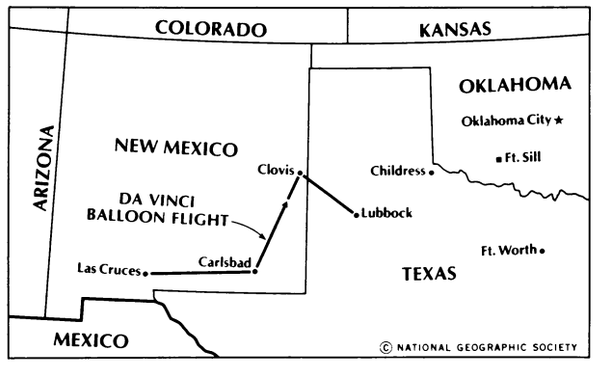
A journey for science by balloon



The route of Project da Vinci—if the winds cooperate. One of the goals of the elaborate atmospheric study is to make future research balloon flights more predictable and controllable.

On the morning of Oct. 12, if all goes well, a 70-foot balloon will rise gracefully from Las Cruces, N.M., Municipal Airport, carrying four people and numerous scientific instruments on one of the most elaborate lighter-than-air research flights ever conducted. Called Project da Vinci, the journey will involve the Atomic Energy Commission, the Army, the National Oceanic and Atmospheric Administration and the National Geographic Society, as well as several other agencies, organizations and universities.

The crew will spend the 36 hours of their mission in a cramped, aluminum and fiberglass gondola, trying to follow an exhaustive work schedule in the limited space not taken up by more than two dozen experiments' worth of instrumentation. Their activities will include releasing as many as 20 smaller balloons, dropping reflective chaff, throwing out strips of paper attached to a wire and blowing loud, periodic "blats" on an atmospheric sounding device. Meanwhile, back on the ground, other groups will be shining laser beams, releasing balloon-borne transmitters and trying to follow the floating crew in a pair of vans and a motor home.

The overall goal of all this, according to project officials, is to obtain a detailed picture of everything that happens to a given "parcel" of air as it travels across differing terrain. The idea was originally conceived a few years ago by balloonist-sculptress Vera Simons, who envisioned the trip as both a scientific and an artistic effort. As more groups began to take interest and provide support, the scientific side began to grow until it finally took over the entire project, with Simons as co-pilot and Jimmie Craig, a civilian employee of the U.S. Naval Weapons Center in California, as pilot. Meteorologist Rudolf Engelmann, deputy manager of environmental programs for the AEC, will be the on-board scientist for the mission, accompanied by a photographer for the National Geographic Society, which is providing part of the funding.

The 25 experiments on the flight are divided into five groups: atmospheric structure and turbulence, atmospheric constituents, electrical fields, radiation, and balloon dynamics and response.

Besides temperature and humidity measurements, the atmospheric structure experiments will include repeated blasts, at 30-second intervals, of a loud, 110-decibel sounder that will seek turbulence layers and inversions much as a depth finder seeks them in water, timing the reflected pulses as indicators of distance. An experimental instrument (one of several being tested on the project) will enable atmospheric density to be measured directly using a sample of promethium 147 as a source of beta rays, which are reflected by air molecules and can be detected with a Geiger counter tube; the conventional technique requires density to be calculated from temperature and pressure data. The ground-released radiosondes, released from three locations while the main balloon is aloft, will gather data for comparison with that obtained from the gondola. Paper strips tossed from the gondola will show small-scale wind-shear patterns, while a group of four-sided, helium-filled "tetroons" will be released from the gondola, ballasted to float at the same altitude, to study larger-scale wind movements. Other experiments will use microphones to record low-frequency sounds made by so-called "gravity waves," which can contribute to clear-air turbulence, and study small-scale turbulences with a group of instruments mounted on a flexible, 100-foot-high framework suspended from the gondola on a 300-foot cable.

Ozone, sulfur dioxide, aerosols, water vapor and other atmospheric constituents will be measured using filters, a ground-based laser beam and chemically reactive sensors.

One of the goals of Project da Vinci's research on electrical fields is to aid in the development of piloting systems for remotely controlled drone aircraft. Electric field sensors will be unreeled on a cable to hang a kilometer below the gondola in an 85-pound "down package" that also carries several other instruments. In addition, chaff consisting of fine, aluminum needles will be released by the crew to see if it can reduce the strength of built-up electric fields; these will be relatively weak fields, however, compared to the lightning-prone ones being studied elsewhere by NOAA aircraft.

A variety of studies will be aimed at measuring the absorption and reflection of various wavelengths of solar radiation, as well as at studying the effects of different types of terrain and man-made features on the ground below. Finally, the researchers will try to find out whether monitoring the air inside and outside the balloon itself, while incorporating wind speed and other data, can enable more accurate design and control of balloons for future flights.

The crew will use oxygen masks during part of the flight, which is designed to remain between 4,000 and 14,000 feet. To condition themselves, they are thus spending the two weeks before taking off living and hiking in the Rocky Mountains west of Boulder, Colo. If the ambitious mission is a success, others are planned, the first one to take place next spring. □

X-ray astronomy: The long and short

The growing field of X-ray astronomy continues to expand. Despite an aggravatingly elliptical orbit, the recently launched Netherlands Astronomy Satellite (SN: 8/24/74, p. 121) is holding out the possibility of more than 26 months of observations, while a U.S.-British team is preparing the 1975 flight of a huge X-ray telescope whose entire working life will be scarcely six minutes.

Next June, climaxing three years of preparation, the 2,000-pound telescope, more than 42 feet long, will poke its nose briefly into space atop a sounding rocket not much bigger than the telescope itself. The sole goal of the mammoth instrument is to take a single, 243-second glance at a single stellar object, the fading remnant of an ancient supernova known as Puppis A (SN: 7/13/74, p. 26).

The target is a particularly fascinating one for astronomers. It is one of the few known objects in the sky that is a source of visible radio and X-ray emissions. Distant even by astronomical standards (it is some 2,000 parsecs

away, out beyond the Gum Nebula) Puppis A is still large enough to occupy a substantial microfraction of arc in the sky, enabling observers to distinguish between its center and the filaments at its rim. Also, its radiations are intense enough to be viewed in discrete wavelength bands, unlike many dim objects from which every available photon, regardless of wavelength, must be brought together to build up a useful image.

The rocket-borne telescope, assembled at NASA's Marshall Space Flight Center in Alabama, will be looking at Puppis A's X-ray emissions. A similar instrument was used aboard Skylab to photograph and study the sun, but the newer version will be updated with advanced mirror-polishing techniques and equipped with a position-sensitive proportional counter that can radio an image to the ground (in case the parachute-equipped telescope and camera don't survive the landing). Shepherded by co-investigators Richard B. Hoover of Marshall and Ian Tuohy of Mullard Space Science Laboratory in London, the telescope will be carried by a British Skylark rocket launched from Woomera Rocket Range in Australia, aimed at a planned altitude of 171 miles.

Another feat of space astronomy, meanwhile, has gotten off on the right foot with the successful launching on Aug. 30 of the Netherlands Astronomy Satellite, instrumented for both X-ray and ultraviolet studies of the sky. Despite a 72-hour delay due to technical problems, this first Dutch-built satellite, launched by NASA from California, marked the winning of a five-year-old bet for Netherlands officials, who in 1969 had predicted the launch of their maiden space probe right to the month.

A problem with the Scout launching rocket (it apparently pitched over too far before releasing the satellite) put the probe into an elliptical orbit ranging from 165 to 727 miles above the earth, rather than the nearly circular, 316-by-347-mile orbit planned. This is likely to mean that the worldwide NASA tracking system will have to supplement that of the European Space Research Organization throughout the probe's working life, rather than just during preliminary operations as originally planned.

All three of the satellite's instruments have been turned on and are working properly, although some computer correction of the data will be needed to compensate for the unanticipated orbit. Despite the orbit, NASA calculations indicate that the probe will be able to stay aloft for more than 800 days, which is as far ahead as the prediction program runs. □

NAS scores EPA's research setup

For once, a committee of the National Academy of Sciences didn't mince words. In unusually blunt terms, an NAS committee appointed to evaluate the system by which the Environmental Protection Agency conducts research has found that present procedures "are not a satisfactory base for management and must be abandoned." The present system, the report concluded last week, "has started in a wrong direction and . . . a fresh start is needed."

The study was requested by EPA Administrator Russell E. Train, who accepted the academy's criticism gamely: "I very much appreciate the candor" of the report. The recommendations, he said, will serve as the basis of future actions, beginning with the appointment of a new assistant administrator for research and development. Both Train and the academy committee stressed that the report was a criticism not of the research performed by individual EPA scientists but of the methods of supervising and assimilating their work. The committee referred to researchers in various regional EPA laboratories as "dedicated and competent scientists."

The problems, according to the report, began outside the agency, with enabling legislation that is "noncoherent" and research objectives and timetables that are "unbalanced and uncoordinated." The problem has been aggravated by "parochial political pressures," the lack of an integrated approach to R&D and a "roller coaster" budget.

Inside the agency, the committee found priorities in a shambles because of a "vacuum cleaner" approach to soliciting ideas. "Severe resentment" has developed among researchers because planning is often separated from responsibility for execution of the work required. The system is overcomplex, demands excessive detail at all planning levels, and lacks a long-term program to meet stated goals. Relationships between headquarters and the field are "strained at best" and a "state of frustration in the field staff is apparent."

To overcome the internal problems, the committee recommends delegation of research program responsibility to the research center directors in the field, who would then report directly to an assistant administrator for research and development. He, in turn, would analyze the input and define R&D needs and objectives. To further the decentralization process, a performance evaluation system using outside committees should be established, the committee recommended, and permanent Washington staff should only be large enough to competently monitor grant and contract work. "The pyramid should decentralize quickly from Washington headquarters to major field units."

EPA has come under increasing criticism for the way it runs its R&D operations, with some critics even suggesting that this capability be removed altogether (SN: 7/28/73, p. 52). Train is thus expected to act quickly on the academy's recommendations. □

Lagrangia: Pioneering in space

The migration of earthlings from our planet to another one is an old theme in science fiction. The trip can be taken for adventure, but often it is done because earth is overpopulated or has been made uninhabitable by natural or artificial means. Two facts now cross the fiction: Earth is becoming overpopulated, and the two most popular candidate planets, Mars and Venus, seem less and less hospitable as we know more about them.

Therefore why not artificial habitats out in near space at the Lagrangian points of the earth-moon system? This modest, close-to-home beginning is the suggestion of physicist Gerard K. O'Neill of Princeton University. After talking it up in a number of places he presents it in the Aug. 23 NATURE.

The Lagrangian points are chosen because matter put there will stay and orbit the earth in synchrony with the moon. The most likely Lagrangian points lie on the moon's orbit sixty degrees before and behind the moon and move with it. A modification of the space shuttle could get things there, and O'Neill believes that the technology of the current decade could build a habitat for 10,000 people. Once there, the pioneers of Lagrangia could sustain themselves using sunlight for energy and the mineral resources available on the moon. They could then construct ever larger habitats until by 30 years from now there could be communities of 100,000 to 10 million people. "Replication of these communities could lead to the exponential growth of new land area, with a growth rate more rapid than that of the total human population," O'Neill concludes, and he alleges that these communities could be as comfortable as the most desirable parts of the earth. □