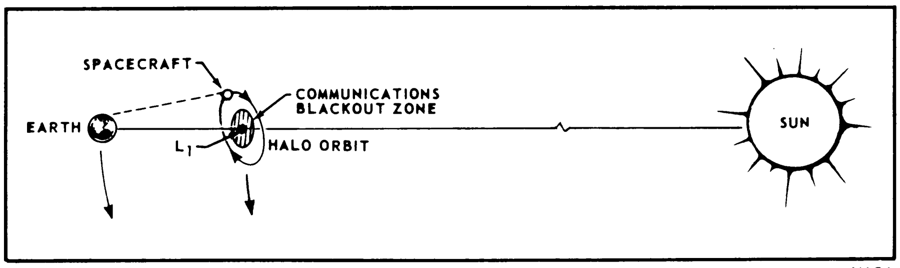
V. Yu. Petrumcin and V. A. Podlevskiy (SOVIET TECHNICAL PHYSICS LETTERS, Vol. 2, p. 296). Sixty meters is a conceivable length over which one might want to transport an electron beam for fusion purposes, but still maybe the Soviet government knows what it is being nervous about. The whole subject of particle beam weapons (SN: 7/23/77, p. 60; SN: 10/29/77, p. 281) is fraught with noninformation, deliberate misstatement, horror tales and spy-spook mystification. Still, it seems evident that the United States and the Soviet governments and possible others are thinking about them.

The idea of a particle-beam weapon is to produce a copious burst of energetic particles, be they electrons, protons, ions (or, as the Soviets now seem to be suggesting, neutral [?] particles), send them X kilometers through the atmosphere and zap! there goes your capital city ("biological target") or, more likely, zap! there goes your incoming cruise missile. Those in authority who call the idea a fairy tale usually stress the difficulties of inventing an engine to produce the particles in sufficient density and with sufficient energy and the difficulties of propagating the beam (some voices with the unassailable assurance that comes from years of giving commands have said "impossibility"). Yet there is ongoing research that can be brought to bear on these questions. Incidentally, the background gas through which the laser makes the path in the NRL experiments is air. □

Unusual orbit for sun-earth satellite



NASA

Around an invisible point, on an imaginary line, there is "the halo." It is not a definition in abstract topology, but the calculated path for a satellite whose planned orbit, according to the National Aeronautics and Space Administration, is "the most unusual ever proposed for a NASA space mission." The probe that on August 12 was launched toward the halo, furthermore, has an unusual job to go with its unique location: early warning system for two other satellites. Their paths too, in fact, are hardly conventional.

The goal of all this complexity is the coordinated study of the earth's complex responses to the equally complex outpourings of the sun. With emphasis on the "coordinated." Numerous satellites over the years have monitored various aspects of the sun-earth system, but they have done so for the most part "independently." How does the tail region of the earth's magnetic field, for example, respond to a burst of charged particles from the sun, compared with the response at the "bow shock" where the burst is striking the geomagnetic field head-on? To get data from their desired locations, researchers have often had to combine measurements from completely different solar outbursts, perhaps months or years apart.

One attempt to deal with this problem is a series of satellites known as the International Sun-Earth Explorers. Last October 22, NASA launched ISEE 1 and 2 aboard a single rocket that placed them in what amounts to a common orbit, chasing each other around the planet. Because the orbit is a radically stretched ellipse, varying from about 480 to 144,800 kilometers above the planet, the distance between the satellites changes—sometimes hundreds, sometimes thousands of kilometers. In addition, flight controllers at the NASA Goddard Space Flight Center in Maryland sometimes raise or lower the orbit a bit, so that the whole pattern of catching up and dropping back changes. A single solar burst reaching the earth can thus be monitored at two known — and adjustable — locations.

In order to best take advantage of such a system, it would be useful to have data on what is actually coming from the sun, before it is affected by the earth's presence at all. And so, last Saturday, NASA launched ISEE 3, bound for "the halo."

About one percent of the way along a line from the earth toward the sun is a so-called "libration point," where the gravitational influences of the two bodies (with slight corrections for other factors) are balanced. It is about 1.5 million km from earth, well sunward of the geomagnetic bow shock, and it is where ISEE 3 is heading for its sunwatch. The probe will arrive around Thanksgiving, but it will not settle right at the libration point, since that would put the probe in line with solar interference that would drown out the data being radioed to earth. Instead, ISEE 3 will be placed in the "halo" orbit *around* the line, so that it clears the line by about 120,000 km to the (ecliptic) north and south and about 640,000 km to either side. The halo orbit's inertia would normally cause the plane of the orbit to drift so that it was no longer perpendicular to the sun-earth line, so thrusters on the satellite will be used to make periodic corrections. There is fuel for about three years. Once on station, ISEE 3 will provide data to "calibrate" the responses reported by ISEE 1 and 2, and in some cases will even give scientists time to modify certain experiments aboard the earth-orbiting probes in preparation for whatever is coming from the sun.

The ISEE probes are part of the large, multi-year project known as the International Magnetospheric Study, which also includes other satellites and ground-based sensors. In addition, says U.S. IMS coordinator Robert Manka of NOAA, data from NASA Goddard are being used to alert IMS scientists in advance of useful alignments of as many as a dozen satellites (as if several will be strung out down the geomagnetic tail on a given date), enabling widely spaced, "timed" looks at the earth-sun system. □

Sherman to Austin: Pass the bananas

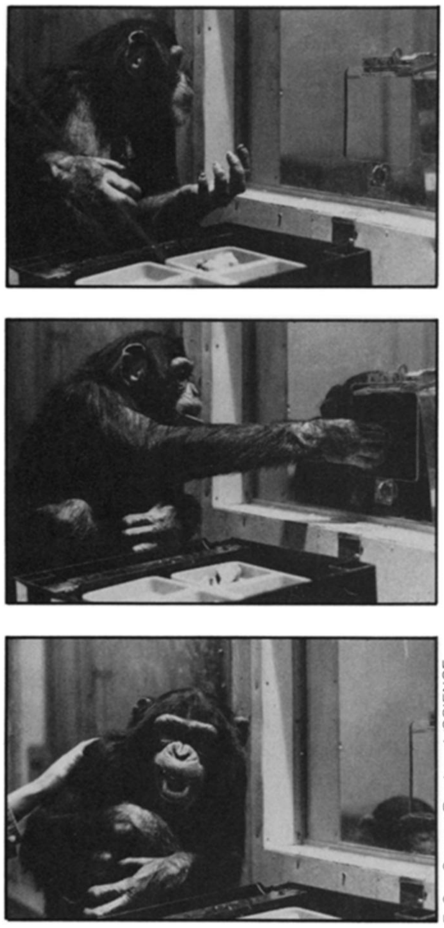
It has been clearly demonstrated that Washoe and other chimpanzees can use sign language to communicate with human beings (SN: 7/29/78, p. 72). Now psychologists at the Yerkes Regional Primate Research Center and Georgia State University report "the first instance of ... symbolic communication between non-human primates."

"This simply shows that these [symbolic communication] processes are accessible to their intelligence," E. Sue Savage-Rumbaugh of Yerkes told SIENCE NEWS. Prior to the experiments, "I didn't know whether they would pay any attention to one another's behavior," she said. But the results—reported with colleagues Duane M. Rumbaugh and Sally Boysen in the August 18 SCIENCE — illustrate that chimps can indeed communicate symbolically with each other.

The chimps — four-and-a-half-year-old Sherman and three-and-a-half-year-old Austin — first learned to identify symbols for individual foods. Each geometric symbol was embossed on individual keys of a keyboard. Depressing a key caused that symbol to appear on a screen above the keyboard.

Austin and Sherman then learned to ask for certain foods by pressing the corresponding keys. This was achieved by one of the researchers symbolically asking a chimp which food was in a certain container, and then giving him that food after correct identification was mastered. The second chimp learned the process from watching the first.

In a final progression of steps, Sherman and Austin learned to ask for, give and receive food from each other by using the keyboard system. In the last phase, the



E. Sue Savage-Rumbaugh/SCIENCE

Sherman "reads" Austin's request for bread (top), complies by feeding his friend (center) and "smiles" broadly in response to praise from technician.

chimps were separated by glass with a square hole cut into it. The chimp on one side requested a certain dish, whose symbol was flashed by the projector for the other's view. The chimp with various containers of food — there were 15, including peanut butter and jelly sandwiches, orange drink and M&Ms — read the request and complied by serving his companion through the square opening. Over numerous trials of this type, the chimp team was accurate from 70 to 100 percent of the time, according to the researchers.

In the latest, yet-to-be-published experiments, the chimps have learned to ask one another for certain "tools" to get at specific dishes of food placed in hard-to-reach spots. A sponge, for example, is used to sop up water where the chimp's hand will not reach; other tools include a lever, key and stick.

This type of "cooperative and reciprocal symbolically mediated food exchange" is "very atypical" of chimps in the wild, says Savage-Rumbaugh. She added that the chimp communication system is being applied experimentally to several youngsters at the Georgia Retardation Center. It is designed to get the children to learn to communicate with each other during meals and in other instances, rather than depend exclusively on staff members. □

Chloroplast genes: A separate map

If you plan to thank a green plant today, you should probably thank its chloroplasts. Those are the layered structures within plant cells that are responsible for a leaf's green color, as well as for photosynthesis, the light-powered conversion of carbon dioxide and water into carbohydrate and oxygen. Along with the chemical machinery for photosynthesis and protein production, each chloroplast contains DNA separate from the genetic material of the plant cell. The maize chloroplast chromosome is large enough to contain 100 average-size genes, but few have been identified. With the same methods used to analyze the DNA in cell nuclei (SN: 8/3/78, p. 83), investigators are now examining chloroplasts' genetic messages.

A chloroplast gene expressed during one stage of development is reported in the July PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES by researchers at Harvard University and Massachusetts Institute of Technology. The scientists grew maize seedlings in the dark for a week and then exposed them to light. As the chloroplast developed to its mature, green state, a new membrane protein was produced. John R. Bedbrook, Gerhard Link, Donald M. Coen, Lawrence Bogorad and Alexander Rich identified the active gene on the chloroplast chromosome by binding a radioactive probe to cut DNA pieces.

Known genes account for about 10 percent of the chloroplast chromosome. Besides the membrane protein, researchers have located the sequences that produce the RNA of the chloroplast's ribosomes and most of the transfer RNA the chloroplast uses for protein production. the only other protein so far mapped to the maize chloroplast chromosome is a subunit of the major soluble plant protein, ribulose bisphosphate carboxylase. Experiments on a green algae, *Chlamydomonas reinhardtii,* have shown that some genes for the proteins of the large subunit of the chloroplast ribosome are on the chloroplast chromosome, but others are on the DNA in the plant cell nucleus. Such dispersion of genes suggests that genes may have moved from the chloroplast to the nucleus during evolution or that chloroplast genes mutated and plant genes were able to provide a satisfactory substitute for the chloroplast product. The question remains whether chloroplasts originated from microorganisms trapped in nucleated cells or from clusters of genes and metabolic machinery compartmentalized by a membrane. □

Vitamin lack: Bat mimics human condition

When a South African hematologist learned that fruit bats never suck blood, he followed his hunch that the bats might become a suitable small animal model for a poorly understood human vitamin deficiency. Vitamin B_{12} is required in such small amounts that it has been difficult to make laboratory animals deficient. Rats, mice and guinea pigs, even if successfully made deficient, do not develop symptoms like those of humans. Human victims suffer both blood and bone marrow abnormalities and neurological symptoms, ranging from loss of touch and position sensation to psychotic behavior and paralysis. The clinical problem is inability to absorb the vitamin, rather than a nutritional lack.

Fruit bats in a laboratory, living on a strict diet of insect-free bananas, oranges and other fruit, do develop neurological symptoms, reports Ralph Green of the Scripps Clinic and Research Foundation in La Jolla, Calif. In his experiments in South Africa he found that vitamin B_{12}-deficient animals had difficulty climbing the sides of their cages and were unable to fly normally. "They don't seem to have any control of position of their wings in space," Green says. The bats showed serious deficiencies after only 200 days of the vitamin-deficient diet. They thus seem to use up their stored vitamin more rapidly than humans, who stock enough vitamin B_{12} in the liver to last for 12 years.

Twenty fruit bats were recently flown to California from South Africa, and Green plans to import about 80 more. To satisfy government officials that the bats would not get loose, multiply and threaten California's fruit orchards, Green imports only males and houses them in cages secured with double doors. Green plans to examine the bats' entire nervous system in microscopic detail to determine how it is damaged by vitamin B_{12} deprivation. (In preliminary experiments there was no change in the bats' blood.) Vitamin B_{12} deficiency in humans causes deterioration of the myelin sheath that insulates nerve fibers, so examining myelin is first priority.

A final puzzle is why the fruit-eating bats do not develop vitamin B_{12} deficiencies in the wild. Other small herbivorous animals ingest their own feces, which contain vitamin B_{12} from bacteria in the lower portion of their intestinal tract. But the bats do not eat fecal matter. Green speculates that the vitamin may come from the bats' drinking water or from insects that also prey on the fruit. □

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