Interpreting DNA fingerprints

SIR — Brookfield[1], commenting on the statistical interpretation of forensic DNA typing results, suggested that surveys of diverse human populations using single-locus probes should have revealed patterns of subpopulations characterized by high frequencies of VNTR (variable number of tandem repeat) alleles that are rare in the population as a whole, if such population substructure existed. In fact, the available survey data, generated by the FBI laboratory[2] and by Kidd et al.[3], to the extent that they allow sub-populations to be identified and analysed at all, tend to support the hypothesis of population substructure.

The FBI data for caucasians and blacks, although drawn from many US sources, are collected in such a way that most geographical and ethnic distinctions are lost. Even so, for two of six loci surveyed among caucasians, and five of six surveyed among blacks, significant excesses of individuals with single-bin patterns were observed over the frequencies expected if bins could be equated with alleles and the populations were in Hardy–Weinberg equilibrium. The meaning of this excess is unclear because of technical limitations of the assay used to collect the data: closely spaced alleles are unlikely to be re-solved, and small alleles may not be detected at all[2]. Nevertheless, the data cannot be taken as strong or unambi-guous support for the notion of popula-tion homogeneity.

Kidd et al.[3], in a survey of VNTR allele frequencies among Amerindian populations, discovered several instances of near-fixation of a single VNTR allele in a population, and numerous instances of significant allele frequency differences between populations. These results too can be rationalized: the populations sur-veyed could represent extreme instances of isolation and small population size. Once again the data do not straightfor-wardly support the notion that large urban populations are homogenous.

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3. Kidd, J. R. et al. Hum. Biol. 63, 775–794 (1991).

BROOKFIELD REPLIES — I agree that it would be beneficial to have further data concerning the degree of population sub-structure for VNTR loci, and I welcome recent moves to obtain them[1]. The im-portant issue is whether we should pre-vent the legal use of DNA profile in-formation unless and until we have these data. It is my view that no sufficient case has been made that we should. It does not follow from a legal presupposition of innocence that justice will always be served by ignoring incriminating evi-dence against defendants.

It is inaccurate to present the debate as being between alternative hypotheses of some substructure and no substruc-ture. Everyone accepts, on both empiric-al and theoretical population-genetic grounds, that there will be at least a small amount of substructure within 'ra-cial' groups. The important question is whether the degree of substructure will be enough to render seriously inadequ-ate probability calculations assuming none. Calculations reveal that quite large degrees of substructure can leave these calculations fairly accurate. Furth-ermore, the evidence suggests that the degree of substructure is not large[2]. Thus, except for the special case when both suspect and the truly guilty person are known, a priori, to belong to the same inbred racial group, an assumption of no substructure will give probability estimates that are approximately correct.

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Right thinking

SIR — Victor Smetacek (Nature 355, 118; 1992) argues convincingly that the ability to write in mirror script reflects latent left-handedness. But I take issue with his extension of these arguments that the right-to-left format of Etruscan and Archaic Roman scripts was essen-tially conceived in the hemisphere of the brain naturally associated with output via the left hand.

A far simpler explanation is that those scripts, together with Semitic scripts, had their origins among right-handed stonemasons. I am informed by my right-handed friends that a hammer and chisel are naturally picked up in the right and left hands, respectively, so that asked to inscribe a caption on stone, they would naturally move from right to left. Therefore the direction of the script appears likely to have had its origins exclusively in the medium (stone versus parchment, papyrus, paper and so on) on which the script was originally formulated.

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Pulsar emissions

SIR — The recent discovery of pulsed hard X-ray emission from PSR1509−58 (G. Fishman, personal communication) significantly adds to the list of known radio pulsars with energetic emissions. We propose for theoretical reasons an 'activity index' given by B/P, which is proportional to the electrostatic charge on the neutron star (B is the polar surface magnetic field and P the rotation period). The known pulsars with high energy emissions also have the highest value for this index. This index is also inversely proportional to the characteris-tic age of a pulsar, which suggests that a similarly active pulsar will be found when the debris from supernova 1987A clears sufficiently.

A plausible mechanism for producing hard photons from a radio pulsar is a pair-production cascade[1], given that the hard photons are involved in the cas-cade. But magnetic opacity would pre-vent escape of hard photons if emitted near the surface[2]. Phenomenological models[3,4] have cascading in vacuum gaps high in the pulsar magnetosphere. There is sound theoretical justification for such gaps[4,5], and recent calculations show that cascading can occur not only high in the magnetosphere but can also produce dense bunches low in the magneto-sphere, which could account for the coherent radio emission[6].

The accelerating agent in these models is basically the net charge on the system, which scales as the net charge on the neutron star. The net charge is prop-ortional to B/P (refs 5,6). Doubling the charge moves the same potential out a factor of two, decreasing the magnetic field by a factor of eight. This ratio is also proportional to $(\dot{P}/P)^{1/2}$, where $P/2\dot{P}$ is the standard pulsar characteristic age.

The table shows the pulsars with large activity indices (small ages); it can be seen that three of the top five have high-energy emissions whereas the other two are quite distant. A strongly magne-

PULSARS ORDERED ACCORDING TO ACTIVITY INDEX

PSR	$(\dot{P}/P)^{1/2}$	B/P (10^{12} gauss s^{-1})	Distance (kpc)
0531+21 (Crab)	3.55×10^{-6}	114	2.0
1509−58	3.20	102	6.67
0540−69 (LMC)	3.08	99	55
1338−62	1.21	39	12.9
0833−45 (Vela)	1.18	38	0.5
1758−24	1.01	32	4.35
1800−21	1.00	32	5.27
1259−63	9.96×10^{-7}	32	2.34
1706−44	9.49	30	1.43
1853+01	8.82	28	3.30
1046−58	8.80	28	2.59
1737−30	8.76	28	3.08
1823−13	8.61	28	5.51
1727−33	7.75	25	4.13
1930+22	6.31	20	6.58

Data from A. G. Lyne, R. N. Manchester and J. H. Taylor (personal communication)