in nitrate concentration for the 42 rivers. We repeated the analysis for a calculated nitrate export (concentration × mean runoff) and found a similar significant relationship ($P < 0.00001$) that accounts for 53% of the variation in nitrate exported to coastal waters (part *b* of figure). Other watershed characteristics such as area and water flow showed, in general, no significant relationship to either nitrate concentration or nitrate export.

River nitrate concentration and export are affected by complex biotic, abiotic and anthropogenic factors, so it is striking that they show such a marked relationship to population density. Other variables, such as water flow and watershed area, did not explain a substantial amount of variation when included in multiple regression analyses. Our study demonstrates that human population density in a watershed is the best predictor of river nitrate concentrations and export.

If we consider human influences alone, river nitrate could be affected by sewage loading, atmospheric deposition, agriculture and deforestation. We used an estimate of per-capita nitrogen loading in sewage[5] and found that sewage loading was the same magnitude as nitrate exported from the selected rivers. We also found a significant relationship between calculated atmospheric nitrate deposition and river nitrate concentration, confirming studies that show atmospheric deposition to be a significant source of nitrogen in rivers[3,6]. We did not quantify the impact of agriculture and deforestation, but these additional human disturbances have been shown to contribute significantly to nitrate exported from watersheds[7,9].

Human activity clearly dominates nitrate export from land, whether or not we take into account all sources of anthropogenic nitrate. Projected global population growth will potentially result, therefore, in increased nitrate export from rivers, with often undesirable consequences for coastal ecosystems.

BENJAMIN L. PEIERLS
NINA F. CARACO
MICHAEL L. PACE
JONATHAN J. COLE

Institute of Ecosystem Studies,
The New York Botanical Garden,
Mary Flagler Cary Arboretum,
Box AB, Millbrook,
New York 12545, USA

1. D'Elia, C. F. *Environment.* **29**, 6–11; 30–33 (1987).
2. Walsh, J. J., Rowe, G.T., Iverson, R. L. & McRoy, C. P. *Nature* **291**, 196–201 (1981).
3. Fisher, D. C. & Oppenheimer, M. *Ambio* (in the press).
4. Meybeck M. *Am. J. Sci.* **282**, 401–450 (1982).
5. Vollenweider, R. A. *OCED Tech. Report DAS/CSI/68.27* (1968).
6. Paerl. H. W. *Nature* **315**, 747–749 (1985).
7. Likens, G.E., Bormann, F. H., Johnson, N. M., Fisher, D. W. & Pierce, R. S. *Ecol. Monogr.* **40**, 23–47 (1970).
8. Kohl, D. H., Shearer, G. B. & Commoner, B. *Science* **174**, 1331–1334 (1974).
9. Haycock, N. & Burt, T. *Nature* **348**, 291 (1990).

DNA fingerprinting in India

SIR — In India, the DNA fingerprinting test was used for the first time during June 1989 to settle a drawn-out paternity case in Madras[1,2]. Another court judgement based on DNA evidence was given in a dispute between an unmarried mother and her lover in Kerala state[2,3]. This biotechnology-based commercial service is mainly carried out by a team at the Centre for Cellular and Molecular Biology, Hyderabad. The *Bkm* (banded krait minor satellite DNA) probe developed by this team costs one-tenth of the tests used in Europe or the United States. Paternity-disputed court cases are much more common in India, and most are now being referred to the Centre for Cellular and Molecular Biology for DNA evidence.

Several reports[4–7] have raised doubts about the accuracy of these tests in identifying suspects in criminal cases. The question raised by the population geneticists is of serious concern to this new forensic tool. There are special problems in using the tests in India, a tropical country with heterogeneous environment, covering a latitudinal range of about 28°. Environmental factors change the overall genetic structure of the populations that regularly change with latitude. This phenomenon exists in *Drosophila melanogaster* chromosome inversion polymorphism (A. D. and B. N. Singh, manuscript in preparation). Different human subpopulations exist in India (with respect to religion, caste and subcaste), each with a different history of settlement and migration pattern. Castism is acute, and intracaste marriages are still predominant over the intercaste marriages. Thus, there are various subpopulations of random mating in which genetic material is shuffled within a gene pool that remains isolated from other such populations. Therefore, it is much more difficult to prepare a common population genetic database in India than in other countries because genotype frequency, or the frequency of a particular pair of alleles at a given locus, cannot be calculated — thus it is impossible to calculate the Hardy–Weinberg equilibrium for the whole population. Also, it cannot be assumed that the allele types are shuffled at random, or that the occurrence of one allele is dependent on the second allele. It is possible that in some populations, alleles are tightly linked to others present either intra- or interchromosomally.

A low-cost DNA evidence test would be a step forward for a developing country like India, but the question lies in reliability. Countries such as the United Kingdom and the United States are still in search of clear, common guidelines for the DNA profiling test and a correct genetic database for populations to interpret the observed results. In India, with its different subpopulations, it is an uphill task to construct a correct genetic database. The problem could be solved by preparing separate databases for different randomly mating subpopulations. Separate genotype frequencies could be obtained and calculation of linkage equilibrium between loci could be performed for such populations. The databases thus prepared could be used to estimate the rarity of a common allele in the given population in which the DNA match is to be performed.

There should be special legislation to cover the results of DNA analysis, but there is at present no such legislation on the admissibility of DNA evidence in India. As the opinion of the expert is valid in court under Indian law[3], such 'experts' should be very careful in interpreting results.

APARUP DAS

Genetics Laboratory,
Centre of Advanced Study in Zoology,
Banaras Hindu University,
Varanasi-221 005, India

1. Jayaraman, K. S. *Nature* **340**, 175 (1989).
2. Das, A. *Inven. Intell* (in the press).
3. Jayaraman, K. S. *Nature* **346**, 208 (1990).
4. Lander, E. S. *Nature* **339**, 501–505 (1989).
5. Neufeld, P. J. & Colman, N. *Scient. Am.* **262**, 46–53 (1990).
6. Joyce C. *New. Scient.* **127**, 24–25 (1990).
7. Thompson, W. C. & Ford, S. *New. Scient.* **125**, 38 (1990).

Extraterrestrial synthesis

SIR — Shock and Schulte[1] have calculated the metastable equilibrium concentrations of amino acids and other organic compounds formed from pyrene, fluoranthene, CO_2, NH_3 and H_2O. They propose that this was the mechanism of synthesis of the amino acids on the Murchison meteorite parent body. The pyrene and fluoranthene are thought to have been produced in carbon stars or on interplanetary dust. This calculation is accepted by others[2] as a mechanism for the synthesis of some Murchison organic compounds.

But there are fundamental errors in these types of thermodynamic calculations. Organic reactions that involve the breaking and reforming of many carbon–carbon bonds generally do not come to equilibrium at temperatures below about 700 °C. Dehydrogenations and ester/ether formation come to quasi-equilibrium at lower temperatures, but no carbon–carbon bonds are broken in these reactions. At higher temperatures equilibrium may be obtained, but the equilibrium concentrations of organic compounds that contain more than a few carbons are extremely low. Catalysts able to achieve such favourable equilibria at low temperatures are not known.

Shock and Schulte's choice of pyrene and fluoranthene as starting materials is arbitrary; different results would be obtained with other, more abundant organic molecules found in the Murchison meteorite. Their choice of products is also arbitrary, as many other compounds are possible: for example there are 551 isomers of decanoic acid alone[3]. An arbitary choice of reactants