

10/10/10 Belt #1

EVOLUTION

The genetic code probably evolved in conjunction with the transition from a ~~cellular~~ to cellular kind of organization; that is, during the evolution of single cells. The code probably became fixed at a relatively early date as suggested by Hinegardner, et al., because soon after much information had been acquired, further modification of the code probably was restricted to those which would not prevent the information which had been acquired, from being expressed. The earliest fossil bacteria, which have been reported, are estimated to be $3,000 \times 10^6$ years old; however, the fossil record first becomes abundant approximately 600×10^6 years ago. Virtually all of the invertebrate ~~filia~~ ^{phyla} and the first vertebrates had evolved 500×10^6 years ago.

The genetic code ~~must have~~ evolved as the cell evolved, Fossil bacteria, one to three billion years of age, have been reported; however, the fossil record first becomes abundant about 600 million years ago, ~~since~~ ^{neurons} must have evolved as multicellular forms

appeared and became more highly differentiated. Therefore, the ~~genetic~~ ^{genetic} code is older than neural codes, since single-cell organisms, such as bacteria, are highly sophisticated, biochemically, It seems probable that the early neural mechanisms employed extremely sophisticated enzymatic mechanisms. The mechanisms, almost surely, were based on

mechanisms ^{tt.} which are operative in single cell organisms or simple multicellular organisms; however, problems involving selective expression of genetic information and basic mechanisms required for differentiation were available. Basic mechanisms involving cell-cell contact undoubtedly had evolved. The cells probably were mobile. Hormones probably had evolved in simultaneous attempts to integrate the activities of multicellular organisms. Probably directional cell migration and the formation of highly specific cell interactions were possible.

One, possibly major, difference between the evolution of the genetic code and the evolution of neural codes should be mentioned though; ~~that is,~~ ⁰ one must distinguish between the origin and the evolution of ~~each kind of code~~. ^{genetic & neural} If the genetic code arose only once then the nature of the de novo code may ^{be} greatly restrict the course of it's subsequent evolution. Alternatively, the genetic code may have been selected from a large population of precursor codes. Therefore, the genetic code may have evolved from only one precursor rather than from the population of precursors, and so the influence of possible non-random origin may still be apparent. In contrast, neural codes almost certainly were selected from a large population of precursors. Basic biochemical mechanisms, upon which the neural codes were based, almost surely evolved at a very early stage by a process of selection,

that is, from a statistical event--not from a single event.

Biochemistry in general and certainly the biochemistry of the genetic language demonstrates that molecular complexity is achieved by combining relatively few kinds of ^{small} molecules in different sequences. The rather obvious examples are nucleic acids and proteins. Polysaccharides may also be cited.