

# Dif-fusion: Beware the Ideas of March

More than 40 sunrises powered by old-fashioned fusion have passed since the day B. Stanley Pons and Martin Fleischmann told the world they may have found a new, room-temperature route to potentially practical fusion power. While wanting to believe the claims, most scientists say their skepticism mounts as the days pass without convincing independent experimental confirmations. Some who have tested Pons' and Fleischmann's claims already have written them off as misinterpretations of imperfectly performed experiments.

In March, two separate reports of tabletop cold fusion at room temperature sparked a research firestorm that might now quickly die out. It all started with a press conference at which Pons, of the University of Utah at Salt Lake City, and his British colleague Fleischmann claimed to have measured far more heat energy emerging from an electrolytic cell than they put into it in the form of electricity. In their cell, an electric current passes between palladium and platinum electrodes immersed in a solution of so-called heavy water and lithium. The current splits the heavy water into its atomic constituents, oxygen and the hydrogen isotope deuterium.

Pons and Fleischmann contend that the deuterium nuclei in their experiments, instead of reforming into deuterium gas and bubbling out of the container as would happen with most other electrodes, pack into the unusual palladium metal at such high densities that some of them fuse. Poorly understood nuclear events appear to account for the excess heat, they conclude.

In the second, less spectacular March revelation, Steven E. Jones of Brigham Young University in Provo, Utah, told a gathering of physicists at Columbia University that he and co-workers at Brigham Young and the University of Arizona at Tucson had evidence for extremely low levels of cold fusion occurring in an electrolytic cell akin to, but different from, Pons' and Fleischmann's. Jones said his group observed modest excesses of what appeared to be fusion-produced neutrons emitted from titanium electrodes, though the levels measured were so minuscule that no excess heat would be observable. He said at a press conference following the meeting that it would be "20 years to never" before the putative new route to fusion could become practical.

But since the March announcements, only a handful of perhaps hundreds of hastily assembled cold-fusion research groups worldwide have reported evidence that provisionally confirms some

of the earlier observations, mostly those of Jones' group. The vast majority of labs have found no signs for either the excess heat claimed by Pons and Fleischmann or the small excess of possibly fusion-produced neutrons claimed by Jones' team.

Only one group besides the Pons-Fleischmann duo has publicly reported evidence of getting more energy out of their cell than they put into it. Stanford University materials scientist Robert A. Huggins testified at an April 26 congressional hearing that his group had confirmed the observation of excess heat, though he stopped short of suggesting nuclear fusion was the explanation.

That night, Huggins' experiments came under sustained attack at a cold-fusion session at a meeting of the Materials Research Society in San Diego. Commenting on the congressional hearing, Howard Birnbaum of the University of Illinois at Urbana-Champaign wryly jested: "Never mind the peer review, pass the pork." And scientists in the audience raised objections ranging from faults in Huggins' overall experimental design to possible interpretational pitfalls based on subtle experimental details.

At the same meeting, chemist Linus Pauling of Palo Alto, Calif., also voted thumbs down on cold fusion. Previewing a 300-word letter he had submitted to NATURE, he outlined a chemical mechanism he argues could account for the excess heat. In short, he says, as the deuterium packs into the palladium, bonds form between them and the metal atoms. These bonds then break, releasing enough heat, Pauling suggests, to account for Pons' and Fleischmann's claims.

At an April 29 gathering of fusion researchers in Washington, D.C., MIT nuclear physicist Martin Deutsch also went on the record as disbelieving the claims. "In one word, it's garbage," he told SCIENCE NEWS. Deutsch says the cold-fusion reports he is aware of are not suitable for publication because they lack the care he would expect even from an undergraduate researcher. In the passion of the moment, scientists are failing to do even simple but crucial control experiments, he adds.

Chemist Nathan Lewis of the California Institute of Technology in Pasadena has aired what may be the most damaging refutation to date of Pons' and Fleischmann's claims. In a special session at last week's American Physical Society meeting in Baltimore, he described an exhaustive series of experiments in which he and co-workers explained all of Pons' and Fleischmann's original lines of evidence as the result of either faulty assumptions in their calculations or poorly

controlled experiments. In another of many refutations, Caltech's Steven E. Koonin went so far as to suggest Pons and Fleischmann had deluded themselves. Although invited to attend the meeting, neither Pons nor Fleischmann could make it and so were unable to mount a defense. Jones and his University of Arizona colleague Johann Rafelski did participate.

The drama that has been unfolding for the past six weeks has exposed science to the bone, notes Edward F. Redish, nuclear physicist at the University of Maryland at College Park and chairman of the American Physical Society's cold-fusion session. Normally, scientists challenge each other's preliminary results behind closed laboratory doors, then by peer review of manuscripts and finally by wider scrutiny in the open scientific literature. Only after such a multi-tiered review do the original preliminary findings evolve into an accepted piece of the scientific puzzle, Redish says. In the recent fusion fury, this entire process has occurred in the open.

But the sun may be setting on benchtop fusion, at least as portrayed by Pons and Fleischmann. Echoing his colleagues' emerging consensus, Koonin says the prognosis at this point is "gloomy but not yet terminal."

— I. Amato

## Relative downfalls behind elder abuse

The increasing awareness that some elderly persons are physically abused and neglected by family members has been accompanied by a widespread assumption about elder abuse: that it is inflicted by well-meaning individuals, often the adult children of victims, who are pushed over the edge by the stress of caring for a frail, dependent old person.

But that assumption is turned on its head by findings from the first large-scale random sample of elder abuse in a metropolitan area. Relatively well-functioning elderly people are usually the victims of abuse, which is often inflicted by emotionally disturbed or violent family members, say psychologists Karl Pillemer and David Finkelhor of the University of New Hampshire in Durham. A typical abuser is a spouse who depends on the victim for money, transportation, housing and household repairs.

Pillemer and Finkelhor randomly selected subjects aged 65 and older from 1985 town lists in the Boston area. Interviews with 2,020 individuals identified 61 cases of elder abuse. This yields an estimate of 32 victims per 1,000 elderly

people in the area — “a small but significant percentage,” say the researchers, who describe their findings in the April AMERICAN JOURNAL OF ORTHOPSYCHIATRY.

The investigators conducted follow-up interviews with 46 abuse victims and a comparison group of 251 nonabused elderly.

Pillemer and Finkelhor defined maltreatment as one or more of the following: at least one act of physical violence toward the victim (ranging from throwing something at them to assault with a gun or knife) since they turned 65; withholding help important to daily life 10 or more times in the preceding year; and verbal aggression, including insults and threats, 10 or more times in the preceding year.

Spouses were responsible for 26 of the 46 abuse cases, the researchers note. Abuse victims were almost evenly split between men and women. Victims were no more disabled or dependent on their abusers than were comparison subjects on their relatives.

However, abusers were much more likely than relatives in the comparison group to have been arrested, hospitalized for a psychiatric disorder, involved in violent behavior outside the family or limited by a physical problem. In addition to relying on their victims for money, transportation and housing, abusers were more likely to have suffered a physical illness or the death of a relative in the previous year.

The high level of abusers' dependence on victims, seen most clearly in adult children who abused their parents, suggests the victims were also exploited for money and other possessions, the researchers say.

Their findings are consistent with a trend among family-violence researchers to deemphasize the characteristics of victims — whether children, women or the elderly — and concentrate on the psychological problems of abusers.

Revelations about elder abuse have important implications for treatment programs, the investigators maintain. Such programs generally aim to reduce caregiver stress by providing in-home assistance in the care of elderly persons and offering support groups.

But many abusers need psychological counseling, Pillemer and Finkelhor assert. Those who are dependent on their victims may also need help in finding employment and separate housing. Greater police involvement and legal assistance to victims would deter exploitation by abusers, they say. Furthermore, emergency shelters for elder abuse victims, similar to those provided to younger battered women, would provide temporary refuge from abusive situations.

“The view that the elderly cause their own abuse by becoming frail and dependent should be discarded,” the researchers conclude.

— B. Bower

## Smallest aerosol pollutants linked to disease

In August 1986, labor disputes shut down the Geneva steel plant west of Orem, Utah. Thirteen months later, the mill resumed operations under a new owner. It also resumed belching huge quantities of particulates — dust-sized aerosol pollutants — from its coking ovens and open-hearth furnaces. Almost at once, people living nearby began commenting on a decline in air quality — and in the health of their children.

Now, a researcher at Brigham Young University in Provo, Utah, has confirmed that respiratory health among area residents improved during the plant's shutdown. And for the first time, his study links a region's increased levels of the smallest particulates — 10 microns and smaller — with increased rates of children's hospitalization for bronchitis, asthma, pneumonia and pleurisy.

The Environmental Protection Agency made aerosols 10 microns and smaller ( $PM_{10}$ ) its new gauge of hazardous air particulates in July 1987. Previously, the agency measured and set limits only on “total suspended particulates” — the total dust wafting in air.

The State of Utah, however, had begun continuous  $PM_{10}$  monitoring in the Orem area two years earlier. So by mid-1988, Brigham Young environmental economist C. Arden Pope III had roughly three years' worth of data to analyze, including more than a year's data preceding Geneva's shutdown. That's important, he notes in the May AMERICAN JOURNAL OF PUBLIC HEALTH, because the steel mill emits approximately 82 percent of the area's industrial  $PM_{10}$  emissions when it's operating. Even after accounting for other, largely seasonal sources, such as household wood stoves, Pope found that Geneva's emissions represent 47 to 80 percent of the area's  $PM_{10}$  total.

His analysis shows that  $PM_{10}$  levels in the area climb in the fall and peak in the winter. While mean  $PM_{10}$  concentrations in the fall of 1985 were 35 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) of air — just 13 percent higher than a year later, when the steel mill was shut down — fall hospitalizations for Utah County children with bronchitis and asthma were more than twice as high in 1985 as they were in the fall of 1986. In fall 1987, after the plant reopened, hospitalization of children with bronchitis and asthma exceeded even the 1985 level. Adult hospitalizations for these diseases showed no similar increase that fall.

In the winter of 1985-86, mean  $PM_{10}$  levels were  $90 \mu\text{g}/\text{m}^3$  — 75 percent higher than the next winter's mean. Hospitalizations of children with bronchitis and asthma in the 1985-86 winter season were more than three times as numerous and admissions for pneumonia and pleurisy almost 2.5 times as numerous as in the

following winter, when the mill was closed. Winter increases also showed up in adult hospitalizations for bronchitis and asthma. Pope says  $PM_{10}$  levels can explain 30 percent of the variability between years in the adult hospitalizations.

Pope acknowledges that in a study like this — identifying correlations only — “there's no way to establish absolute cause and effect.” However, he told SCIENCE NEWS, “this study does find some very damning correlations.”

Pope's analysis is “a landmark study,” says Douglas W. Dockery of the Harvard School of Public Health in Boston. In epidemiology, he explains, “you look for unique situations where there is a natural experiment going on.” Geneva's shutdown provided such an experiment, he says, enabling Pope to identify a strong relationship between small particulates and respiratory disease.

Dockery recently found a similar association in his study of 5,422 children aged 10 to 12 from six U.S. cities: Portage, Wis.; Watertown, Mass.; Topeka, Kan.; St. Louis, Mo.; Kingston, Tenn.; and Steubenville, Ohio. Of the seven measures of air pollution he analyzed — including total suspended particulates, ozone, nitrogen oxides and sulfur dioxide — only particulates 15 microns and smaller ( $PM_{15}$ ) served as a strong predictor of respiratory disease.

Dockery's study shows that children living in the “dirtiest” city — steel town Steubenville, with an average annual  $PM_{15}$  level of  $58.8 \mu\text{g}/\text{m}^3$  — run more than double the bronchitis risk of children in the “cleanest” city, Portage, with its average annual  $PM_{15}$  level of  $20.1 \mu\text{g}/\text{m}^3$ . Children with asthma and persistent wheezing represented the majority of the excess bronchitis cases in the more polluted communities, Dockery and his colleagues report in the March AMERICAN REVIEW OF RESPIRATORY DISEASE.

The Brigham Young and Harvard studies are the first to focus on the smallest particulates and to confirm what researchers have long suspected — that these aerosols are the most important in terms of respiratory-disease risk. Pope focused on acute effects of exposure, while Dockery's group focused on long-term effects.

Both analyses yield evidence that EPA's current  $PM_{10}$  standard is not sufficient to protect children's health. For instance, even though Orem-area  $PM_{10}$  levels never exceeded EPA's 24-hour standard of  $150 \mu\text{g}/\text{m}^3$  in fall months, twice as many local children were hospitalized for bronchitis and asthma in years when the plant was operating compared with the year when it wasn't. Similarly, Dockery found “health effects occurring at levels below the current annual average  $PM_{10}$  standard” of  $50 \mu\text{g}/\text{m}^3$ .

— J. Raloff