Getting the **Lead Out**

In the battle between the heavy metals lead and zinc that occur in human cells, lead has always been the winner. But Assistant Professor of Chemistry Andrzej Jarzecki's research on lead molecules and their bonding processes in protein cells may give zinc a fighting chance and ultimately provide the basis for more effective treatment of lead poisoning.

Jarzecki joined the Brooklyn College faculty two years ago. His research, funded by a grant from the National Institutes of Health, focuses on the strong bonds that lead ions are able to form with proteins, resulting in a depletion of the body's supply of much-needed zinc ions. When bound to protein, lead exhibits intense charge-transfer "bands"—an indication of the strength of the electronic charge between atoms. Studying the source of the charge transfers within the cells will ultimately provide insight into how lead and protein interact.

"Knowing how lead bonds within human cells will also reveal how other toxic environmental metals and elements, such as mercury, arsenic, chromium, and cadmium, bond also," says Jarzecki, who hails from Toruń, Poland, the birthplace of astronomer Nicolaus Copernicus.

In the United States, nearly nine hundred thousand children under the age of six have elevated lead levels in their blood. High concentrations of lead can severely damage the brain and kidneys and result in anemia. Adding to the urgency of Jarzecki's research is the fact that Brooklyn's Bushwick neighborhood has the highest incidence of lead poisoning in the city.

Although the total incidence of lead poisoning has steadily decreased in New York City, more than three thousand children under the age of six were identified in 2003 as having harmful blood lead levels. The following year the New York City Council passed a law mandating annual inspections for traces of lead paint and other toxic hazards in all rental apartments that house children under the age of seven.

"All paint pigments are based on lead compounds," says Jarzecki, "but another source of lead in older buildings in New York City is water pipes, where, over time, lead leeches into the water." He notes that "once lead enters the body, it is extremely difficult to remove."

According to Jarzecki, "lead targets the proteins that deal with development, so lead poisoning is far more dangerous in children than in adults." He explains that lead targets and attacks a cycle of proteins containing calcium and zinc, one of the many cycles involved in the production of hemoglobin. "When zinc is displaced by lead, there is an interference in the communication between the proteins and DNA."

Jarzecki is using a technique known as "Resonance Raman" to detect and study lead bands and the patterns associated with them in proteins. The charge-transfer transitions are of fundamental interest because they are essential for distinguishing lead patterns against the background of protein frequency modes. Monitoring these lead-binding molecules is key to understanding the process of lead poisoning.

Jarzecki hopes that by using model structures of lead and of the vibrational frequencies found in proteins and environmental compounds, his research will reveal how the various zinc-binding proteins are structurally altered by lead poisoning.