The Month at Caltech

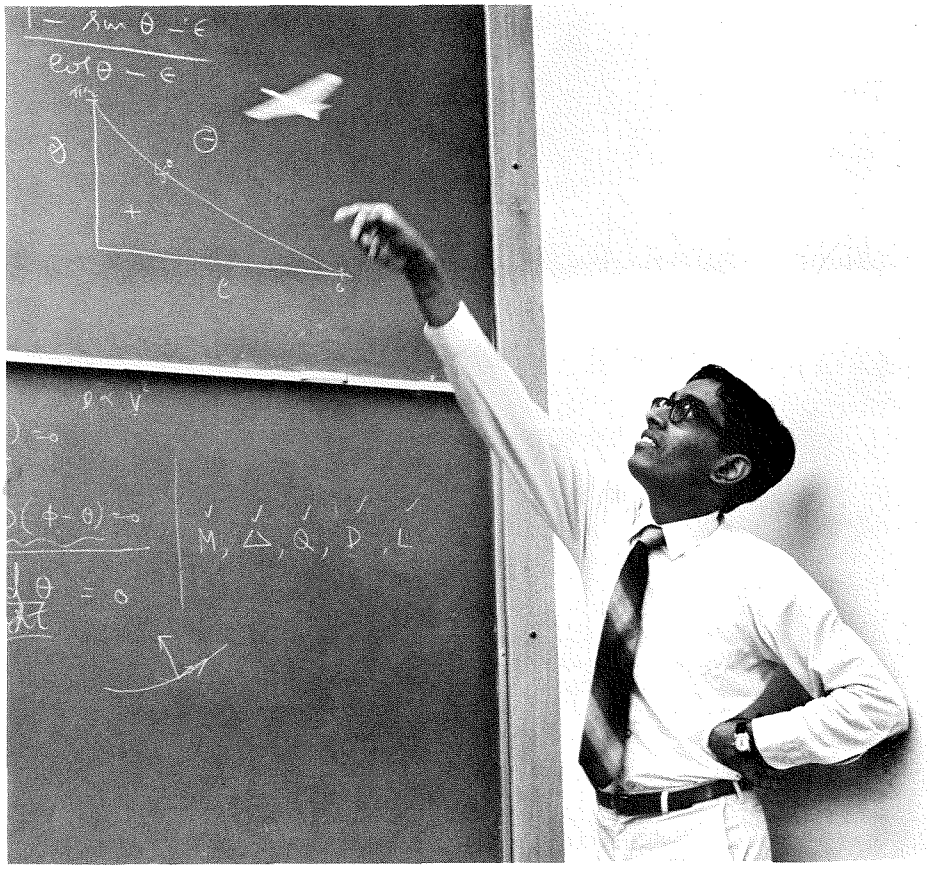
The National Medal of Science

Allan R. Sandage, staff member of the Hale Observatories, has been awarded the National Medal of Science by President Nixon. Sandage, whose research has concentrated on stellar evolution and the birth and death of stars, helped discover quasars—the mysterious power sources believed by some astronomers to be the most distant objects in the universe. He is currently making studies to determine the accuracy of the Hubble Constant, a formula that describes the rate at which the universe is expanding.

According to a White House announcement, the award was given to Sandage "for bringing the very limits of the universe within the reach of man's awareness and unraveling the evolution of stars and galaxies—their origins and ages, distances and destinies." The National Medal of Science is the highest award of the federal government for outstanding contributions to scientific and engineering development. Since 1963 it has been given by the President to 78 men and women in the physical, biological, mathematical, or engineering sciences.

Sandage is one of five Caltech faculty or alumni who have been so honored. The very first recipient was Theodore von Karman, professor of aeronautics and director of the Guggenheim Aeronautical Laboratory at the Institute from 1930 until his retirement in 1949. He was awarded the medal by President Kennedy in February 1963. A. H. Sturtevant, Thomas Hunt Morgan Professor of Biology and a member of the Caltech faculty for 42 years, was given the award in 1967. Other Caltech recipients are Wolfgang K. H. Panofsky, PhD '42, who is now at Stanford University as professor of physics and director of the Stanford Linear Accelerator Center; and John R. Pierce, '33, MS '34, PhD '36, executive director of the Research-Communications Division of Bell Telephone Laboratories

Sandage received his AB in physics from the University of Illinois in 1948, and his PhD in astronomy and physics from Caltech in 1953. He also holds ScD's from both Yale University and the University of Chicago.



S. P. Govindaraju launches a paper glider on a successful flight—and demonstrates principles of airplane dynamics at the same time.

The Dynamics of Paper Gliders

Teaching airplane dynamies is often hampered by the absence of anything concrete to experiment with. S. P. Govindaraju (PhD '70), graduate research assistant in aeronautics, has found a way around this problem.

Far from being a put-on, Govindaraju's technique demonstrates that the dynamics of paper gliders involve the same mathematical equations that the dynamics of real airplanes do. Of course, the nature of the construction material (a sheet of paper and a couple of strips of Scotch tape) imposes some pretty severe design constraints, namely that the experimental craft have to be kept fairly small—say, nine inches or less in wingspan. But there are some offsetting advantages, too; for example, the cost is significantly lower than that of most experimental tests in aerospace technology.

There are other advantages: Since everything happens so slowly with paper gliders, it's easy to observe what they do in flight. And while few of us would be willing to entrust our lives to an aircraft constructed of paper, the material is nevertheless rigid enough (if the proper wing curvature is achieved) to return to its original shape in case it crashes into a chair or something. This makes it easy to ensure experimental validity by repeating experiments using the same construction and shape, and to observe the effects of any changes.

Govindaraju's squadron exhibits a variety of construction designs—straight wings, swept-back wings, and even a weird-looking affair with swept-forward wings that looks as though it had been overtaken by a very strong tailwind. But they all fly, and each one demonstrates something different in the discipline of airplane dynamics. In a recent lecture on "The Dynamics of Paper Gliders," one of Govindaraju's aircraft flew in a series of increasingly suicidal oscillations until it finally plopped, belly down, on the floor. The

oscillations were induced by marginal static stability (the nose wasn't heavy enough). Another flew in a series of stalls —straight down to the floor. Yet another required a higher launching altitude, so Govindaraju had to stand on tiptoe for that one. (It flew in a long, straight glide path, brave and true—and drew a rousing cheer from the audience.)

Govindaraju doesn't know when he'll use the demonstration technique again, but he is already thinking about refinements. For example, photographing the flight of his craft using a strobe light against a black background would make it easy to plot the flight path in precise measurements. It would, he says, be a good undergraduate project.

It would also be a lot cheaper than most any other kind of experimental aircraft.

Give-it-a-second-thought Department

Caltech's Environmental Action Council (CEAC) is one year old and still going strong. Last spring's Ecoweek, featuring speakers, displays, and an Ecology Faire, was the first big event sponsored by this student group—*E&S*, May 1970. It was well publicized, well attended, educational, and a lot of fun as well. CEAC's subsequent activities have been less spectacular, though one of them—the recycling center—is making a special kind of contribution to reducing environmental problems.

The center consists of an open-air area located behind the Campbell Plant Laboratory on the campus, north of San Pasqual Street and on the west side of Michigan Avenue. Anyone who wants to leave materials there for recycling can do so at almost any hour. There is a sign and lots of accumulated material to indicate where to put things: An old platform area is for deposition of glass containers and aluminum cans, foil, and baking dishes; and there is a roofed shelter for newspapers so that a rainstorm won't turn them to pulp prematurely.

What doesn't show in a casual inspection of the site is the applied thought, social concern, long hours, and muscle-building labor of the students who have manned the recycling center for the eight months it has been in operation. Many students and other anonymous volunteers have contributed time to keeping the center going, but continuing leadership has been provided by Dwight Carey, a junior in geology; graduate students Karl Bell in chemical engineering, Bob Rohwer in biology, and Bill Beranek in chemistry; Russell McDuff, a sophomore in engineering; and freshmen Chris Goldstein and Rob Olshan. One female volunteer, Patty Horne, a graduate art student from Cal State Los Angeles, spends several hours a week at the recycling center—a good part of it in the office in the Dolk Plant Physiology Laboratory reading and answering the increasing volume of mail. She is also helping to prepare a brochure describing the services of the center. When it is printed, it will be available in some local supermarkets, at other recycling and collection centers, and upon request by mail. Right now the center has no mailing address or telephone of its own, but uses the services of the campus YMCA.

The manual labor at the center during the week consists of tying newspapers in bundles and stacking them, loading glass into 55-gallon metal drums and then using steel rods as plungers to smash it, and pounding cans with a 12-foot-long four-by-four to flatten them. The purpose of all the crushing and smashing is simply to reduce the bulk of the material, which is considerable in the round.

Glass must be freed of any metal rings or lids or plastic parts; then it must be sorted by color—clear, green, or brown. Sometimes a very nice discrimination is needed to make a color choice—particularly, Carey notes ruefully, if you're color blind. If the glass is properly

Caltech's Environmental Action Council has collected, smashed, and sold approximately 50 tons of glass for recycling in the last eight months. Dwight Carey wields an effective tool—a metal rod.

separated, manufacturers can use 20 percent old glass to 80 percent new glass. If it has been mixed, impurities—by glassmakers' standards—mean that the percentage of old glass must be reduced in the new mix, and so the old glass is less salable. Incidentally, paper labels on a glass jar make no difference; the heating and washing processes at the manufacturing plants take care of that kind of adulteration.

Newspapers are tied in bundles because most dealers will not accept them in any other condition, and *no* magazines are accepted. Getting rid of magazines is everyone's problem, though magazines left at the center—like other unsalvageable material—are picked up and hauled away by the Institute's trash collection service at CEAC expense.

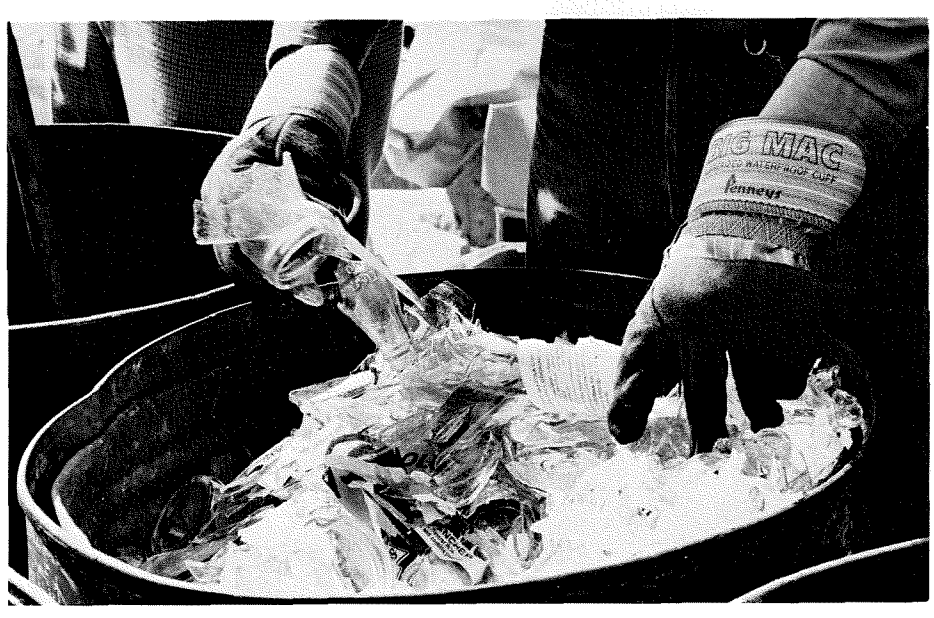
Getting materials for recycling has never been a major problem, and the volume of material handled has increased steadily since the center opened last May. About three tons of discards are now processed each week.

Once a week—usually on Saturday—the students load the bundles of newspapers, and metal drums of crushed glass and aluminum, onto rented trucks (the kind with elevator-style tailgates) and take them to manufacturers in the Los Angeles area who have agreed to buy them for recycling. The Caltech group cooperates with other collection centers in the Pasadena area by pooling what they collect for the weekly sales trips, and Caltech students drive the trucks. When the center first started, very few truckloads of used materials were turning up at the various unloading docks. Now, Saturdays at least are days of land-office business for cooperating manufacturers, and the trucks have to line up to unload.

The uncertainties of dependable manpower have been one of the big problems in keeping the recycling center a going concern. In fact, because of lack of adequate help, final exams for the regulars, and some understandable concern on the part of Institute authorities regarding the sanitation and esthetics of the operation, the center was closed for most of December and early January. Now it's open again and is soliciting continuing contributions of material for recycling and increased regular volunteer help.

The money the center receives from the sales of discards is used for maintenance, to buy such equipment as heavy gloves, to rent trucks, and—in time, maybe—to acquire machinery for automating the operation. Smashing glass by hand can relieve a lot of tensions (volunteers are invited to come over and lend a hand and get a little simultaneous therapy), but machines would be a lot more efficient. A glass crusher and a can smasher are high-priority items.

Meanwhile, realizing that we live on a small planet with increasing environmental problems, the staff of the center is putting a lot of dedicated muscle and valuable time into the job. "We have no illusions," Carey says, "that the center—here or in combination with all the other recycling centers in the area—is really doing anything substantial toward solving pollution. We would like to think that maybe we're helping to educate people about the magnitude of the problem. Maybe they'll even begin to give a second thought to what they buy and how it can be disposed of and where more is coming from."



A three-day accumulation of glass adds up to a mountainous mass. Kim Mitchell, Patty Horne, and Bill Beranek apply themselves to sorting and reducing the volume. Eventually, in 55-gallon drums, it will be sold for recycling. A small part of the proceeds goes to buy the protective—and essential—heavy gloves.