ENZYMES

RNase H Activity

from our Cell Biology Correspondent

WHEN an enzyme becomes as fashionable as reverse transcriptase from RNA tumour viruses has become since its discovery in 1970 one can guarantee that any interesting new claim about its properties will rapidly be confirmed or refuted, as the case may be. That is perhaps the chief benefit stemming from such competitive situations. Take, for example, the seminal observation reported by Mölling and her colleagues in 1971 (*Nature New Biology*, **234**, 240). They found that reverse transcriptase isolated from virions of avian myeloblastosis virus (AMV) has an associated ribonuclease H activity which specifically digests the RNA moiety of an RNA.DNA hybrid molecule but which does not digest single stranded RNA or double stranded RNA or DNA. This report stimulated several groups to pursue further the characterization of this RNase H activity, and during the past couple of months the fruits of their labours have appeared in print.

Baltimore and Smoler (*J. Biol. Chem.*, **247**, 7282 ; 1972) have reported that the DNA polymerase and RNase H activities of reverse transcriptase from AMV cannot be separated by analytical chromatography or centrifugation. And by using tailor made synthetic RNA.DNA substrates they established that the RNase H activity releases oligonucleotides and mononucleotides with 3′ hydroxy groups and 5′ phosphoryl groups. Because some of the products of digestion are oligonucleotides they describe this activity as an endonuclease.

Keller and Crouch (*Proc. US Nat. Acad. Sci.*, **69**, 3360 ; 1972), who also found that the DNA polymerase and RNase H activities of reverse transcriptase cannot be separated, studied the degradation of both synthetic RNA.DNA molecules and the RNA containing DNA of the plasmid *Col* E_1. Like Baltimore and Smoler they find that the products of digestion are oligonucleotides as well as mononucleotides, but their data also indicate that the RNase H activity requires a substrate, the RNA moiety of which has free ends. This would indicate that the viral RNase H activity is an exonuclease but it digests internal phosphodiester bonds presumably by leapfrogging from the free end to some internal position in the RNA chain. Whether such an enzyme should be called an endonuclease or an exonuclease is almost an argument over semantics. Keller and Crouch also established that the RNase H activity of AMV particles is distinct from the RNase H activity in chick cells and KB cells, an important point when it comes to deciding the origin of the enzyme.

Grandgenet, Gerard and Green (*J. Virol.*, **10**, 1136 ; 1972) have, by screening ten different viral reverse transcriptases, established that an RNase H activity is a universal property of reverse transcriptases from RNA tumour viruses. They have also shown that enzymes from different viruses have slightly different specificities for synthetic substrates, for example only the reverse transcriptases from Moloney mouse sarcoma leukaemia viruses and RD feline leukaemia viruses hydrolyse the poly(U) of poly(U).poly(dA).

A more interesting observation reported by this group (*Proc. US Nat. Acad. Sci.*, **70**, 230 ; 1973) is that the reverse transcriptase of AMV occurs in two separable forms : one consists of two polypeptide chains, an α chain with a molecular weight of about 65,000 and a β chain with a molecular weight of about 105,000 ; the other form is a single polypeptide chain with a molecular weight of 65,000. The two forms of the enzyme have antigenic determinants in common, the same template specificity and both RNase H and DNA polymerase activities. Reverse transcriptase from viruses other than avian RNA tumour viruses resembles the second form of the AMV enzyme, and consists of a single polypeptide chain. These data coupled with those of Keller and Crouch, and the properties of various mutants of avian RNA tumour viruses, strongly suggest that the α chain is coded by the viral genome. But what is the origin and function of the β chain? Perhaps this is the beginning of a story that will prove to be as complex as that of the origin and mechanism of action of phage $Q\beta$ RNA replicase.

The question of the role of the RNase H activity of viral reverse transcriptases is, of course, a matter of considerable speculation. This activity may well be necessary for the synthesis of a double stranded DNA provirus from a single stranded RNA viral genome. But that remains to be proven.

BIOLOGICAL CONTROL

Attack on Thistles

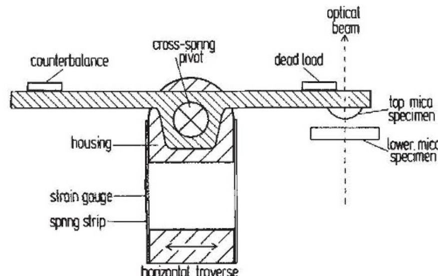
from our Plant Ecology Correspondent

IN spite of the publicity which has been evoked by the successful biological control of certain species of pest, these success stories are still few in number. This is especially true of the control of plant pests by the introduction or encouragement of herbivore populations. Classic examples are the control of *Opuntia inermis* in Australia by the beetle *Cactoblastis cactorum*, and that of *Hypericum perforatum* in the rangelands of North America by the beetle *Chrysolina quadrigemina*.

It may seem strange that in north-west Europe, one of the most intensively farmed areas in the world, there are no examples of effective control of a weed species by introducing a predator. This is not because the area is lacking

Shear Properties of Molecular Films

AN investigation of shear in molecular films, which has a bearing on the boundary lubricating action of long chain amphipathic molecules (those with one end hydrophilic and the other end hydrophobic), is described by Israelachvili and Tabor in next Monday's *Nature Physical Science* (February 19). Previous related experiments have been carried out by Bailey and Courtney Pratt (*Proc. Roy. Soc.*, **A227**, 500 ; 1965) who studied calcium stearate films on curved mica sheets. These experiments used low pressures, and the sheets were flexible ; experiments using metal surfaces have also been carried out, but in these the area of molecular contact was not known precisely. In the experiments reported by Israelachvili and Tabor, both thickness and area of sheared film were measured and contact pressure could be varied from 10^6 to 10^7 N m^{-2}.



The experimental arrangement is shown in the figure. The mica sheets, with backs silvered, are glued to cylindrical glass supports and viewed by multiple-beam interferometry to determine the area of contact. The load applied (dead load) can be up to 50 g, and the sliding speed can be varied between 3 and 40 μm s^{-1}. Mono and multimolecular stearate films have been investigated. The results show that the first adsorbed monolayer is firmly attached to the mica substrate, and the shear strength (3 to 4×10^6 N m^{-2}) is much the same as that reported by Bailey and Courtney Pratt, and others. The thickness of the monolayer, 48 ± 3 Å, suggests that molecules stand normal to the mica surfaces. At contact pressures of up to 10^7 N m^{-2}, the limit possible with the present experiment, the molecules of the monolayer remain oriented normal to the surface of the mica; thicker molecular layers are, however, easily dislodged and broken up by the sliding process.

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