

grows, we also increase our efforts on the space frontier."

A complaint often raised about NASA's planetary program recently has been a lack of continuity. With appropriate continuity, Paine said, launch vehicles should be "coming down the assembly line, at a rate that we've all agreed is an efficient rate to produce them, and then we go ahead and put the spacecraft for the outer-planet missions — which, again, will have been built either serially or else in batches of three or four or five — and we put each of those where it does the most good. . . . The biggest expense with any of these spacecraft is the R&D to produce the first one. It costs very little then to

make the additional ones, and we haven't been taking advantage of those economies."

As for the possibility of Martian life — dismissed these days by some researchers but still as vital and potentially momentous as ever to others — Paine takes another view, independent of whether the Big Question can be answered by robot space probes. A staunch advocate of human exploration of Mars as a goal, in part, to get the U.S. space program back on track for the future, Paine told the Boulder meeting: "If there isn't life on Mars, and if there wasn't life on Mars, there's damn well going to be."

— J. Eberhart

Star motions may alter view of galaxy

The motions of the stars in our galaxy yield information relevant to many astrophysical and cosmological questions, particularly those involving the structure and evolution of the galaxy itself. In astronomers' long history of studying such motions, the latest entry is a particularly large one, the just completed Lick Northern Proper Motion (NPM) program of the University of California's Lick Observatory (headquartered on the university's Santa Cruz campus). The NPM will catalog the proper motions of thousands of stars, intending to provide an abundant statistical basis for studying a wide range of questions.

Already the first study done with information from the NPM has found anomalies in the rates at which certain faint blue stars rotate around the center of the galaxy; this in turn raises questions about astronomers' conventional view of the kinematics and evolution of the galaxy.

Proper motion is a star's motion across the sky as viewed from earth. To determine proper motions, astronomers photograph the same part of the sky at intervals of years and compare the photos to see what has moved and by how much. The NPM, which is currently directed by Burton F. Jones and Arnold R. Klemola, consists of two sets of photographs of the northern sky. C. Donald Shane of the Lick Observatory took the first set between 1947 and 1954; the second series began in 1971 and is now 97 percent complete. The more recent observers used the same photographic emulsion Shane used 40 years ago to ensure comparability of the plates. A companion study of the southern sky is being done by Yale University Observatory and the National University of San Juan, Argentina.

Traditionally, two plates of the same field of the sky — from different years — are put into a machine called a blink comparator, which shifts a human observer's vision rapidly between them. The observer notes which images

"move" and marks them down for measurement. Although a blink comparator is still used to select objects for study, the measuring is done by an automatic machine developed by Stanislavs Vasilevskis of Lick. Motions of the stars are measured against a background of distant galaxies, 40,000 galaxies being used as a reference for the motions of 300,000 stars. The final catalog will list stars according to many classes of interest to astrophysicists. Klemola reads the literature to determine such interest and enters the appropriate classes into the program.

In what he calls "a first scratching of the surface" of the information, Lick Associate Research Astronomer Robert B. Hanson used the proper motions of 60,000 stars to study the rotation of the galaxy. The sun rotates around the center of the galaxy, and so do other stars in the flat disk of the galaxy. As the sun moves along, the proper motions of nearby stars show a streaming effect: They move toward us from the direction to which the sun is going and away from us in the direction from which the sun has come. Hanson found that for a group of 16th-magnitude blue stars lying somewhat above and below the disk, the streaming effect seems wrong: Either the sun is not going where astronomers think it is going or these stars are lagging behind the general rotation. Because the sun's motion is confirmed by other studies, Hanson concludes that these blue stars are lagging.

Astronomers have believed that the galaxy consists of two main components, the central sphere or bulge and a flat disk outside it. The stars in the sphere are old and do not rotate — presumably they formed before the galaxy began to rotate. The stars in the plane do rotate. Hanson suggests that either something happened to the blue stars during their development that altered their kinematics, or they are a third component between the other two, and the simple two-component model of the galaxy needs adjustment.

— D. E. Thomsen

Animal patent debate heats up

In a hearing that presaged a confrontation between Congress and the patent office, a congressional subcommittee last week heard testimony on a controversial decision to allow patents on genetically engineered higher organisms (SN: 4/25/87, p.263). Rep. Charles Rose (D-N.C.) announced that he would soon introduce legislation to put a moratorium on the granting of such patents until the economic and ethical implications could be considered by Congress. Sen. Mark O. Hatfield (R-Ore.) is planning to introduce similar legislation in the Senate.

The debate centers on the U.S. Patent and Trademark Office's decision, effective last April 21, to consider all genetically engineered multicellular organisms — including all animals except human beings — patentable. Developers would thus be eligible for the 17-year monopoly on the sale and use of those animals as provided by U.S. patent law. (The board ruled that genetically altered humans could not be patented because ownership of humans is prohibited by the Thirteenth Amendment to the Constitution, which forbids slavery.)

The patent office has delayed processing the first applications for patents on higher animals, but barring any definitive word from Congress the process may begin Oct. 1. Fifteen such patents are already pending.

"While the new patent policy will affect almost every sector of the economy, the most dramatic impact may well be felt in the agricultural community," Rose testified to the committee. "This new policy places major chemical, biotechnological and pharmaceutical companies in the position to virtually take over animal husbandry in America."

Many farmers are concerned that the granting of patents for genetically altered farm animals will result in a new kind of tenant farming, in which farmers will no longer own the animals they use. Cy Carpenter, president of the National Farmers Union, which represents more than 250,000 U.S. farm families, said patenting would likely lead to a corporate consolidation of the livestock industry, with farmers having to pay royalties to patent owners. "Five major corporations now control 120 seed companies that were formerly independent prior to seed patenting," he said. Seed patents have been allowed since 1970.

Others, however, noted at the hearing that the patent system provides financial incentive to develop new ideas into commercially available forms. The patent system is "the engine and the machinery driving the investment in biotechnology," said William H. Duffey, a patent attorney for St. Louis-based Monsanto Corp. He