lower redshifts than the emission lines, which are narrow, are formed under low-excitation conditions and can exist in many different redshift systems in the spectrum of one object. The nature of the Class II absorption lines is highly controversial. Rival hypotheses state on the one hand that they are due to material ejected from the quasar at speeds up to $0.6c$; and on the other that they are due to diffuse interstellar gas in unseen intervening galaxies at the normal cosmological redshift. The second hypothesis is favoured by the distribution statistics of number of systems in one object and by the resemblance between the absorption-line spectra and that of the interstellar medium in our own neighbourhood, but requires the extent of interstellar gas in at least some galaxies to be larger than expected. The presence or absence of Class II absorption lines (which are chiefly seen shortward of Lyman-α) in 3C 273 provides a critical test between these two hypotheses, because 3C 273 is as luminous as at least one of the high redshift quasars in which several absorption-line systems are seen and is presumably very similar to them physically so that it is equally capable of expelling matter; but it is so near to us that the probability of an intervening galaxy being present is negligible.

Although the spectral resolution of the experiment of Davidsen *et al.* is too low to detect individual absorption lines, the number of lines in high redshift objects is so great as to produce a depression of about 30% in the continuum below Lyman-α, and this can still be easily detected at low resolution. The observed depression in 3C 273 is only $2 \pm 6\%$, which provides an impressive argument in favour of the intervening-galaxy hypothesis. □

Cell transformation with herpes simplex viruses

from Franklin H. Portugal

HERPES simplex virus, one type of which causes cold sores and another genital tract infections, is receiving increasing attention as a model for understanding how virus expression leads to host cell transformation. In certain conditions infection of mammalian cells with HSV leads to a non-productive infection in which only part of the viral genome is expressed. When mouse cells lacking the enzyme thymidine kinase are transformed by ultraviolet-irradiated HSV, the cells develop thymidine kinase activity which is coded by the virus and which can be distinguished from the host cell enzyme by various biochemical criteria. So far cells transformed in this way cannot be induced to release infectious virus, suggesting that a fragment of the viral genome, although unable to produce infectious virus, is able to maintain the virus-transformed phenotype. Nucleic acid hybridisation indicates that in mouse cells infected with irradiated HSV-1, either five copies of about 23% of the viral genome (Kraiselburd, Gage & Weissbach *J. molec. Biol.* **97**, 533; 1975) or four to six copies of a 10% fragment of the viral genome (Davis & Kingsbury *J. Virol.* **17**, 788; 1976) are present. Hamster cells transformed by irradiated HSV-2 seem to contain one to three copies of between 8% and 32% of the viral genome (Frenkel *et al. J. Virol.* **18**, 885; 1976). It is not yet known whether the viral genes become integrated into the host chromosome or remain in the cytoplasm.

Maitland and McDougall (*Cell* **11**, 233; 1977) now report that they have been able to transform mouse cells lacking thymidine kinase activity with DNA fragments produced from HSV-2 DNA either by specific cleavage with restriction endonucleases or by mechanical shearing. The transformed cells were selected by their ability to grow in medium containing hypoxanthine, aminopterin, and thymidine, which indicates the presence of a thymidine kinase-positive cell. The cells contained the virus-induced enzyme as well as HSV-specific immunofluoresence. The DNA fragments produced by endonuclease cleavage can be located on a map of the HSV-2 genome and from this information, the thymidine kinase gene seems to be located in the long segment (L region) of the viral genome. Wigler *et al.* (*Cell* **11**, 223; 1977) report the transformation of thymidine kinase-negative mouse L cells with a *Bam*I endonuclease restriction fragment of HSV-1. Cells treated with *Eco*I restriction fragments were not transformed. Bacchetti and Graham (*Proc. natn. Acad. Sci. U.S.A.* **74**, 1590; 1977) also report that thymidine kinase-negative human cells can be transformed by mechanically sheared fragments of HSV-2 DNA. Several lines of transformed cells have been established that grow continually in the selection medium, express thymidine kinase activity of viral origin, and differ in the stability of thymidine kinase expression.

As well as thymidine kinase, a recent study suggests that a new species of another enzyme, deoxycytidine deaminase, is induced when mammalian cells are lytically infected with HSV-1 (Chan *Proc. natn. Acad. Sci. U.S.A.* **74**, 1734; 1977). The results strongly suggest that this enzyme is also coded by the virus. This study is of particular importance because the induced enzyme may affect cytosine arabinoside, a drug commonly used to treat HSV infections, thus making it less effective.

The fact that specific fragments of the HSV genome, coding for clearly defined biochemical functions, can transform mammalian cells suggests that the HSV system will become an increasingly important model for defining those genes required for both biochemical and morphological transformation. In addition, this system has already begun to provide evidence for the mechanisms that control the viral genome in mammalian cells. This information will presumably be of use not only for specific chemotherapy of human HSV infections but also for understanding virus transformation in general, including oncogenic transformation. Furthermore, it may eventually become feasible to use the HSV model for DNA-mediated gene transfer between mammalian cells. □

Franklin H. Portugal is Associate Managing Editor of the Proceedings of the National Academy of Sciences.

Electron storage rings as lasers

from John Pendry

A NEW mechanism for laser action has been demonstrated by a research group working at the Stanford linear accelerator (Deacon *et al. Phys. Rev. Lett.* **36**, 892; 1977). The device is built on the theory that an electron deflected by a magnetic field can emit stimulated as well as incoherent radiation. So far the device has worked in a pulsed mode extracting 7 kW peak power of laser radiation from the kinetic energy of the electron beam. It appears that only

John Pendry is Head of the Theoretical Physics Group at the Daresbury Laboratory.