SUMMARY

1. Attempts have been made to study some of the molecular mechanisms of differentiation in hydra particularly with respect to RNA and protein metabolism.

2. Incorporation studies with \(^{3}\text{H}\)-uridine in normal non-regenerating hydras showed that in hydra there exist various phases with respect to RNA metabolism. In the preliminary phase, the RNA synthesis remains stationary following which it increases swiftly in the growth phase. Considerable breakdown of RNA molecules take place during the phase of starvation in the organism which is found to range between 20 and 78 hours after feeding. After 78 hours, the RNA synthesis remain stationary for some period, following which it declines.

3. A highly variable pattern of RNA synthesis is observed to take place during regeneration in hydra. This has been characterized by abrupt elevations in the rate of synthesis followed by sudden declinations. In a continuously labelled hydra regenerating for hypostome formation of peaks of activity are noted to occur during 6th, 14th, 18th and 24th hour after the amputation and during other periods, the synthesis remain practically low.

4. Regenerating basal discs also involve with such variations in RNA synthetic activity. However, during
this act of differentiation an enhanced rate of synthesis is noted to occur as a whole. The formation of peaks of activity are denoted more or less similar with the pattern observed during hypostome differentiation, except for the occurrence of a peak of slight activity at the 28th hour after the amputation.

5. Protein synthesis also follows essentially the pattern of RNA synthesis. However, the culmination into high peaks of activity are noted to occur less frequently than what observed in the RNA spectrum. In the case of basal disc regenerating hydra, continuously labelled with $^{14}$C-isoleucine, formation of such peaks occur during two periods of regeneration, namely at 18th and 24th hour; where as the entire spectrum of protein synthesis in a hypostome regenerating hydra shows the formation of only one peak of activity.

6. The observed variations in the patterns of RNA and protein syntheses are correlated with variations in cellular activity taking during the process of regeneration in hydra. The initial spurt in RNA synthesis and the subsequent elevations and declinations in its rate are characterized as reflections of cellular activities such as wound healing, delamination of ectoderm from endoderm, proliferation of gland cells, dedifferentiation and redifferentiation of cells and the ultimate region specific attenuations. Similarly,
independent cell characteristics, stage specific transcription and translation and differential gene expression etc, have been discussed as important phenomena underlying the process of differentiation in hydra.

7. The pulse-labelling studies conducted with \(^3\text{H}\)-uridine and \(^1\text{C}\)-isoleucine revealed mostly the stability and turnover of the macromolecules during various hours of regeneration.

8. The stochastic pattern of synthetic activity is noted to prevail in the regenerating, pulse-labelled hydras also. The data have been discussed on the basis of prevailing evidences related with development and differentiation.

9. Differentiating basal disc always accounted for an enhanced manifestation of synthetic activity. It is assumed that the accomplishment of proteins, presumably structural and functional, is more needed to restitute a basal disc than a hypostome.

10. Treatment with 60 \(\mu\)g/ml actinomycin D with a preamputational duration of 12 hours inhibit the incorporation of \(^3\text{H}\)-uridine into RNA by about 98% in regenerating hydras. The other treatments only retard the incorporation.

11. In such RNA synthesis-inhibited hydras the incorporation of radioactive aminoacid takes place during the 1st hour
after amputation suggesting that the templates for
the first protein synthesis upon the onset of regenera-
tion are stable in this system.

12. In budding hydrams treatment with 60 μg/ml actinomycin D
for 12 hours prior to the bud formation inhibits the
RNA synthesis by 98%.

13. Measurements of half-life of messenger in hypostome
and basal disc regenerating hydrams suggest that in the
case of hypostome it is approximately 8 hours, whereas
in the case of basal disc the half-life is extended
approximately till 18 hours. This variation in the
activity with respect to the two opposite morphogentic
centres has been discussed on the basis of a variation
in tissue-type differentiation.

14. Cycloheximide, when used at a concentration of 75 μg/ml
with a 12 hour preamputational treatment, inhibits the
incorporation of 14C-isoleucine into proteins by about
95% in regenerating hydrams. Treatments with lesser
concentration of the drug do not result in complete
suppression of protein synthesis.

15. Cordycepin also inhibits the RNA synthesis; a maximum
inhibition of 90% is obtainable when the drug is used
at a concentration of 100 μg/ml and with pretreatment
duration of 12 hours. Appreciable inhibition is not
obtained with other treatments of the drug, even with
various preincubation timings.
16. In cordycepin treated hydres, the protein synthesis rises to higher levels than control, many a times during the period of differentiation. This particular nature of synthesis is expressive in cordycepin treated hydres only and is characteristically denoted with formation of clear sharp peaks of synthetic activity occurring during certain hours of regeneration followed by subsequent and sudden declinations.

17. This anomaly in molecular expression has been discussed on the basis of regulation of gene expression. Indications are that during the translation process there may be the interaction of one or few translational control RNAs which are affected by cordycepin on the basis of the biosynthesis of poly A. Further analyses are being carried out regarding this control mechanism.