circumstances polymerize under the action of DNA-dependent RNA polymerase to form poly-F, and co-polymers with other nucleotides. Ward and Reich (*Proc. US Nat. Acad. Sci.*, **61**, 1494; 1968) have now examined the properties of these polymers; they find that poly-F has a number of interesting differences, both biochemical and physical, from poly-A. It is, for example, orders of magnitude more resistant to exo and endonucleases, but with pancreatic ribonuclease it degrades not very slowly, like poly-A, but at a rate comparable with poly-C. These results must be taken to reflect an important structural difference from poly-A, which is presumably the configuration about the glycosidic bond, and the optical properties are consistent with this interpretation. Neutral poly-F is hypochromic, with a broad melting profile, indicative of a single-stranded stacked structure, like that of poly-A. In two-stranded polymers, the melting is sharp. Complexes of poly-F with poly-*r*U or poly-*d*T melt 30° C or more below the corresponding poly-A complexes. In alternating copolymers with U and its analogues, the melting temperatures are similar or higher than those of the poly-A-containing analogues, with one exception—alternating poly-(F-pseudo-U), which melts 25° C lower than poly-(A-pseudo-U). Now in pseudo-U the sugar is again joined to a carbon atom in the base. In its own complexes with poly-A and the like, polypseudo-U is stated to show increased thermal stability compared with poly-U, and so behaves very similarly to poly-F.

Optical rotatory dispersion curves of the various complexes have also been measured. In two-stranded complexes, the curves qualitatively resemble those of the poly-A-containing counterparts, though the absorption bands and thus the Cotton effects are shifted to the red. Single-stranded poly-F, on the other hand, has an optical rotatory dispersion of the opposite sense. In single-stranded copolymers with A, G, U, C and I the ORD varies between low positive and negative values, depending on composition. The conclusion is that F residues can be *syn* or *anti*, the latter being required for Watson–Crick helices, as an examination of the geometry shows. Single-stranded poly-F is in its preferred fully *syn* state, and in copolymers there is a mixture of forms, depending on the fraction of F present. It may be inferred that the rotational barrier between the two forms is low. An interesting speculation arising from these results is the possibility that pseudo-U, which occurs, for example, in *t*RNAs, might serve as a hinge point for a conformational transition, and indeed it has been reported that chemical modification of pseudo-U produces considerable changes in *t*RNA structure and stability.

The function of F-containing polynucleotides as messengers has been studied by Ikehara *et al.* (*Biochim. Biophys. Acta*, **174**, 691; 1969). Poly-F itself will evidently not code, but alternating poly-FC stimulates thr-*t*RNA binding to ribosomes almost to the same extent as does poly-AC, and his-*t*RNA binding half as much as poly-AC. In a cell-free system, poly-(his-thr) is produced, and poly-(arg-glu) if the messenger is poly-FG, exactly as expected. There is a high degree of fidelity, and the F works in all respects like A. Presumably the *anti* configuration is mandatory for messenger function, inasmuch as this involves Watson–Crick pairing, so that the efficiency of the process must again reflect the low rotational barrier between the two states.

BACTERIOPHAGE

ΦX174 Replication

from our Cell Biology Correspondent

SINSHEIMER has come to be almost a synonym for ΦX174, the single stranded DNA coliphage. The latest issue of the *Journal of Molecular Biology* contains three papers from Sinsheimer's group on the ΦX174 infection process, bringing the group's score so far to twenty-seven. Knippers, Salivar, Newbold and Sinsheimer (*J. Mol. Biol.*, **39**, 641; 1969) have investigated the transfer of parental DNA into progeny phage particles in conditions in which the host *E. coli* cells, growing in a minimal medium, are infected with high multiplicities of parental phage. In these conditions some of the infecting parental DNA molecules become encapsulated in coat protein to form progeny phage. This transfer only occurred when the multiplicity of infection was greater than three. Furthermore, the parental DNA which is encapsulated seems to be preferentially derived from parental replicative form (RF) molecules (double stranded circular DNA molecules containing a parental strand from an infecting phage and its complementary strand synthesized in the host cell) which are never associated with the host cell membrane but occur free in the cytoplasm.

This result leads to the intriguing suggestion that the location of the RF molecule in the host cell determines its function in the DNA replication process. Infecting parental DNA which becomes attached to the cell membrane and converted into double stranded parental RF seems to function as a complex for the semiconservative and symmetrical replication of progeny RF molecules which are released into the cytoplasm. There, together with a fraction of parental RF molecules that never become attached to the membrane, they are used for the synthesis of progeny single stranded DNA molecules which eventually become encapsulated into progeny phage. During this stage in the cycle some of the parental strands must be displaced from RF and so become available for encapsulation.

In the two other papers, Levine and Sinsheimer (*J. Mol. Biol.*, 619 and 655) deal with one of the ΦX174 proteins, that specified by cistron VI, whose synthesis is not sensitive to chloramphenicol. Conditional lethal mutants of this cistron can convert the parental infecting DNA into a parental RF but further stages in infection are blocked. No progeny RF is formed. Cistron VI protein is apparently required for progeny RF synthesis but not for the synthesis of progeny single stranded DNA. What function does the protein serve? The kinetics of synthesis of the protein and progeny RF molecules are similar and the protein and the progeny RF appear to be made in approximately equimolar amounts. During infection the protein first appears associated with the cell membrane and then in the cytoplasm, thus paralleling the movements of the progeny RF. There is evidence that it is not required for the maintenance of the parental RF form nor for attachment of the parental RF to the cell membrane. Furthermore, it does not seem to be required for nicking DNA molecules. Levine and Sinsheimer suggest therefore that it acts as a denaturing agent allowing the synthesis of progeny RF, perhaps by attaching the minus strand of a parental RF to the membrane where it can then act as a template for synthesis.