scopes at Kitt Peak near Tucson and the Lick Observatory atop Mount Hamilton in California. They presented their findings this week in Tucson at an American Astronomical Society meeting and have detailed their work in the Jan. 1 ASTROPHYSICAL JOURNAL LETTERS.

The galaxy lies an estimated 12 to 15 billion light-years from the Milky Way. (The distance depends on the much-debated value of the Hubble constant, a number that provides a measure of both the universe's rate of expansion and its age.) Telescopes are like time machines: As they look deeper into space, they look further back in time. Thus, the distant galaxy looks as it did when the cosmos was just one-tenth its current age.

Yet Dey notes that the northern half of the galaxy is extremely red, indicating that it has already undergone substantial aging. The red color has two possible explanations — that old stars are present in the youthful galaxy or that the object is cloaked in dust. The existence of dust implies that a previous generation of stars in the galaxy has already lived and died. Massive stars expel dust as they eject their outer shells in supernova explosions.

Spinrad notes that the galaxy spans 200,000 light-years in diameter, making it about five times the size of Andromeda, the Milky Way's nearest spiral neighbor. Using a model to determine what kind of galaxy in the nearby universe 8C 1435+63 might resemble as it ages, the team speculates that it shares a common heritage with giant elliptical galaxies. The galaxy's irregular shape suggests it may be in the process of merging with another body. *— R. Cowen*

HIV toll: Over a billion white cells a day

This week, a pair of independent research teams describes the intense battle that erupts when HIV, the AIDS virus, gets a foothold in the body. Using biochemical and genetic techniques, both groups tracked the rise and fall of HIV and of CD4 T lymphocytes, the white cells targeted by the virus. Their results confirm that HIV eventually overwhelms the immune system.

The new analyses document the "titanic struggle" between HIV and the body's immune system, comments Simon Wain-Hobson of the Pasteur Institute in Paris. Wain-Hobson's editorial and the teams' reports appear in the Jan. 12 NATURE. The work provides "the precise quantitative and mathematical confirmation of a phenomenon that was strongly suspected . . . but never nailed down," adds Anthony S. Fauci, director of the National Institute of Allergy and Infectious Diseases in Bethesda, Md.

Last year, scientists began to realize that HIV is not inactive during the time between infection and the appearance of AIDS. Instead, the virus gradually accumulates in the lymphoid organs (SN: 3/27/93, p.196).

The new studies indicate that HIV replicates like mad. "We believe it is the engine that drives the . . . disease," says David D. Ho of the New York University School of Medicine in New York City. At the same time, CD4 T cells are multiplying at terrific rates, he notes. The result is a relentless race between the infecting virus and the immune system, one eventually won by HIV.

For this work, Ho's team administered the antiviral drug ABT-538 to 20 people, most of whom had advanced HIV infection. Throughout the study, the researchers monitored the concentrations of virus and CD4 T cells in the volunteers' blood. Meanwhile, George M. Shaw of the University of Alabama at Birmingham and his colleagues treated 22 HIV-infected people with ABT-538 or other antiviral drugs. Shaw's team also began tracking virus and white cells.

Before treatment, virus destroyed by the immune system was replaced with new virus on an ongoing basis. To keep up its offensive against HIV, the body gets rid of about a billion virus particles per day. With treatment, the amount of virus halved approximately every 2 days for the first few weeks, both groups note.

These drugs also cause a sharp boost in the production of CD4 T cells, the two teams report. They calculate that without treatment, the body loses — and must make — more than a billion of these white cells daily.

The dark side of HIV treatment began to surface after drug therapy, however, when Shaw's group found that the dramatic drop in HIV didn't last. Within 2 to 4 weeks, virus that resisted the drug blast replicated, producing a more dangerous, drug-resistant HIV infection.

— E. Pennisi and K.A. Fackelmann

Chaotic chaos in linked electrical circuits

Little could be more disconcerting and frustrating to a scientist than discovering that supposedly identical experiments somehow produce radically different results. Such perplexing, discrepant data would typically end up in a wastebasket rather than a journal.

But the mathematical — and now physical — evidence that such a situation can actually occur is mounting. Mathematicians have pinpointed how certain features in equations, including some of those used to describe physical phenomena such as fluid flow, lead to an extreme kind of unpredictability in the solutions to those equations. Physicists have demonstrated similarly erratic behavior in sets of linked electrical circuits.

"You have a deterministic system, yet you lose experimental replicability," says James C. Alexander of the University of Maryland at College Park. "You're always going to have little errors, and such small changes in initial conditions may lead to completely different long-term behavior."

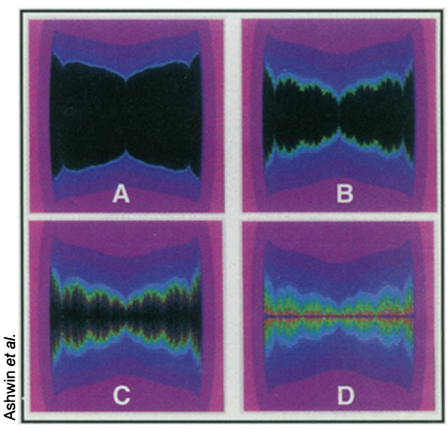
Alexander described these developments at a Mathematical Association of America meeting held last week in San Francisco.

A wide range of physical systems shows the sensitive dependence on initial conditions that characterizes chaotic behavior. For example, in certain electronic circuits, small changes in the initial voltage can alter the pattern of voltage fluctuations that occur at later times in the circuit.

Nonetheless, a chaotic system's long-term, average behavior remains qualitatively predictable. A particular set of initial values leads to a certain type of outcome, even though one can't predict the details of that behavior.

Equations representing such systems can also have multiple solutions, or attractors, which correspond to different types of behavior. In some cases, a certain set of starting values may lead to one attractor, whereas other values lead to a completely different attractor.

In 1992, Alexander and his colleagues found a theoretical example in which the



Ashwin *et al.*

Increasing the value of a particular parameter (from top left to bottom right) alters the basin of attraction (A, black area) corresponding to one type of behavior. The basin becomes riddled (B and C), then virtually disappears (D).

set of initial conditions, or basin of attraction, leading to one attractor is riddled with points corresponding to initial conditions leading to another outcome. In other words, the two basins are completely intermingled (SN: 11/14/92, p.329).

Soon after, John C. Sommerer of the Johns Hopkins University Applied Physics Laboratory in Laurel, Md., and Edward Ott of the University of Maryland discovered similar behavior in a differential equation representing the motion of a particle traversing a force field having a particular geometry (SN: 9/18/93, p.180). They also suggested that behavior indicative of riddled basins could occur in oscillator circuits that generate chaotic signals. It's possible to link these circuits to synchronize their chaotic behavior (SN: 10/12/91, p.239).

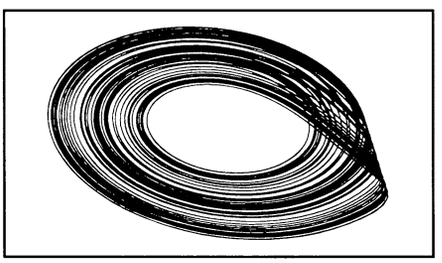
Recently, Peter Ashwin, Jorge Buescu, and Ian Stewart of the Mathematics Institute at the University of Warwick in Coventry, England, investigated the behavior of an identical pair of such circuits. By weakening the link between the two circuits, they showed how the system's behavior gradually changes from a totally synchronous state to one in which the oscillators operate independently, passing through a stage in which the system switches unpredictably in and out of synchrony.

"We studied the details of this loss of synchrony and showed that it is entirely consistent with the riddled-basin scenario," Stewart says.

James F. Heagy, Thomas L. Carroll, and Louis M. Pecora of the Naval Research Laboratory in Washington, D.C., used a system consisting of four linked oscillator circuits. They concentrated on the details of the system's behavior when the connection between the circuits was weak enough to allow both synchronous and nonsynchronous behavior.

"Our work has shown that riddled basins indeed exist in real physical systems . . . and must be taken into account for a proper understanding of the system," the researchers say. They report their findings in the Dec. 26, 1994 PHYSICAL REVIEW LETTERS.

Now, researchers are searching for traces of riddled basins in other settings. But the documented evidence is skimpy. These are not the kinds of results normally reported in journals. — *I. Peterson*



Heagy, Carroll, Pecora

Chaotic attractor representing voltage fluctuations of an oscillator circuit.

Grief sometimes heads down a grievous path

When loved ones die, they leave behind a legacy of emotional pain. Many clinicians and researchers view depression as the most worrisome psychological fallout of bereavement, because the sense of personal worthlessness and despair typical of that condition can lead to suicide.

But bereavement may also trigger a unique and previously unrecognized disorder that disrupts lives for at least 2 years afterward, a new study suggests. Known as complicated grief, this persistent yearning for a deceased person and other, related symptoms often occurs without signs of depression.

"The symptoms of complicated grief, while appearing to be normal reactions to the loss of a loved one, nevertheless were significantly associated with later impairments in global [psychological] functioning, mood, sleep, and self-esteem," psychologist Holly G. Prigerson of the University of Pittsburgh School of Medicine and her coworkers assert.

The findings support Sigmund Freud's contention in a 1917 monograph that depression touched off by a loved one's death drags down self-esteem, whereas grief (or what Freud called mourning) does not. However, Freud, the founder of psychoanalysis, viewed grief as a uniformly healthy process, while Prigerson's group argues that it can sometimes take a virulent form.

The researchers administered questionnaires to 82 men and women, age 60 to 85, 3 to 6 months after the death of their spouses. The team collected follow-up data from 50 participants 18 months later.

Analysis of initial responses revealed two distinct clusters of symptoms that in some cases overlap, the scientists report in the January AMERICAN JOURNAL OF PSYCHIATRY. Bereavement-related depression includes apathy, insomnia, extreme sadness, low self-esteem, and thoughts of suicide. In contrast, complicated grief consists of searching and yearning for the deceased, crying, feeling stunned by the death, not believing that the loss occurred, and being preoccupied with thoughts of the loved one.

Fourteen of the volunteers who completed the follow-up had begun the study with moderate to severe depression. Of 13 participants who cited substantial problems with complicated grief, only 7 also reported marked depression.

While those suffering from complicated grief displayed several psychological and sleep difficulties at the follow-up, volunteers with bereavement-related depression reported an increase in medical illnesses.

If further research confirms these results, it may be necessary to develop specific treatments for complicated grief, the researchers contend.

"Depression requires a psychotherapeutic and psychopharmacological approach, whereas grief lends itself to the support of a responsive ear," writes Milton Viederman, a psychiatrist at Cornell University Medical College in New York City, in an accompanying comment.

Current diagnostic guidelines for psychiatric disorders emphasize treating depression linked to bereavement but not symptoms of intense grief.

Earlier research, which did not measure complicated grief, found that frequent thoughts of a deceased spouse or child, as well as depression and failure to resolve the loss, often endure for as long as 7 years (SN: 2/7/87, p.84).

Conversely, some people encounter no grief after a loved one's death and may experience beneficial changes in their view of the world, Viederman asserts. The lingering or sudden nature of a death, its finality or ambiguity (as in cases of soldiers missing in action), the way in which death occurred, and the psychological relationship of a survivor to the deceased all influence the expression of grief, he notes. — *B. Bower*

HIV's infectious nature

People infected with HIV are far more infectious during the first 2 months after contracting the AIDS-causing virus than previously suspected, a new study shows.

James S. Koopman of the University of Michigan in Ann Arbor and his colleagues collected epidemiological data from a number of studies, including one that looked at more than 8,000 homosexual men in San Francisco and Chicago and one that included 1,115 military personnel in Thailand. Using a computer simulation, the researchers examined how certain variables affect the spread of HIV. Only when the scientists assumed a very high degree of infectiousness during the first 2 months did the computer model match the real-life epidemic.

The data suggest that rates of HIV infection during that early period may be 100 to 1,000 times higher than in the long asymptomatic phase that follows. Koopman and his colleagues initially detailed their study in the November JOURNAL OF ACQUIRED IMMUNE DEFICIENCY SYNDROMES.

The findings suggest that vaccine researchers should focus on blocking that early, infectious stage. If one could devise such a vaccine, it might effectively slow the epidemic, Koopman notes. — *K. A. Fackelmann*