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Formation and Function of Polyribosomes in the Early Embryonic Development

By ALBERTO MONROY. (*Consiglio Nazionale delle Ricerche, Laboratory of Molecular Embryology, Arco Felice, Naples, Italy*)

It has been shown that in the eggs of several animals the rate of protein synthesis is very low before fertilization, i.e. there is a small number of active polyribosomes. After fertilization the rate of protein synthesis increases rapidly and this is accompanied by a concurrent rapid build-up of polyribosomes (Rinaldi & Monroy, 1969; Firtel & Monroy, 1970). There is evidence that the structural state of the ribosomes of the unfertilized egg prevents their interaction with mRNA (Maggio, Vittorelli, Caffarelli-Mormino & Monroy, 1968). It is known that until approximately the blastula stage most of the protein synthesis is directed by mRNA that was synthesized during oogenesis (summary in Monroy, 1965). Nevertheless from the earliest post-fertilization stages some heterogeneous rapidly labelled RNA, which is neither rRNA nor tRNA, is synthesized and becomes associated with polyribosomes; most of this rapidly labelled RNA is found in a class of small polyribosomes (Rinaldi & Monroy, 1969; Kedes & Gross, 1969; Firtel & Monroy, 1970), which are the ones most sensitive to actinomycin (Infante & Nemer, 1967; Firtel & Monroy, 1970). Contrary to earlier assumptions (Spirin & Nemer, 1965) these polyribosomes are not inactive in protein synthesis; in fact there is evidence that they are the site of the synthesis of histones (Nemer & Lindsay, 1969; L. H. Kedes & P. R. Gross, personal communication; M. Crippa, personal communication). In the early stages of development the largest percentage of the new (i.e. of zygotic origin) mRNA thus appears to be translated by the small polyribosomes. Data on amphibians (Crippa & Gross, 1969) and on sea urchin (M. Crippa, personal communication) show that only about 50% of the total amount of mRNA present in the young embryo (cleavage stages to early blastula)

is associated with polyribosomes. DNA-RNA hybridization experiments suggest that both in the amphibians (M. Crippa & E. Costantino-Ceccarini, personal communication) and in the sea urchin (M. Crippa, personal communication) mRNA may be stored in rapidly sedimenting heavy particles. The molecular hybridization technique is being applied in an attempt to determine how the mRNA that is synthesized during oogenesis is stockpiled and rendered untranslatable in the unfertilized egg.

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The Function of Polyribosomes Attached to Membranes in Animal Cells

By P. N. CAMPBELL. (*Department of Biochemistry, University of Leeds, 9 Hyde Terrace, Leeds LS2 9LS, U.K.*)

The role of the membrane-bound polyribosomes in the synthesis of protein for export from animal cells is well established. In addition to facilitating the passage of protein from the cell, the containment of the protein within the membrane of the endoplasmic reticulum has other advantages. Thus in the assembly of immunoglobulin G from light chains and heavy chains the controlled environment provided by the membranes is important for the interaction of the four chains (Williamson, 1969).

Brew (1969) has described the role of membranes in the synthesis of lactose by the mammary gland. Thus α -lactalbumin is synthesized by the membrane-bound polyribosomes, released to the cisternal space (Brew & Campbell, 1967) and passed to the Golgi apparatus, where *N*-acetyl-lactosamine synthetase is located (Coffey & Reithel, 1968; Fleischer, Fleischer & Ozawa, 1969). The α -lactalbumin changes the substrate specificity of this enzyme and lactose is synthesized (Brew, Vanaman & Hill, 1968).

There is a marked variation in the rate of metabolic turnover of the proteins of the endoplasmic reticulum (see e.g. Kuriyama, Omura, Siekevitz & Palade, 1969; Arias, Doyle & Schimke, 1969). In particular there is a differential effect on the activity