

try to attach a cable that could be used with a surface winch to pull Alvin up. Though it weighs only 10,000 pounds on the bottom, Alvin, full of water, would weigh almost five times as much in the air. Winches on the Chain, officials said, would be able to lift it, if they get the chance.

**Even with** a prompt recovery, engineers face a time-consuming job of refitting Alvin. "It may take several months, at least, to repair the equipment damaged by water," says Dr. John Schlee, a U.S. Geological Survey marine geologist who has been working with the vessel. Because Alvin's hatch was open, he says, "it did not implode from

sea pressures, but a lot of electrical equipment may be ruined."

**In any event,** more Alvins are on the way. At its Groton, Conn., yards, home of most of the U.S. nuclear sub armada, General Dynamics Corp.'s Electric Boat division is building a pair for the Navy. One will reportedly go to Woods Hole via the Office of Naval Research, while the other is destined for the Navy's Advanced Underwater Test and Evaluation Center. The new craft, expected to be completed next month, will have two maneuverable claws instead of the downed Alvin's one, will be two feet longer and capable of 500 feet of additional depth.

## PLUTO

### Reconciling the mass

There are two ways to calculate the mass of a planet. One is from the effects it has on the motion of nearby planets. The other combines its size with the density of the matter that is known or assumed to make it up.

In the past, when the two methods were applied to the planet Pluto, they led to widely disparate results. Now a new analysis of the motions of Neptune by a team from the U.S. Naval Observatory brings the two figures reasonably close to each other.

Motion effects, observed on a known planet, have sometimes begun the search for an unknown one. The identification of Neptune in 1846 resulted from studies of the motion of nearby Uranus.

In Pluto's case, motion data were not sufficient to predict its position, though they did lead astronomers to suspect its existence. The actual observation came from an intense search of the sky rather than preknowledge of its position.

Earlier analyses, one based on the motion of Neptune and the other on Uranus and Neptune, had given Pluto masses of 0.91 and 0.82 earth masses respectively. (One earth mass is  $5.98 \times 10^{21}$ —nearly 6,000 billion billion—metric tons.)

Such a mass would give to Pluto a density of at least 40 grams per cubic centimeter.

The problem with this figure has been to decide just what Pluto could be made of to be so dense. Earth's density is only 5.5 grams per cubic centimeter. Iron, which makes up a large part of the earth, has a density of 7.8. A solid lead Pluto would have a density of 11.3; solid uranium, the heaviest stable element, would give only 18.95.

**On the other** hand, if one took the size of Pluto—best recent measurements give an upper limit of 6,400 kilometers for its diameter—and assumed that the composition of Pluto, like that of other

terrestrial-sized planets, was similar to the earth's, the mass of Pluto would be only 0.13 times that of the earth.

But, Drs. R. L. Duncombe, W. J. Klepczynski and P. K. Seidelmann point out in *SCIENCE*, for Nov. 15, the orbits of Neptune that have been used in the older calculations did not really predict the motion of the planet very well. Each of these had been carefully fitted to observed positions of Neptune up to the time of calculation, but when it was compared to positions of Neptune observed since then, discrepancies—up to 1/720 of a degree—in Neptune's position in orbit appeared.

The Naval Observatory group therefore decided to make trial calculations of the motion of the five outermost planets using supposed values of Pluto's mass that ranged from 0.18 to 0.91 earth masses, to see whether one of them would give a better fit to Neptune's motion for all positions observed since 1795. One of the difficulties in making such a calculation is that all these observations represent only about 70 percent of a single Neptunian orbit.

**The best fit** was found with Pluto's mass equal to 0.18 earth masses. If Pluto has the same density as earth, this figure would require it to have a diameter of 7,200 kilometers. If the observed figure of 6,400 kilometers is taken as accurate, then Pluto's density must be at least 1.4 times that of the earth, or 7.7 grams per cubic centimeter, a much more plausible figure than 40.

Though the figures have been brought a good deal closer together, the end is not yet. "Further refinement," the three astronomers conclude, "of the value of the mass of Pluto and the elements of the orbit of Neptune must await completion of a systematic discussion of the observations of Neptune now being made at the Naval Observatory." ◇

## THE NEW FEMINISTS

### Equality, not protection



*Mrs. Friedan: not laughed off.*

After several years of limping along behind minority groups, women are making a strong bid for job equality.

Fed up with years of watching men win promotions they think should be theirs, factory women are fighting both unions and employers in the courts of half a dozen states. The outcome will determine whether old state laws limiting the hours and conditions of female employment are still valid. Industry has used these laws as reason for not promoting women. Ironically, the laws were enacted in the first place to protect women workers.

**The drive by** factory women reflects stirrings of a larger feminist movement given new life by the Civil Rights Act of 1964. The act prohibits job discrimination on the basis of race, national origin or sex. But while the Government acted immediately to implement the racial provisions, those dealing with sex were treated with something less than seriousness.

"The minute sex got into the act, it was treated as a joke," says Betty Friedan, author of "The Feminine Mystique" and president of the National Organization for Women. "No one intended doing anything about it. Sexual discrimination was the only kind of discrimination still considered moral, or at least fashionable."

Nevertheless, the legislation provided a focus for female discontent and complaints began pouring into local offices of the Equal Employment Opportunities Commission. They equal and some-

## The space board reports

times surpass the number of racial complaints. At the same time, activists in now and other women, particularly Congresswoman Martha Griffiths (D-Mich.), began pressing the EEOC to implement Title 7 of the Civil Rights Act as regards sex.

As a result of the pressure, the EEOC this year agreed that sex-segregated job advertising should not be legal. As of Dec. 2, employers cannot list job openings under separate "men" and "women" headings unless they want to risk violating Title 7.

"Sex discrimination can no longer be laughed off so easily," says Mrs. Friedman. Factory women appear to have caught the message.

"**There has** been a real awakening," says Marguerite Rawalt, a Washington lawyer and former president of the Federal Bar Association, as well as the National Association of Business and Professional Women. "They have worked beside men for years watching them earn the overtime and become the supervisors." Labor statistics show that in the past decade, the median yearly income for women rose by \$900, but the income for men went up \$2,000.

Several cases under Title 7 have now reached the courts, where they are running up against state protective codes. Some 44 states have labor laws, dating from the last century, which restrict the hours a woman can work or the weight she can lift (often limited to 25 or 35 pounds).

The laws appear to be invalidated by Title 7 and this year the EEOC makes that clear in its argument filed in support of a California woman. The EEOC argued that Title 7 overrides California's protective codes and the court agreed. Los Angeles District Judge Warren J. Ferguson ruled in September that the Southern Pacific Company violated Federal law by refusing a promotion to Leah Rosenfeld, who had bid for a job as station agent-telegrapher for which she had seniority. The case is the first to be decided, and if upheld in higher courts, it will signal the end of state protective laws.

**Several women** are suing their unions as well as their employers and industry does not mind passing the blame along.

In an Indiana case still pending, the Colgate-Palmolive Company admitted that "for many, many years in our contracts with the union and in our practices, we did have sexual discrimination. Why did we do it? Because the union wanted it that way.

"Colgate couldn't care less whether these jobs were occupied by women or men," said the company's counsel. "We just don't care, assuming, of course, that the job can be performed adequately."

Out of the decade spent so far in exploration of the space near the earth, among the more significant findings is that it is far from the empty void that scientists used to think it. It is filled with subatomic particles, generally protons and electrons. These stream off the surface of the sun, forming the solar wind that flows to the outermost reaches of the solar system.

Surrounding the earth is a sphere of such material, the magnetosphere, which is bound by the earth's magnetic field.

In the magnetosphere, and at its boundary with the solar wind, are many questions, including the number of the particles, how they move and affect the earth's atmosphere and how they relate to the solar wind.

**In the next** decade scientists want to make detailed studies of these and other questions. So advises the Space Science Board of the National Academy of Sciences in the report *Physics of the Earth in Space*, which Board President H. H. Hess of Princeton University has presented to the National Aeronautics and Space Administration.

The report summarizes the deliberations of 31 scientists who met during August at Woods Hole, Mass., under the chairmanship of Dr. Herbert Friedman of the Naval Research Laboratory. He was assisted by Dr. Francis S. Johnson of the Southwest Center for Advanced Studies.

"The past decade," says the report, "has given a tantalizing glimpse of the microscale processes that occur in the magnetosphere, but our knowledge is very incomplete."

What is needed are more detailed measurements, as well as simultaneous measurements that can distinguish between qualities that change as time passes and those that vary with location in space.

Two proposals for getting simultaneous measurements are made. One would provide small subsatellites to the large Interplanetary Monitoring Platforms that are now used. These would orbit at short distances from the IMP.

The second method would be to launch a cluster of satellites into eccentric orbits with the same booster. These would go out to about 75,000 miles from the earth. After launch they would be separated by about 300 miles, and in six months they would spread to about 8,400 miles.

At the other extreme, the scientists recommend satellites with a capability for dipping rather deep into the atmosphere—as low as 75 miles. This would



Navy

*Dr. Friedman: tantalizing glimpse.*

require them to have boosters aboard that could give them kicks to compensate for air drag. The subject here is the structure of the upper atmosphere and the gross, world-wide circulation of the air.

**The other** major target of these observations is the sun, which is the ultimate source of the particles that fill the space around the earth, and of the energy that keeps life, the weather and other terrestrial activities going. Indeed, because of its intimate connection with the earth, the sun is of more interest nowadays to geophysicists than it is to most astronomers. "To an astronomer," says one geophysicist, "the sun is just another medium-sized second rate star."

The scientists want to continue the program of Orbiting Solar Observatory satellites, along with other satellites that specialize in monitoring solar radiation. They endorse planning for a solar probe to penetrate to within three-tenths of the earth's distance from the sun—less than 30 million miles—to investigate the solar wind as close to its source as possible.

Close and continuous watching of the sun, they hope, will compile enough data to determine indices for predicting solar disturbances—sunspots, magnetic storms, solar flares. These occurrences have important terrestrial effects such as enhanced auroras and short-wave radio blackouts. They also present a severe radiation hazard for manned lunar flights.

**How much** of the detailed plan the scientists have presented will be carried through depends on opinion in the space administration and on fiscal considerations and priorities established by the new President and his appointees. The present plan—which goes to 1976—would spend about as much per year on these activities as has been spent in each of the last five or six years, something approaching \$130 million.