systems has been assembled to handle the probe's data, but a weak launch at first threatened to keep it from getting into its fixed position. Fortunately, undaunted flight controllers have been able to move it slowly and painstakingly toward its goal by subtly adjusting its orbit, and it should get there with at least a week to spare before its first mission: participation in the huge, international GATE program to study the meteorological effects of the tropics. SMS-1 is already sending back the sharpest photos of earth ever taken by a synchronous satellite, revealing features such as cloud formations as small as half a mile across.

Almost lost in the flurry of attention surrounding its fancier big brothers is Hawkeye, a little satellite carrying only three experiments, sent to explore the so-called "polar cusps" in earth's magnetic field that let in the solar wind to form the shimmering, curtain-like aurora borealis.

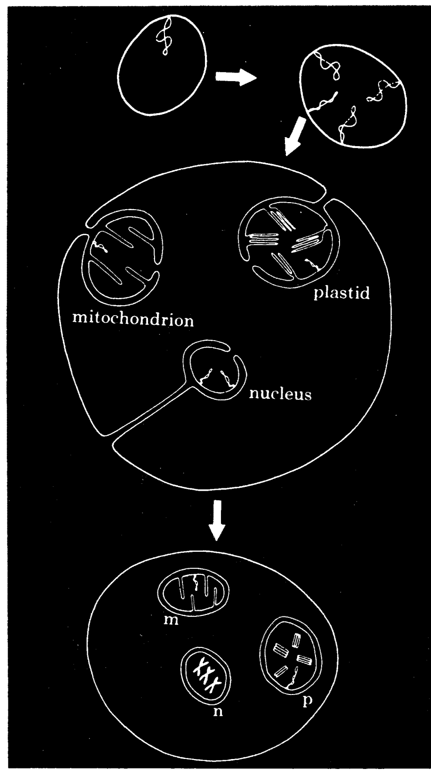
Hawkeye is actually seventh in a series of satellites called Injuns, but a complaint to a senator from a constituent resulted in the name change. (The series would have been called Hawkeye in the first place, says James Van Allen of the University of Iowa, who has been the chief scientist for all seven, except that in 1959, when the name was proposed, it conflicted with that of a U.S. Navy missile.) The previous Injuns were placed so as to pass directly through the aurora at altitudes of about 1,000 kilometers. Hawkeye instead was launched June 3 into an unusual, elliptical polar orbit that lets it spend most of its time over the North Pole, where the weak outer fringes of the magnetic field dip in closest to the planet. The dip forms a cornucopia-shaped region whose apex, called the neutral point, is the gateway to the aurora. Electrons and protons from the solar wind, held away from most of the planet by the magnetic field, pour down the cornucopia into the denser layers of the upper atmosphere, triggering the aurora.

One of Hawkeye's experiments will measure the magnetic field itself, mapping the shape of the cornucopia. Another will measure the distribution, direction and intensity of the protons and electrons from the solar wind to see just how many are really entering the neutral zone. The third experiment explores the gross instabilities in the solar wind plasma wrought by the steep sides of the cornucopia.

Finally, with all the excitement going on around the earth, the Soviet Union has sent the 22nd probe in its Luna series to orbit the moon. Launched May 29, the unmanned observer was announced early this week to have entered lunar orbit with its instruments working. It is not intended to land. □

Parts of the cell: How did they evolve?

A current, widely accepted hypothesis, called endosymbiosis, attempts to explain how highly evolved cells (eukaryotes) with membrane-bound interior organelles got those specialized units in the first place. The theory holds that specialized organelles such as mitochondria (the site of cellular respiration) and plastids (the site of photosynthesis) once existed as primitive, free-living prokaryotes (cells without membrane-bound organelles). These came to inhabit the interiors of other primitive prokaryotes and existed in a symbiotic relationship with each unit retaining its own genetic material. Specialization of the inner cells occurred, allowing the host cell to carry on respiration and photosynthesis, and thus allowing it to evolve into a higher, more adaptive cell form.



Model for double-membrane formation.

Now two researchers, Thomas Uzzell, associate curator of herpetology at the Academy of Natural Sciences in Philadelphia, and Christina Spolsky, a postdoctoral fellow of the American Cancer Society at the University of Pennsylvania, take that theory to task. In the May-June AMERICAN SCIENTIST, they put forth a quite different theory.

They think the current theory may be a retrogressive one, ignoring slow, step-by-step evolutionary pathways. They find it implausible that one cell could inhabit another, merge and lead directly to the evolution of a higher cell type while each cell retained its genetic material and certain of its original functions. Instead, they feel that the principle of step-by-step adaptation and evolution from a primitive progenitor into a more advanced cell with new organelles seems more logical.

Uzzell disagrees with the assumption that similarities in cell characteristics necessarily reflect the kind of "special creation" endosymbiosis implies. "In considering cell characteristics," he says, "instead of just looking at how similar they are, we must look at what has happened to those characteristics during evolution. The [reproductive and respiratory] similarities between prokaryotic cells and certain mitochondrial and plastid characteristics are impressive. In fact, they look so good, that I think there has been a failure by many biochemists and microscopists to think of those characteristics in terms of phylogeny and relationships."

Uzzell and Spolsky propose that many similar characteristics now thought to have evolved in a parallel fashion reflect, instead, the parallel retention of primitive states. For example, the diagram illustrates their hypothesis of the events leading to the evolutionary formation of double organelle membranes from the same primitive cell and not from two separate cells. In the first step, genetic material of a single prokaryotic cell duplicates without cell division. The cell membrane then folds in upon itself near the attachment points of the genetic material to form double membrane structures. With time, the organelles become autonomous and increasingly specialized. The outer membrane of each organelle is thus encoded by the genes of the cell's nucleus while the inner membrane is encoded by the genetic material within the organelle.

Uzzell and Spolsky also hypothesize the ancestry of the proto-eukaryotes which lead to three modern groups of organisms with quite different respiratory and photosynthetic characteristics: the blue-green algae, the purple nonsulfur bacteria and the other aerobic bacteria. The important, and Uzzell says most controversial, aspect of the proposed phylogenies is the loss and de-emphasis of various systems (instead of the traditional assumption of parallel evolution).

They point out that the simplest hypothesis is usually preferred in science and argue that the evolution of organelles concept is at least as simple as endosymbiosis. They feel that a common ancestor could plausibly have carried on the functions symbionts would have supplied and could have adapted and evolved into the various cell types and species now present without relying on "special creation." □