tein- and fat-digesting enzymes within the cell that destroy it," says Stevens.

The idea that overstimulation of NMDA receptors might cause brain damage has prompted researchers to develop compounds that might block the activity of the receptors and prevent nerve cell death. For instance, a class of compounds, including MK-801 and the hallucinogen phencyclidine ("angel dust"), appears to block the NMDA ion channel. Last year, Leslie Iverson of Merck, Sharpe & Dohme Research Laboratories in Harlow, England, and his colleagues proposed that MK-801 may be a treatment for preventing brain damage during a heart attack or stroke.

Several other research groups are trying to unravel the precise mechanisms by which MK-801 works. Among them are Stuart Lipton and Elias Aizenman of Harvard Medical School in Boston and their collaborator Andreas Karschin of the Max Planck Institute for Brain Research in Frankfurt. They are pursuing an earlier observation that MK-801 works best when the NMDA ion channel is already open. "We find that the action of MK-801 is dependent on the concentration of agonist," says Lipton. "The more NMDA you put on a cell, the better MK-801 blocks its effects. And, if you think about it, this is exactly the way you would want the drug to work."

Like others, Lipton reasons that in the brain of a stroke patient, damage to nerve cells increases with the release of more and more excitatory neurotransmitter. If MK-801 works in vivo as it does in the Harvard group's in vitro system, then the drug should have its maximal blocking effect in a patient with escalating levels of excitatory neurotransmitter in the brain.

The past 5 years have produced an explosion of information about NMDA receptors. Complex chemical and electrical mechanisms regulate their activity. NMDA receptors, in turn, regulate synaptic changes that may underlie learning and memory. They also appear to participate in normal synapse structuring in the brains of developing animals. But the same receptors probably cause some of the brain damage that occurs during ischemia. Despite the progress in understanding NMDA receptors and ion channels, key questions remain about their precise structure, regulation, location, and function. These issues will most certainly sustain this research field as one of the most exciting in neuroscience today. ■

DEBORAH M. BARNES

ADDITIONAL READING

(Special issue) "Excitatory amino acids in the brain—focus on NMDA receptors," *Trends Neurosci.* **10**, 263 (1987).

Corals Remain Baffling

Marine scientists are still baffled by the mysterious coral "bleaching" that swept through the Caribbean last summer and early fall (*Science*, 27 November, page 1228). The reef-building corals have not died in large numbers, as feared, and many are recovering, but the episode appears to be more widespread and more complicated than previously believed.

Bleaching occurs when corals expel the algae, known as zooxanthallae, that normally reside within their tissues, providing energy and oxygen in exchange for nutrients. It is called bleaching because when the brown algae are expelled, the corals turn a startling white. If bleaching is severe enough, corals may die, and the reef ecosystem itself becomes vulnerable to erosion and physical devastation.

Isolated bleaching events are fairly common in response to environmental stress, such as extremes in water temperature or pollutants. But starting last June, corals throughout the Caribbean basin became bleached at almost the same time, in an area stretching from the Florida Keys to Jamaica and as far east as the Virgin Islands. Bleaching on this scale had never been observed in the Caribbean before. However, an even more massive bleaching event devastated coral reefs in the eastern Pacific in 1983, leading to mass mortality.

Alarmed that the Caribbean bleaching, too, might portend mass mortality, some 50 researchers met at a hastily convened workshop in St. Croix in December. The picture that emerged is somewhat mixed, though prospects for recovery seem brighter than they did a month or two ago. "There are definite signs that it is getting better," says John Ogden, director of the West Indies Laboratory of Fairleigh Dickinson University in the Virgin Islands and one of the organizers of the meeting. Most of the corals in St. Croix seem to be recovering, Ogden says, but some colonies, especially brain coral, have died. In Jamaica and Looe Key, there is evidence of recovery as well, he says.

But the picture is not universally rosy. In all, some 60 species of coral and coral-like animals have been affected, although not all species at all locations, says Ernest Williams of the University of Puerto Rico, who is compiling data on the event. "Although most of the corals are recovering, some are getting worse. It has become more complicated than it originally appeared. And I'm not sure the episode is over yet," says Williams, who has new reports of a second bout of bleaching in previously unaffected areas in the southern Caribbean, off the coasts of Venezuela, Panama, and Colombia. The Caribbean episode looks "more and more similar to what happened in the Pacific," he says. "There were a number of bouts. Some species were bleached at one time, others at another."

Efforts are now under way to collect data in a more standardized way on exactly what species are affected, and to what degree. By comparing those data with information on water temperature, salinity, solar irradiation, and wind speed, researchers hope to get a firmer fix on the cause of the bleaching.

The evidence still points to the slightly elevated water temperatures of last summer, researchers generally agree, but not in isolation. Only temperature explains the near simultaneous bleaching over such a wide area, but "temperature alone does not explain all the bleaching in all the locations," says Ogden. For example, the apparent second bout of bleaching, which began in the fall when waters were cooler, is hard to explain by temperature alone. "There is a problem with every simple cause that has been suggested," says Williams. The favored hypothesis is now temperature in combination with changes in ultraviolet light, either decreased light penetration due to sedimentation, or increased light from unusually calm waters.

What is particularly troubling about the bleaching episode is that it is the latest in a series of unexplained mass ecological disturbances in the Caribbean that include the massive fish kill of 1980, the 1983–84 sea urchin (Diadema) die off, in which 95 to 99% of these sea urchins were killed, and a slowly spreading disease, white band disease, that is now devastating elkhorn coral, the principal reef-building coral in the Caribbean.

"Are all these events warning signs of something bigger that we are not aware of?" asks Ogden. "We are treating them as isolated events. But when you put them all together, are we looking at a bellwether for something we should be getting hot about?" ■ **LESLIE ROBERTS**