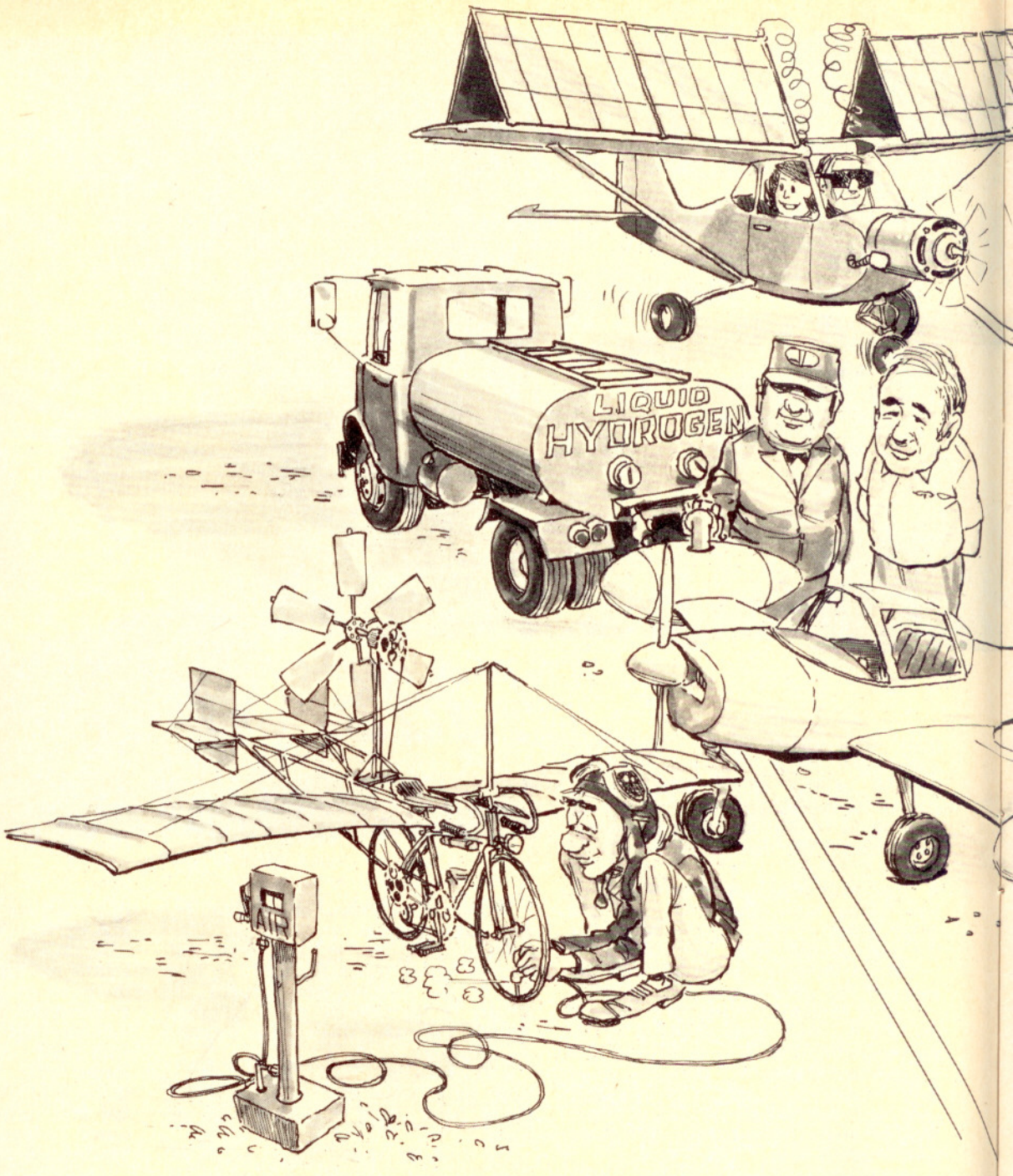


Oil stocks are limited, so the search is on for a fuel that will keep you flying...

by BERL BRECHNER / AOPA 466558

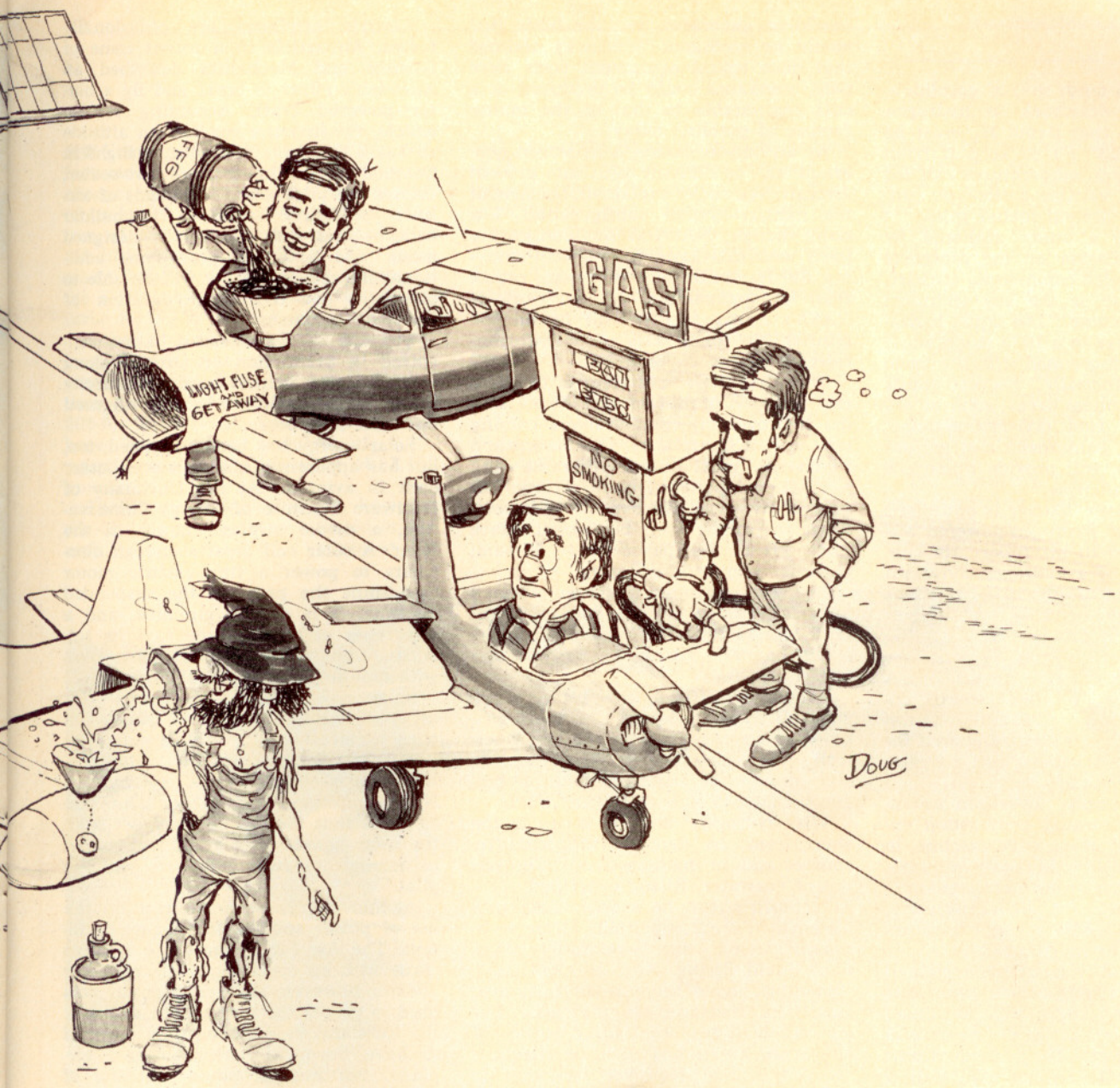
■■ Ever think that in 20 years, when you taxied up to the pumps at your airport and said, "Top 'em off," the line boy would fill your plane with liquid hydrogen?

Why not? If liquid hydrogen can move a 300,000-pound rocket from the earth to the moon, why shouldn't it be able to propel your 2,500-pound airplane from Iowa City to Terre Haute?

There are a bunch of aeronauts (and would-be aeronauts) who are trying to pick up the $125,000 Kremer prize for man-powered flight. No gas, no overhauls, no sticking valves. Just aching arms and blistered feet.

But with a little less fanfare, there are researchers and pilots around the country who are trying to make airplanes fly with power from sources other than fossil fuels, the 80- and 100-octane lifeblood of powered flight. The fuel crisis of last year, along with growing environmental awareness, has brought about the realization that gasoline and oil will not be available forever, and something will soon have to replace them as the world's prime source of energy.

Experiments have been made with energy from the sun, from atoms, from batteries, and from grains.



When the Gas is Gone

But the most promising source of energy so far, and apparently the most well researched, is hydrogen.

Beech Aircraft Corp. has jointly sponsored construction of a hydrogen-powered automobile with the Billings Energy Research Corp. in Provo, Ut. The car is operational, Austin Rising, a Beech vice president, recently told Federal Energy Administration officials. "Hydrogen is perfectly feasible as a power source for everything from lawn mowers to locomotives, home heating units, automobiles, boats and aircraft."

Rising, who is in charge of corporate planning and distribution development for Beech, admitted there are still big problems to overcome. Producing hydrogen and making it readily available is probably the largest obstacle now, but one easily solvable, he said.

Rising told The PILOT that the "big thing we need right now is to have government, the nation, and private-business support—to decide on hydrogen as the alternate fuel and get going on it, like we did to go to the moon."

But other experts disagree. "I don't think you and I will ever see the general use of hydrogen around the country," countered William Wintucky, head of the engine section for the National Aeronautics and Space Administration's Lewis Research Center at Cleveland. "It makes sense for commercial aviation because of the large size and large storage capacities available," he said. But problems with liquid hydrogen volume and storage make it almost unfeasible for use in cars and smaller airplanes, he added.

Hydrogen as used in the space program, and as proposed for personal transportation use, would be in liquid form. At present, more than three gallons of hydrogen would be required to produce the same amount of energy as one gallon of gasoline. But hydrogen's

mass is about a tenth that of gasoline's.

The biggest drawback to hydrogen use, though, is that liquid H_2 must be kept cold (−423° F) to keep it from evaporating. Such temperatures call for insulation of a vacuum-bottle-type construction, often several inches thick.

According to a study authored by William J. D. Escher on the prospects for hydrogen-fueled commercial aircraft, hydrogen storage is the key technical problem to overcome. "The liquid hydrogen tank," he says in a 1973 study, must be "thoroughly integrated with the basic airplane." Additionally, Escher points out, "Other technical areas, such as engines, onboard fuel delivery systems, aircraft fueling equipment and ground storage systems, will provide numerous and difficult challenges."

Overall, however, Escher is optimistic on prospects for hydrogen-powered airplanes. Included in his report are conceptualizations of a hydrogen-converted Boeing 747 and a DC-10/L1011-class aircraft. He doesn't foresee such planes, he says, until 1990 or beyond.

More relevant to the present are studies now under way at the NASA Lewis facility. There, two aircraft engines, a Lycoming O-320 and a Continental TSIO-360, are being prepared for testing what the scientists call a hydrogen-enrichment system.

To put it simply, hydrogen is injected into an internal combustion engine's carburetor along with gasoline, to allow for a leaner burning mixture. Early tests of the system with automobile engines have not been conclusive, although some NASA sources have reported a 20% saving in gasoline.

NASA's Wintucky, however, explained that although gasoline consumption was down, enough hydrogen was consumed in the process so that the net result was "no energy savings." The additional testing with aircraft engines will, during the next year, either prove or disprove the value of the system.

If hydrogen injection does show its worth, three major additional components will be required on piston aircraft. First, there will be a tank about one fourth to one fifth the size of the fuel tanks, to hold a water/methanol mixture. (Methanol is a type of alcohol that can most practically be produced from coal, but can also be made from grain.)

This solution is fed into a generator, a second component of the system that is about the size of a small auto muffler, say NASA researchers. The generator is in the plane's exhaust system and, with heat as a catalyst, it breaks down the water/methanol mixture into carbon dioxide and hydrogen.

These chemicals, now gases, are fed through the third component, an evaporator, which improves the combustion characteristics of the hydrogen and creates a more efficient system.

The water/methanol mixture may prove to be a fuel in itself, said Wintucky. A small amount of hydrogen would be generated, but the basic fuel would be methanol. Wintucky claimed that once initial equipment costs were paid, methanol could be produced at a cost comparable to that of the manufacture of gasoline today.

As an add-on device, a hydrogen generator will be difficult to fit into present aircraft, Wintucky explained, because of the exhaust-system configuration. For now, though, NASA is not concerning itself with this hangup; it is still studying the feasibility of the system, rather than its applicability. All the work at NASA's Lewis facility will be on the ground. No flight tests of a hydrogen-injected engine are planned.

Stan Green, vice president of the General Aviation Manufacturers Assn., sees the hydrogen-injection systems coming into use in lightplanes. His association represents most major airframe and aircraft component manufacturers in general aviation. He expects that such a system might even be commonplace in five years. But beyond that, he said, there is "very little going on."

In Green's opinion, hydrogen-powered aircraft would be large planes, not general aviation aircraft. "When it happens, it will happen because someone else did it first," he says.

Even Austin Rising at Beech Aircraft, with all his enthusiasm for hydrogen-powered airplanes, thinks the big American auto manufacturers are going to have to lead the way in applying hydrogen technology to the everyday world.

Why hydrogen? Because it can, in the short term, be derived from coal resources and, in the long term, be broken out of seawater, Rising explained.

"Hydrogen can be economically produced; it is environmentally clean, technically sound, and potentially abundant," said Rising. And, he continued, "Scientists agree there is an unlimited supply of hydrogen in the seas. Our nation's coal resources [as a source of hydrogen] are estimated to be adequate for 500 years. However, research is needed in developing improved methods of recovering hydrogen from these two sources."

Hydrogen as a fuel for airplanes is by no means a new idea. In 1956, under the auspices of NASA's predecessor, a B-57 jet flew with one engine fully liquid hydrogen fueled. About the same time, the Air Force contracted with Lockheed to design an operational liquid-hydrogen-fueled airplane. The project was later scrapped, but the design went on to become Lockheed's SR-71, the Air Force reconnaissance plane that has been slashing transatlantic speed records in recent months.

But it was the space program in the sixties that made hydrogen as a fuel "commonplace." Highway transport of liquid hydrogen evolved, along with increased knowledge of handling and storage methods.

Are other power sources feasible for use in airplanes? Several are occasionally suggested, but there is a good deal of concomitant skepticism about the few remaining alternates.

Electric airplanes are occasionally tested. An article in a recent issue of Science and Mechanics described an Austrian's effort to build and fly a battery-powered craft. According to the article, the inventor reached an altitude of 1,000 feet in a nine-minute flight in October 1973. The craft, a two-seater, carries the pilot and 132 pounds of airliner-type Varta batteries. The builder believes that with a specially designed motor and batteries, plus some additional improvements, he will be able to obtain a powered flight duration of about 40 minutes.

But one of the skeptics, a man involved in production of aircraft along more traditional lines, said, "Electricity has great potential, but he hasn't figured out those long cords."

Solar energy has been suggested, too, but has apparently made an even lesser dent in aviation. At the University of Delaware Institute of Energy Conservation, a model airplane hangs in the foyer. A solar cell creates enough electricity to power a tiny electric motor that spins the prop on the suspended airplane. It is only a gimmick, and a researcher at the institute says its scientists have not concerned themselves with creating energy for airplanes.

Solar power would require a vast array of sunlight-absorbing panels on wing surfaces—and would be somewhat less than efficient in IFR conditions. And the skeptic in this instance, a NASA employee, said, "I would venture to guess that the power you'd get from the solar panels on a lightplane would be enough to run a fan to cool the pilot."

Atomic energy seems lowest on the list of power sources for general aviation. The Air Force once flew a cargo plane with an operating nuclear reactor aboard; however, no atomic power was used to propel the aircraft. In addition, the Russians were at one time reported to have flown a nuclear-powered airplane. But nuclear power, because of the weight of lead shielding, is virtually inapplicable to light aircraft. Moreover, there are the safety and public relations problems to be confronted as a wary public eyes the potential of mini-nuclear reactors zipping over towns and villages.

Pedals and bicycle chains might be the answer to the fuel problem—for someone. But as scientific heads turn away from gasoline, there appear to be more practical substitutes on the horizon—though far on the horizon.

One researcher conceded that "the so-called experts are divided" about the benefits, as weighed against the disadvantages, of the several alternate fuels proposed for general aviation.

His analysis was verified by a call to the Federal Energy Administration. An official of the Office of Oil and Gas, Resource Development Section, pointed to significant pitfalls in almost every proposed alternate fuel. "There is no easy solution," he said. "A lot of research, a lot of time, and a lot of energy are going to have to be expended. We just don't have any answers now." □