tested very very carefully because a related group of compounds [the Harmala alkaloids] are hallucinogens."

Paul and Skolnick described at the meeting another kind of benzodiazepine antagonist, an imidazopyridine, that selectively blocks only the anxiety-reducing actions of these drugs. It does not affect the sedative, muscle-relaxant, or anticonvulsant activities of benzodiazepines. The drug, says Skolnick, "may not have any practical value but it does suggest that you can separate the action of benzodiazepines."

Bernard Beer, Claire Klepner, and Arnold Lippa of American Cyanamid's Lederle Laboratories have direct evidence that the actions of benzodiazepines are separable. They have found a compound, a triazolopyridazine, that counteracts anxiety and is an anticonvulsant without being a muscle relaxant or a sedative, and without interacting with alcohol. Beer explains that the Lederle group now believes there are two types of benzodiazepine receptors. Drugs that bind to "type 1" but not "type 2" will counteract anxiety without having the other benzodiazepine effects. The benzodiazepines themselves are indiscriminate, binding equally well to both receptor types.

Finally, John Tallman of NIH, Skolnick, and Paul suggest a way to speed up the screening for benzodiazepine antagonists. At the present time, researchers must test compounds in vitro to see if they bind to the benzodiazepine receptors and then must test them in animals to see if they affect behavior. But, Tallman found, benzodiazepines bind better to their receptors in the presence of the neurotransmitter GABA. In contrast, substances that block or antagonize benzodiazepines bind to benzodiazepine receptors equally well when GABA is present as when it is not. Thus, it looks like researchers may be able to use the receptor binding assay in the presence and absence of GABA to decide if a compound will mimic or antagonize benzodiazepines before ever testing the compounds in animals.

The search for drugs having some, but not all, effects of the benzodiazepines and the search for drugs to block or antagonize effects of benzodiazepines is just beginning. But, predicts Skolnick, "soon I suspect that we'll have compounds that will disrupt or mimic each of the actions of benzodiazepines." At the very least, these compounds should be invaluable research tools in probing the basis of human anxiety and it is likely that they will be clinically important as well.—GINA KOLATA

Neutrinos: No Oscillations?

Opening another chapter in a continuing controversy, a team of American, German, and Swiss physicists have reported new evidence casting doubt on the idea that neutrinos exhibit a bizarre phenomenon called "oscillation." The results of the new experiment were discussed by California Institute of Technology physicist Felix Boehm at the annual meeting of the American Physical Society in Washington, D.C.

They thus bring the controversy full circle. Neutrinos, ghostly particles released in certain nuclear reactions, have no electric charge and very little propensity to interact with matter. They do, however, come in three varieties, known as the electron, mu, and tau neutrinos. Since 1931, when Enrico Fermi first postulated the particles' existence, physicists have also assumed that neutrinos are massless, like the photon.

In 1980, however, experiments in the Soviet Union indicated that neutrinos might indeed have a small mass. At the same time, physicists from the University of California at Irvine reported evidence for oscillations: one type of neutrino can turn into another as it moves along, rather as if a swallow were to metamorphose into a hawk. The two experiments were considered mutually supportive, since for mathematical reasons it is impossible for neutrinos to oscillate unless they also have mass.

The massive neutrino concept was immediately taken up in other disciplines. Cosmologists hoped that swarms of massive neutrinos might account for the invisible "missing mass" which seems to exert gravitational effects on individual spiral galaxies and on clusters of galaxies (*Science*, 30 January 1981, p. 470). Astrophysicists believed that the oscillation phenomenon might solve the solar neutrino problem: that nuclear reactions in the core of the sun should produce far more neutrinos than are observed. The detectors used to date look only for electron-type neutrinos, however, so if electron neutrinos emitted in the sun have changed to something else by the time they reach Earth, then the paucity is explained.

But now researchers from the California Institute of Technology, the Technical University of Munich, and the Swiss Institute of Nuclear Research have searched for neutrino oscillation with a much more sensitive apparatus than the Irvine group's and have found no evidence for the phenomenon. Their work does not directly contradict the Soviet experiment, however, so neutrino mass is still quite possible.

For a neutrino source, Boehm and his colleagues used a 2800-megawatt power reactor near Gösgen, Switzerland. (Fissioning uranium atoms emit electron-type neutrinos.) Their detector was set up near the containment building, 38 meters from the reactor core. Since neutrinos so rarely pay attention to ordinary matter—they can easily sail through the core of the earth without slowing—the intense flux of neutrinos from the reactor yielded only about three events per hour in the detector. Still, this setup represented about ten times the sensitivity of the group's previous experiment using a 57-megawatt research reactor at Grenoble, France.

The detector responded only to electron neutrinos. Thus, the difference between the number of events expected from calibration measurements made at the core, and the number actually found at the detector, represented the number of electron neutrinos that had oscillated away and changed to some other type as they traveled the intervening distance.

That number, the group concluded after running the experiment from June 1981 to February 1982, is consistent with zero. In technical terms, the physicists were able to exclude the possibility of neutrino oscillations down to a mixing angle of 0.16 and a mass-squared difference of 0.02 square electron volts. This represents a very large region of parameters where oscillations could possibly be found, said Boehm.

In May, the researchers will begin an effort to set still more stringent limits by moving the detector back to a distance of 48 meters from the reactor core. If the neutrinos are going to oscillate at all, they will then have another 10 meters in which to do it. Moreover, comparison of the two sets of data will eliminate calibration uncertainties.—M. MITCHELL WALDROP

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