BEHAVIOR

Serotonin: A natural anti-depressant?

Serotonin, a naturally occurring neurochemical transmitter, has been under constant investigation since it was first identified over a quarter century ago. For the past decade the substance has been suspected of playing a role in serious depressive illness. But the evidence linking serotonin to depression has been confusing and at times contradictory; although anti-depressant drugs appear to work by binding to nerve membranes and affecting the flow of serotonin between neurons, it is unclear whether mood disorders result from too much or too little of the transmitter — or whether the serotonin abnormality is a product of depression. Recent evidence from several laboratories using different research strategies now makes a strong case for a specific defect in one part of the serotonin transport process — a defect that may represent the body's own attempt to stave off depression by augmenting the supply of this behavior-regulating messenger in the brain.

Neurotransmitters are stored in neurons of the brain, which convey information by releasing the chemicals into the synapse between nerves; the chemicals bind to specific receptor sites on the adjoining nerve membrane, activating that nerve. Once a transmitter has filled a synapse, it is then deactivated by presynaptic proteins that reabsorb the unbound transmitter. In depression, recent studies indicate, presynaptic "reuptake" of serotonin appears to be abnormal.

Scientists are able to study serotonin transport through examination of blood platelet, in which serotonin activity closely resembles that of the brain. University of Chicago psychiatrist Herbert Y. Meltzer has found a marked decrease in serotonin uptake in the platelet of depressed patients when compared to normals. The deficiency was not found in schizophrenia, a thought disorder, although it was evident in schizoaffective illness, a disorder of thought and mood. In support of Meltzer's findings, National Institute of Mental Health psychiatrist Steven M. Paul recently reported a decrease in the concentration of binding sites for imipramine, an anti-depressant drug, in depressed patients. Because such binding sites are suspected of modulating the reuptake of serotonin, Paul says, the diminished concentration in depression suggests a defect in the deactivation mechanism for serotonin. In addition, Paul notes, other researchers have discovered low levels of serotonin metabolites in the spinal fluid of suicidal patients — evidence that supports the notion of faulty serotonin uptake in serious depression.

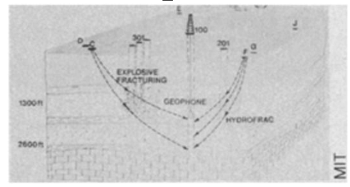
Although several lines of research seem to be converging in support of a serotonin uptake hypothesis, the evidence contradicts the existing evidence about serotonin. Past research has indicated that drugs that increase serotonin improve depression and drugs that decrease serotonin cause relapse; deficient uptake from the synapse would suggest the opposite, that depression is characterized by excess serotonin.

Researchers differ in theories about this paradox. According to Paul, the link between depression and excess serotonin makes sense, because anti-depressant drugs achieve their effect by blocking the post-synaptic reception of serotonin. In addition, he says, there is evidence from twin studies that density of binding (and presumably reuptake) sites is an inherited trait.

But Meltzer offers a quite different theory. He believes that depression is linked to an insufficient supply of serotonin and that drugs have their effect by making receptor proteins supersensitive. The diminished serotonin uptake capacity, he suggests, is a mutation that takes place in people who are vulnerable for depression. It is a natural adaptation to depression — an attempt to make available the amount of serotonin that the normal brain needs. But finally, Meltzer says, the natural reduction in uptake sites is an insufficient adaptation and cannot prevent the appearance of depression.

EARTH SCIENCES

Oil wells: Good to the last drop



As hard as it is to discern the often irregular underground contours of oil reservoirs, it is even more difficult to extract the last drops of fuel from a well. Geologists often give nature a hand by pumping pressurized water or steam into a well to create a fracture and free the remaining oil. But how does one know where the fracture is and how much of the oil field is affected?

Roger Turpening and M. Nafi Toksoz of the Massachusetts Institute of Technology have devised a solution. On the surface, they fire a specially modified mortar blank. Then, using a detector that has been lowered down a well, they measure the seismic waves created by the recoil. The result is a map of the shadows of the underground fracture. The more frequently used, less costly surface method of vertical seismic profiling (as the mapping procedure is called) measures only compressional waves, which are polarized in the direction in which the seismic waves propagate. The newer MIT method also measures shear waves, which move roughly parallel to earth's surface. These waves, unlike the compressional waves, cannot move through the water abundant in the reservoir. Instead the waves stop at the water-filled crack; this enables engineers to read precisely the outline of the fracture.

"The thing that's important is the recoil," Turpening explains. "We isolate the shear wave, extrapolate it to the hole containing the detector, shoot off another mortar, get another shadow, and so on. Slowly, we build up a three-dimensional picture of the crack." The first phase of the research was funded by the U.S. Department of Energy.

Twister picture

In its 14-mile journey along the ground, the swirling tornado that swept past Binger, Okla., last May 22 generated winds up to 196 miles per hour, and hurled from its funnel cattle, farm combines, a semi-trailer truck and other debris at speeds of 43 miles per hour. The first radar measurements of the size and wind velocity of a tornado were recorded during the Binger twister by a 400-pound portable weather station designed by researchers at the National Oceanic and Atmospheric Administration's Wave Propagation Laboratory. The station — a super-sturdy instrument package that resembles a barrel with an antenna — is outfitted with specially equipped Doppler radars that revealed the outline of the tornado from its base to the top of the clouds 7.5 miles from the earth's surface. At 2,000 feet above ground, the funnel was 3,200 feet wide, expanding to more than a mile wide 2.5 miles above ground.

Scientists with NOAA's Severe Storms Laboratory in Norman, Okla., report that radar echoes showed a "hole" 2.2 miles in diameter where there was very little of the precipitation, dust, or other objects that reflect radar beams. This area coincided with the size and location of the tornado as described by wind patterns, and was surrounded by a rim of very strong echoes. The finding fits prevailing theory and rare visual observations.

Volcanoes quiet in 1981

Fewer volcanoes erupted in 1981 than in any year since at least 1970, reports the Smithsonian Institution's Scientific Event Alert Network. Last year 47 of the world's volcanoes erupted, well below the average of nearly 60 active volcanoes a year over the last decade. Fourteen volcanoes erupted explosively, compared to 23 of the 53 active volcanoes in 1980.