Racial difference in drug response

An international team of researchers has found that Americans and Chinese differe significantly in their ability to metabolize a major class of anti-psychotic drugs, suggesting that reported differences in response to psychiatric treatment may be under genetic control. The preliminary study also indicates that, while the Chinese tend as a group to be slow in clearing anti-depressant medication from their bodies, a previously unrecognized pocket of Caucasians seem to metabolize such drugs extraordinarily rapidly and may, as a result, be unresponsive to the routine dosages prescribed for depression.

According to National Institute of Mental Health psychiatrist William Potter, an anti-depressant drug called "desipramine" was given to 30 healthy subjects (16 Americans, 14 Chinese); measurement of the metabolic by-products of the drug over the next five days revealed that the typical American subject rid his system of the drug more quickly than the typical Chinese subject. The amount of medication in the body at a given time is a good indicator of the drug's effectiveness in staving off the symptoms of depression, indicating that Chinese depressives might require a lower dosage of drugs than do Caucasians, Potter told SCIENCE NEWS. Potter and NIMH colleague Matthew Rudorfer ran the experiment in collaboration with Mingdao Zhang and Wen-Ho Chang of China and Elizabeth Lane of Australia.

Psychoactive drugs such as desipramine must be metabolized in the liver in order to be cleared from the body. Several metabolic processes — including one called "hydroxylation," which is responsible for about 70 percent of drug metabolism — were shown to be slower in the Chinese than in the American subjects. The enzyme systems involved in these metabolic processes are known to be under genetic control, Potter says.

The subjects fell into three groups according to their metabolic rates, Potter notes. The group that was very slow at clearing the desipramine was exclusively Chinese; the group with very rapid metabolism was exclusively American; and a third mixed group cleared the drug at an intermediate rate. Although such an inheritance pattern might suggest that variance in a single gene is responsible for the metabolic variation, the results are too preliminary for such a conclusion, according to Potter. The genetic mechanism controlling the hydroxylation enzymes remains a mystery, he says.

But according to University of Toronto geneticist Werner Kalow, the results of the NIMH study are consistent with his own research results, which point to a single responsible gene. Kalow compared drug metabolism in a population of Hong Kong Chinese to that of Caucasian controls and found that, while only 8 percent of the Caucasians were unable to metabolize the hypertensive drug called "debrisoquine," a full 30 percent of the Oriental subjects were unable to do so. In test-tube experiments, Kalow demonstrated that the same enzymes that act on debrisoquine are crucial to the metabolism not only of common anti-depressant drugs but also the so-called "beta blockers," which are used in the treatment of cardiovascular disease. What the evidence suggests, according to Kalow, is that slow metabolizers are a genetic "type" more common in the Oriental than in the Caucasian population. Interestingly, he points out, the Chinese tend to metabolize alcohol much more quickly, suggesting that there may be a large-scale genetic difference between populations, with one type of enzmye more prominent in Caucasians and another in Orientals.

The finding that Chinese subjects are more responsive to anti-depressants is in keeping with reports that fewer such drugs are prescribed in China. But for cultural reasons depression is very rarely diagnosed in China, Potter says, and it is possible that many Chinese diagnosed as suffering from nervous exhaustion are actually depressed and are going untreated. Response to desipramine could be used to help diagnose organic depression and to more accurately predict the most effective dosage level of anti-depressant, which is currently determined through trial and error. *—W. Herbert*

Zapping pollutants from power plants

The trend in coal-burning power plants is to burn low-sulfur coal, but attacking one pollution problem raises another. Conventional electrostatic precipitators, which use high voltages to charge and collect particles from escaping gases, become less efficient because of the higher resistivity of fly ash from low-sulfur coal. Electron beams may be the answer for effectively removing fly ash produced by this coal.

Physicist Robert H. Davis of Florida State University in Tallahassee, Fla., at a recent congressional hearing on coal research, described the high-risk, high-technology research on the use of electron beams in precipitators. The principal approach is to break up the action of the precipitator into two stages, one that charges the particles (called a precharger) and a second that does nothing more than provide an electric field for particle collection. Davis's research group is investigating how to charge particles efficiently.

Florida State University has a unique wind tunnel "racetrack," which allows the study of both aerosol physics and electron beam treatment. The working gas picks up test particles (plastic or hydrated aluminum hydroxide, for example) from an aerosol generator. Instruments monitor the number of particles present before and after the gas passes through an electron beam precharger. The researchers can also measure the charge and charge-to-mass ratio of the particles. Davis says, "We need to establish conditions under which electron beam treatment is useful for particulate matter control."

More advanced is research on the use of electron beams to remove sulfur and nitrogen oxides from flue gas. Energetic electrons cause extensive ionization and formation of radicals, and these products trigger a series of chemical reactions that lead to the formation of substances more easily removed than sulfur and nitrogen oxides. Recently, researchers from Avco Everett Research Laboratories in Everett, Mass., and a Japanese company reported an electron beam process that removes more than 90 percent of the pollutants and, coupled with ammonia, produces ammonium sulfate and ammonium nitrate, suitable for making fertilizers.

Although electron beam sources are routinely used in some industrial processes like plastic coating and welding, their cost is still high. As a result, much research is devoted to "dose enhancement" so that weaker, less costly electron beams can be used. Work at Florida State University has confirmed earlier Japanese research that the presence of an electric field increases the number of particles charged or the rates of chemical reactions due to irradiation. "That good news is seriously eroded by the conclusion that power consumption for a given dose is discouragingly high," says Davis. He adds, however, that there may be situations in which the power requirement penalty may need to be paid to control some undesirable emissions.

Davis says that preliminary experiments also show that electron irradiation can reduce resistivity by a factor of 50 in dust layers. "An unexplained but curious result is the persistence of this reduction over periods of tens of hours," he says.

Davis notes the enticing possibility of using the large doses required for sulfur and nitrogen oxide removal in a combined treatment system that also controls particulate matter. A workshop organized earlier this year considered the possibility. "The question is still quite open," Davis says, "It's certainly an interesting possibility."

Practical electron beam systems for particle removal are probably still about a decade away, Davis estimates. "The progress the Japanese have been making is an early warning that we ought to really come up to speed in order to stay with them," he says. "It is high technology and high risk, but there's an air of excitement amongst the Japanese, so look out." *—I. Peterson*