Natural Highs in Natural Habitats

By JOEL GREENBERG

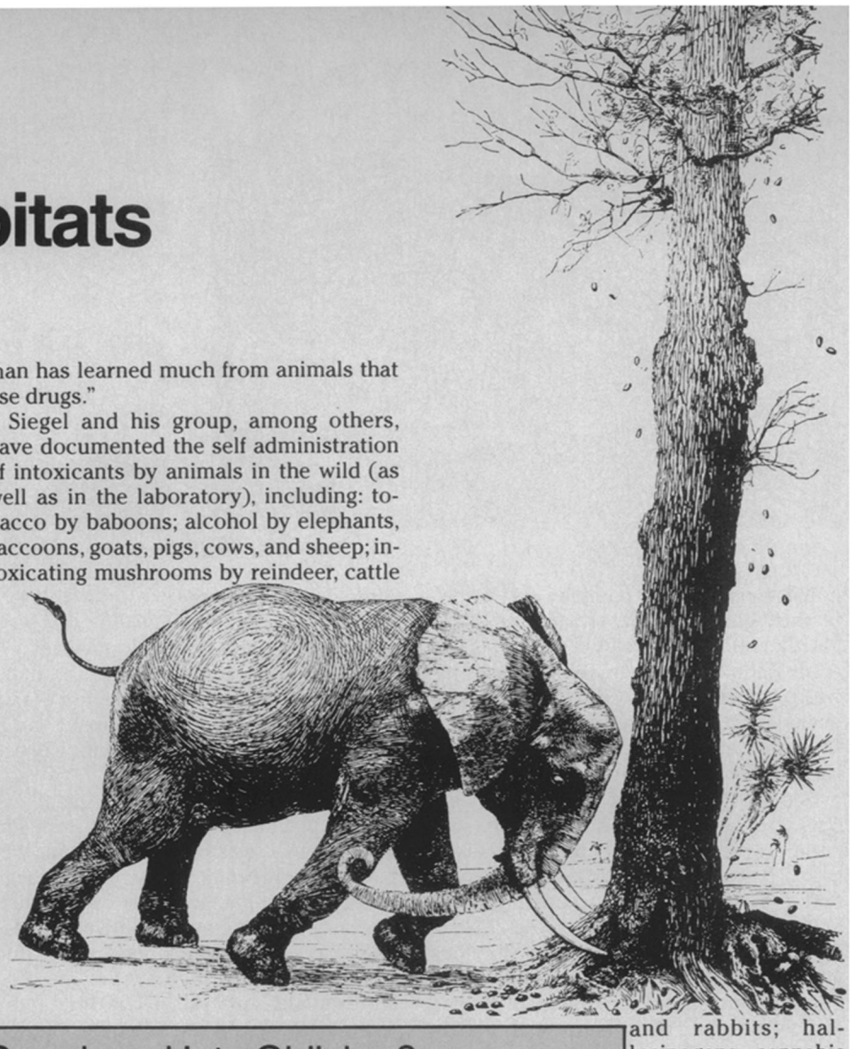
There's the case of Marty, the Marijuana Mouse, who invaded the narcotics vault of the San Jose, Calif., police department and sampled a potpourri of heroin, cocaine and other drugs before settling — literally — on marijuana. Marty was later found nesting in the marijuana seeds. "As the availability of a drug increases, then the animal will acquire a taste for it," says Ronald K. Siegel of the psychiatry department of the University of California at Los Angeles. Siegel, who subsequently studied Marty in his laboratory, believes the "acquired taste" idea might at least partially explain what he describes as the popularity among animals in the wild of alcohol and other intoxicants found in grains and plants.

Siegel says that he and his colleagues have observed more than 2,000 cases (and investigated 310 of them) over the years of animals self-administering naturally occurring drugs in Africa, South America and elsewhere around the world. "In the 310 cases we've investigated," he says, "there are sufficient observations and data to suggest that these ingestions are both intentional and addictive."

Mammals, birds, insects, reptiles, fish — all seek out ways to get high, Siegel recently told an amused audience of psychologists in Anaheim, Calif., at the annual meeting of the American Psychological Association. The implications of such a phenomenon, however, range far beyond the humorous, Siegel said.

"It is widely held that man is the only species that intoxicates itself through the administration of psychoactive drugs — that man is the only animal that becomes addicted to drugs outside of lab settings," he says. "Hence, drug addictions [are seen as] unnatural, deviant and pathological. Our studies...suggest that man has learned much from animals that use drugs."

Siegel and his group, among others, have documented the self administration of intoxicants by animals in the wild (as well as in the laboratory), including: tobacco by baboons; alcohol by elephants, raccoons, goats, pigs, cows, and sheep; intoxicating mushrooms by reindeer, cattle and rabbits; hallucinogens, cannabis and other natural drugs by a variety of species.



In addition to his observations in the wild, Siegel has studied animals in a wide variety of outdoor controlled conditions, as well as in the lab. His most extensive work has been with elephants — one of at least 28 species that appear to gravitate toward alcohol. "Elephants have a long association with alcohol," Siegel notes. Stories abound of herds of elephants breaking into stills and grain storage facilities, or munching on fermented fruit (such as that of the mgongo tree in Tanzania) and then rampaging through villages and towns.

In their own controlled studies at game preserves in Southern California,

Dinosaurs: Overdosed Into Oblivion?

Ronald Siegel says that all this "natural intoxication" suggests that drug taking is "not unnatural, but a natural biological response to our environment." He further suggests that a study of prehistory reveals that natural intoxication may have had a role in the evolution or extinction of certain species. Specifically, he points to the beginning of the Mesozoic Era some 225 million years ago, when angiosperms, which include the major groups of flowering plants, began to flower and produce two substances: hydrolysable tannins, antifungal agents that are bitter-tasting to animals; and aromatic, amino-acid-based alkaloids, bitter tasting substances that constitute the major groups of psychoactive agents.

It is these plants, Siegel suggests, that may be largely responsible for the extinction of dinosaurs. The dinosaurs, some of which apparently ate about a ton of forage a day, had two great built-in disadvantages, according to Siegel: They failed to evolve effective mechanisms to taste the plants' bitterness and they failed to evolve effective livers with which to detoxify the alkaloids. The result? Mass and massive drug overdoses, Siegel says. "I'm not suggesting that all dinosaurs OD'd on plant drugs, but it certainly was a factor [in their extinction]," he says. It also helps explain why many dinosaur fossils have been found in contorted positions, he adds.

Nicholas Hotton, a research curator at the Smithsonian Institution's Department of Paleobiology in Washington, D.C., disagrees with Siegel's interpretation: "Total, unmitigated bull—," says Hotton. "There is no way to tell whether dinosaurs tasted bitterness...it would be nice if we knew what kind of livers dinosaurs evolved [but we don't]." Upon reflection, Hotton added: "Pardon my extreme reaction, but I'm a dinosaur chauvinist." It is likely, he conceded, that dinosaurs "were probably adapted to older plants" and that angiosperms may have had something to do, indirectly, with dinosaurs' demise. "But the changeover [to angiosperms] took place 60 million years before the extinction...the timing is off" in the drug overdose scenario, he says.

Hotton says he gravitates toward the "catastrophic extinction" theory — where an asteroid or some other object is thought to have wiped out the dinosaur population — because the dinosaurs became extinct "more abruptly" than other species. Siegel's work "suggests lines for further research," he says, "but I doubt [his premise] very much."

— J. Greenberg

Siegel and his colleagues made available to Asiatic and African elephants various concentrations of alcohol in calibrated buckets. Each elephant, according to Siegel, drank the equivalent of 20 beers at a time. "The highest concentration of alcohol they would accept was seven percent," he says, "although, with fruit juice disguising, some took up to 10 percent. Interestingly, seven percent is the exact percentage of alcohol in fermented fruit."

In each case, the alcohol — which the elephants would collect with their trunks and squirt into their mouths — would trigger the same behaviors: trunk-wrapping (suggesting the alcohol gave off a burning sensation), vocalization, ear flapping (this is how elephants ventilate, since they have no sweat glands), head shaking (usually only done to shake off insects), extreme lethargy, swaying and leaning (in some cases, falling down). In addition, there was a breakdown in group behavior — the elephants spent less than 45 percent of their time herded together while intoxicated, compared with 80 percent when sober.

Such alcohol-induced behaviors, researchers believe, have distinct implications for humans. In a recent issue of SCIENCE, for example, researchers from Harvard Medical School in Boston and the New England Primate Center in Southborough, Mass., described how female macaque monkeys, when given access to alcohol in the lab, became alcoholics. The subsequent reproductive system failure "following self-induced dependence on alcohol," the researchers write, "parallels the results of clinical studies of alcoholic women."

Attempting to discover the implications of his own work for human behavior, Siegel "increased the stress" on the elephants by restricting them to only two acres of land for one month. During this period, the researchers found the animals' alcohol consumption increased by three-fold; they fell down regularly and were aggressive toward experimenters. This behavior, Siegel notes, was similar to that observed among extremely dense herds in Kenya, where competition for food was severe.

"We've recorded increases in these intoxications in Africa over recent years, concommitant with increases in poaching, destruction of herds by drought and destruction of millions of acres of range forests by timber companies," Siegel says. "The few elephants that are left in Africa move about in herds so dense that stress is inevitable and severe.

"Taken together, these preliminary observations suggest that environmental stress may be an important variable in the self-administration of alcohol in these natural habitats," Siegel says. "Elephants drink, perhaps, to forget ... the anxiety produced by shrinking rangeland and the competition for food. And I think we can see a little bit of ourselves in this kind of behavior." □

"El Niño" *continued from p. 299*

southward, it weakened the trades and initiated the warm spot in the ocean. "There's no end to this thing," Namias says. The basis for the dip in the band of westward winds, he says, is tied to the preceding general circulation of the atmosphere, and to underlying sea surface temperatures in the temperate latitudes.

The El Niño may be in decline, but residual effects abound. Surface temperatures in parts of the eastern Pacific still are several degrees above normal, so that an observer unaware of events in the last year or two would rush to sound an El Niño alert. The excess heat in the Pacific waters and the persistent eastward winds encourage formation of tropical storms and cyclones, which still persist at unusual strength and frequency. James Sadler and Bernard Kilonsky of the University of Hawaii in Honolulu report that "tropical cyclones in the South Pacific east of 180° in 1983 have no historical rival in terms of numbers, area of formations or prolonged season."

Sadler and Kilonsky have measured rainfall at several stations in the central Pacific. They find that during the El Niño, Christmas and Autuona islands each experienced rainfall two or three times above previous records. At Christmas Island the mean rainfall for January is 65 mm; this year 772 mm fell, up from a 1958 record of 575 mm. In February 1983, Autuona received 1,021 mm of rain, compared to a 90 mm mean and the February 1931 and 1942 records of 295 mm.

The combination of heavy rainfall and warm water was disastrous, in human terms, for Pacific populations of some fish, birds and marine mammals. These animals feed from waters on or near the surface. When upwelling of deeper water ceases, the surface warms and rapidly becomes depleted in nutrients. The single-celled plants important at the base of the food chain decline, providing less food for small fish that usually are prey for larger fish, birds, seals and sea lions. Ralph Schreiber, of the Natural History Museum of Los Angeles County, Calif., calls the El Niño phenomenon a "major evolutionary forcing factor for the whole of biological oceanography."

When faced with adversity, such as too little food, marine birds and mammals turn to a well-known survival tactic — they shut down their reproductive cycles and abandon their young. The biological reason is that babies are cheaper than adults, who by saving themselves, can return to breed again. In past El Niños many sea lion pups died and this event was no exception. In October 1982 near a research station in the Galapagos Islands, there were 90 pups. By mid-February only one pup remained. In both coastal Peru and the Galapagos, adult sea lions and fur seals died as well as pups.

Dominique Limberger of the Max Planck Institute in Seewiesen, West Germany and colleagues from Scripps and the University of Cambridge in England suggest in the October TROPICAL OCEAN-ATMOSPHERE NEWSLETTER that fur seals are especially vulnerable to an El Niño's effects. These animals prey on marine fish that normally migrate to the surface at night. Fish such as the Peruvian anchovy avoid the influx of warm water and stay beneath the thermocline, out of the fur seals' reach.

On Christmas Island, the fall 1982 breeding too was a total failure: All of the nestlings died. The adult birds fled the island in search of food and, Schreiber suspects, because the relentless rains had made the island such a soggy and unappealing roost. The adults took to the skies, but the survival ploy may not have worked. When Schreiber visited the island last June, some individuals of all species had returned, but in vastly diminished numbers. Of an estimated 17 million resident birds before the El Niño, only one percent had come home. He cannot say for sure what befell the missing millions but he thinks that they could not find enough to eat and starved while they soared over the sea, searching for food.

What birds there are have resumed breeding, but Schreiber thinks it will take the birds, many of which live 35 years and possibly as long as 50 years, a decade or more to re-establish their populations and breeding patterns. "In an evolutionary context," he says, "El Niños are the major factor that keeps bird populations at the levels we see them."

Smaller marine organisms may prove more resilient. This event is the first El Niño in which biologists have watched the recovery, says Richard Barber of Duke University in Beaufort, N.C. The lowest biological activity off coastal Peru occurred in May 1983, and remained sluggish through the first week of July. Then on July 7, he says, cool water surged up along the coast, and with it, productivity of marine microorganisms such as phytoplankton. In a band stretching 200 kilometers out to sea, productivity was 20 times greater, nutrients were 30 times as abundant, and biomass increased 20 times compared to conditions in May.

Barber has been working closely with officials in South America who must help their nations cope with the phenomenal repercussions of the climate upsets. In northern Peru and Ecuador alone, flooding between December 1982 and June 1983 claimed 600 lives and caused a total of $650 million damage to crops and property. In southern Peru and western Bolivia, drought losses totaled $240 million. Barber says that El Niños, which occur every three to ten years, "have a frequency that is just terrible for society. They are too far apart for people to plan on, and too frequent to ignore." For the nations of North and South America, the variations of El Niño need to be part of the agricultural and meteorological plan, he says, adding, "There is going to be another one." □