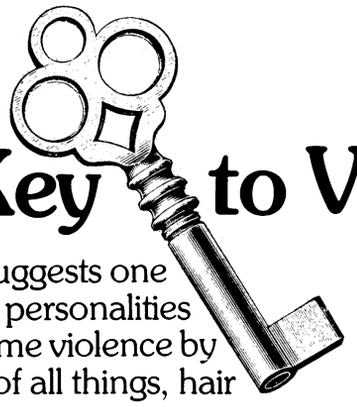
Locks — A Key to Violence?



New research suggests one can predict personalities prone to extreme violence by analyzing, of all things, hair

By JANET RALOFF

"The first people I really got to know well at Stateville Prison," William Walsh recalls, "were people who had been on death row—some of Illinois' most famous murderers. I wondered what made people like this."

During business hours, Walsh labors as an analytical chemist at Argonne National Laboratory, just west of Chicago. But for the past 17 years, his spare time has been devoted to working with inmates of correctional institutions in Illinois. The Prisoner Assistance Program, for instance, which he founded 11 years ago, arranges for volunteers to visit inmates and to help parolees find employment; it even stages prison art shows to help creative detainees earn both money and respect.

It was as a result of these endeavors that Walsh found himself asking the inevitable: What is it that drives people to commit such reprehensible acts that they must be isolated from society, shut in behind bars? Research he's just completed—part of the growing field of bio-behavioral research—suggests inborn chemical imbalances may underlie some of the severest criminal violence.

That notion would have struck most social scientists as heretical when studies such as Walsh's first began. However, a sound body of research, developed largely over the past decade, now points convincingly to chemistry's strong influence on behavior. Many investigators in this growing field have focused on ferreting out the diet-behavior connection (see p. 125). A few have actually explored neurochemical correlates to criminal impulsivity (SN: 10/30/82, p. 282). Until very recently, though, most attempts to delve into the chemical underpinnings of violence per se amounted to little more than collecting anecdotal evidence.

Walsh began his inquiry with an exhaustive search of the scientific literature in the areas of schizophrenia, mental illness, criminology and related fields. Then he talked at length with mental-health professionals and criminologists. From these sources he learned that psychiatry and counseling have a poor track record in reforming criminal personalities. And it was this that caused him, about seven years ago, to begin looking at body chemistry for clues to the destructive behavior from which violence erupts.

The work progressed slowly because of its volunteer nature. In designing his study population, choosing research tools and planning specific avenues of attack, Walsh culled the collective wisdom of the research community in which he works — most notably, Argonne National Laboratory. Physicians, epidemiologists, chemists, statisticians, computer analysts — more than 20 volunteered their knowledge, and often their services as well. They had to, as Walsh had no formal financing.

Initial attempts to sleuth out the chemistry behind violence, by examining blood and urine, proved unsuccessful. Body levels of the elements that most interested Walsh (based on his surveys of published research) were too low to register cleanly in these tests. "Then I read about the work some people had done at McGill University in Montreal, Canada, on hair analysis," he recalls.

Before long, Walsh had joined the burgeoning ranks of researchers examining hair. And his studies, reported for the first time on May 15, at a small symposium convened by the Schizophrenia Foundation of New Jersey's Brain Bio Center, indeed show a provocative link between extreme violence and the levels of certain key trace metals in hair.

"Hair has about 200 times the concentration of trace elements in it that blood does," explains Robert Thatcher, a researcher investigating the effects of trace metals on behavior at the University of Maryland–Eastern Shore, in Princess Anne. Thatcher points out that, within hours or days, almost any substance entering the bloodstream has been broken down, used, eliminated or stored within the body. So blood is only an indicator of recent exposures. To study chronic, long-term exposures, one must turn to hair.

Walsh wanted to investigate whether there might be some factor relating to inborn body chemistry — perhaps a metabolic disorder — which predisposed its victims to violence. He suspected that if such a metabolic problem led to the selective retention or malabsorption of certain elements in the diet, hints to that condition might appear as skewed elemental abundances in hair.

For his first experiment, Walsh chose 24 pairs of male siblings between the ages of 8 and 18. "I selected pairs where there was a very delinquent, violent kid in the same family, in the same house, eating the same food with an 'all American boy' — a kid who had never been in trouble, who was an excellent student, and whose incidence of violence was zero," Walsh explains.

From each subject, half a gram of hair was shorn from an area close to the scalp. (Because hair deteriorates after growing out of the head, the interior tissue of strands several inches from the scalp cannot be trusted to reflect true hair chemistry. What's more, pollutants can invade hair; the longer the hair, the more likely it has been contaminated.) For obvious reasons, Walsh rejected anyone whose hair had been chemically treated.

Hair samples were sent to one of two local laboratories that not only provided commercial trace-metal analyses using atomic-absorption mass spectroscopy, but that also permitted Walsh to calibrate their devices with the standard reference materials he had acquired. (Those included certified materials — such as tree leaves purchased from the National Bureau of Standards — for which precise elemental compositions were known.)

At the labs, hair was cleansed, rinsed with triple-distilled water, dried, weighed and dissolved completely with acid. Then a known fraction of the standard was injected into one of the spectral analyzers and obliterated at temperatures exceeding 5,000°C. Photomultiplier tubes scattered about the interior of the spectral analyzer's chamber—tuned to the characteristic wavelengths of specific elements (such as iron or phosphorus)—recorded the emissions as a sample was "zapped," to quantify its elemental abundances.

Walsh's calibration experiments showed either laboratory could be trusted to reliably measure only 11 elements. Thus he was limited to monitoring calcium, magnesium, sodium, zinc, copper and

phosphorus "with high accuracy," and potassium, iron, manganese, lead and cadmium with what he terms "acceptable accuracy." Occasionally he looked at lithium and cobalt too, though he laments he hasn't been able to get good numbers on either of them in more than a year.

As analyses came back, Walsh pulled out results for standard reference materials which he had sent along. Because each sample had been coded, "there was no way anybody at the labs could tell whether one was a test sample, a standard, or a control," Walsh claims. But if Walsh found that the wrong value had been obtained for an element in the standards, he threw out all readings for that element from the tests run at a lab that day. (He would also notify the lab of the problem. Subsequent analysis might show a photomultiplier tube was mistuned or had failed.) Finally, identifications of the sibling pairs were decoded and their data compared, element by element.

"The results were quite clear," Walsh says. Not only did the hair from all 24 of the violent boys register abnormal readings for the elements examined, but also the levels exhibited were nonrandom, falling into one of two distinct groupings.

Relative to levels Walsh previously recorded for normal individuals, both of these violent groups were extremely high in lead, cadmium, iron and calcium; extremely low in zinc (lithium and cobalt too, whenever the data were available). But whereas one group also exhibited high levels of sodium and potassium, coupled to low levels of copper, the other group displayed "just the reverse." (Phosphorus levels, Walsh found, didn't correlate with anything.)

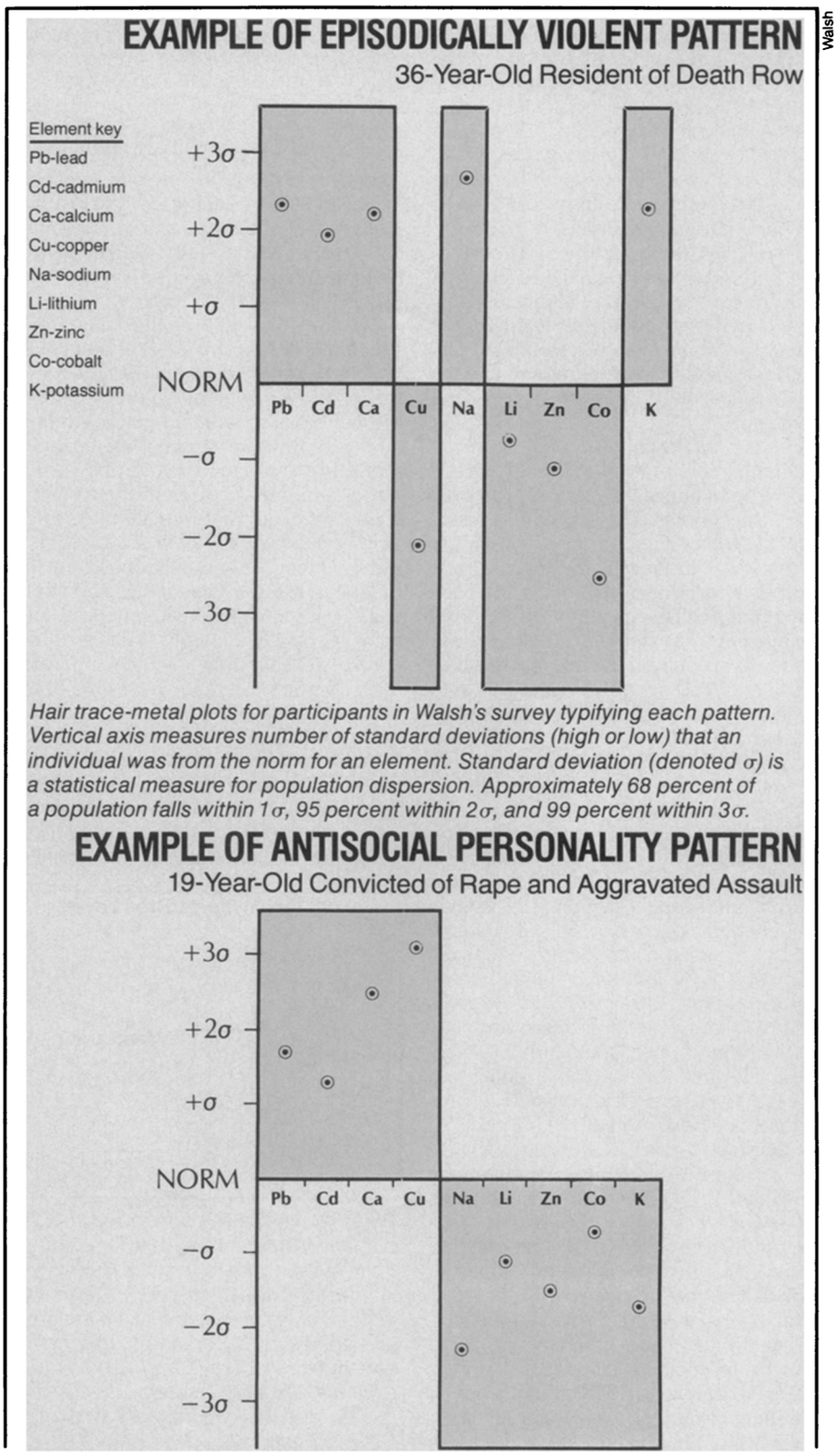
Most important, *none* of the nonviolent siblings exhibited either of these patterns. Since brothers ate similar if not identical diets, Walsh suspected the radical difference in elemental ratios that characterized the violent youths indeed resulted from a chemical imbalance or metabolic disorder.

Sociologists and criminologists who study violence separate their subjects into two general categories — episodic criminals and the so-called sociopaths. An episodic personality may appear absolutely normal for long periods, then erupt suddenly into extreme violence. By contrast, the sociopaths (normally referred to now as "antisocial personalities") are consistent in behavior, frequently becoming "career criminals." This personality differentiation is important because the two trace-metal patterns Walsh identified among the violent siblings distinguished between these two classes of violent behavior.

(Shortly after completing the sibling study, Walsh also learned that a simplified version of one of the two patterns he had identified in the violent boys — where copper levels were high, zinc levels very low — had already been reported in Supplement 1 of the 1972 INTERNATIONAL REVIEW OF NEUROBIOLOGY; it was associated with paranoid schizophrenics.)

The sibling test "was a scouting experiment," Walsh says. "It formed the basis of a hypothesis to be tested."

That second phase of testing began in 1978. It involved 96 extremely violent men and 96 nonviolent counterparts (controls) who had been matched to the violent group by age, sex, race, socioeconomic status and whether they lived in an urban, suburban or rural setting. In each group, one-third were blacks, one-third Hispanics and one-third of European heritage. To ensure that any measured effects were not just artifacts of the prison environment (such as trace-metal content of the water supply), the violent group included not only residents of Stateville and Menard prisons, but also individuals who had left prison at least two years earlier, or



Walsh

Hair trace-metal plots for participants in Walsh's survey typifying each pattern. Vertical axis measures number of standard deviations (high or low) that an individual was from the norm for an element. Standard deviation (denoted σ) is a statistical measure for population dispersion. Approximately 68 percent of a population falls within 1σ, 95 percent within 2σ, and 99 percent within 3σ.

who were juveniles and first offenders that had yet to see the inside of a jail.

Participants ranged in age from 8 to 62 (with a median age of 33), and individuals were considered violent for the purposes of this study only if they had deliberately and repeatedly harmed another human physically. To be classed nonviolent, one must *never* have hurt another deliberately, even as a child.

Results from this more demographically diverse group confirmed what had been found earlier with the siblings. "In looking at the violent people," Walsh told SCIENCE NEWS, "all but four exhibited one of the two patterns identified in the sibling study;" 35 were type A, or episodic; 57 type B, or antisocial personalities. Three controls also showed those patterns, he added, "so it was not a perfect discrimination—but it was pretty darn close."

What's intriguing, he says, is that those four violent participants whose hair exhibited neither of the original two patterns "were also peculiar and identical: They were very, very low *in absolutely every nutrient* — which usually means that they do not process food properly. And in fact," Walsh points out, "they were all very slender people."

Cobalt was initially the most powerful predictor. "We took a group of violent people and controls and found you could practically predict their degree of violence from cobalt concentrations," Walsh says — the lower the levels, the more violent the individual. However, he says, "It's been frustrating; we haven't gotten good cobalt analyses in three years." (Cobalt analyses require a special procedure and are harder to do.) Moreover, Walsh has reason to suspect the cobalt correlation may not be spurious. Cobalt is a central element in vitamin B-12. In scouring the literature, he discovered vitamin B-12 has been linked with several mental disorders.

Like Walsh, Robert Thatcher at the University of Maryland has been using hair analysis in studies to identify the effects of toxic metals on behavior. The metals Thatcher has focused on — lead and cadmium — were both abundant in hair taken from Walsh's violent subjects. In a study reported in ARCHIVES OF ENVIRONMENTAL HEALTH last year, Thatcher and coworkers found a significant correlation between elevated levels of those metals and low scores on tests measuring intelligence and school achievement for 149 children on Maryland's rural Eastern Shore.

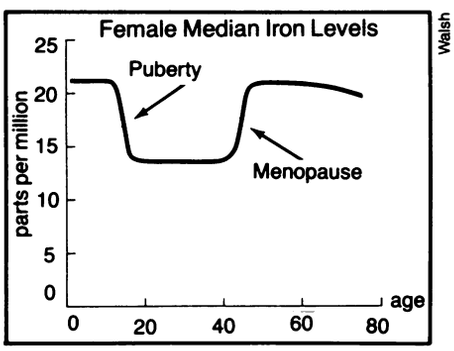
Particularly interesting was a difference in effects attributable to each metal. Lead related more strongly to reduced "performance" (knowledge- or experience-based) IQ, whereas cadmium seemed to diminish "verbal" (or innate) IQ.

In a related study, Thatcher and colleagues found hair cadmium correlated with the proportion of refined carbohydrates in the diet of 184 children studied. (Refined carbohydrates include white sugar, white flour, white rice, white pasta and synthetic "instant" potatoes.) What it amounted to, says Thatcher, was "the higher the proportion of the diet attributable to junk food, the higher the amount of cadmium in their hair." The scientists also reported that scores on tests to measure full-scale IQ, verbal IQ, performance IQ, reading and math appeared to have been adversely affected by the proportion of refined carbohydrates in the diet.

To date, the Maryland team has examined more than 500 children with a battery of tests—including computerized analysis of brain waves and "evoked potentials" (which essentially record brain-reaction time), together with assessments of school achievement, intelligence and motor coordination. Though Thatcher acknowledges he has not yet focused on heavy metals and violence, he told SCIENCE NEWS, "We're going to try to discriminate violent offenders from siblings, similar to what [Walsh] did, based on a set of biological measures such as hair and brain waves."

The Health Research Institute (HRI), which Walsh founded in Clarendon Hills, Ill., has begun a program to send some of the extremely violent youths identified through Walsh's work to get a complete metabolic workup at major medical centers. HRI's goal is to identify the specific conditions that caused the unusual trace-metal hair patterns observed in the violent cohorts. The next step will be to see if treating these conditions in any way mitigates a boy's violent behavior. Until statistically significant numbers of subjects are tested, and until Walsh is able to control for possibly confounding variables, he won't elaborate on results of this program — except to say, "This work is *very* promising."

Walsh anticipates that one of the key questions of those reviewing his work will be whether or not his hair analyses are valid. "There are a lot of irresponsible people using hair analyses," he acknowledges, and as a result, the credibility of legitimate researchers using the technique often suffers by association.



Physiological events become visible in population studies using hair analysis. For example, after analyzing hair from hundreds of healthy females, Walsh found that iron levels in girls up to age 12 average 22 parts per million (ppm) in hair. Between ages 12 and 16, iron falls dramatically, signaling puberty, and remains there until menopause, when it rebounds back to 22 ppm.

As a procedure, hair analysis certainly has had a colorful history. The British pioneered the technique in 1922, using it to determine mineral levels in mummies. But it has found most widespread use in forensics. Since its introduction there a half century ago, hair analysis has been providing crime-scene investigators with a fingerprint-quality matching tool. Each individual's unique combination of diet, metabolism and environment ensures that elemental abundances identified in one hair sample will match only those hairs produced by the same individual.

Outside forensics, however, the credibility of hair analysis has come into question. Criminologist Alexander Schauss, director of the American Institute for Biosocial Research in Tacoma, Wash., explains why: About 15 years ago, certain commercial labs — not the "good ones" — began allowing nonprofessionals to use their services, he says. At about the same time, he recalls, "you started seeing ads in national magazines where people could send in $25 and a sample of their hair to have it analyzed." The problem, Schauss points out, is that the ads made impossible claims — "you know, that it [hair analysis] can predict osteoporosis, or show someone's got cancer." Even with a detailed medical history, hair analysis cannot do those things.

At least as irresponsible, Schauss believes, was the fact that the ads didn't describe limitations of the test, nor explain precisely how to cut hair (even use of the wrong shears can contaminate hair). What's more, laboratory techniques and accuracy varied considerably. Notes criminologist Stephen Schoenthaler of California State College-Stanislaus, "You could take two identical samples of hair, send them to different labs and come up with two separate sets of results. It made for a holy nightmare." As a result, says Schauss, "By the late 1970s, the medical community was ready to hang anyone doing hair analyses."

But things are changing. In 1981 researchers in the field published a standardized protocol for hair analysis, spelling out exactly how to cut and analyze hair. And this year Schauss finished a four-year survey of what constitutes "normal," healthy hair.

On his own, Walsh has also been trying to advance hair analysis techniques to improve their accuracy and reliability. "And I think we have succeeded," he told SCIENCE NEWS. "We [HRI] have the world's only hair standards — large numbers of hair samples for which we know precise elemental concentrations."

In fact, Walsh anticipates that within a decade or two, trace-metal analyses of hair will be as common a medical screening procedure as blood tests are today. Hair analysis provides a noninvasive and

The Diet-Behavior Connection

Perhaps more than anyone else, Barbara Reed has made the criminal-justice system sit up and take notice of diet. A probation officer in Ohio for 20 years, Reed found that a change in her own diet — away from sugary "junk foods," white flour and canned goods — changed her life. The recurring nightmares which had plagued her disappeared, as did the mental lapses, fatigue and violent mood swings.

By 1971 she was advocating a similar dietary reform to all her probationers. Those who followed her instructions reported feeling better, more energetic and more emotionally stable. Most important, she told SCIENCE NEWS, the recidivism rate amongst her charges plunged. And that's something William Pike, a judge with the Municipal Court of Cuyahoga Falls, Ohio, noticed; "I was amazed at the dramatic results in persons who were placed on probation to her through my courts," he said.

Though the data that Reed gleaned in attempting to improve the diet of more than 1,000 probationers are anecdotal, penal systems throughout the country have found it persuasive enough to begin giving it a try.

The research community, less willing to be swayed by anecdotal accounts, has begun its own investigation of diet's role in behavior. And several studies now suggest that diet not only affects behavior and intellect (see accompanying story), but may also play a role in tempering antisocial behavior — much as Reed's accounts had suggested. What's more, this new research may also lend indirect support to the findings recently reported by William Walsh — for the inborn body chemistry of Walsh's violent subjects might cause them to experience nutrition that is in effect similar to, if not worse than, that of junk-food addicts.

Stephen Schoenthaler, director of the Social Justice Program at California State College, Stanislaus, began a study of juveniles at Virginia's Tidewater Detention Center in Chesapeake during 1980, to specifically probe whether a relationship existed between sugar consumption and what he terms "antisocial behavior." Although the initial study was small, the results it suggested were striking — potentially a halving of incidents requiring formal disciplinary action.

The Tidewater studies involved drastically restricting refined (white) sugar in detainees' diets. Because one couldn't substitute fruit juice for Coke, or honey for table sugar, without the youths noticing, Schoenthaler had the detention home's project director, Frank Kern, announce that fiscal difficulties were necessitating menu changes. Neither the staff, the children, nor the cooks were informed of the real reason for the diet change, Schoenthaler says.

Changes in antisocial behavior were measured from records kept daily by staff counselors. Every incident requiring discipline was recorded. Comparing data from the four months prior to and three months following the diet change, Schoenthaler found a 45 percent drop in

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antisocial behavior among the home's changing population (most youths stayed only a month awaiting their court appearance).

Then he controlled for race, age, gender and arresting offense using records from a year before and following the sugar restrictions (which increased the number of subjects from 58 to 276). And still, he says, "there was a 48 percent reduction in antisocial behavior." Finally, the 934 incidents that occurred over that two-year period were analyzed by type of offense. Schoenthaler found "an 82 percent reduction in assaults, 77 percent reduction in thefts, 65 percent reduction in horseplay, and 55 percent reduction in refusal to obey orders" — after limiting sugar. And "the people most likely to show improvement," he noted, "were those who had committed violent acts on the outside."

His work has not gone unnoticed. Kern says correctional facilities throughout the nation have expressed keen interest in the Tidewater research, and Virginia is even contemplating institutionalizing aspects of the Tidewater diet throughout its correctional system. Schoenthaler has follow-up studies in six states. And Kern expects to host a five-day symposium in October on theoretical and practical applications of dietary therapy in corrections.

Diana Fishbein, a University of Baltimore criminologist exploring diet and maladaptive behavior — including violence — has also focused on sugar. "When your blood sugar is low, your brain can't function properly," she says, "because the brain uses 50 percent of all glucose in the blood. And if the brain's not functioning right, your behavior will be modified."

She says research suggests low blood sugar may contribute to irritability, headaches, agitation, frustration and explosive behavior. And "it's ironic," she says, "but the more sugar one consumes, the lower one's blood sugar tends to be." Together with Robert Thatcher and colleagues at the University of Maryland, she is investigating how diet affects brain function and sugar metabolism. Conceding "I can't really say there's good, conclusive data" yet linking sugar and other carbohydrates with maladaptive — and potentially criminal — behavior, Fishbein says research certainly points in that direction.

Schoenthaler suspects that chronic deficiencies in elements essential to glucose metabolism — such as zinc, iron, phosphorus and magnesium — may contribute to a deprivation of the chemical energy needed by the brain for intellectual functioning. He told SCIENCE NEWS, "We know that if there is an [energy] shortage, the limbic system, the most primitive part of the brain, gets priority since that's the part that controls involuntary muscle responses" — such as those for breathing and pumping blood. That region also seems to control emotions. Therefore, he speculates, if the brain is denied sufficient energy, the region "sacrified" might be that which contributes to reasoning. He points out that Walsh's data, Thatcher's findings and his own Tidewater studies are all consistent with this theory.

relatively inexpensive way to view physiological events. For example, he says, looking at age-related iron levels in women, "You can see puberty clear as a bell." More provocative, after conducting hair analyses for thousands of normal individuals, Walsh has found that healthy individuals invariably separate into one of six basic groupings. He says, "We think these relate to six basic body-chemistry types, somewhat analogous to blood types." Walsh has already been contacted by at least one industrial firm interested in developing and marketing commercial hair typing.

HRI has also begun looking for correlations between body chemistry and disease. Hair samples from victims of Alzheimer's disease, Tourrette's syndrome and even alcoholism are being studied. It's possible that similarities in trace-metal abundances might characterize sufferers of a particular disease. If so, such findings could aid in understanding what causes the ailment and whether it might be amenable to chemical — including dietary — therapy.

While not limiting itself to any one test, HRI's specialty, Walsh believes, "will probably be trace-metal analysis." Walsh acknowledges the jury is still out. "But my suspicion," he says, "is that these trace-metals are going to correlate with a lot of things besides violence." □