This estimate will certainly rise, though Kliore says it will probably be somewhat less than double.)

Discrepancy or no, the Pioneer scientists are elated at the discovery, which bodes well for future explorations into the depths of the Jovian atmosphere. The higher temperatures mean a more diffuse atmosphere, which would present a smaller than predicted shock to a diving atmosphere probe. The large amount of hydrogen would provide good cooling during entry, and Pioneer's improvements in knowledge of the shape and gravity of Jupiter would allow flight controllers to better calculate the risky, shallow entry angle such a probe (launched from another spacecraft in orbit around the planet) would require. This could knock as much as five years off the time needed to produce a probe capable of withstanding a colder Jupiter.

The giant planet's wonders, however, extend beyond its atmosphere, and Pioneer is now revealing that they reach very far indeed. For a month before the spacecraft flew by the planet last Dec. 3, the University of Chicago's John Simpson had been recording huge, periodic bursts of highly energetic charged particles. Increasingly fine-toothed analyses of the data have now shown that the bursts were in evidence while the spacecraft was still six months away, writing Jupiter's signature across 100 million miles of sky. During the last third of that time, they even carried the 10-hour cyclic variation of the planet's rotation. "It looks," says Simpson, "as though we have gone from a region where the sun dominated . . . to a region where Jupiter dominates."

On the same titanic scale is the planet's strange magnetic field, which now looks considerably stranger. The real-time surprise of the mission occurred when the spacecraft, traveling inside the bow shock that is the junction between the magnetic field and the solar wind, passed back out of the bow shock and more than 10 hours later popped back in. The data tapes now show that when leaving the vicinity of the planet, Pioneer crossed the shock wave no fewer than 17 times. Where the sides of the shock cross Jupiter's orbit, the width of the field is some 80 percent of the mean distance between Venus and the earth. The radiation belts trapped within the field are similarly enormous, and intense. Unexpectedly vast numbers of high-energy electrons were as much as 1,000 times greater than the most extreme earth-based predictions, and make themselves felt millions of miles out in space. "We've been monitoring Jovian trapped radiation for years and years," says NASA's James Trainor, "and didn't know what it was."

Computer enhancement of Pioneer's photos of Jupiter show that it is fittingly spectacular. Several additional red spots range up to about a third the size of the famous one, which could easily swallow half a dozen earths. These, along with numerous surprisingly clear white spots, seem indeed to be rising convection cells, heated from below. Dark borders surrounding the white spots may simply be the overturning edges of the cells, where warmed vapor droplets or aerosols cool upon reaching the cloud tops and begin their cyclic descent. The most conspicuous feature, never before seen by man, is a 600-mile-wide cloud head emerging near the equator, trailing an 18,000-mile cloudy plume that may be driven by a violent Jovian jetstream roaring overhead at some 300 miles an hour. Chains of remarkably symmetrical whorls of cloud extend for several times the diameter of the earth along the sharp-edged belts of Jupiter, a planet to remember—and to visit again. □

A piece of the earth's core?

A group of Cornell University scientists believe that specimens of a mineral they have analyzed in their laboratory are pieces of the earth's outer core. If confirmed, the rocks would be the first samples of the core ever identified. The core's outer boundary lies at a depth of 2,900 kilometers, nearly half the distance to the center of the earth.

The evidence was reported this week at the annual meeting of the American Geophysical Union in Washington by Cornell geologists John M. Bird and Maura S. Weathers and chemists George H. Morrison and Robert I. Botto.


Cornell Univ.

Josephinite: Origin in earth's core?

The specimens are of the mineral josephinite, an iron-nickel alloy found along Josephine Creek in the Klamath Mountains of southwestern Oregon. Josephinite is apparently unique, having no resemblance in size, texture or total composition to other terrestrial iron-nickel minerals. The density of the rocks precisely matches that of the earth's outer core, determined through accumulation of seismic data.

The strongest evidence that the rocks are from the earth's core is the particular appearance of garnet in them. The garnet is aligned in strange, maze-like patterns that outline the crystal structure of the metal in the rock. The Cornell scientists regard the configuration as proof that the garnet became exsolved from the iron-nickel alloy in the solid state. They believe that this phenomenon could only have occurred as a result of the relaxation of pressure as the materials ascended from the inner earth.

"We propose that the josephinite is outer core material, having come from the core/mantle region of the earth's interior," say Bird and his colleagues.

How the material reached its present location is explainable by ramifications of the theory of plate tectonics. The material rose to the surface by some kind of convection mechanism as part of a slowly ascending plume of material from the deep mantle. It became incorporated in the Pacific crustal plate—a vast segment of the earth's crust and upper mantle underlying the Pacific Ocean. Westward movement of the Pacific plate eventually brought the portion containing the josephinite into contact with the Americas plate, where it was pushed up into its present location in the Klamath Mountains. □

Evidence for weakening gravity

Several theories of gravity propounded by modern cosmologists call for a gradual decrease in the strength of the force of gravity as the universe ages. But the most generally accepted theories, Newton's and Einstein's, hold the force of gravity constant throughout the ages. They explain most things so well that to cast doubt upon them requires discovery of some effect of weakening gravity that one or more of the other theories perdicts.

Now Thomas Van Flandern of the U.S. Naval Observatory reports that he has discovered such evidence for a weakening of gravity. He told the meeting of the American Geophysical Union in Washington this week that the evidence comes from a study of the motions of the moon.

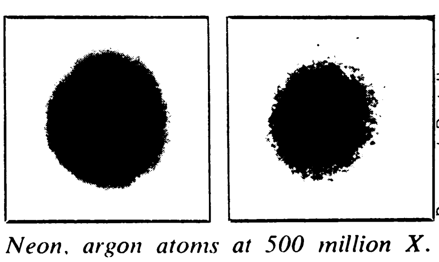
If gravity is weakening, the orbits of planets around the sun or of satellites around planets will expand, and the orbital period of these bodies will correspondingly increase. Some such expansion is provided by tidal forces in these systems, and the trick is to subtract out the tidal part and see if there is any left over.

Working with the calculations of two other observers, Van Flandern reports he has found there is an increase of four centimeters a year in the radius of the moon's orbit that is not accounted for by tidal action. "This is the first numerical result which appears to have as its most probable explanation that gravity is decreasing."

The amount of the decrease is about one part in ten billion per year. This leads to an increase in the lunar month (moon's orbital period) of about one two-thousandth of a second per year. It also means that a person weighing 70 kilograms would lose about seven millionths of a gram per year.

If Van Flandern is correct, the shock waves will reverberate, not only through cosmology but through all of physical science. Surely now there will be a number of observers poring over the orbital data of bodies in the solar system trying to confirm or reject Van Flandern's results. □

Photographing the insides of atoms



Ritz and Bartell

Neon, argon atoms at 500 million X.

Over the past century atomic physicists have built up a sophisticated theory of the structure of atoms based on indirect evidence, largely the light and X-rays the atoms emit. X-ray crystallography gave direct evidence for the existence of atoms, and in recent years electron microscopy has gotten overall images of single atoms (SN: 5/30/70, p. 524).

Now it is possible to look inside atoms, so to speak, to make images of the electron distribution within them. The apparatus that does it is a two-stage instrument at the University of Michigan in Ann Arbor that uses electron-microscopic techniques together with holography. It was designed by C. L. Ritz and L. S. Bartell. The achievement was reported at a symposium on molecular structure in Austin, Texas, in March.

They have obtained pictures of neon and argon atoms taken under conditions that show the electron distribution in the L shell (the second shell out from the nucleus) enlarged 500 million times. (Since the electrons are always in rapid motion, the distribution shows as a kind of haze.)

Already visual evidence of one piece of atomic-structure theory appears: Argon's L shell is only half the diameter of neon's. Theory expects this because the electric charge of the argon nucleus is twice as large as neon's. More such visual confirmations are likely to follow.

The idea for their apparatus goes back to a two-decade-old suggestion by Dennis Gabor, who won the 1971 Nobel prize in physics for the theory of holography. Gabor suggested using electron waves (electrons, like all physical particles, also behave as waves) to make a hologram of the electron distribution in an atom and then use optical techniques to make an enlargement of the holographic image.

To build the microscope Ritz and Bartell had to solve a serious problem in the making of an electron hologram, the provision of a reference beam. In making a hologram a train of waves that has been reflected from the object to be recorded is combined with a reference beam that has not been so reflected. The combination produces an interference pattern, which is recorded on film. If light is then later shone on this film it will reconstruct an image of the object.

But the reflected beam and the reference beam must be coherent—vibrate at all times in phase with each other. In the optical domain it took the invention of lasers with their extremely powerful coherent beams to make holography possible. How to provide an electron-reference beam in a world that lacks electron-wave lasers? Gabor didn't suggest.

But as they thought about the problem, it occurred to Ritz and Bartell that where pictures of an atom's electron distribution were wanted, the solution might be quite simple: In such a case an electron beam directed at an atom is multiply reflected. The electrons provide a weak reflection. A strong reflection comes off the nucleus of the atom. Why not use the reflection from the nucleus as the reference wave? Since it came from the same beam as the reflections from the electrons the necessity of coherence would be satisfied. They tried it and it worked. □

Conservation: Tigers or habitats?

Like so many paramedics evading battlefield crossfire to save the wounded, conservationists are learning the painful art of triage—how to rescue the salvageable while leaving the doomed to die. The process was dramatized last week as leaders of the World Wildlife Fund (WWF) confronted biologists from around the country in a meeting jointly sponsored with the Smithsonian Institution to assess the state of the conservation movement and to identify the crisis it is likely to face in the years ahead.

The challenge seems overwhelming. Speaker after speaker chronicled the demise of yet another species or habitat and spoke of "homogenization" of vast tropical jungles as an imminent event. In Indonesian Borneo, a new policy may allow lumber companies to cut practically all the trees below an elevation of 1,500 feet. "Slash and burn" agriculture follows the progress of trans-Amazonian highways, replacing virgin forest with crops until the fragile soil gives out in roughly three years, when useless scrub takes over. Japanese fishermen appear intent on driving various whale species into extinction, in a last desperate effort to find profit in an already dying business.

Against this global challenge stands a motley array of private and public ad hoc projects, funded at one end by less than $20 million from various United Nations programs, and at the other by groups such as WWF, which last year had only about $400,000 to devote to research. The meeting focused on how to use such limited funds more effectively in levering governments and industries into cooperation.

The lively debate, which took place in the secluded setting of a pre-Revolutionary estate owned by the Smithsonian Institution in Belmont, Md., divided roughly into two arguments: whether WWF and its sister organizations should jump into immediate action, purchasing land preserves and directly sponsoring the salvation of endangered species, or whether they should concentrate on conducting studies of problem areas and training professionals to handle the specific problems involved.

Championing the need for a new breed of conservation professionals is Yale professor F. Herbert Bormann, who likens the struggle to a military campaign. "The British Empire started at Sandhurst," he declares, and proposes foundation of a similar, practi-