the preservation of similar sequence variants in species of rodents separated by 40 Myr, and instead they propose that selection has operated on some as yet unknown function of satellite DNAs.

They base their arguments on the rate of evolutionary divergence (~3%) in mouse satellite DNA that was assessed by Southern (*J. molec. Biol.* **94,** 51; 1975) from the relative amounts of monomers and multimers of fragments of DNA produced after a complete digestion of mouse satellite with restriction endonuclease *Eco* RII. A geometric decrease in amounts of higher order multimers from the monomer length is taken as a reflection of a random process of nucleotide divergence in regularly spaced restriction sites. Fry and Salser estimate that the same rate of divergence would produce a base change of 40–50% in the HS-α satellite. However, estimates of this kind are currently under suspicion for not only can mouse satellite be completely digested to monomer length under certain conditions with *Eco* RII and *Ava* II but also the different distribution of sites to other restriction enzymes suggests an apparent rate of divergence of ~30% in other portions of the satellite that also contain *Eco* RII sites (Horz & Zachau *Eur. J. Biochem.* **73,** 383; 1977).

In the light of such intriguing anomalies and in our ignorance of the full range of the behavioural quirks of replicating DNA we should tread cautiously before we reject arbitrary mechanisms of preservation and change despite the seeming difficulty in accommodating all the data.

For example, similarities in amplified sequences between species may result either from the presence of the same 'library' of starting sequences in the species group before amplification or because the species inherit a previously amplified sequence from a common ancestor. A comparison of the distribution of ten satellites in five of the seven sibling species of the *melanogaster* species subgroup with the phylogeny of the species based on the distribution of chromosomal inversions tells us that both processes may be operating (Barnes *et al. Chromosoma,* in the press). Another study in our laboratory on the distribution of satellites in species and subspecies (races) of the genus *Glossina* (tsetse fly) tells us that despite the proliferation of satellites in the group there are no obvious homologies between them and that neither process is operating. Instead, amplification might occur, subsequent to divergence, of sequences that are unique to each species. The data from Gramineae clearly suggests that amplification and maintenance of homogeneity continues, even after species divergence.

Differences in abundance of a satellite sequence common to several species may be the result of differences in the length of time during which the process of amplification of a member of a 'library' has taken place. Alternatively, differences in the chromosomal location of a sequence may be important in determining the rate at which amplification proceeds—a situation that has some support from the measured differential rates of sister chromatid exchange in different parts of the genome.

Similarities in minor sequence-variants in rodents are of course hardest to explain. They might be explained in two ways. For any given short repeated sequence there might be a restriction on types of mutational change that could occur (a situation that has some validity in the preferential transition of A→G in other DNA sequences) and so limit the numbers of sequence permutations in a six-base sequence to a few variants. Alternatively, it might be that there are only specific sequences to which the amplification process addresses itself—not in absolute terms but in terms of the positions of bases in a sequence in relation to other levels of chromatin organisation. The relic higher-order periodicities of the same length common to satellite DNAs of diverse mammalian species (Maio *et al. J. molec. Biol.* **117,** 637; 1977) are considered to be the result of nucleosome size determining the size of the presumed unit of amplification. In the case of the α satellite of African green monkey similarities in size are exact for some restriction endonuclease sites (at which illegitimate recombination might occur) fall at the interstices of adjacent nucleosomes (Musich *et al. J. molec. Biol.* **117,** 657; 1977).

Present-day distribution of sequence variants and rates of apparent divergence of satellite sequences might be a reflection of the differential registers of repeating DNA sequences and repeating histone octamers.

Finally, it is not improbable that amplification and interspersion of new with old sequences as seen in Gramineae and *Plethodon* are part and parcel of the same random process.

A process of computer simulation in our laboratory has shown that unequal exchange at the boundary of two different adjacent blocks of homogeneous sequences can generate a pattern of interspersed sequences determined by the initial unequal overlap.

It is always refreshing to relate new findings to the overall biology of organisms and to the processes of adaptation and speciation, and in this respect Fry's and Salser's interpretation of their data is highly pertinent and heuristic. For it can be argued that even if the processes responsible for the current distribution of satellites operate randomly, the arbitrary appearance of satellites and the ensuing change in karyotype could still conceivably be related to speciation. Bush *et al.* (*Proc. natn. Acad. Sci. U.S.A.* **74,** 3942; 1977) confirm a strong correlation between the rate of speciation and the rate of chromosome evolution in 225 genera of vertebrates. If it were to be shown that there is a direct causal relationship between the two, then we are left with the possibility, surprising as it may seem, that the initial steps in the genetic process of speciation are the result of accident rather than adaptation. □

NATURE

A hundred years ago

A NOVEL and valuable application of electricity, designed to prevent the possibility of collisions on railways, is now the subject of experiment in the Marseilles station. It consists of an electric mirror, in which all the movements on a line 100 kilometres in length are brought vividly before the eye, and enables the station-masters to follow exactly the progress of every train. By this means it is hoped that all accidents resulting from delays or too rapid runs can be entirely avoided, and arrangements are being made for the general introduction into the stations of the new invention.

From *Nature* **17,** 7 March, 371; 1878.

Nuclear jet in a radio galaxy

from F. Graham Smith

QUASARS have a very potent source of energy, which may well be the gravitational field of a black hole. According to Lynden-Bell, the black hole is at the centre of a rotating galactic nucleus, so that matter falls in along two vortex lines at opposite ends of the spin axis. Outbursts of energy and radiation are emitted along the two axes, giving the linear patterns and central symmetry commonly seen in the radio emission from quasars and radio galaxies. We shall never see the black hole itself, but we can test the model by looking at the outbursts from it. A new test of this kind is to be found in recent observations of the elliptical galaxy NGC