known about the transport of processed mRNA from the nucleus into the cytoplasm and there is uncertainty about the proteins which occur in association with mRNA precursors in the nucleus and with free and polysomal mRNA in the cytoplasm. These mRNA–protein complexes are a characteristic feature of eukaryotic cells, but their functional significance is obscure.

As discussed by J. E. Darnell (Rockefeller University) for adenovirus mRNA, capping of transcripts takes place very early, perhaps at the beginning of transcription. RNA polymerase reads past the site at which poly(A) is subsequently added and the primary transcript is cleaved endonucleolytically before addition of the 200-residue poly(A) tail. Methylation then takes place, followed by splicing to give the final processed transcript. The size of the primary transcripts of eukaryotic genes remains somewhat controversial with K. Scherrer (Cancer Institute, Lausanne) still favouring very large products. This question will ultimately be settled by comparisons of nucleotide sequences of genomic DNA, primary transcripts and processed messengers. The use of restriction endonucleases and DNA cloning has led to rapid progress as illustrated by the discussions of globin gene expression (R. Flavell, University of Amsterdam), the structure of late SV40 mRNAs (W. Fiers, University of Ghent), post-transcriptional processing of the yeast tyrosine tRNA, which contains a 14 nucleotide intron (J. S. Beckmann, Beth-Dagan, Israel), and mouse pre-mRNA structure (A. P. Ryskov, Inst. Molecular Biology, Moscow).

The complexity of heterogeneous nuclear RNA was illustrated by the isolation from nuclei of both 30–50S monomers and heterogeneous polymers, which differ in protein composition and resistance to ribonuclease digestion (M. Jacob). In some cells, the 30S nuclear RNP contains multiple copies of four major structural polypeptides (molecular weight 34,000–40,000) held together by protein–protein interactions (T. E. Martin, University of Chicago), whereas in others as many as 87 different proteins have been identified, including some 20 with molecular weights of 30,000–40,000 (Scherrer). In addition to hnRNA, nuclear RNP particles contain also a low molecular weight RNA (snRNA) which has a longer half-life and appears to be hydrogen-bonded to hnRNA by sequences of some 15–25 nucleotides (A. Alonso, Cancer Centre, Heidelberg).

Free and polysomal messenger ribo-

nucleoproteins present in a wide range of different cells were much discussed. No definite conclusion emerged concerning relationships between any particular protein(s) and the functional state of the messenger, but there is increasing evidence for the view that mRNP proteins may be turning over independently of the mRNA. Thus, proteins associated with free mRNP from muscle cells were reported to be displaced during translation of the messenger in reticulocyte lysates (S. Sarkar, Boston Med. Res. Inst.). The widespread occurrence of RNA-binding proteins in eukaryotic cells (L. P. Ovchinnikov, Molecular Biology, Moscow), as well as the observation that free globin mRNA becomes associated with proteins during translation in a cell-free system from Ehrlich ascites tumour cells (H. R. V. Arnstein, King's College, London), all lend support to the idea of a dynamic state of mRNP proteins despite the well-known strong chemical interaction between the proteins and mRNA.

Differences in mRNP proteins of membrane-bound and free polysomes (N. Standart, Univ. College, Cardiff) and also after virus infection of cells (J. G. Tasseron-de Jong, University of Leiden) suggest possible functions of proteins in relation to the intracellular location of messengers and control of translation. Two other specific proteins, ribophorin I and II, which are present in the rough endoplasmic reticulum of rat liver and other secretory tissues are also involved in binding ribosomes to the membrane (D. A. Sabatini, New York University Medical Center).

Several contributions dealt with the cytoskeleton and its significance for protein synthesis. Thus, polysomal mRNA may be linked to the cytoskeleton by the poly(A) tail and poliovirus mRNA displaces cellular mRNA from intermediate filaments, which may explain the cytopathic effect of poliovirus and other viral infections (S. Penman, Massachusetts Institute of Technology). In lens tissue a particular membrane protein is synthesised by polyribosomes which are specifically bound to the action of the cytoskeletal framework (H. Bloemendal, University of Nijmegen). It was also suggested (A. O. Pogo, N.Y. Blood Center) that in interphase hnRNA is bound to a highly ordered structure formed by non-histone protein interactions and that after post-transcriptional processing mRNA leaves the nucleus already attached to the cytoskeleton. Thus, both processing and transport of mRNA may be dependent on the internal structural organisation of the cell.

In the session on translational control, differences in the distribution of mRNA between the polysomal and non-polysomal cytoplasmic fraction

were reported in Friend erythroleukaemic cells before and after induction of globin synthesis with dimethylsulphoxide (F. Gabrielli, University of Pisa) and in mouse ascites cells (Martin). Also, during the development of the dormant gastrulae of *Artemia salina* changes seem to occur in both the translational efficiency and sequence complexity of mRNA (T. C. James, NIMR, London). Dormant gastrulae contain a unique 19S protein complex, which is an aggregate of 40–50 molecules of a 24,000 molecular weight protein with similar properties to the *Artemia* elongation factor-1$_{II}$ (M. Kondo, University of Antwerp). On resumption of development this complex decreases, suggesting the existence of translational control involving elongation either in addition to or instead of the more usual regulation of initiation. Finally, the apparently endless complexities of translational control were illustrated by the discovery of an 11S cytoplasmic protein which prevents the inhibition of protein synthesis by the haemin-controlled repressor (H. O. Voorma, University of Utrecht). This factor is also able to reactivate reticulocyte lysates after preincubation in the absence of haemin, has no eIF$_2$ activity and probably functions by restoring the activity of the endogenous initiation factor. □

*H. R. V. Arnstein is Professor in the Department of Biochemistry, King's College, London.*

## A hundred years ago

### *CAPTAIN COOK*

It seems on first thoughts rather a strange proceeding to publicly celebrate the centenary of the death of a great man, especially when that death was a murder. But this is what the Paris Geographical Society have arranged to do tomorrow in the case, not of any of their own explorers or navigators, but in the case of England's greatest exploring navigator, Captain James Cook, who was murdered 100 years ago tomorrow by the natives of the Sandwich Islands. Cook, and with him England, owed some gratitude to the French, whose government of the time, though at war with this country, generously gave instructions to their warships and colonial governors, not only not to molest Cook in his pursuit of knowledge, but to render him all reasonable assistance. To him we owe the discovery of the Sandwich, and many other Pacific Islands . . . and proved that [Australia] was unconnected with New Guinea, and above all, dispelled the long-lived illusion of a great southern continent, having been the first to cross the Antarctic Circle.
From *Nature* **19**, 13 Feb., 334; 1879.