SCIENCE NEWS of the week

Pattern in Mass Extinctions

For six years John Sepkoski of the University of Chicago has been engaged in the tedious job of compiling records of when families of marine organisms vanished from the fossil record. Recently, with David Raup, also at Chicago, he drew up graphs presenting the data. A curious pattern emerged, one that the scientists could neither explain nor ignore. Roughly every 26 million years for the last 250 million years, the numbers of extinctions jumped above the background of extinctions that occur in the normal course of life. Mass extinctions, they conclude, are not random events, as has been widely believed. Instead, it appears, at regular intervals something perturbs the biological system, not destroying it but resetting it so powerfully that the ensuing changes forever twist the course of evolution.

In 1977 two scientists suggested that 32 million years elapse between mass extinctions, but the idea was not pursued. The periodicity in mass extinctions was very unexpected," Sepkoski says. "We expected that it probably would be random, because it has usually been assumed that each mass extinction was caused by a unique plexus of stress." Instead they found that a 26-million-year cycle seems to be "a very robust feature of the data."

The hypothesis, if correct, means that there is some force outside terrestrial biology that periodically upsets the system. Some organisms survive whatever blow afflicts the planet, but which ones do depends not on qualities developed to ensure survival, but on chance and good fortune, such as living in middle or high latitudes where extinction is less common than in the tropics, says David Jablonski of the University of Arizona in Tucson. While organisms can prepare for catastrophes that may occur on shorter time scales, they cannot prepare for an event that occurs only once in 26 million years.

One puzzling aspect of the 26-million-year period is that no natural process is known to follow a cycle of that length. Raup and Sepkoski generally favor a solar or galactic forcing agent for the pattern, but still are searching for a specific cause. "We're kind of stumped," Sepkoski says. "We can speculate, but so far we haven't found anything in the astronomical or solar literature that has fixed cycles in that range." The only thing that comes close, he says, is the passage of the solar system through the arms of the Milky Way galaxy. But that event occurs in periods between 50 million and 100 million years—too long to explain the mass extinction peaks.

At a meeting last month on the dynamics of mass extinction, Eugene Shoemaker of the United States Geological Survey in Flagstaff, Ariz., reported that every 50 million years the earth may withstand a significant impact with one of the rocky bodies vaulting through space. A strong 50-million or 52-million-year period could mean that the peaks are an amalgam of periodic and random events, so that the average position of the random events would fall midway between impacts, Sepkoski told SCIENCE NEWS. But when Raup and Sepkoski ran their computer simulations using a 52-million-year cycle with some random events included, the results were not conclusive. "We feel that a 52-million-year cycle is less plausible than a 26-million-year cycle, but it's a possibility," Sepkoski says.

The causes of mass extinctions have been pondered for several centuries, but in the last few years new life has been infused into the topic. This vigor stems mainly from the hypothesis that one of the extinction peaks occurred 65 million years ago when an asteroid struck the earth, bringing huge numbers of organism families to an abrupt end (SN: 1/12/80, p. 22; 11/14/81, p. 314). Regardless of whether the impact idea is right, "it's thrown the entire forum of mass extinction debate into a much more testable framework," Jablonski says. Likewise, the Raup/Sepkoski hypothesis, with its firm statistical underpinning, can be tested and debated by paleontologists trying to patch together the record of ancient life. One reason for the widespread interest in the 26-million-year cycle is that it is based on Sepkoski's new data set, which refines the time between sampling periods in the geologic record to a few million years. This still is coarse in relation to the time scale of extinction, making it difficult to discern whether a mass extinction happened suddenly or over a period of up to a million years or more. Nonetheless, it is far better than has been available so far.

One way to test the hypothesis, Jablonski says, is to refine the fossil time scale further still, and to look more closely at ecological and geographical patterns of extinction. He says the cyclic nature of extinctions is "a very seductive idea. The biological world blithely goes on and all of a sudden from outside, some terrible catastrophe comes in and resets the evolutionary clock. Then biology picks itself up and continues to evolve and the survivors, whatever they may be, continue to evolve and re-radiate and get clobbered again in a periodic sort of pattern."

—C. Simon

Unconstrained harvest of brain genes

The nerve cells that make up the intricate, powerful, diverse communication network of the brain are ruled by their genes, as are all cells. In an ambitious merger of the most recent techniques for genetic and brain research, scientists are beginning to identify the thousands of genes active only in brain cells and are using them to discover "in an unconstrained way" perhaps unexpected rules of brain activity.

In the first analyses of genes from a grab bag of those active in the brain, the investigators have discovered two novel proteins, one of which may be the signal chemical in a major, previously unrecognized system of brain connections. The work also provides evidence for a new twist to gene function, Floyd E. Bloom of the Salk Institute in San Diego, Calif., reported last week at the meeting in Boston, "Molecular Biology Now and Tomorrow, Thirty Years of DNA."

The collection of genes active specifically in the brain was compiled by comparing gene activity in the rat brain, liver and kidney. When a gene is active, enzymes transcribe it into a molecule called messenger RNA, which carries information from the gene to the rest of the cell. The scientists estimate that 30,000 different types of messenger RNA molecules are produced by brain cells and that more than half, and perhaps as many as 90 percent, of these different messages reflect genes active only in the brain.

So far more than 200 different brain messenger RNA molecules have been examined. The researchers have concentrated their analyses on those detectable only in brain cells. In each case they determine the sequence of nucleotides, the subunits of the gene or messenger RNA that encode information for making protein. By applying the genetic code, the scientists deduce the amino acid sequence of the protein it encodes. Then they chemically synthesize parts of the protein and make antibody that binds to these parts for use in locating the protein both to regions within the brain and to areas within individual cells.

The first messenger RNA so analyzed was located in large nerve cells throughout the brain. Its distribution within the cells suggests a role in synthesis or transport of material in the receiving branches (the dendrites) of nerve cells.

Another of the first group of brain-specific genes to be analyzed appears likely to be a signal chemical. Bloom and Robert J. Milner (also at the Salk Institute) and J. Gregor Sutcliffe and Thomas M. Shinnick of Scripps Clinic in La Jolla, Calif., report that this messenger RNA encodes a chain of more than 300 amino acids that is probably processed in brain cells to form shorter chains, called peptides. The scientists synthesized the three peptides anticipated, and made a set of 8 to 10 an-

tibodies that bind to each one.

"These peptides are present in an extensive system throughout the brain," Bloom reports. The system includes a pathway between two different brain areas that plays a role in signalling the brain to initiate body movement. No neurotransmitter had previously been identified in these connections.

Although, so far, assays for these peptides are not sensitive enough to document release from activated brain areas, Bloom reports that they exhibit some other characteristics of transmitters. They are associated with structures involved in chemical signal release, and the substances can alter the electrical activity of some nerve cells.

A novel aspect of DNA structure also has been detected during these studies on genes active only in the brain. A common sequence of 82 nucleotides has been determined in eight genes—every one examined so far—in regions called intervening sequences (or introns) that do not carry information about making protein. Bloom, Sutcliffe, Milner and Richard Lerner of Scripps Clinic call this segment the "identifier (ID) sequence," suggesting that it is a signal carried within genes to specify that they are to be expressed in the brain.

The scientists predict different ID sequences will be detected in other types of tissue. The brain ID sequence is also found in short pieces of RNA, of unknown function, that are present in brain but not in liver or kidney cells. This is the first specific signal to be found in intervening sequences. Scientists had proposed their only role was to allow more recombination between different parts of proteins during evolution (SN: 7/7/79, p. 12).

The unconstrained approach to studying the nervous system should allow scientists to discover unexpected rules about how genes function and how the brain operates. "We are looking with our eyes open," Bloom says. He and his colleagues propose that "since the brain-specific proteins are chosen at random, these studies are not biased by preconceptions as to what sort of proteins one ought to study to define brain function. Many experimental avenues not currently apparent may be illuminated by such an unbiased approach."

— J.A. Miller

More evidence for volcanoes on Venus

Besides the earth, the only object in the solar system that is known to be volcanically active at present is Jupiter's moon Io. A growing list of observations and analyses, however, is pointing tantalizingly at the same possibility for Venus. There are no Venus data as conclusive as the Voyager spacecraft photos of Io, showing the bizarre moon's eruptions taking place even as the cameras looked on. But the hints about Venus continue to accumulate, ranging from radar scans of areas resembling volcanic regions on earth to measurements of lightning discharges that seem concentrated over these same, apparently young areas.

The latest addition comes from measurements made over half a decade by the orbiting Pioneer Venus spacecraft, which has been looking down at the planet's atmosphere from on high since December, 1978. Ultraviolet spectra taken over that span, says Larry W. Esposito of the Univerity of Colorado in Boulder, show that the amount of sulfur dioxide at the top of the Venus clouds has declined by more than 90 percent since the orbiter started taking its measurements. In addition, he says, so has the amount of fine (sub-micron) haze particles seen above the clouds. When the spacecraft first arrived, Esposito says, both of these constituents were found in concentrations far greater than even the maximum amounts derived from previous earth-based observations, and they have been declining ever since. Venus had, however, revealed a similarly hazy appearance in polarimetry data from the late 1950s.

A possible message from all this, according to Esposito, is that major volcanic eruptions, decades apart, have taken place on the surface of Venus. Such a blast, he suggests, could send a column of hot, sulfurous gases high into the clouds. The SO_2 in this gas would rapidly form into small aerosol particles of sulfuric acid, which would eventually grow into larger particles and fall out into the main cloud deck, leaving decades-long periods when neither the small aerosols nor SO_2 would be visible. Esposito's implication is that just such a major eruption may have taken place shortly before the orbiter got to Venus, and that another occurred in the late 1950s. The thermal energy required for such an ejection, he says, is about 10 times greater than even "the largest of recent earth eruptions." By the same token, the amount of haze in the Venus middle atmosphere at the orbiter's arrival was about 10 times more than has been found in earth's stratosphere following major terrestrial eruptions.

In addition, Ronald G. Prinn of the Massachusetts Institute of Technology in Cambridge notes that analyses of the Venus surface by the Soviet Venera 13 and 14 landing craft show "free calcium" to be considerably more common than calcium sulfate. Since free calcium would react readily with SO_2 and remove it from the atmosphere, he says, the fact that abundant SO_2 remains in the presence of free calcium suggests that the SO_2 must have been a recent addition—perhaps, he suggests, as recent as 10 to 1,000 years ago. Esposito's analysis is certainly not "proof" of volcanism on Venus, but it changed Esposito's mind from "possible" to "likely."

—J. Eberhart

Aluminum cutback to prevent senility

A possible preventive against senility (senile dementia or Alzheimer's disease) is being proposed by a Washington, D.C. toxicologist. The technique involves reducing levels of aluminum in one's diet, since there is increasing evidence that aluminum can accumulate in the brain and cause several kinds of dementia, including the senile type (SN: 11/6/82, p. 292).

Armond Lione, a toxicologist and president of Associated Pharmacologists and Toxicologists in Washington, D.C., writes in FOOD CHEMISTRY AND TOXICOLOGY (Vol. 21, No. 1), that nonprescription drugs containing substantial amounts of aluminum include a number of antacids, buffered aspirins, anti-diarrheal products, douches and hemorrhoidal medications. Foods that contain ample amounts of aluminum include many household baking powders, individually wrapped sliced process cheeses, pancake mixes, frozen dough and self-rising flours as well as some pickled cucumbers. Aluminum cookware, he has found, can also add to people's daily aluminum intake, especially when salty, acidic or alkaline foods are cooked in it.

Although no studies have yet shown whether aluminum reduction can prevent senility, Lione told SCIENCE NEWS, some scientists are now trying to see whether reducing the aluminum intake of senile patients can counter their disease.

—J. A. Treichel

Laser clears clogs

An experimental laser treatment that may replace bypass surgery for clogged arteries in the heart and legs has successfully burned away cholesterol blockages in the leg of a 62-year-old man, Stanford University Medical Center announced this week. The patient walked away from the hospital 24 hours after the operation.

Robert Ginsburg, a cardiologist who helped develop the procedure, says, "To our knowledge this is the first successful use of laser angioplasty as a treatment for vascular disease. ... Once we feel more comfortable with this technique in diseased legs, we'll move on to our ultimate goal of attempting the procedure on coronary arteries." He added that the risks of burning a hole in the artery and the chance of blood clotting keep the technique "a long way off from being an everyday procedure."

The clinical trials at Stanford, ongoing since March, come after several years of experiments with animals, human cadavers and optical physics research at Stanford and other places (SN: 10/2/82, p. 213). Ginsburg adds that much more work is needed before the procedure can become generally available. □