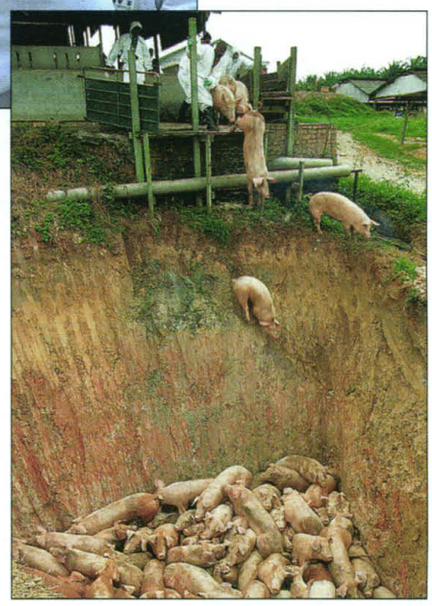
New Virus Fingered in Malaysian Epidemic

Scientists have unmasked a killer responsible for the deaths of at least 95 people in Malaysia in the last 6 months, most of them pig farm workers. The culprit, named the Nipah virus for the small town from whence the strain was first identified, is a previously unknown virus that replicates in pigs and seems to be easily transmitted to humans. It is closely related to another notorious agent, the Hendra virus, which surfaced in Australia in 1994 and killed two people and more than a dozen horses. But the new virus spreads much more rapidly, making it "an emerging virus of grave concern," says John Mackenzie, head of the department of microbiology and parasitology at the University of Queensland in Brisbane, Australia.

The country's health authorities initially assumed they were dealing with an outbreak of Japanese encephalitis (JE), which causes similar symptoms, and some critics have accused the Malaysian government of being slow to consider alternative causes. Indeed, even now authorities insist that the country is battling a "dual epidemic" of JE and the new disease. But last week the U.S. Centers for Disease Control and Prevention (CDC) in Atlanta said that the Nipah virus is the main culprit, and that the JE virus has played at best a marginal role in the continuing tragedy. The epidemic peaked around the middle of March and seems to be waning now. Early this week, the Malaysian Ministry of Health put the total number of cases at 251. Since early March, Malaysian health authorities have killed over 800,000 pigs to halt the spread of the virus.

The first cases of the disease occurred in late September near the city of Ipoh, in the northern state of Perak. The victims, all of whom worked in the pig industry, came down with high fever and encephalitis (an inflammation of the brain), and some died. Officials concluded that they had succumbed to JE, which is transmitted by *Culex* mosquitoes and known to replicate in pigs.

Circumstantial evidence supported that theory. A few dozen people contract JE in Malaysia yearly, and the numbers usually rise at the end of the year. In addition, tests at the University of Malaya in Kuala Lumpur and the Institute of Tropical Medicine in Nagasaki, Japan, confirmed that blood and cerebrospinal fluid of some patients contained antibodies against JE. To contain the outbreak,



Deadly business. Over 800,000 pigs were killed to halt the spread of the Nipah virus, first isolated by Lam Kai Sit (*top right*) and Chua Kaw Bing.

Malaysian authorities fogged thousands of pig farms and nearby houses with insecticide and inoculated tens of thousands of people at risk with a vaccine for JE.

But the disease kept spreading. By late December, when several dozen cases had been reported, it reached the southern state of Negeri Sembilan. Scientists also began to notice that the outbreak wasn't behaving like JE. For one, it was killing pigs, which are carriers of JE but rarely its victims. For another, it was felling adults, whereas JE mostly kills children. Third, it seemed to affect only those who had been in close contact with pigs while their family members stayed healthy, which didn't fit the pattern of a mosquito-borne disease. Furthermore, some people contracted the disease after being vaccinated for JE. And finally, scientists were unable to isolate live virus from any of the patients whose blood contained JE antibodies.

At the time, the investigations were still handled by the country's Institute for Medical Research, a part of the Ministry of Health, which stood by its initial diagnosis. But when all prevention measures failed and the epidemic spread, the government sought help from Lam Kai Sit, head of the University of Malaya's department of medical microbiology. Five days after they obtained the first patient blood and cerebrospinal fluid samples on 1 March, Lam and his colleague Chua Kaw Bing had isolated a virus that, judging by its appearance, belonged to the Paramyxoviridae, a family that doesn't include the JE virus. They noticed that the virus caused cells to clump together in giant multinucleate cells or "syncytia." Mackenzie then suggested that the Malaysian samples be tested for Hendra, which also produces syncytia and causes encephalitis in humans, and for Menangle-virus, a paramyxovirus that was recently isolated from Australian pigs.

Chua took the samples to the CDC in Atlanta, and tests showed that Mackenzie's hunch was correct. The new virus reacted with antibodies to the Hendra virus, indicating a similarity between the two. The CDC then sequenced the viral genome and showed the new virus to be about 20% different from the Hendra virus, says Brian Mahy, director of CDC's Division of Viral and Rickettsial Diseases. The Nipah virus was found not only in the tissues of patients, but also in sick pigs and in 11 abattoir workers from Singapore who had fallen sick in March after contact with Malaysian pigs.

> "The ministry made an early presumptive diagnosis, and they have difficulty admitting it was a mistake."
>
> —Jane Cardosa

Although there have been no cases of human-to-human transmission, the CDC classified the new virus as a P4-pathogen. That meant samples can be collected and handled only by researchers clad in space suits and examined only in high-level safety labs. As for the virus's mode of transmission, one theory is that it is present in pig lungs and urine and that humans can get infected by inhaling aerosols. What is particularly worrying, says Mahy, is that one of the Australian victims of the Hendra virus died 14 months after he was infected. If the new virus has a similar lag time, he says, the current fatalities may only be the beginning.

Another riddle is how the virus entered the Malaysian pig population. Scientists have shown that four species of Australian fruit bats normally harbor the Hendra virus, and they suspect horses could become infected if they ingest bat urine or part of a bat placenta, both of which contain the virus.

As for any link to JE, most researchers now think that a few cases of JE may have occurred simultaneously when the outbreak began but that JE didn't cause the widespread epidemic. The presence of antibodies in some patients, they say, is not surprising given JE's prevalence in Malaysia, and because many people—especially pig industry workers—may have been exposed to JE without getting sick. "I don't think the JE virus has been involved in any significant way in this current epidemic," says Mahy.

But Malaysian health authorities remain convinced that JE is involved. Lam says he alerted the ministry immediately after the CDC informed him on 18 March about the new virus. But 5 days later, a press release by the ministry's director-general summed up the arguments behind the initial diagnosis and repeated that "the present outbreak is confirmed as JE." The release briefly mentioned the discovery of the Hendra-like virus but said "we are not sure if the virus is a pathogen."

This week, Mohamad Taha Arif, director of the Disease Control Division of the Malaysian Ministry of Health, said that "currently the [Nipah] outbreak is more prominent," but insists there is a dual epidemic and that measures to prevent the spread of JE need to remain in place. He says there wasn't enough proof on 18 March to say that the new virus had caused the epidemic.

Some Malaysian scientists say they are not

ScienceScope

Sold! Elsevier Science of the Netherlands has bought Cell Press, publisher of the journal *Cell* and its sister publications *Immunity*, *Neuron*, and *Molecular Cell*. Clearly regarding the acquisition as a coup, outgoing Elsevier CEO Herman Bruggink told shareholders this week that the purchase will help the journals move strongly into electronic publishing.

Benjamin Lewin, *Cell*'s editor since 1974, will stay at the helm. "Ben Lewin is *Cell*," says George Yancopoulos, a reviewing editor for the journal. It "is dominated by [his] view of what is hot."

All in the Family Astronomers have discovered another star that is orbited by more than one planet. Two teams announced this week that a pair of giant planets is circling the star Upsilon Andromedae—bringing the number of known planets in this "stellar system" to three. The find means that three stars, including the sun and a distant pulsar, now have confirmed planetary families (*Science*, 17 January 1992, p. 290).

The researchers, who have submitted their findings to *Astrophysical Journal*, also estimated the planets' temperatures. The middle planet is probably above the boiling point of water, says Timothy Brown of the National Center for Atmospheric Research in Boulder, Colorado, whereas the most distant one is below freezing. As for the scorched innermost planet, which whirls around its sun in just 4.6 days, Brown says it is "undesirable real estate."

Bucket Brigade A 20-liter plastic bucket may not be high-tech, but California engineer and former nuclear weapons designer Bill Wattenburg says it's a cheap, clean, and mobile way for Kosovo refugees to dispose of their waste. Wattenburg, who has an enviable track record of promoting the creative use of everyday materials to confront crises, including airdrops of food to help Bosnian refugees, was stirred by recent images of squalor to propose that refugee families be given buckets to use as latrines.

The idea is winning over former colleagues at Lawrence Livermore National Laboratory in California. "There's often a giggle factor to his ideas, but they work," says Milton Finger, a senior Livermore administrator. And it may even be implemented. According to the Pentagon's Colonel Jay Erb, military brass have passed the plan along to relief teams in the Balkans.

surprised at the government's rigidity. Jane Cardosa, a virologist at the Institute for Health and Community Medicine at the University of Malaysia in Sarawak, says she called the health ministry in November and again in January, urging officials to look for alternative infectious agents. She also expressed her doubts in a January message to ProMED, an electronic forum for emerging-disease researchers. The government's response, she says, was an e-mail reprimanding her for questioning the official theory. "The ministry made an early presumptive diagnosis, and they have difficulty admitting it was a mistake," she says. When costly fogging and vaccination campaigns failed to halt the disease, she adds, "it became even more difficult to admit there was an error." Lam, too, says "it was quite obvious to us right from the beginning that not all the cases were due to Japanese encephalitis." But not being involved in the official investigation, he didn't look for other possible culprits.

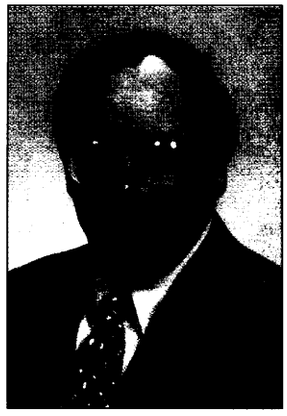
David Quek, editor of the journal of the Malaysian Medical Association, says the episode reminds him of a heart infection outbreak in Sarawak in 1997, in which more than 20 children died. Health authorities blamed that epidemic on the Coxsackie virus—and kept doing so long after scientists had ruled it out as the culprit. This time, says Quek, "we hope that the authorities can be a bit more enlightened. Sometimes it's all right to admit an error." **–MARTIN ENSERINK**

VACCINE DEVELOPMENT

NIH Scientist to Head IVI Institute in Korea

SEOUL—An epidemiologist at the U.S. National Institutes of Health (NIH) has been named the first director of the International Vaccine Institute (IVI) in Seoul, Korea. The appointment of John Clemens to a 5-year term is a major step forward for the independent institute, founded in 1997 by the United Nations Development Program to research and promote vaccines in Asia.

Clemens is chief of the epidemiology branch in the intramural program at the National Institute of Child Health and Human Development, which he joined in 1990. He has spent 15 years in Latin America, Egypt, India, Vietnam, and Bangladesh and has broad experience with pediatric infectious diseases and vaccine development. "He's at home in Asia ... and has real clinical trial experience," says immunologist Barry Bloom, chair of IVI's board of trustees and dean of Harvard School of Public Health in Boston.



Heart and Seoul. John Clemens brings a commitment to pediatric vaccines to IVI post.

Clemens's first challenge after moving to Korea this summer will be to draw up a scientific program for IVI, which has begun to build a $50 million laboratory on the campus of Seoul National University that will be completed in late 2001. He plans to expand studies already under way on the prevalence of disease in the region to include Japanese encephalitis, rotavirus (a cause of diarrhea), and pneumococcal infections. IVI recently launched a study in Korea, China, and Vietnam of *Haemophilus influenzae* type b, which was dethroned as the leading cause of pediatric meningitis in the United States after a successful vaccination campaign. Five major pharmaceutical companies are supporting IVI's effort to study its prevalence in Asia.

IVI is also working with the World Health Organization (WHO) to enroll 600,000 Vietnamese in a test of a promising oral cholera vaccine that costs only 20 cents a dose. "If this vaccine proves to be protective ... it could make a major impact on the global control of cholera," says Clemens.

IVI's long-range goals include helping developing countries raise their rates of vaccination and working jointly with teams of researchers and international health organizations. Its 15,000-square-meter lab will provide space for a staff of 200 recruited internationally and for limited production of vaccines used in clinical trials. Although Clemens has never run an independent research institute, his colleagues are confident that he will learn fast. "He knows how to do what needs to be done," says Bloom.

IVI has already overcome a rocky start. Some saw it as a competitor to private industry and to existing organizations such as WHO (*Science*, 6 December 1996, p. 1607). But 7 years after the institute was first proposed, Clemens asserts that those conflicts have eased. "IVI will serve as a collaborator with WHO wherever and whenever it is appropriate," says Clemens, who has spent 8 years on various WHO vaccine-related steering committees. "But we are not a coordinating agency for other organizations nor a policy-making body [for the community]."

The institute has also survived Asia's economic crisis. The South Korean government, which is paying for the lab, has kept all its financial commitments to date, says Bloom, and the Program for Appropriate Technology and Health, a Seattle-based group that works with developing countries on reproductive technologies, is setting up its Asian office at IVI as part of a $100 million grant last year from Bill Gates (*Science*, 11 December 1998, p. 1971). The grant is expected to be especially helpful in boosting IVI's roster of non-Asian contributors. **–MICHAEL BAKER**

Michael Baker writes from Seoul, Korea.

ANIMAL RIGHTS

Activists Ransack Minnesota Labs

The University of Minnesota is reeling from one of the most damaging attacks on a U.S. research facility by animal rights activists in recent memory. The Animal Liberation Front (ALF) claimed responsibility for an incident last week in which vandals stole over 100 research animals and ransacked labs at the university's Twin Cities campus, causing at least $2 million in direct damage and the disruption of dozens of research projects. Some of the sabotaged projects, in research areas such as Parkinson's disease and cancer therapy, involved human cell cultures but no animals.

In a press release, the ALF said it had "liberated" the animals and called other damage "economic sabotage" to "decrease profits to the animal abusers." The attack surprised some observers, however, as ALF, whose North American press office is in Minneapolis, had lately turned its attention to fur and farm operations rather than labs. "This is really the first time in at least half a dozen years where there's been major damage to a biomedical research facility," says Frankie Trull, head of the National Association for Biomedical Research in Washington, D.C., which monitors animal rights groups.

In the Minnesota attack, vandals broke into the basement of a psychology building early on Monday, 5 April, and took 116 rats, mice, pigeons, and salamanders. Among the stolen animals were several transgenic mice for studying Alzheimer's disease that Karen Hsiao's group has described in *Science* (4 October 1996, p. 99). A video released by ALF shows several people in black clothes and masks dropping pigeons into white containers and spray-painting the walls with slogans like "No More Torture" and "Animal Liberation Now."

What happened to most of the animals is unclear. A university animal care official found 14 of the 27 pigeons and five dead and three live rats in a field east of Minneapolis. But ALF spokesperson Kevin Kjonaas questions "the validity of anything coming out of the university right now," noting that ALF usually puts animals into homes.

The vandals also broke into a building housing otolaryngology, ophthalmology, and