CYTOLOGY

Looking at Flagella

from our Cytology Correspondent

ELECTRON microscopy has revealed that the flagella of plant and animal sperm are very similar in structure, composed of microtubules arranged to give a pair of single tubules surrounded by nine parallel doublet tubules (a 9+2 pattern). Phillips presents evidence, from an examination of nearly 200 species, that insects have a modified sperm flagella pattern where there is an additional peripheral row of nine single tubules, thus giving a 9+9+2 pattern. He reports (*J. Cell Biol.*, **40**, 28; 1969) some deviations from this pattern among insects, which suggest that microtubule patterns other than 9+2 or 9+9+2 are compatible with functional sperm. For example, in *Psocus* (Psocoptera) the outer nine tubules are not in the usual parallel alignment but are arranged in a long pitched helix around the inner tubules. This helical arrangement seems to be a feature of sperm maturation, for in the young spermatids the outer tubules are parallel to themselves and the flagellar axis. Other insect species, for example some mayflies (Ephemeroptera), lack the central tubules, while in *Culex* and *Aedes* (mosquitoes) there is only one central element and this seems to be a solid rod rather than a tube. In two species of caddis fly the central area is occupied by seven tubules and the outer ring of nine is lacking. In treehoppers there is yet another pattern. In four species examined the flagella branch into four tails. Three tails were found to contain two doublets and two singlets and the fourth three doublets and three singlet tubules. Phillips points out that sperm of only a handful of the estimated 700,000 species of the very ancient insect order have been examined and it is not unreasonable to think that some variation on the basic pattern should have arisen which is still compatible with functional sperm.

Another sperm type that lacks the 9+2 arrangement of tubules is found in the mealy bugs. Ross and Robison (*J. Cell Biol.*, **40**, 426; 1969) found that two to three concentric rings of up to a total of fifty-six microtubules surround the nuclear material in the sperm of *Pseudococcus obscurus*. The sperms of these insects are enclosed in groups of sixteen in a sperm bundle of complex morphology which itself is motile. Ross and Robison believe that the motility of the bundle is due to the movements of the individual sperm but they cannot say what the energy source for motility is, for mitochondria are apparently excluded from the sperm.

Sperm flagella of algae carry hair-like appendages or mastigonemes. Bouck (*J. Cell Biol.*, **40**, 446; 1969) has found that the mastigonemes of the sperm of *Fucus* and *Ascophyllum*—two brown seaweeds—have three regions: a tapering base, a tube and fine fibrils at the tip. Superficially, the mastigonemes resemble bacterial flagella, but unlike the bacterial flagellum, the mastigoneme seems inflexible and has nothing resembling a basal disk for attachment into the body of the algal flagellum. How the mastigonemes are formed and come to be located on the flagella is not clear, but during flagellum formation what look like mastigonemes appear in membrane-limited sacs in the cytoplasm. These sacs may have arisen from the Golgi apparatus which, in chrysomonads, is known to elaborate the scales that cover the flagella.

All these reports leave many tantalizing questions unanswered, especially the question of the relation between structure and function. Yet these observations show evolution and differentiation at work at a very subtle and fundamental level.

NUCLEIC ACIDS

Messengers for Everyone

from our Cell Biology Correspondent

IT seems that mammalian messenger RNAs are about to become common property in many laboratories. In last week's issue of *Nature*, (**221**, 1103; 1969) attention was drawn to Kazazian and Freedman's ingenious proposal to exploit L-*o*-methylthreonine in order to isolate gene-specific messenger RNAs. On page 1217 of this issue, F. Labrie reports the isolation of what is probably pure rabbit haemoglobin *m*RNA by the more conventional methods of centrifugation and electrophoresis. Briefly, Labrie increased the percentage of reticulocytes in rabbit blood by repeated injection of phenylhydrazine, lysed the cells and separated the polysomes, ribosomes and associated *m*RNA by centrifugation. He then isolated the crude *m*RNA fraction by sucrose gradient centrifugation, in the presence of EDTA, of the resuspended ribosomal pellet. The fraction containing messenger RNA sediments as a band at between 12–14*S*.

The 12–14*S* material is further resolved into seven or eight fractions on polyacrylamide gel electrophoresis, two of which must be the *m*RNAs for the α and β globins. But which two fractions? Assuming that the *m*RNAs are monocistronic, estimates of their molecular weights, based on the knowledge that they must have enough information to code for polypeptide chains of 141 and 146 amino-acids, eliminate all but two gel fractions, the 9*S* and 10*S* fractions. Three additional pieces of evidence support this conclusion. First, *in vivo* labelling kinetics show that these two fractions label more readily than the others, which are presumably parts of, or degradation products of, translation machinery. This is as expected, because messenger is likely either to turn over faster than translation RNA or to be made later in the cells' differentiation. Second, fingerprints of the 10*S* RNA eliminate the possibility that it is derived from ribosomal RNA. And finally, the binding properties of the 10*S* fraction to ribosomes are characteristic of messenger.

None of these pieces of evidence, suggestive though they are, proves that the 10*S* RNA is haemoglobin messenger; proof will depend on showing that 10*S* RNA directs synthesis of globin in an *in vitro* protein synthesizing system. If the experiments reported in last week's issue of *Nature* (**221**, 1118; 1969) by Laycock and Hunt can be substantiated, they will provide just the system in which to put Labrie's messenger to the test, but will also make the experiment redundant. Laycock and Hunt seem to have hit on the conditions for translating haemoglobin *m*RNA in an *E. coli* cell free system and a very simple fractionation procedure which yields a mixture of the two haemoglobin messengers in a pure form. The secret of the cell free system seems to be adding N-acetyl-valyl-*t*RNA to the brew to act as an initiator, instead of N-formyl-methionine-