

information from either of two silent loci is sequentially expressed after transposition to a third (MAT) active locus this transposition is similar to that in prokaryotes as the information remains unchanged at the donor site. The focus of both molecular and genetic studies reported by three groups, Nasmyth (University of Washington), Klar (Cold Spring Harbor) and Haber (Brandeis University), is the cellular control of these three loci. It is not clear how sequences transposed to the MAT site become active. The active MAT site is a complex locus each MAT allele coding for two genes, divergently transcribed from opposite strands (Nasmyth and Klar). Yeast strains carrying recessive mutations in unlinked regulatory genes can express the silent mating type cassettes which shows that the silent copies, normally under negative control in trans, are relieved from this control when the information is switched to the active mating type locus. This rules out a system of the type demonstrated for sarcoma viruses where the cellular *sarc* structural gene and a strong promoter can be brought together to transform cells with high efficiency. Lambda-like independent excision and integration events were ruled out by evidence presented by Klar. He favored a duplicative transposition mechanism where the silent locus physically interacts with MAT since recombinants between MAT and the silent loci have been observed. The genetic studies of Haber (Brandeis University) were also consistent with this view.

Another eukaryotic system where genes are expressed in a mutually exclusive fashion occurs in the protozoan responsible for sleeping sickness. This parasite escapes from the host immune response by altering the dominant surface antigen which constitutes 95% of surface protein. Individuals of the species

Trypanosoma brucei have the ability to express one of many hundreds of special genes as this surface protein and so escape the host immune response. It appears now from work reported by Borst (University of Amsterdam) that at least some genes are moved to special genomic sites to become active. This may be the first generalization of the yeast cassette model and it is intriguing to speculate that other classes of genetic differentiation may be achieved by moving information around the genome.

What are we to make of all this genetic instability? Work on the proteins which mediate genetic recombination: *recA*, *recBC*, *synaptase* and the topoisomerases, emphasizes the ease with which the DNA may be rearranged. At least two conclusions follow: first, where genetic maps are conserved between bacteriophages or between the human and mouse X chromosomes this arrangement must have a selective advantage. Second, there may be systems where widespread genetic rearrangement is favoured over the usual conservative gene arrangement. We know of some of these situations; the recovery of bobbed *Drosophila* and the amplification of *Xenopus* ribosomal genes. A report by Jones (Edinburgh University) suggests that

we may no longer be able to relegate these rearrangements to the miscellaneous file. He has found a sequence in the heterogametic W chromosome of female snakes which is conserved in echinoderms, *Drosophila* and mammals. This repeated sequence has at least two dramatic properties. Its sequence arrangement in different tissues of *Drosophila* varies and in mammals, its arrangement in males and females differs. When sex reversed Sxr mice which are phenotypically male but have a female karyotype were tested they exhibited the male pattern. If it is true that Sxr males are not Y autosome translocations but express constitutively the gene normally triggered by a Y chromosome signal, the implication is that the genomic rearrangement is a secondary sexual characteristic. This hypothesis could be tested by examination of another mouse strain Tfm (testicular feminisation) and of bovine freemartins where hormonal regime rather than genetic inheritance is known to mediate altered sexual differentiation. It is a measure of how far our views have changed that Jones' findings were met with interest and not instant disbelief. Of course we are now confident that the clones and blots will tell all. □

The nature of gravitation

from A.H. Cook

EXPERIMENTAL studies of gravitation have been discouraged by the attitude of many theoreticians who, from the time of Newton, have taken gravitation as something 'given'. Experimenters are not, however, so easily put off by theoretical detachment even though the very small strength of gravitation makes its investigation difficult — the gravitational force between proton and proton is about 10^{-39} of the electrical force which, in practice, means that any laboratory study of gravitation will be bedevilled by all manner of extraneous disturbances.

A simple-minded approach to the experimental study of gravitation is to look at the inverse square law and ask such questions as: what is the 'mass'? Is it always proportional to inertial mass or are there differences from substance to substance? Is there any screening of one body by another, as with electrostatic forces? Is the 'constant' of gravitation constant, or does it depend on velocity, time, position, or the direction of the line joining two attracting bodies, and finally, is the inverse square law strictly obeyed?

We have experimental answers to these questions for the electrostatic force, and they are expressed in the appropriate Maxwell equations. We have some answers for gravitation. Experiments for many

years have failed to detect any dependence of gravitation upon material — all hadrons are equivalent gravitationally to within about 1 part in 10^{11} . A few astronomical and geophysical observations have shown the absence of any shielding effect to about the same limit. Geophysical observations of Earth tides show that if there is any dependence of gravitation on direction it cannot exceed 1 part in 10^8 . These and other effects can be incorporated in certain sorts of theory known as parameterised post-Newton (PPN) gravitation theories, provided sufficient parameters are included. If some of these parameters differ from the values predicted from general relativity, then certain effects in celestial mechanics would occur and might be detectable in refined observations of space craft or the Moon. Although such observations, for example, laser ranging measurements of the orbital motion of the Moon, are now possible, no derivations from the predictions of general relativity have so far been detected.

It should be emphasized that the type of experiment being considered is quite different from attempts to detect gravitational radiation. No one seriously doubts that radiation is entailed by general relativity but the question is whether any object radiates strongly enough to be observed with techniques available on Earth.

With the growth of interest in unified theories of gravitation and other inter-

100 years ago

The *Philadelphia Record* deserves credit for its successful efforts to break up the sale of bogus medical diplomas. These diplomas were chiefly sold abroad, and it is appalling to learn, that 11,000 of them have been issued during the past few years. "It was well known," the *Times* correspondent writes, "that Dr. John Buchanan, the Dean of 'The American University of Philadelphia,' and several other similar institutions, was engaged in this traffic; but as they were all properly chartered medical schools, and, though disreputable, existing under the sanction of law, the difficulty was to get evidence of the sale of diplomas. Diplomatic complaints about the traffic came from various Governments of Europe, and our people began to be restive under the stigma." By the clever tact of the city editor of the *Record*, however, Buchanan has been brought within reach of the law, and the detectives are on his track. He attempted to put them off the scent by getting a man looking like himself to pretend to drown himself; this bogus case of drowning, however, has deceived nobody.

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