merase being a critical factor in normal sporulation.

The implication of all these experiments extends, of course, beyond bacterial genetics. Batteries of different sigma factors may well be involved in the co-ordinated switching on and off of genes during differentiation of eukaryotic cells; even the transformation of cells by tumour viruses can be interpreted in terms of sigma factors. Polyoma and SV40, for example, replicate in some cells but fail to replicate and transform other cells. Perhaps the permissive cells contain sigma factors which allow the complete expression of the viral genome and the replication of the virus, while the sigma factors in non-permissive cells allow only partial expression of the viral genome. In the non-permissive cells the virus would fail to replicate but the viral genome would be available for insertion into the host cell's chromosomes, an event which may lead to the transformation of the host cell.

Advice for Teminizers

TEMINISM—the activity triggered off by Temin's discovery that RNA tumour viruses can reverse the normal direction of flow of genetic information by acting as templates for the synthesis of DNA—is booming. But a major difficulty in assessing progress, which also seems to be confusing many of the research teams now frenetically searching for information reversal enzymes, is how to decide just which enzyme is fulfilling what function. "Know your enzyme" may be a good motto for Teminizers, but it is proving one difficult to live up to.

The one enzyme whose catalytic function is clear is the so-called RNA dependent DNA polymerase (see *Nature*, **226**, 1209 and 1211; 1970). This acts on the viral genome to synthesize DNA complementary to its RNA. So far, however, the extent of RNA–DNA hybrid formation seems to be rather limited; only a small part of each RNA genome is converted into DNA.

The obvious advantage for RNA tumour viruses to be able to convert RNA to DNA is that their genetic information can then be integrated into the genome of the host cell. This would require the synthesis of duplex DNA from the RNA–DNA hybrid, and at least two further enzyme activities are likely to be involved. (This, however, is not to say that the enzymes are necessarily represented by two distinct protein entities; one difficulty of working with viral information-transfer is that as yet the catalytic activities of the virion have not been identified with protein moieties, and one enzyme may well turn out to have more than one catalytic activity.)

If integration of duplex DNA into the cell genome is to be assured, there must first be a replacement of the RNA strand of the hybrid by a DNA strand, which implies one distinct enzyme activity. This single piece of duplex DNA will then probably need replicating so as to provide more copies, which is another enzyme activity. Distinguishing these two enzyme activities *in vitro* is difficult enough, but finding out just how they work *in vivo* may prove impossible until the protein(s) responsible can be characterized. And even these are unlikely to be the only enzyme activities involved. It is possible, for example, that more viral RNA may be synthesized from the DNA–RNA hybrid, and integration of the DNA itself will probably demand yet more enzymes, such as a nuclease to prepare gaps in the cell chromosome at the sites where duplex DNA is to be inserted. Indeed, the identification of the enzymes involved in this process may well throw light on the vexed issue of recombination, a closely analogous process, the details of which remain largely elusive in more conventional systems.

CANCER VIRUSES

More of the Same

from a Special Correspondent

IF people were obliged to publish anonymously, tragicomic situations such as that revealed last week at the 1970 Tumor Virus Meeting at Cold Spring Harbor might be less frequent. If a prize were to be given for the work that has caused the most whip-cracking and unnecessary duplication of experiments, Temin, Mizutani and Baltimore would win hands down. Even the most innocent enthusiasts must now be having second thoughts, however, when so many groups are busily copying each other, characterizing RNA dependent DNA polymerase and the other enzymes in RNA tumour viruses. To judge from the remarks of Dr T. E. O'Connor (National Cancer Institute), however, those who run the institute's Special Virus Cancer Program are all too keen to pour even more money into an instantaneously overcrowded field. He invited the packed hall—the idea that the specialist meeting at Cold Spring Harbor should be intimate and eclectic has gone by the board—to send requests for free samples of RNA tumour viruses to Bethesda as soon as possible. The programme, which must be delighted at the prospect of finding something on which to spend its millions, would then be able to match supply with demand. Feline leukaemia virus is included in the offer, albeit with a mild caution that a virus that jumps species barriers so readily and which grows well in human cells might be dangerous. It is therefore hardly surprising that the standing sick joke has become that, because it is proving hard to find even epidemiological evidence of human RNA cancer viruses, the Special Virus Cancer Program will be content if its pensioners manage to manufacture them in their laboratory.

And what are the fruits of two months' frantic activity? Mizutani and Temin (Wisconsin) have now found two more enzymes in the virions of mouse sarcoma virus—an endonuclease activity which one can speculate may have a role in integrating the viral DNA into the host cell chromosomes on transformation.