Navigation satellite carries atomic clock

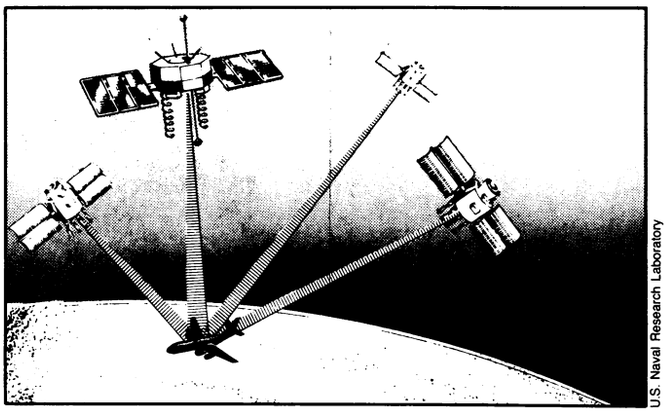
A satellite carrying a cesium-vapor "atomic clock," accurate to within one second in more than 150,000 years, was sent into orbit on June 23, the latest step in a planned worldwide navigation system for aircraft, ships and landbound users. The completed system will consist of 24 satellites expected to let users determine their latitude, longitude and altitude to within 10 meters or less, and their speed in all three directions to within 0.1 meters per second.

The satellite launched last week, called NTS-2, is the fourth in a series developed by the U.S. Naval Research Laboratory to test increasingly sophisticated "clocks" in orbit for the defense Department project, to be known as the NAVSTAR Global Positioning System. Launchings of the two dozen satellites for NAVSTAR itself will begin later this year, with the system scheduled to be complete by the early 1980s.

A user of the system would carry a receiver capable of receiving time signals from three or more of the satellites simultaneously, with a computer to integrate the signals to provide near-instantaneous position, direction and speed readings. The satellites will be arranged in three circular orbits, each in a different plane, with eight satellites in each orbit. This is intended to put users anywhere in the world within range of three or more satellites, 24 hours a day.

The first clock test was conducted with a satellite called Timation I, launched on May 31, 1967, carrying crystal oscillators accurate to within 3 parts in 100 billion, or 1 second in about 1,000 years. Timation II, launched Sept. 30, 1969, tripled the accuracy of its similar oscillators by the use of equipment to correct for atmospheric effects such as instabilities in the ionosphere. The success of the modifications was demonstrated in 1972 when the satellite was used to link atomic clocks at the Royal Greenwich Observatory in England and the U.S. Naval Observatory in Washington, synchronizing the two devices to within one two-millionth of a second. A year later, the experiment was repeated between the Naval Observatory and Australia's Division of the National Mapping—with a fivefold increase in accuracy.

From the crystal oscillators, it was onward to atomic clocks. Timation III, renamed NTS-1 (Navigation Technology Satellite 1), was lofted on July 14, 1974, carrying a rubidium-vapor clock with an accuracy of one second in more than 20,000 years (SN: 7/13/74, p. 27). It lasted only about a year, however, due to the darkening of the glass bulb holding the gas, a problem common with rubidium-vapor clocks. The cesium used in NTS-2 is free from this problem, although since it is a mercurylike liquid until vaporized, it may pose difficulties of its own due to the effects of weightlessness in orbit.



U.S. Naval Research Laboratory

Just launched NTS-2 statellite (second from left) will be joined later this year by satellites in the NAVSTAR system in the first tests of a worldwide navigation system for aircraft, ships and ground users.

NTS-2 will be used in tests with the first five NAVSTAR satellites, three of which will have rubidium-vapor sources with cesium sources in the other two. Meanwhile, the Naval Research Laboratory is planning the 1981 launch of NTS-3, carrying a hydrogen maser accurate to one part in 10 trillion, or a second in more than 3 million years. Many of the NAVSTARS will already have been launched by then, of course, but improvements will be incorporated as new satellites replace earlier ones.

The NAVSTAR program is primarily for military users—it has managers from the Air Force, Army, Navy, Marine Corps and Defense Mapping Service. But Defense Department officials have visions of reducing the system's cost by generating a substantial civilian market for the service. They are reported to have been briefing the Federal Aviation Administration, airlines and others, who would make use of a less-accurate open channel from the system while the armed services keep the highest-precision channel under restricted access. Besides aiding navigation, the system could find use as a collision-avoidance tool, if planes and ships could be guided according to a common worldwide reference system. □

New precursor to natural painkillers

One of the more exciting areas of biological research during the past two years has concerned natural peptide painkillers found in animal pituitary glands. These peptides, called endorphins (from "endogenous morphine"), behave similarly to morphine when tested in various biological systems, thus encouraging hope for development of nonaddictive painkillers.

These morphinelike compounds seem to be part of an extensive polypeptide family. The 5-amino-acid sequence of an enkephalin is contained within the 31-amino-acid sequence of beta-endorphin, which is itself part of a larger, 91-amino-acid polypeptide called beta-lipotropin. Beta-lipotropin shows almost no morphinelike activity.

Now a polypeptide about three times as large as beta-lipotropin has been added to the list, according to Roger Guillemin of the Salk Institute in La Jolla, Calif., and Sidney Udenfriend of the Roche Institute of Molecular Biology in Nutley, N.J. They reported last week, in separate talks given in San Diego at the Fifth American Peptide Symposium, that they find a pituitary polypeptide of approximately 30,000 molecular weight which, when hydrolyzed, yields smaller peptides with morphinelike properties. Further studies should determine whether beta-lipotropin, and other molecules with biological activity, lie within this new, large polypeptide.

Natural concentrations of the pituitary peptides provide clues to their physiological roles. For instance, in rat pituitaries that are frozen immediately after the animal's death, Udenfriend finds 150 times as many molecules of beta-lipotropin as of beta-endorphin. On the other hand, when the pituitaries are not quickly frozen, the ratio of lipotropin to endorphin decreases, suggesting that degradation has occurred. Cow, sheep, guinea-pig and rabbit pituitaries show qualitatively similar results. Large polypeptide chains may thus provide a way of storing smaller molecules in an inactive form in the pituitary. Upon receiving an appropriate signal, a storage polypeptide could be hydrolyzed to release beta-endorphin and other active molecules. □

Measuring melanin in the brain

Melanin—it's weird stuff. A black chemical glob that provides pigmentation in the skin of humans and animals, thus serving as a sunscreen. Some of the toughest material there is (even boiling it in acid does not change it). Its chemical structure is a mystery. Even more bizarre, melanin has been observed in the brains