condense out of the atmospheres of oxygen-rich stars. The next clue is in a paper by Knacke, Gustad and Gillett of California, and Stein who is associated with both California and Minnesota (*ibid.*, **155**, 189; 1969). Their contribution is an infrared spectrum of a cool supergiant in Taurus, in which they have identified absorption features at 9.7 and 10.6 microns which could be produced by a silicate and which they attribute to interstellar grains. The silicates $(\text{Mg,Fe})\text{SiO}_3$, called orthopyroxene inosilicates, seem to fit better than $(\text{Mg,Fe})_2\text{SiO}_4$, olivine, although the authors say the absorption spectrum can be built up by some juggling of the two minerals. The fourth and fifth papers in the series describe infrared maps of the centre of the Orion nebula, in particular four stars embedded in the nebula and called the Trapezium stars. Ney of Minnesota and Allen of The Observatories, University of Cambridge, have mapped several regions of extended emission between the stars which they say can be interpreted as low-mass shells of dust and gas heated by hot stars (*ibid.*, **155**, 193; 1969). Stein and Gillett have looked at the infrared spectrum of the region between the Trapezium stars, and find the same emission features that Woolf and Ney found in the spectra of cool stars. The inference is that the interstellar silicate grains are being heated to emission by the young, hot stars of the Trapezium.

What must be happening if this explanation of interstellar material is correct is the production of silicate dust by cool stars, followed by dispersion of the dust by the outward pressure of starlight. Clouds of dust coalesce into new stars, and this is what is taking place in the Orion nebula. Not all the dust is made of siliceous matter, however; according to Gilman's calculations, carbon will be the dominant product of carbon-rich stars, and stars containing roughly equal amounts of carbon and oxygen will generate silicon carbide. Indeed, there is some observational evidence for the production of carbon, but stars which are sufficiently carbon-rich to make a contribution seem to be rare. Woolf conjectures that if some of the dust aggregated into smaller condensations orbiting the new stars, then silicate-rich planets like the Earth would be formed. In this respect the infrared measurements also fit in with the radio detection in nebulae of complex molecules which are important for life-forming processes. But the graphite/hydrogen explanation also has its implications: Hoyle, Wickramasinghe and Reddish have shown that the condensation of hydrogen on graphite grains can be a controlling factor in the evolution of the universe (*Nature*, **218**, 1124; 1968). It will be interesting to see whether the infrared measurements can overturn the body of observational evidence which has built up for the graphite/hydrogen explanation.

NUCLEIC ACIDS

Satellite DNA

from our Cell Biology Correspondent

In Britain, at least, Professor Peter Walker's group at Edinburgh seems to have a virtual monopoly on the study of satellite DNA. Unfortunately, the group's latest data (Flamm, Walker and McCallum, *J. Mol. Biol.*, **40**, 423; 1969) serve only to make ideas about the function of this strange DNA fraction even more obscure.

In the mouse, *Mus musculus*, satellite DNA accounts for about 10 per cent of the genome and it consists of a number of repeats of a sequence, or a few sequences, of about 300–400 bases. Moreover, self-annealing experiments with single DNA strands isolated from the satellite DNA duplex molecules indicate that some of these 300–400 base sequences must be periodically reversed between the two strands of the duplex. The latest experiments, involving hybridization of satellite DNA with satellite DNA or total cell RNA, indicate that satellite DNA is not transcribed. Less than one molecule in 60,000 in the total RNA population of mouse liver, spleen or kidney cells hybridizes with either of the two single strands of satellite DNA. This is not surprising, of course; indeed, it would have been most embarrassing to find that satellite DNA was transcribed. That would mean that the mouse devoted 10 per cent of its genome to producing an RNA, and presumably a protein, of very abnormal and restricted sequence.

But if satellite DNA is not transcribed, what is its function? Flamm *et al.* are impressed by the fact that numerous copies of a nucleotide sequence of 350 bases have been maintained during evolution in face of the tendency to accumulate random mutations. This implies that satellite DNA has some important function. They suggest that it is required for "house-keeping", the folding and packing of DNA in the chromosomes. In the absence of any critical data or any way of testing for the function of this DNA, that is as good a suggestion as any.

An even more puzzling property of satellite DNA is its species specificity. Only a minute fraction of the total DNA of other rodent species is complementary to mouse satellite DNA, even though the rest of the mouse DNA, which is transcribed, is homologous to the DNA of related species. This must imply that the function of satellite DNA demands that in any one species the sequences of this DNA are similar, and at the same time these satellite sequences must differ from their counterparts in very closely related species. These two properties of mouse satellite DNA have been confirmed by studies of satellite fractions from four other rodents. There is no sequence homology between species. And to add to the confusion, satellite DNA accounts for different proportions of the genome in each species. It hardly needs saying that ideas about the way satellite DNA has arisen are as obscure as ideas about its function.

Maio and Schildkraut (*J. Mol. Biol.*, **40**, 203; 1969) have recently published some evidence which is at least compatible with the "housekeeping" hypothesis. Exploiting their elegant methods for the isolation and partial fractionation of mammalian chromosomes, they have shown that mouse satellite DNA is not restricted to a few chromosomes of the total complement. Satellite DNA forms roughly the same proportion of the total DNA in chromosomes of all size classes and, furthermore, the satellite DNA appears to be more intimately associated with the chromosomal protein than the rest of the DNA. Like the Edinburgh group, Maio and Schildkraut are convinced that satellite DNA has some vital, albeit unknown, function. The mouse cells they used have been in tissue culture for twenty-eight years, but despite the stringent selection pressures imposed by culture conditions, which have led to a highly abnormal chromosome complement, these cells have maintained the same proportion of satellite DNA as normal mouse tissue.