amino acids and the base pairs that make up DNA and RNA. "That's rather distressing," he says.

The scrapie agent is also unusually resistant to ultraviolet radiation and to other treatments that destroy nucleic acids. One view, entertained by Stanley B. Prusiner, a scrapie researcher at the University of California at San Francisco, is that the agent may be the aberrant fibrous protein that is deposited in infected brains. If the rogue protein could somehow catalyze its own formation from a healthy version of the protein that is present in all brains, it might not need any nucleic acid. Gajdusek has even speculated that a mineral could play a role.

Rohwer thinks that the protein-only theory of scrapie is "increasingly implausible." His analysis of heat and radiation experiments leads him to conclude the agent is probably a small virus. Other experiments demonstrate the existence of different strains of scrapie, suggesting some genetic component. "The Andromeda-strain stuff is based on an overinterpretation of disinfection experiments," Rohwer surmises. He fears contamination may explain some results.

The most common view seems to be an intermediate one: the agent is a protein protecting a tiny amount of nucleic acid too small to code for protein but big enough to carry a little genetic information. Marsh is a supporter of that idea. He has found a fragment of mitochondrial DNA in scrapie proteins that have been extracted from infected brains. He has not yet been able to prove its role by identifying a sequence that is present only in scrapie extracts.

With no obvious technological catastrophe to blame, why is CJD so common in Orava? Genes may play a part. Experiments show that mutations in the gene that codes for the healthy scrapie protein can affect an animal's susceptibility to the disease. Lev G. Goldfarb, Brown, Gajdusek and their co-workers have found a specific mutation in the human scrapie-protein gene in five unrelated individuals who were stricken with CJD, including some cases from Orava.

So Oravske kuru could be the result of genetically susceptible people being exposed to the scrapie agent. "I think both factors are important," Mitrová says. Half of the Orava cases are in families that have other cases, which lends support to a role for genes. Yet many CJD cases do not carry the mutation. A lot could be hanging on the efforts of Gajdusek and Mitrová to solve the mystery. —*Tim Beardsley*

BUFO MARINUS, ***or cane toad, secretes venom from glands on its upper back.***

Bufo Abuse

A toxic toad gets licked, boiled, teed up and tanned

Plump, greenish-yellow and pebbly in texture, it is not much to look at. It can be a nuisance, too, poisoning dogs and squishing noisily under automobile tires. But *Bufo marinus,* also known as the cane toad, has become an international celebrity of late, inspiring drug-war hysteria in the U.S. and trade talks in the Far East. Here is its tale, warts and all.

This large toad—some attain the girth of Frisbees—once lived quietly in the warmer regions of the Americas, ranging as far north as central California. In the 1930's it was exported to Australia in an attempt to control beetles infesting cane fields (hence its common name). Like many amphibians, *B. marinus* wards off predators by secreting a toxic goo from glands in its skin. The secretion contains a compound called bufotenine, which resembles the neurotransmitter serotonin and also occurs in certain toadstools and plants. Although these bufotenine-containing substances can be lethal, they have reportedly been used as intoxicants by some "primitive" societies.

Intrigued by these accounts, U.S. researchers synthesized bufotenine and began testing it in humans—along with many other psychoactive drugs—in the 1950's, according to Stephen Szara, chief of the biomedical branch of the National Institute on Drug Abuse. These investigators, he says, hoped to gain insights into schizophrenia and other mental disorders. The Pentagon and the Central Intelligence Agency also supported the work as part of an effort to develop brainwashing agents.

In one experiment, researchers injected bufotenine into four inmates of an Ohio prison. The prisoners experienced hallucinatory effects "reminiscent of LSD and mescaline" as well as nausea and chest pains, the scientists reported in the May 18, 1956, issue of *Science.* The investigators also observed that "if the color of an eggplant were diluted, it would approximate the unique purple hue of the faces of the subjects." These side effects, Szara says, discouraged further studies of bufotenine—of an official nature.

The U.S. Drug Enforcement Administration outlawed bufotenine in the late 1960's. Ironically, the DEA's action inspired a few people to try licking live toads, says Darryl S. Inaba, director of drug programs at the Haight-Ashbury Free Medical Clinic in San Francisco, ground zero of the 1960's drug culture. But these adventurers became sick rather than high, he adds, and toad licking never caught on.

For the past two years, however, newspapers have been filled with lurid accounts of cane toad abuse. In April, 1988, *USA Today* reported that Australian "hippies" were "forsaking traditional drugs for cane toads, which they

boil for a slimy, potentially lethal cocktail." Although Australian authorities have denied the story, it apparently primed the media for more. A few months later Inaba gave a lecture on drugs in which he mentioned—for comic relief, he says—the rare 1960's practice of toad licking. Soon reporters all across the world were calling to inquire about "crazed hippies licking toads in the mountains," says Alex Stalcup, director of the clinic.

Inaba and Stalcup assured the reporters that there is no evidence that anyone is ingesting toad secretions—an assertion that law-enforcement officials confirm. "It's not anything the Drug Enforcement Administration is worried about," says Cornelius Dougherty, a spokesperson in Washington, D.C. But the story persisted. "Toads take a licking from desperate druggies," exclaimed the *New York Post* this past January. "How low will people stoop to get high?" sneered the Santa Clara (California) *Press Democrat.*

Inevitably, reality imitated fiction. Last year, Stalcup says, two teenagers in New Mexico ingested cane toad toxin after reading stories about the "fad" and had to be hospitalized. An Australian youth died after eating cane toad eggs. "This rumor has caused a lot of misery," Stalcup says.

Meanwhile Australia is coping with other toad-related problems. Cane toads have become so abundant in the northeast of the country that they have driven out indigenous amphibians and have poisoned other wildlife and pets. Some dogs have even become compulsive toad lickers, according to Glen Ingram, a herpetologist at the Queensland Museum. "It gives them a kick, perhaps like alcohol," he explained to a newspaper. Angry Australians have organized "toad eradication" outings; golf clubs and cricket bats, while officially frowned on, are the favored instruments of execution.

Yet the citizens of Brisbane may have found a silver lining in the toad glut. They recently persuaded China, whose traditional medicines include compounds from other *Bufo* species, to explore the therapeutic potential of *B. marinus* venom. In April Brisbane's Office of Economic Development shipped 100 grams of the stuff to the Shanghai Industry Foundation. Other Brisbanians are marketing products made of toad leather. Although single toad skins are somewhat small, says Mark C. Underhill of the development office, they make "quite attractive" wallets, purses and even outerwear if artfully sewn together. If you can't lick them, join them. —*John Horgan*