much faster than that of third sound and, after making due allowance for certain complicating factors, they could deduce the velocity of fifth sound from the measurements. Results from the Los Angeles experiment are shown in Fig. 1. Agreement with the theoretical prediction (lower full curve) is quite remarkably good, and this clearly remains the case even when a little helium-3 is added to change the relative proportions of the normal fluid and superfluid components (the helium-3 contributing only to the former).

Fifth sound constitutes an interesting addition to the rich variety of diverse phenomena already known to occur in liquid helium-4. No doubt efforts will soon be made to observe an equivalent mode in the case of superfluid helium-3: for temperatures around 2 mK the mean free path of vapour atoms is effectively infinite and, to this extent (if not in any other), the experimental design will be simpler. □

Measuring weak absorption spectra

from T.F. Hunter

THE past decade or so has seen a major advance in our ability to measure very weak absorption spectra. Such measurements are needed for analysis of trace amounts of materials or for studying intrinsically weak transitions. In the latter category come vibrational transitions to high energy overtone and combination bands, say in the visible region of the spectrum, and of considerable importance to an understanding of chemical kinetics; spin-forbidden electronic transitions; and transitions due to non-linear coupling of the radiation field with a molecular system, for example, two-photon absorption.

Normal absorption spectroscopy, with its measurement of incident and transmitted intensities, can be of value in this area if sufficiently long pathlengths are used; turntable laser sources, allowing multiple-passage of the radiation beam to be set up more readily, have helped. However, very long optical pathlengths are awkward experimentally, and, in measuring the difference between the incident and transmitted beams, no distinction is made between absorption and scattering, a distinction which may be of consequence for very weakly absorbing samples.

Modern photo-electric detection systems measure the intensity of emitted photons with high sensitivity and, for some time, weak absorptions have been followed by so-called excitation spectroscopy where the intensity of emission is plotted as a function of excitation wavelength. For example, two-photon absorption studies in vapours (Hochstrasse *et al. J. Chem. Phys.* **60**, 317; 1974; Schlag *et al. J. Chem. Phys.* **66**, 386; 1977) have been studied with high resolution and sensitivity using fluorescence monitoring of this kind. However, many classes of compound show effectively no fluorescence because the dominant deactivation process from the excited state is a non-radiative coupling to other states and other forms of energy.

In any system where the quantum yield of emitted photons is less than unity (and this means essentially all systems), the non-radiative coupling leads to excess heat being produced following the absorption process. An increase in temperature or pressure in the system results. Two techniques, using this flow of heat energy, have been developed.

Thermal lensing spectroscopy (Gordon *et al. J. appl. Phys.* **36**, 3; 1965; Albrecht *et al. J. Chem. Phys.* **65**, 179; 1976) uses a powerful beam of radiation from a tunable dye laser for example. Following the absorption of some radiation by the weak transition under study, the temperature of the sample fluid rises; since the cross-sectional profile of the intensity of the laser beam is Gaussian in shape so is the temperature distribution. Such temperature variation leads to a concomitant variation in the refractive index, a phenomenon which constitutes a thermal lens. The laser beam diverges slightly due to the flow of heat energy. By intensity-modulating the incident beam and thus enabling lock-in devices to minimise interference from noise (thermal, optical, electrical), and by monitoring a part of the transmitted beam through a pin-

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Eukaryotic transcription *in vitro*

by Eleanor Lawrence

IN an unscheduled talk at the recent ICRF Tumour Virus meeting* R. Roeder announced to an appreciative audience the development of an *in vitro* transcription system in which initiation of the adenovirus major late gene transcription unit at the 'correct' site has been unequivocally demonstrated.

He and his colleagues P.A.Weil, D.Luse and Jacqueline Segall at the Washington University School of Medicine, St Louis, have obtained specific initiation and transcription of part of the adenovirus late genes, using either full-length purified adenovirus DNA or restriction fragments containing the start of the transcription unit, in a system consisting of a crude extract (the soluble fraction, S100) of uninfected human KB cells to which purified human RNA polymerase II has been added. Purified polymerases II from other vertebrate cells are also effective but that from wheat germ is not.

Although still in a primitive state this *in vitro* transcription system promises to provide the means by which the basic requirements for the transcription of eukaryotic 'class II' genes can be determined. Class II genes are those transcribed by RNA polymerase II and include many of the single copy sequences in eukaryotic cells, as opposed to the ribosomal RNA genes for example, which are transcribed by RNA polymerase III.

Roeder has yet to test his system on other eukaryotic genes, but the close resemblance of the putative 'promoter' sequences for the adenovirus late genes to those of beta-globin and ovalbumin amongst others, suggests that the system may work equally well for them. Successful transcription of the adenovirus late genes in the absence of any components from infected cells is of particular interest as the late genes are not transcribed *in vivo* until replication of the adenovirus DNA has begun. This suggests either that these genes are being transcribed at a low level even early in infection, or, more attractively, that control over their expression is exerted at a higher level, that of chromatin organisation perhaps, and that these controls are bypassed when purified DNA is transcribed.

The site at which transcription starts *in vivo* has been mapped precisely (see Ziff & Evans *Cell* **15**, 1463; 1978) and so Roeder was able to determine that the 5′ end and oligonucleotide fingerprints of the RNA produced in his system matched those of transcripts *in vivo*. Although initiation is specific, transcription does not continue very far into the gene *in vitro* and is also slower than *in vivo*. So one task is to determine whether this premature *in vitro* termination can be overcome, by adding extracts from adenovirus-infected cells for example. The long term aim is gradually to refine the system until it is fully characterised (as with the *in vitro* assays for DNA replication developed for the small bacteriophages). Determination of which regulatory DNA sequences preceding and within eukaryotic genes are essential for faithful transcription is already well underway in the *Xenopus* oocyte transcription/translation system and more recently through the insertion of defined fragments of eukaryotic genes into mammalian cells using SV40 vectors. A fully characterised *in vitro* assay however, could also identify the array of cell proteins that might be expected to be needed.

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