A dream of wings—via feet

Superman's strength and X-ray vision are as nothing, to his earthborn observers, compared with his ability to fly under his own power. Even among people who pursue no such conscious goal, flight is a recurrent theme in dreams, whether as physical escape or as a metaphor for a more psychological yearning. On Aug. 23, Bryan Allen climbed aboard a fragile, winged craft named the Gossamer Condor, strapped his feet to a pair of bicycle-like pedals connected through a linkage to a 13-foot propeller, and flew.

He was not the first. One early flight took place in 1929, when Hans Werner Krause flew an "ornithopter" designed by Alexander Lippish, for 300 yards, using his feet to flap the craft's delicate wings. Allen estimates, in fact, that 30 to 40 aircraft have successfully flown—not just glided—using human muscles as their only source of power.

A major difference, however, was that Allen's flight met the conditions necessary to win the "Kremer prize," an award equivalent to 50,000 pounds sterling, contributed by British industrialist Henry Kremer to inspire just such efforts. Kremer first offered a 5,000 pound prize in 1959, open only to British attempts. In 1967 he doubled the amount and opened the competition to all nationalities, still with no successful takers. The amount was raised to 50,000 pounds in 1973.

Yet, except for the participants, the money may be beside the point. What the competition did do was provide a strict set of rules against which the entrants would be judged. It was not the first of its kind (the Italian government offered a sum in the 1960s equivalent to Kremer's original prize), but it did mean that the winner would be truly flying, not just providing an occasional supportive nudge to a glider.

The Gossamer Condor effort was organized by Pasadena engineer Paul D. MacCready, who designed the craft together with Peter Lissiman. The design was translated into hardware by Vern Oldershaw, using a mylar wing surface over bent metal ribs along tubular aluminum spar, with piano wire for bracing and cardboard for the wing's leading edge. The 10-foot-long fuselage was suspended beneath the 96-foot-wide wing, which also carried a strut leading forward to a smaller wing, or canard. The entire construction weighs about 70 pounds; Allen, according to Allen, weighs about 135.

The conditions of the attempt, as set up by the Royal Aeronautical Society of England, required the flight to cover a figure eight around two pylons half a mile apart. The craft had to take off under its own power (no slingshots, for example), from nearly level ground (a slope no greater than 1 part in 200), and to cross the start/finish point at least 10 feet above the ground.


UPI

Bryan Allen pedals the Gossamer Condor above Shafter, Calif.

The Condor taxied along a runway at Shafter Airport in Shafter, Calif., on small wheels, driven by the push from the aft-mounted propeller, until it developed enough lift to rise from the ground. The craft's maximum speed is about 12 to 13 miles per hour, Allen says, and stall speed is about 7. During the prize run, he was pedaling at from 80 to 90 revolutions per minute, with slight gearing (1.2:1) producing a propeller speed of 96 to 108 rpm. The flight lasted 7 minutes and 28 seconds, of which 6 minutes 22 seconds comprised the official run. The craft has accumulated a total of about 6.5 hours of time aloft since it began flying in March, says Allen, including about 10 attempts at the prize and a maximum duration of some eight minutes for a single flight.

Allen believes that human-powered aircraft are unlikely ever to become "practical"—even minimum performance, he feels, is too close to maximum human capabilities. Such a craft might, however, work wonders with the addition of a small, 1.5-to-2-horsepower engine. "Imagine," he says, "flying across the country on six gallons of gas. At 30 miles per hour." □

jects easier to digest by the new population of students entering the educational system. More diversity, not less, is what is needed, the panel says. Texts and classes should offer stimulation and challenge to all levels of students, not just the lowest common demoninator.

Harold Howe II, vice chairman of the College Board panel and vice president of education and research for the Ford Foundation told SCIENCE NEWS that "lack of confidence of society in itself is depressing the attitudes of children. We're asking people [in reading this report] to pause and think about what affect these attitudes are having on our children."

Sandra Clark, a panel member and head of the English department at a Bellevue, Wash., high school, says we have to rethink what it is students are learning in school and what it is society thinks they ought to learn. Perhaps lower achievement expectations are the price we have to pay for educating increasing numbers of students. Benjamin S. Bloom, another panel member and Distinguished Service Professor of Education at the University of Chicago, disagrees. He points to the Japanese, who educate an even larger percentage of their population than the United States does, as proof that the masses can be educated without watering down the quality of student achievement expectations. □

Nitrogen fixation: A piece of the action

The future will demand more food, and food production demands that nitrogen be converted from its atmospheric form to biologically useful ammonia. But providing nitrogen fertilizer by the industrial processes available today will lead to ever-increasing fertilizer prices and continuing massive consumption of nonrenewable fossil fuels, William E. Newton of the Charles F. Kettering Research Laboratory told the meeting of the American Chemical Society this week in Chicago. "Such a situation will be devastating for all nations," Newton warns.

Newton and other researchers studying nitrogen fixation expect to find the key to the fertilizer dilemma by learning from the system that most efficiently converts nitrogen to ammonia without high temperature and pressure. That system is the enzyme nitrogenase, which is found in certain bacteria, some of which live on the roots of soybean plants and other legumes. Isolated in the laboratory, the enzyme demands only about half as much energy as does the industrial process. But to imitate the bacterial enzyme, chemists need to know the details of its operation.

Researchers have long known that an essential cog in biological nitrogen fixation is a "cofactor" that contains the metal molybdenum. However, that component has eluded standard isolation procedures. Now Vinod K. Shah and Winston J. Brill of the University of Wisconsin have succeeded in teasing from the nitrogenase complex a string of amino acids about 1 percent the size of the enzyme. The surprising cofactor contains not only the metal molybdenum, but also many sulfide groups and iron atoms.

Although the cofactor itself cannot reduce nitrogen, it can repair mutant bacteria lacking that essential component. "The cofactor is like an engine of a car," Brill explains. "It won't run anywhere by itself."

Species differences seem to pose no barrier to the effectiveness of the cofactor, even though the isolated enzyme will not function in different species. Mutant bacteria of one type are made active by addition of the cofactor from any of a number of species with very different characteristics.

The reason that early isolation attempts have failed, Brill told a press conference, is that the cofactor is extremely unstable: Both oxygen and water knock out its activity. The researchers screened numerous solvents before discovering one, N-methylformamide, that preserves the cofactor's activity. Because the intact enzyme system is not harmed by oxygen or water Brill and Shah speculate that the protein core of the enzyme maintains a protective environment for the cofactor.

Cofactors to other enzymes that require molybdenum have also yielded to the new technique. The researchers were surprised to find quite different cofactors in different enzymes. Earlier genetic and biochemical results had suggested that all molybdenum-dependent enzymes share a common cofactor. The amino acid sequences of the cofactor are currently being analyzed. They may contain some unusual amino acids, Brill says.

An understanding of the cofactor and the enzyme that catalyzes biological nitrogen fixation should be an aid to chemists attempting to synthesize ammonia, Brill says. "They can get some idea of how a very efficient nitrogen-fixing system works."

Although other biologists are already transferring the genes for nitrogen-fixing enzymes between bacteria (SN: 8/27/77, p. 138), Newton believes that it will be necessary to understand the mechanisms of the operation at a molecular level before nitrogen fixation can be productively introduced into new crops. Bacterial or plant cells would not be able to handle all the ammonia that would suddenly be produced, he explains.

Besides being useful as a model for chemical nitrogen fixation, knowledge of the structure of this cofactor should be useful for understanding the role of molybdenum at the active site of nitrogenase, the role of ligands close to molybdenum in electron and photon transfer, and the catalytic mechanism of nitrogen fixation, Shan and Brill conclude. □

IQ, culture and adopted children

Searching for the determinants of intelligence—be they genetic or environmental—is not a favorite pastime of psychologists. For one thing, any results from such studies are usually attacked. Conclusions leaning toward a genetic basis of intelligence are sharply criticized by environmentalists. Results favoring upbringing and surroundings as the major contributors to intelligence, are scored by geneticists. Beyond that, problems in defining intelligence, centering around the cross-cultural adequacy of current IQ measures, have made it difficult to establish solid, empirical data in the field.

Now, almost certain to fuel both sides of the controversy, comes an extensive study of intelligence and school achievement among 324 adopted and 375 "biological" children (living with their natural parents). The study results, presented last week at the American Psychological Association's annual meeting in San Francisco, give evidence that intelligence, as it is measured in the United States, is determined by both strong environmental and genetic components.

"In regard to hypotheses about genetic differences [in intelligence], this is a pretty important study," says Sandra Scarr, a developmental psychologist at Yale University. Scarr's research, performed in the Minneapolis area while she was a part of the University of Minnesota faculty, examined 130 black and interracial children who were adopted by middle-and upper-class white families and compared them to 143 biological children in the same families. Scarr also studied 194 adopted white children and measured them against 232 biological children from similar (again, white middle- and upper-class) families. The black children averaged seven years of age and their adoptive siblings ten, while the white adoptees and their biological counterparts ranged in age from 16 to 22 years. Both the black and white adoptees were born into severely deprived and disadvantaged environments before being put up for adoption. Scarr found that:

- All adoptees attained IQ scores 5 points to 15 points higher than would have been predicted had the children remained in their original, disadvantaged environments. In addition, the adopted black youngsters averaged in the top half of their class on school achievement tests; the average disadvantaged black child in the Twin Cities area usually scores between the 15th and 20th percentile, according to Scarr.
- Beyond those improvements, however, environmental factors apparently had little impact on the youngsters. This points to a definite "genetic component" in intelligence, says Scarr. She estimates that the genetic component accounts for around half, or perhaps more, of a person's IQ score.

The first finding shows dramatically that "there is an advantage in being brought up in a higher socioeconomic environment ... a different culture," Scarr says. "Genetically average children are performing above average when brought up in an advantaged environment." The average "adjusted" IQ score for a black child in Minnesota is around 90, Scarr notes. The adoptees in her study attained average scores of 106 to 110. Almost identical improvements were registered by the white adoptees. (Adoptive parents IQ's averaged 116 to 119 in the two studies—in both cases, well above those of the parents who gave up the children for adoption.)

Scarr's results help document the importance of environmental factors, but there were two major findings indicating strong genetic determinants for intelligence. Despite the improved scores, adoptees still averaged about six points lower in IQ than the biological children of their adoptive parents; the adopted youngsters' intelligence measures did not appear to correspond to their adoptive educational and economic levels. The adoptees' IQs ranged from 75 to 150, but Scarr says those who scored highest were not necessarily those placed with the most affluent, well-educated parents. Some children adopted by skilled working-class families—at the lower end of the adoptive parents spectrum but still much more advantaged than the youngster's original parents—scored much higher than many of those placed in families headed by doctors, lawyers or other professionals, Scarr reports.

The performance of the biological children, though, did correlate with the IQ levels of their parents. That, combined with the slight but consistent score superiority of the biological youngsters, leads Scarr to conclude that "there are genetic differences." Beyond the basic reculturation of adoption, she says, "it is not justified to believe that all parents should raise their children as professionals would. We may be trying to create unnecessary homogeneity—it may not make any difference whether you take the child to a ballgame or to a play."

Scarr emphasizes that her results have practically nothing to do with race. In fact, she reports that the black and interracial adoptees scored slightly higher IQ readings than the white adoptees. "I'm not saying that black families are bad—the children we looked at never had a chance to live with their [real] parents, so it was not a question of shifting them from black to white upbringing." The problem, she says, is cultural rather than racial. And the crux of the problem lies with the school systems to which IQ tests are geared. In that context, she says, "white families do a better job of preparing youngsters for the system"—an observation that by no means justifies the