locus probe testing. Therefore, as Lewontin points out, this term is used incorrectly throughout the Lander–Budowle article.

The continued existence of a Flat Earth Society and the increasing popularity of Creationism demonstrate that it is never possible to convince every individual of the validity of a scientific theory. However it is clear that the concepts of evolution and the spherical shape of our planet are "generally accepted" in the scientific community and would pass the Frye test for courtroom admissibility. *Nature*'s chronicle of the arguments against HIV as the causative agent of AIDS is another example of how a tiny, vocal minority with access to media outlets can attempt to sway public opinion against generally accepted medical and scientific opinions.

Charles M. Strom
Section of Medical Genetics,
Illinois Masonic Medical Center,
836 Wellington Avenue,
Chicago, Illinois 60657, USA

SIR — Lander and Budowle[1] highlight legitimate domains of convergence between two former opponents but stint on views of others and on unresolved issues. Lander and Budowle strongly doubt that the new NRC committee can make recommendations substantially to improve forensic DNA analysis. Recent correspondence by Lewontin[3] and Hartl[4] is largely tangential to that issue. Their letters consist mainly of speculation on the motives of individuals and the possible future behaviour of the FBI. Helpful comments by Lewontin on possible improvements in quality control and blind testing are diluted by other comments, for example his patronizing assertion that jurors are incapable of understanding the meaning of a 1 in 4 probability and his insistence that the situation is basically hopeless until an entirely different system for DNA identification is developed. New technologies for DNA identification are being developed and each will probably share some of the same problems in the current technology. Therefore, we need not wait for the millennium to find practical improvements. "A steady succession of *ad hoc* committees"[1] is undesirable, but significant work remains for the new NRC committee in advancing the way the existing technology is applied.

(1) Exceedingly small genotype frequencies (for example $<10^{-6}$) may be calculated and, to make the number smaller, one simply has to type more polymorphic loci. Such probabilities are presented to jurors who assess their meaning as best they can and with the assistance of experts such as Lewontin, Hartl and ourselves. However, it is fruitless, beyond a certain point, to continue to type additional markers when we are already as certain as we can be, based on *one* valid test, of genotypic identity. Lander and Budowle cite a frequency reported in one case, 1 in 738×10^{12}, as unrealistic, but provide no mechanism whereby the introduction of such a probability in a courtroom setting would be prevented or made sense of. Due to the possibility of error, exceedingly small genotype frequencies (say 10^{-7}) tell us little more than rare genotype frequencies (10^{-5}), but they may have prejudicial impact. It is more accurate to estimate a meaningful level of significance ($P<10^{-4}$ or $P<10^{-5}$).

(2) The first NRC committee suggested that genotype frequencies should be introduced with an error rate. Most practitioners of the forensic DNA art readily admit the possibility of error. Unfortunately, error rates are usually unavailable. Our suggestion in (1) would also mitigate this problem.

(3) Intrinsic to DNA testing are unique possibilities for eliminating error or fraud. We have two suggestions: (a) Different internal standards should be added to each sample to reveal sample mixing or mixups. (b) The individual performing an analysis should be unaware of which sample, out of a small group, derived from the suspect. This conforms to the established principle of blind testing.

(4) When, as frequently happens, multiple suspects are tested, the estimated match probability must be adjusted to take into account multiple testing. The NRC committee should also develop guidelines for the use of large databases of DNAs from criminal suspects.

(5) Special circumstances warrant the abandonment of the genotype frequency as the match probability. If individuals with a high degree of kinship have not been ruled out as the perpetrator, then the probability of the match is not the genotype frequency (and *pari passu*, idiotyping by DNA sequencing, as suggested by Lewontin, might exacerbate this problem). People differ in the number of close relatives they have; some have many close relatives, and inbreeding can enhance genetic identity by descent. Many individuals have half- or full-siblings unknown to them. As frequencies become increasingly remote, remote considerations loom increasingly large.

(6) What is the relevant genotype frequency, that of the evidence or that of the suspect?

(7) The ceiling principle method was formulated to account for possible differences in allele frequencies between populations. The second NRC committee should emphasize that the same considerations universally apply, for example to DQα.

The first NRC committee provided sound and conservative methods. Although conservative, the ceiling principle is arbitrary. Therefore it is doubtful if it would ever have been implemented save with the imprimatur of a distinguished committee. So far only the modified ceiling principle has been used because the systematic sampling of populations suggested by the NRC has not been performed. The second NRC committee is now in a unique position to refine the use of forensic DNA testing in important ways and to reexplore useful suggestions made by the first NRC committee but only partially implemented.

David Goldman
Jeffrey Long
National Institute on Alcohol Abuse and Alcoholism,
Intramural Research Program,
Rockville, Maryland 20852, USA

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SIR — Lewontin and Hartl[3,4] complain that "because juries are no more capable of interpreting probability statements than they are of interpreting any other piece of highly technical information, there are insuperable barriers to their use in the courts". Perhaps I should recall the words of E. M. East, the pioneer quantitative geneticist[5] commenting on Edgar Allan Poe: "as a poet and mathematician, he would reason well, as a mere mathematician he would not have reasoned at all." I am not surprised that lay people may be confused when some the terms used by Lewontin are also ill defined. The word 'idioplasm' was coined by Karl Wilhelm Nägeli[6] before the Mendelian concepts became known and he used it in the sense of the entirety of the hereditary material. The newly developing genetics, after the turn of the century, abandoned this term for the more meaningful gene and genotype. Immunogeneticists revived it in the form of idiotope, the antigenic determinants in the variable chains of the immunoglobulins and idiotype as a collection of idiotopes distinguishing one type of antibody-producing cells from other clones of cells. Thus it is not a concept of DNA but of a protein and this is worth remembering even now, 30 years after synonymous codons became known. Thus, obviously it is not correct to call fingerprints — and I do not mean DNA fingerprints — idiotype(s). Also, it is well documented that some kindreds display no dermatoglyphs[7]. In some instances, forensic genetics cannot rely with absolute certainty on dermatoglyphics because of developmental differences, mosaicism and more than single gene involvement in the pattern[8].

G. P. Rédei
3005 Woodbine Court,
Columbia, Missouri 65203, USA