A NOTE ON THE DEVELOPMENT OF ORGANISMIC SETS

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It is suggested that the development of organismic sets is governed not by the maximalization of the integral survival value, as suggested previously (Bull. Math. Biophysics, 28, 283–308, 1966; 29, 139–152, 1967; 30, 163–174, 1968), but by maximizing the number of new relations which appear as an organismic set develops.

In a series of preceding papers (Rashevsky 1966a, b; 1967a, b, c; 1968), we discussed the process of development—at first of general types of biological organisms (Rashevsky 1966a, b) and later of what we called organismic sets, which in abstracto represent both biological and social organisms. In the first paper (Rashevsky 1966a), we suggested that the process of development from a simpler to a more complex organism proceeds in such a manner as to maximize the integral value of the survival probability of the organism during all its life span. We used this principle as the basis for giving a plausible even if not rigorous demonstration as to why, in the process of specialization of a metazoan, the specialization of the cells occurs through the inhibition or inactivation of some genes rather than by their complete abolition. Genes which are responsible for and control certain properties of a cell could be absent in a cell specialized in some different biological function. Yet in mitosis all the genes are always equally distributed between the two daughter cells, even if the two daughter cells undergo eventually entirely different specializations.

The same principle was at least tacitly assumed in the subsequent papers (Rashevsky 1966a, b; 1967a). Yet only later (Rashevsky, 1968a) did we attempt to define the concept of survival probability. The equations derived
indicate that the survival probability as defined there will in general decrease with the degree of differentiation or specialization, but that for certain values of parameters it may increase. This may not be so absurd as it may seem to be at first. It may actually give us a criterion according to which certain unicellular organisms never develop beyond their unicellular stages, while others eventually give rise to at first simple then more complex multicellular organisms. Since the above mentioned equations (Rashevsky, 1968a) apply to societies also, the above may also give us the criterion by which some societies seem to have remained “permanently” in a primitive state while others have gradually developed.

In our latest paper (Rashevsky, 1968b) we discussed the possibility of representing by non-oriented graphs different n-ary relations in organisms. We pointed out that if an organism develops according to a scheme proposed by us earlier (Rashevsky, 1954; see also Butz, 1968), the number of possible n-ary relations increases with development. This increase may occur in two ways: either actually new n-ary relations appear for a fixed n, or the same biological function may enter into the same n-ary relation with different other n - 1 biological functions. Inasmuch as we have previously shown (Rashevsky, 1960) that the particular transformation $T^{(1)}$ which characterizes this type of development is only a special case of what we later called biological epimorphism, and inasmuch as we have shown (Rashevsky, 1967b) that the biological epimorphism follows from the basic definition of organismic sets, we see that the development of an organismic set is accompanied by an increase of the different relations $R^{0}_m$ which are induced (Rashevsky, 1967a) in an organismic set. Any specialization of an organismic set increases the number $R^{0}_m$ of these induced relations.

All the above suggests as a possibility a different principle which may determine the course of development of an organismic set, namely, the development of an organismic set proceeds in such a manner as to maximize the total number of relations of any order present in the set.

Such a postulate seems to be in accord with observed biological and sociological facts. A particular type of specialization does in general increase the number of induced relations. According to the suggested new principle, that type of specialization takes place which most increases the number of relations and/or results in the appearance of the greatest number of new relations.

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LITERATURE