assimilation of nitrate by higher plants is regulated by nitrate in a manner which, at least superficially, resembles the coordinate regulation of the *lac* operon in *E. coli*. Although it would be dangerous to conclude from this that similar mechanisms are at work in *E. coli* and tobacco cells, it is nevertheless cause for some celebration whenever the plant kingdom is brought one step nearer the molecular empire. It is to be hoped that further probing of the nitrate assimilation system will lead to discoveries of importance for our understanding of the regulation of gene expression, not only in plants, but also in other eukaryotes.

REVERSE TRANSCRIPTASE

Enzyme with Many Uses

from our Cell Biology Correspondent

A SUPPLY of radioactively labelled DNA molecules complementary to either messenger RNAs or the genomic RNAs of the RNA viruses is something molecular hybridizers have long dreamed of; as specific probes, such DNA molecules would be invaluable when it comes to detecting, for example, the location of genes on chromosomes, the sites of replication of RNA viruses or specific RNAs or DNAs in complex mixtures. The discovery of reverse transcriptase raised hopes that such DNAs might become available; everything depended on the degree to which this enzyme in RNA tumour virus particles is template specific. If reverse transcriptase shared the rigid template specificity shown by phage Qβ RNA replicase—an enzyme which can only use Qβ RNA and variant molecules derived from it—its use would be very restricted, but what if tumour virus reverse transcriptase proved to lack substantial template specificity? This enzyme could then be used to make a DNA complementary to all sorts of RNAs. In the event, as Spiegelman, Watson and Kacian report (*Proc. US Nat. Acad. Sci.*, **68**, 2843 ; 1971), the reverse transcriptase isolatable from avian myeloblastosis virus particles (AMV is readily available in large quantities, unlike many other RNA tumour viruses) seems to lack rigorous template specificity.

This enzyme, which when pure has been shown to consist of equimolar amounts of two polypeptide chains weighing 110,000 and 69,000 daltons (Kacian *et al., Biochim. Biophys. Acta*, **246**, 365 ; 1971), will reverse transcribe, albeit at different efficiencies, not only AMV RNA and synthetic homopolymer duplexes but also natural RNAs from sources as diverse as Qβ phage and Moloney mouse sarcoma virus. In short, reverse transcriptase lacking template specificity should prove to be an enormously useful enzyme.

And if the experiments of Crippa and Tocchini-Valentini (*Proc. US Nat. Acad. Sci.*, **68**, 2769; 1971) and Ficq and Brachet (*ibid.*, 2774) are anything to judge by, it seems that an RNA dependent DNA polymerase (reverse transcriptase) may exist in eukaryotes and play a crucial part in processes such as gene amplification. During oogenesis in the toad *Xenopus laevis* genes specifying ribosomal RNA, which, including a spacer DNA, form a unit about 9×10^6 daltons, are amplified. Crippa and Tocchini-Valentini have attempted to implicate a reverse transcriptase in this process. They have shown, using 5-bromodeoxyuridine as a density label, that the ribosomal DNA cistrons are not themselves apparently used as a template for their own amplification. This finding suggests, of course, that the template for the amplification of the ribosomal DNA cistrons may be an RNA rather than a DNA.

Crippa and Tocchini-Valentini have also shown that, albeit at fairly high concentrations, 2′,5′-dimethyl-N(4′)benzyl-N (4′)[desmethyl]rifampicin, a drug which is known to inhibit the activity of reverse transcriptase in tumour viruses (Gurgo *et al., Nature New Biology*, **229**, 111 ; 1971), inhibits gene amplification during oogenesis in *Xenopus*. This, of course, suggests that the enzyme responsible for amplifying these genes may be a reverse transcriptase. Ficq and Brachet, using autoradiography to monitor the amplification of ribosomal DNA in *Xenopus* oocytes, also show that this drug inhibits the process and draw the same conclusion. It may well be therefore that ribosomal DNA amplification depends on the transcription of the ribosomal DNA cistron into a 47S RNA transcript which is then used as a template by reverse transcriptase.

Laser Studies of Vibrational Energy States

THE availability of high-powered monochromatic beams of laser light, which are well collimated and usually polarized, together with the fact that they may be modulated or pulsed in times as short as 10^{-11} s, has promoted research into many new areas in the field of electromagnetic/vibrational energy interaction.

Energy distribution among the various vibrational modes of single molecules and the interchange of vibrational energy between molecules following laser excitation have become fruitful areas of investigation in recent years. Selection of a laser wavelength which exactly matches an absorption line in a molecule makes it possible to populate efficiently a single vibrational energy state. At present more than twenty vibrational bands, exactly matched by laser frequencies, are known. The rates of the various vibrational energy transfer processes which follow the absorption may be determined with comparative ease and this fact, together with the rapidly expanding number of systems which are becoming amenable to experiment, has made both practical and theoretical approaches profitable.

Since the simultaneous appearance in the literature of the first two reports of laser excited vibrational (infrared) fluorescence, the first involving the asymmetric stretching mode (001) of carbon dioxide and the second involving the bending mode of methane, laser excited vibrational fluorescence experiments have considerably increased the detailed understanding in this field. Several kinds of chemical lasers have been described. Typically, infrared fluorescence originates from rotational lines in the vibrational spectrum of HCl which is formed by flash photolysis of fast flowing mixtures of chlorine and hydrogen. In HCl–CO_2 mixtures both HCl and CO_2 fluorescence have been observed.

In the closely related techniques of double resonance which may involve infrared, microwave or a combination of both kinds of radiation, changes in the vibrational–rotational energy distribution produced by the absorption of a pulse are monitored by means of absorption changes. In the presence of strong monochromatic resonant radiation molecules no longer assume a Boltzmann distribution. If the radiation is applied continuously a steady state will be produced in which the population of a particular level n_i is different from that for a Boltzmann distribution n_i°. The value of n_i–n_i° depends on the power of the radiation and the relaxation time between the levels. Double resonance techniques enable the values of $(n_i-n_i^\circ)-(n_l-n_l^\circ)$ to be measured and therefore provide a powerful insight into the mechanisms of relaxation processes. Collisional relaxation of the (100) state of CO_2 itself has been studied by this technique using CO_2 lasers as pumping and monitoring sources while the more general applicability of the method has been demonstrated in a study of the relaxation processes in SF_6.

As well as the energy transfer studies already mentioned, some uncertainty about the initial absorption process still remains, particularly in cases where the high photon density of the laser beam brings about the involvement of multiquantum processes. In particular, the communication by R. T. Bailey, F. R. Cruickshank and T. R. Jones in next Monday's *Nature Physical Science* should help to resolve some problems.