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Membrane Bioenergetics and Distribution of Functions in Systems of Electrically Coupled Cells

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From the standpoint of modern membrane bioenergetics, membrane-associated proteins, which ensure storage and use of energy accumulated in the form of a membrane potential (MP), are spatially separated. The presence in multicellular systems of electrical communication through permeable contacts (PC) makes it possible to transfer energy through the PC and thus contribute to the division of labor between neighboring cells. Processes occurring in these systems are manifested in changes in the electrical characteristics of individual cells and PCs and can be quantitatively analyzed by describing cells and cellular systems as equivalent electrical cables. The review presents the data of multiannual studies of energy transfer through PC in evolutionarily different multicellular systems: trichomes of fil-

amentous cyanobacteria, hyphae of mycelial fungi, and monolayer cultures of animal cells. The hypha of *Neurospora crassa* as a convenient experimental model is considered in more detail. On the basis of the comparison of the data in our own works with other publications, a hypothesis is put forward about a possible participation of local electric fields in self-organization of intracellular structures at the apex of the growing hypha of *N. crassa*, which are created owing to uneven distribution between cells of the functions of MP generation and utilization of its energy. Ideas about the features of electrical processes and phenomena accompanying the energy transfer through PC can be useful in the analysis of many important issues related to the mechanisms for implementation of genetic instructions in specific life processes.

Keywords: bioenergetics, division of labor, electric coupling, intercellular interactions, local electrical fields, membrane potential, *Neurospora crassa*