past 2 billion years (*4*). Hydrogen loss rates from the lunar surface must therefore be comparable to its delivery rates. "Weathering" effects of the dominant loss rates (micrometoroid bombardment and solar wind sputtering) are thus likely to affect the chemical form of this enhanced hydrogen abundance. In particular, the amorphous coatings of soil grains (*5*) may figure importantly in the retentivity of hydrogen by the lunar surface. Laboratory simulations of space weathering effects at temperatures ranging between 60 and 120 Kelvin will be needed to guide a quantitative understanding of the problem.

W. C. Feldman
Los Alamos National Laboratory, Mail Stop D-466, Los Alamos, NM 87545, USA. E-mail: wfeldman @lanl.gov

S. Maurice
Observatoire Midi-Pyrenees, 14 avenue Edouard Belin, 31400 Toulouse, France

D. J. Lawrence
B. L. Barraclough
R. C. Elphic
Los Alamos National Laboratory

A. B. Binder
Lunar Research Institute, 1180 Sunrise Drive, Gilroy, CA 95020, USA

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Prescribing Heroin

In their Policy Forum "The heroin prescribing debate: Integrating science and politics," Gabriele Bammer *et al.* (*Science's* Compass, 21 May, p. 1277) present incomplete information about the Swiss National Cohort Study (*1*). This study was actually a series of studies, conducted between 1994 and 1996 at 18 sites, in which 1146 long-term and treatment-refractory heroin addicts received injections of heroin several times daily at supervised clinics and at a prison. The cohort study (*1*) experienced 350 dropouts (a rate of 30%), which included 36 deaths from various causes (*2*).

Bammer *et al.* state that addicts showed remarkable gains, including "substantial improvements in health and well-being and very pronounced reductions in crime." A similar commentary published the same week (*3*) says Swiss heroin addicts experienced "substantial declines both in drug use outside the program and in criminal activity, as well as improved social reintegration." Both commentaries say that these results merit further investigation and call for more research, "through peer-reviewed publication" and "more advanced design features" (*3*). Yet both gloss over, as having "similar results," the one Swiss study (*4*) that met these criteria.

That study, conducted in Geneva (*4*), was the only one to randomly assign heroin addicts to heroin maintenance or to a 6-month waiting list (individuals serving as controls were encouraged, but not required, to enter traditional treatments, such as detoxification, oral methadone, or drug-free programs; length of stay in treatment was not reported). Some of the results from the Geneva study (*4*) were similar to those of the larger cohort studies (*1*), but some were not. Similarities: The heroin treatment group used illicit heroin less than the control group, engaged in illegal activity less, and enjoyed improved mental health and social functioning. Differences: The heroin treatment group in the Geneva study did not show improvements in work, housing, physical health, or avoiding abuse of other drugs.

Moreover, because conditions varied widely among control treatment programs, the Geneva researchers concluded that they could not say whether the improvements that were seen in their heroin-treatment group were caused by that treatment itself or by the intensive medical and psychosocial services that group also received.

Also, the Geneva researchers found that 62% of their controls declined to switch to heroin maintenance when it became available to them after 6 months. "Most were successfully treated in methadone maintenance programs" and wanted to stop injecting drugs (*4*). This is a surprising finding in light of the presumed ability of heroin maintenance programs to attract and retain addicts who would otherwise not enter treatment.

Bammer *et al.* in their Policy Forum do not mention these findings from the Geneva study, yet one of the authors, A. Uchtenhagen, had overall responsibility for the cohort and Geneva studies. A. Dobler-Mikola, co-edited the final report about the cohort study with Uchtenhagen and F. Gutzwiller (*1*). And while the cohort study has not yet presented its data and results in the peer-reviewed literature, the Geneva researchers have. Bammer *et al.* also do not discuss the external evaluation of the cohort study, which the World Health Organization (WHO) commissioned, yet Bammer was one of the evaluators (*5*). The WHO report noted that (*5*)

> [T]he Swiss studies were not able to examine whether improvements in health status or social functioning in the individuals treated were causally related to heroin prescription per se or a result of the impact of the overall treatment programme. Thus, from a rigorous methodological viewpoint, it was not possible to obtain internally valid results with respect to the research question of heroin prescription being causally responsible for improvements in health status or social functioning in the individuals treated.

The evaluators are critical of several other aspects of the cohort study, including unsubstantiated claims of cost-effectiveness, reliance on self-reports of illicit heroin use, questions as to whether self-reports of other drug use were corroborated with urine screens, inadequate data about death rates, no measures of patient satisfaction at any but two study sites, and addicts' continued drug use: "one-third of the study population continued daily illicit heroin use, 5% had daily cocaine use, and 9% had daily benzodiazepine use" (*5*).

Those responsible for the Swiss heroin studies owe us all a full account of their findings in the scientific literature. Those who comment on the studies have the same obligation. Selecting portions of the data that support particular points of view will not get us to what must be everyone's goal, finding the most effective ways to treat heroin addiction.

Sue Rusche
Executive Director, National Families in Action, 2957 Clairmont Road, Suite 150, Atlanta, GA, 30329, USA. E-mail: suerusche@compuserve.com.

References and Notes

1. A. Uchtenhagen, "Summary of the synthesis report." This text, which may be read at the Lindesmith Center Internet Web Site, www.lindesmith.org, summarizes a paper in German, *Programme for a Medical Prescription of Narcotics. Final Report of the Research Representatives,* A. Uchtenhagen, F. Gutzwiller, A. Dobler-Mikola, Eds. (Institute for Social and Preventive Medicine, Univ. of Zurich, Zurich, 1997); see also A. Uchtenhagen, F. Gutzwiller, A. Dobler-Mikola, T. Steffen, M. Rihs-Middel, Eds., *Prescription of Narcotics to Heroin Addicts: Main Results of the Swiss National Cohort Study* (Karger, Basel, in press).
2. Seventeen deaths resulted from AIDS and other infectious diseases, the remainder from overdoses of nonprescribed narcotics, suicides, and accidents. Narcotics prescribed in the cohort study produced no fatal overdoses. The WHO report (*5*) notes that while an "overall death rate of 3% appears to be in accord with the limited available data on cohorts of addicts," the Swiss cohort study presents insufficient data to determine how death rates were calculated, and it calls for further clarification.
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I read the Policy Forum by Bammer *et al.* with alarm. I have observed how clinics within this program operate at several locations in Switzerland. The program represents a stunning and unsupported reversal of 40 years of laboratory and clinical research. Bammer *et al.* and your readers should turn to the conclusions of responsible international bodies who have looked at the results of this program, which is at its heart distinctly political, rather than scientific. WHO's evaluation of this endeavor concluded (*1*, p. 11), "the

[Swiss] studies have not provided convincing evidence that, even for persistent methadone failures, the medical prescription of heroin generally leads to better outcomes than further methadone-based treatment."

William Caltrider
Director, Center for Alcohol and Drug Research and Education, 22 West Pennsylvania Avenue, Suite 309, Towson, MD 21204, USA. E-mail: wcaltrid@ix.netcom.com

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Response

Rusche asks why we did not provide a fuller account of the results of the Swiss cohort study and the Geneva substudy or mention the results of the WHO evaluation. The reasons are simple—we were restricted to 2000 words, and the WHO evaluation was not made public until after our Policy Forum was published.

A full account of the Swiss results will be available in a forthcoming book (*1*). Publication of the results in a book allows a level of detail to be presented that is prohibited by the limitations of space in peer-reviewed journals. Nevertheless, results have also been published in peer-reviewed journals (see references in our Policy Forum), and a number of other papers are currently under review.

We agree that the Geneva study raises some intriguing questions, and we incorporated these in a more general way in our discussion of the unanswered issues about heroin prescription.

In many ways, our Policy Forum complements the WHO evaluation. We raise for discussion a number of complexities that draw not only on the experience in Switzerland, but also on that of the United Kingdom and elsewhere.

Caltrider suggests that there is a body of evidence from "40 years of laboratory and clinical research." In our Policy Forum, we summarized the best of that evidence, which stems from the United Kingdom and Switzerland. For reasons of space we had to omit other experience, particularly that from the United States, from clinics established in the early 1900s (*2*), the proposed Vera Institute trial from the 1970s (*3*), and the small amount of laboratory work conducted at various times, especially in the latter half of this century (*4*). The conclusions that can be drawn from that evidence are limited.

Caltrider also cites selectively from the WHO-funded external evaluation of the recent Swiss cohort study, which found, among other positive findings, that (i) "it is medically feasible to provide an intravenous heroin treatment programme under highly controlled conditions where the prescribed drug is injected on site, in a manner that is safe, clinically responsible and acceptable to the community" and (ii) "participants reported improvements in health and social functioning and a decrease in criminal behaviour and in reported use of illicit heroin" (*5*, executive summary).

As we argued in our Policy Forum, more research is needed before any widespread introduction of heroin prescription can reasonably be considered. But we also show that the available results are positive enough to warrant further rigorous scientific research.

We do not have a uniform view about heroin prescription. Some of us are supportive, while others are skeptical. We have, of necessity, had to limit the evidence and arguments we presented. We have tried to raise the most challenging issues in order to stimulate further rigorous research and informed debate, so that we can continue to improve the treatment options for heroin dependence.

Gabriele Bammer, National Centre for Epidemiology and Population Health, Australian National University, Canberra, ACT 0200, Australia. E-mail: gabriele.bammer@anu.edu.au; **Anja Dobler-Mikola,** Addiction Research Institute, Konradstrasse 32, CH-8005 Zürich, Switzerland; **Philip M. Fleming,** Portsmouth City Drugs and Alcohol Service, 130 Elm Grove, Southsea, Portsmouth, Hampshire PO5 1LR, United Kingdom; **John Strang,** National Addiction Centre, Institute of Psychiatry, London SE5 8AF, United Kingdom; **Ambrose Uchtenhagen,** Addiction Research Institute, CH-8005 Zürich, Switzerland

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