BIOLOGY

Julie Ann Miller reports from San Diego at the conference on the Molecular Basis of Cell-Cell Interaction

Mesh anchors red blood cell proteins

Movement of the proteins that stud the outer layer of a cell membrane is regulated by the cell. Daniel Branton of Harvard University has identified a piece of that control, a specific binding protein that links membrane proteins to a meshwork within the cell. Branton hypothesizes that, like microfilaments and microtubules in more complex cells (SN: 10/15/77, p. 250), in red blood cells the mesh of proteins spectrin and actin (SN: 11/6/76, p. 298) anchors membrane proteins. When the underlying meshwork contracts, it pulls the membrane proteins into aggregates.

Branton supports his hypothesis by two sets of data. First, the membrane proteins require mesh proteins if they are to aggregate. When the fluid surrounding red blood cells is made acidic, their membrane proteins group together. However, in artificial cells made only of lipid and membrane protein, acidity cannot cause aggregates unless spectrin and actin are included in the cells. "It is thus possible to add back molecules that seem to exert some control," Branton says.

Branton's second line of evidence is that adding an excess of a newly identified binding protein can enhance mobility of proteins by interfering with spectrin's association with the cell membrane. The additional binding component doubles the rate at which proteins travel between fused cells, presumably by competing with the intrinsic binder. The binding component appears to have the same molecular weight as the major red blood cell membrane protein. Experiments so far indicate those proteins are either the same but differently positioned in the membrane, or different but with an extensive stretch of amino acid sequence in common.

Since all cells have proteins both adjacent to and inside the membranes, Branton believes the modes of interaction he and colleagues are describing in red blood cells share elements with the mechanisms of more complex cells that have yet to yield to detailed analysis.

Gliding on the slime

Movement is crucial to myxobacteria, slime-emitting organisms that live in soil. When their food gets scarce, the bacteria stream into mounds, called fruiting bodies. The gathered cells, as many as 1 million per fruit, then change into heat-resistant spores to await better conditions.

Researchers in the laboratory of Dale Kaiser at Stanford Medical School have been examining how the genes of myxobacteria dictate their rather limited behavior. Progress so far, like the bacterial movement, is steady but slow. (Jonathan Hodgkin reports that the spread of myxobacteria gliding across a flat surface is less than 5 microns per minute, only ten times faster than continental drift.) By studying mutant bacteria, for example those that do not move or those that wander out of the typical swarm, the investigators have found more than thirty genes involved in the slow motion. Surprisingly, gliding behavior divides into two separate systems with different purposes. System A (for "adventurous") controls the movement of individual cells, "going where no myxobacteria has gone before," Hodgkin recounts. System S (for "social") controls the movement of groups of two or more bacteria. Only one gene has been found that plays a role in both types of movement.

Linking the motility genes to elements of behavior is limited by ignorance of the mechanics of the bacteria's movement. According to Hodgkin, only speculation exists beyond the facts that myxobacteria move on a surface but not in solution, they lay down a train of slime as they go and they prefer to move along pre-existing slime trails. No specific organs of motility, such as flagella of other bacteria, have been detected.

Kaiser and colleagues now have data suggesting that myxobacteria interact at very close range. Hodgkin speculates that a chemical signal may hold the swarm together. An individual bacterium would make tentative forays, but return to the swarm when its supply of the signal chemical runs out. The experimental evidence is that a group of nonmotile bacteria with mutations in a particular gene of the A system confer temporary mobility on nonmotile groups of bacteria having different A system mutations. There is no exchange of genes between the bacteria and the stimulation depends on proximity, so Hodgkin proposes either a short-range signal or passage of some component of the motility machinery from the stimulator to the stimulatable bacteria. The identity of the material donated remains unknown. Most experimental manipulations destroy the active agent. Therefore, the interaction, Hodgkins suspects, involves substances bound in the myxobacteria membranes.

Dissecting virus's disruptive mechanisms

Tumor-causing viruses specify the manufacture of proteins that infiltrate cell mechanisms and initiate a complex of changes. Patricia Spear of the University of Chicago reports two compounds dictated by the *Herpes simplex* virus that seem to control fusion of cells infected by that virus. One of these glycoproteins inhibits fusion between the membranes of infected cells. Another glycoprotein promotes that fusion. Because normal herpes don't induce fusion of cells, the inhibitor usually has the upper hand. But mutant viruses that don't make the inhibitor can induce fusion. Spear speculates that the virus initially enters the cell by membrane fusion; but fusion is suppressed when the inhibitory protein is in both membranes. This inhibition might prevent viruses from entering already infected cells.

Renato Dulbecco and colleagues at the Imperial Cancer Research Fund Laboratories in London have examined laboratory-grown mouse cells infected with polyoma virus. In the outer membrane they found several proteins that appear to be specified by the virus, rather than by the cell. Dulbecco suggests that an enzyme that cleaves proteins may split these membrane molecules from a larger precursor, and such an enzyme could have a wide range of disruptive effects.

Tumor gene pick-up

Normal cells may supply the instructions to tumor-inducing viruses that infect them. Peter Vogt of the University of Southern California reports that defective viruses seem able to take on segments of DNA from their bird hosts, and with that genetic material initiate one type of tumor, sarcoma. Animal cells normally contain in their chromosomes numerous, presumably inactive, copies of genes similar to those responsible for transforming cells into a tumor. In Vogt's experiment, viruses were made defective by removing the transformation gene *(src)* and some adjacent DNA. Viruses recovered from the tumorous cells had complete *src* genes, but those genes were different from the DNA previously deleted. "This suggests a new *src* is acquired from the cells," Vogt says. The result also indicates genes may be swapped between sarcoma-causing viruses and the cells they infect, so even a single tumor may be directed by a number of genes. Vogt is also examining the genes of viruses that cause other avian malignancies — acute leukemia and carcinomas. He suggests that within a single type of animal, a variety of genes, making different transforming proteins, may override cells' normal controls.