

S10-2**Autopoietic biomachinogenesis via semiogenesis :****Evolution from genetic codes to biosocial semiotic systems**

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The so-called eusociety of bees or ants is a hierarchical altruistic society consisting of fertile female (queen) and sterile females (workers), and is considered to have evolved by kin selection (Hamilton, 1964). Hamilton also pointed out that multicellular animal is an altruistic society consisting of fertile germ-line unicell animals and sterile somatic-line unicell animals, which are queen-cells and worker-cells, respectively. Both of these are self-learning hierarchical neural network (NNw) machines consisting of workers (input layer, IL) and queens (output layer, OL). Information from outside (environment) and inside of the eusociety or animal body is inputted to IL, and the IL elements (workers) behave altruistically to the OL elements (queen(s)). By letting r denote coefficient of relatedness between worker and queen ($r = 3/4$ in bee eusociety, and $= 1$ in multicellular animal), then worker's altruistic behaviour is equivalent to DNA information flow in which r of the worker's DNA flows to queen(s). The final output from OL is DNA-output by making gametes (eggs), which gives a feedback DNA-flow to the IL and OL of the next generation via fertilization and re-making the eusociety or animal body. In case of animal body, workers altruistically behave by using a DNA-gene set made by fertilization of the previous generation's gametes (outputs), and thereby queen(s) (or germ-line) can mature and make output-gametes by which DNA information is transmitted to the next generation. This means that workers actively select adaptive germ-cells and gametes (i.e. adaptive gene set) by their own altruistic behavior. Workers are gene-set selectors, whereas queens are gene-set transmitters in hereditary process. This gives a basic logic to Lamarck's use-disuse theory. Further considerations clearly concluded that both bee eusociety and animal body are self-revising active cognitive machine of self-learning hierarchical NNw type. Darwin (1859) proposed natural selection theory in which more adaptive individuals can have better chance than other individuals. In animals, multicellular animals have been considered to live and to be selected by natural selection, and worker-cells and queen-cells are elements of the NNw biomachine. Similarly, in case of bees and ants, workers cannot select a strategy of non-altruistic behavior, meaning that they are not living individuals, and elements of IL of the so-called "bee superorganism". Thus, bee-superorganism and ant superorganisms are both "living individuals" having evolved by natural selection after the establishment of sterile worker IL elements. Such biomachinogenesis depends on semiogenesis such as genesis of bee-dance language and other machinogenetic signals or codes. Similar consideration reveals that intracellular tRNA replicative RNA society had evolved to generate a hierarchical society consisting of queen-like tRNAs and worker-like other RNAs (mRNAs, rRNAs, sn-RNAs, etc.) whose life cycle has RNA-phase and DNA-phase. Poly-tRNA theory on the origin of earliest mRNA from early tRNAs (Ohnishi, 1994, 2002) well explains the origin of protein-synthesizing machines as an hierarchical tRNA replicator society via semiogenesis, i.e., via generating triplet codon semiotic system.