

# The Moonbird

It is bigger than a football field. Or a 30-story building. Or the Statue of Liberty. It is the biggest rocket in the world—yet it may not be big enough.

By Jonathan Eberhart

➤ **FASTER** than a speeding bullet, more powerful than a locomotive, able to leap tall buildings in a single bound—that may be enough for Superman but it is hardly adequate to get three mortal astronauts to the moon.

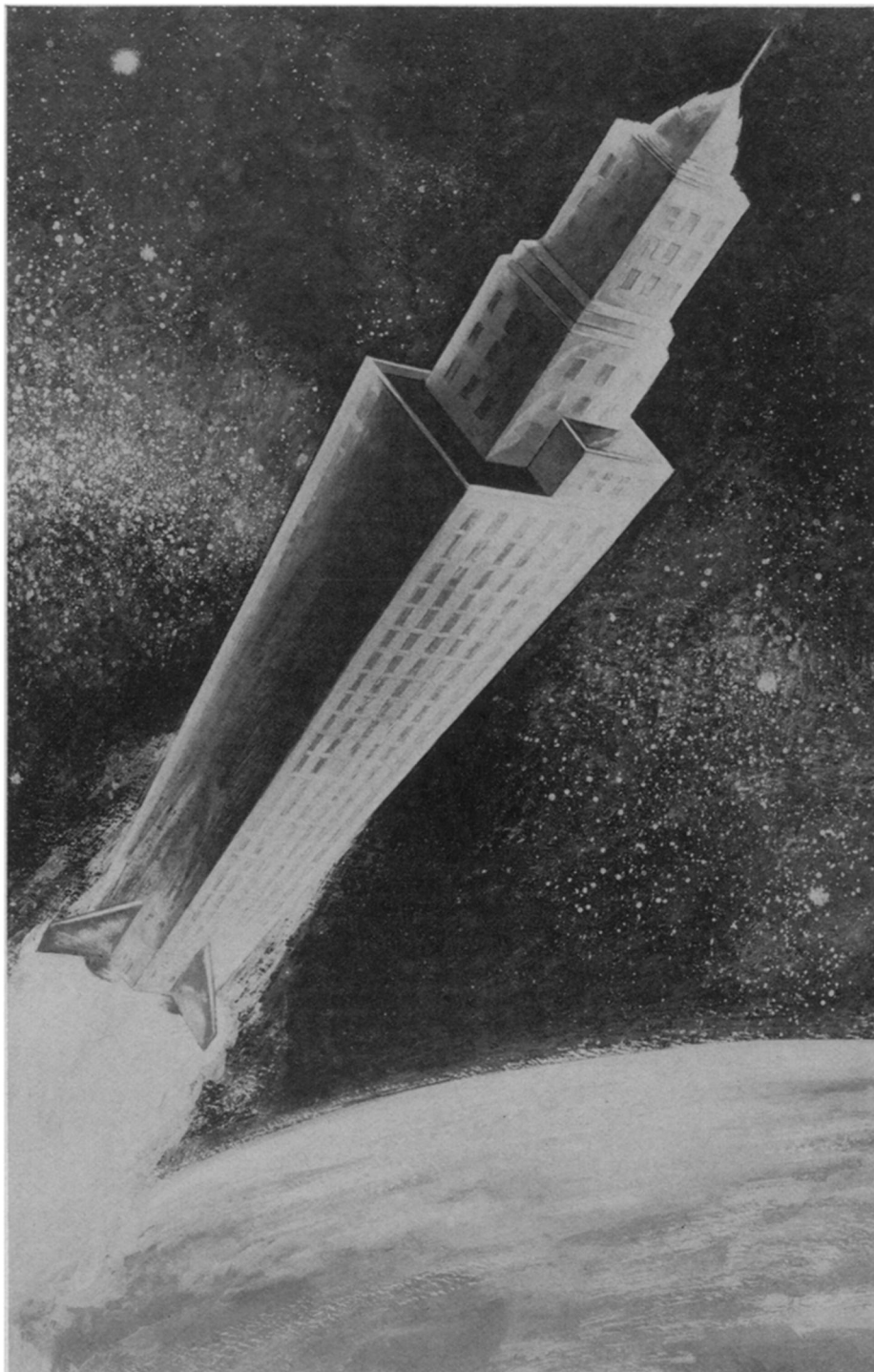
The moon trip is such a mind-boggling project that almost anything afterward will seem like an anticlimax. In fact, that is exactly what is worrying almost everyone in the space business today. It took a declared national goal to amass enough effort for the Apollo men-on-the-moon program, and even that impetus is flagging a bit in such vital areas as the National Aeronautics and Space Administration budget hearings. The problem of what to do next is serious, since Congress is not about to sustain NASA's five-plus-billion-dollar budget without knowing exactly where it is going.

And NASA cannot afford to stall around either. The effect on the economy of letting the big aerospace companies "de-tool" before starting on the next project would be severe indeed. The Big Four companies in the moon effort—Boeing, Douglas, McDonnell and North American—are already past their manpower peaks, especially in their engineering departments, many of which have been working on other things for more than a year.

## Projects in Competition

The Space Age is not likely to end prematurely, however. All sorts of projects are competing for the next big Federal effort, including lunar bases, Mars landings (manned or otherwise), Venus probes, Jupiter probes, permanent earth-orbiting space stations, etc. Some of these ideas do suggest another problem, though, which is almost the opposite of the "what next?" difficulty: is there a rocket big enough?

Scientists working on the Mercury, Gemini and Apollo space capsules have been faced with many problems, but the real hair-tearing has been done by the rocket builders. Every time some spacecraft designer adds another pound to a control unit, it must be compensated for by several times its weight in rocket propellant. As a result, rocket test laboratories such as the Santa Susana field laboratory of North American Aviation's Rocketdyne division (builder of most of the moon



Boeing

**LIKE A 30-STORY BUILDING**—The Saturn rocket that will carry three men to the moon in an Apollo spacecraft towers 364 feet in the air, taller than a 30-story building and more than three times as tall as a Gemini capsule and its Titan booster. The Boeing Company, Seattle, Wash., builders of the Saturn V's first stage, created this impression of the launch.

rocket's engines) have been working around the clock, "uprating" the thrust of the engines in any way possible.

The biggest rocket is not necessarily the most upratable, but Apollo's big booster—the "Moonbird," Saturn V—is certainly a candidate for the honor. The three companies that build it say that it can be made at least 25% stronger than it will be when it goes to the moon, thus enabling it to lift some 7.5 million pounds off the ground. Currently the first stage has a thrust of 7.5 million pounds, but because of the force required to escape from earth's gravity, the lift-off weight will be only six million.

### Many Ways of Uprating

There are all sorts of ways of uprating the Moonbird, and all of them may be necessary if huge, multi-manned payloads of the future are to be launched without having to design an entirely new rocket.

A chief source of extra power is the fuel itself. Rocket fuel is often just plain ordinary kerosene, and that leaves a lot of room for improvement. Liquid hydrogen has already upped the thrust of the second (S-II) and third (S-IVB) stages more than 30%, though several of the problems of handling the super-cold liquid (minus 423 degrees F.) still remain to be solved.

An even more powerful—and more dangerous—substance is FLOX, a mixture of fluorine and liquid oxygen. Most FLOX research has been halted for months by lack of funds, but a need for more power, either to provide more speed or to handle bigger payloads, could start major development programs going again. A year ago, General Dynamics Corporation predicted that FLOX could increase the payload of an Atlas rocket 88% for 100-mile-high orbits.

If the rocket that carried Surveyor to its soft-landing on the moon had been using a 70% FLOX mixture, it could have handled two complete spacecraft instead of one.

Changing the propellant is not the only key. Liquid fuel rockets can be greatly uprated simply by improving

the fuel pump so that liquid can be burned at a greater rate.

Two engineers from Douglas have even suggested adding a fourth stage to the Saturn V's present three. Such a stage could be a Centaur rocket, also liquid-hydrogen-fueled, like the one that kicked Surveyor to the moon. A four-stage Saturn V could carry 20,000 pounds to the asteroid Ceres or 31,000 pounds to an intercept with the comet Encke. Such bizarre destinations are not completely unlikely choices for the future; NASA has already published hundreds of pages of trajectory calculations for flights to Ceres, Vesta (another asteroid) and the planet Jupiter, all based on a flight taking place between 1970 and 1980.

Solid propellant strap-ons could be used to raise the Saturn V's orbital payload (now about 250,000 pounds) to as much as 427,000 pounds. Various combinations of 120-inch, 156-inch and 260-inch boosters could allow "custom-tailored" rockets to be made for all sorts of high energy missions.

### Has 92 Engines

Even without strap-ons and auxiliary stages, the Saturn V has no fewer than 92 individual engines. These range from tiny attitude control motors capable of being turned on or off in one-sixtieth of a second to the huge, first-stage main engines, three times as high as a man, each of which produces more than 1.5 million pounds of thrust.

Of all these engines, however, only 11 are actually used to push the rocket along its path. The rest control direction of travel, or the attitudes of the rocket in space. One is not even being used as a rocket; instead, it is acting as a heater, to convert liquid helium into a gas in order to repressurize the fuel tanks—a necessity for restarting in space. Without the heater,

(Continued on page 109)



**TOTAL LOCK** This lock was tested on a man who is a severe critic of mechanical devices. . . . AND HE BOUGHT IT! This keyless lock securely fastens to any hinged door. . . . goes on or off in a minute. Two small flat pieces of fine steel fitted together makes this a tamperproof, powerful lock without any installation problems. Protects you from intruders. Ideal for people who travel or who are alone much of time. Weighs less than two ozs. Can be carried in purse or pocket. \$2.00 Ea. ppd.

**J. W. HOLST, Dept. L9**  
106 EMERY ST., EAST TAWAS, MICHIGAN 48730  
Send check or M.O.—Satisfaction Guar. No C.O.D.'s.

**GRAPHIC SPEED FILE**  
How to Save Filing & Storage Time With DISPOSABLE DRAWERS

You store material easier and find things faster with feather weight box drawers. Strong corrugated drawers give extra service outside cabinet.

Save transfer time -- store or discard drawers with contents -- add economical replacements.

Eight sizes, all interchangeable in steel cabinet. Use singly or in any sequence to fill your needs.

Your material is stored flat. Hinge type drawer lid gives extra protection. Price only \$49.95 plus drawers.

**FREE** 16 Page BOOKLET No. 20-AE Mailed Without Obligation

**GRAPHIC SYSTEMS, Box 398, Yanceyville, N.C.**

**UNUSUAL SCIENCE BARGAINS**

**Bargain 3" Astronomical Telescope**  
See the stars, moon, phases of Venus, planets close up! 60 to 180 power—famous Mt. Palomar Reflecting type. Unusual Buy! Equipped with Equatorial mount; finder telescope; hardwood tripod. Included FREE: "STARCHART"; 272 page "HANDBOOK OF HEAVENS"; "HOW TO USE YOUR TELESCOPE" book. Stock No. 85,050-Q. \$29.95 Ppd.

**4 1/4" Reflecting Telescope**—up to 270 Power, all-metal pedestal mount. Stock No. 85,105-Q. \$84.50 F.O.B.

**Games of Logic For Thinkers!**  
**WFF'N PROOF**  
Exciting as poker, complex as chess. Gives practice in abstract thinking and math logic. Developed by contemporary Yale professor. If you think learning should be fun, try WFF'N PROOF brain-to-brain combat! 21 games of progressive difficulty. Starts with simple games mastered by some 6-year-olds, 8 1/2" x 5 1/2" case contains logic cubes, playing mats, timer and 224 page Inst. book. Stock No. 60,525-Q. \$6.00 Ppd. WFF'N PROOF EQUATIONS. 5 games for grades 1-12. Stock No. 60,526-Q. \$2.50 Ppd.

**24 Authentic Scale Models of TERRIBLE LIZARDS & MONSTROUS MAMMALS**  
Explore the fascinating prehistoric world of dinosaurs 200,000,000 years ago. New kit contains 12 dinosaurs and 12 mammals in sturdy plastic. Includes Giant Brontosaurus, fierce Tyrannosaurus Rex, Woolly Mammoth of the Ice age, deadly Smilodon ("Saber-Toothed Tiger"), others ranging in size from 2" to 6". Also includes dinosaur bone approx. 1", box of assorted colored lichen for making life-like trees and shrubbery, "How and Why Wonder Book of Dinosaurs," inst. for building your own dinosaur land from readily available materials and complete description. Stock No. 70,817-Q. \$5.00 Ppd.

**Fascinating Toy Adaptation of Binary Digital Computer BEAT "DR. NIM" IN ANCIENT GAME!**  
Not easy, but fun for all! Thrilling for youngsters. Challenging for adults. Teaches computer fundamentals, without need for mathematical ability. To play, release 1 game board through series of flip-flop channels. How you SET flip-flops to begin and path of travel for each marble, determines path of succeeding marbles. All plays predictable. Now DR. NIM automatically plays 1, 2 or 3 marbles. If you can make him take the last marble you win! Game great for playroom and parties, year-round fun. Durable red & white plastic 11 3/4" x 12 1/2" x 1 1/2". 24-p. Instruction Booklet. Stock No. 76,816-Q. \$2.98 Ppd.

**BATTERIES GUARANTEED RECHARGEABLE FOR 5 YRS.**  
Use these remarkable space-age Nickel-Cadmium batteries in flashlights, portable radios, toy or flash guns. Obsolete all others! Low-cost kit includes compact, highly efficient battery charger and 2 "D" size Ni-Cd batteries guaranteed rechargeable to full power for 5 yrs. Power output remains constant—doesn't fade away as with lead-acid cells. Durable, black plastic charger 5 1/2" x 3" x 1 1/4" dp. plugs into standard wall outlet. Completely charges 1 or 2 "D" or "C" size batteries in 16 hrs. Light shows when unit is charging—will not overcharge. Stock No. 60,591-Q. \$9.95 Ppd. Stock No. 60,592-Q (Charger only) \$5.98 Ppd. Stock No. 60,593-Q (Two "D" Cells only) \$5.98 Ppd.

**WAR SURPLUS ELECTRIC GENERATOR**  
Brand-new Signal Corps Generator for endless experiments, electrical uses, demonstrations. Generates up to 90 volts by turning crank. Use in high impedance relays. Charge ground and bring up night crawlers for fishing bait. Has 2 Alnico Magnets. Wt. 2 lbs. Cost Govt. \$15. Stock No. 50,225-Q. \$6.95 Ppd. Same type generator, mounted with light, as electricity demonstrator. Stock No. 50,365-Q. \$11.95 Ppd.

**WOODEN SOLID PUZZLES**  
12 Different puzzles that will stimulate your ability to think and reason. Here is a fascinating assortment of wood puzzles that will provide hours of pleasure. Twelve different puzzles, animals, and geometric forms to take apart and reassemble, give a chance for all the family, young and old, to test skill, patience and, best of all, to stimulate ability to think and reason. Stock No. 70,205-Q. \$3.00 Ppd.

Order by Stock No.—Send Check or M.O. Shipment same day received—Satisfaction or money back.  
**TEACHERS: Write for Educational Catalog Q-2**  
Edmund Scientific Co., Barrington, N.J.

**MAIL COUPON for FREE CATALOG "Q"**  
EDMUND SCIENTIFIC CO.  
Barrington, New Jersey 08007  
Completely new 1966 Edition. 148 pages. Nearly 4500 BARGAINS.  
Please Rush Free Catalog "Q"

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

## The Moonbird

(Continued from page 107)

the helium would have to be stored as a gas, in much heavier tanks. Result of the innovation (created by Douglas engineers): 800 extra pounds of available payload.

One of the few things that NASA is certain about in its efforts to plan future space programs is that existing hardware must be used as much as possible. At least half the cost of the Apollo program is simply that of research and development.

Certainly the biggest piece of hardware around is the Saturn V, so it is a natural choice for as many applications as possible. One, again suggested by Douglas, would be to make experimental space stations out of the empty fuel tanks of spent Saturn V third stages, of which as many as 46 may have been launched within the next 10 years. Each tank would provide 10,000 cubic feet of enclosed, airless space to experiment in, and the necessary modifications could be made by two astronauts with hand tools. A 65-inch-diameter airlock, producible in quantity for \$200,000 apiece, could be installed with no changes in the present design. At a present cost of a million dollars per tank, such double usage could well be worthwhile. NASA thinks so too, and gave Douglas \$50,000 to investigate the matter.

### Taller Than Gemini

A Gemini spacecraft, atop its Titan booster, stands 109 feet high. The first part of its flight is controlled by pre-programmed computers (which work so well that Gemini 9 went up flawlessly despite a malfunction in one computer which prevented it from receiving the most up-to-the-minute launch data). Saturn V, however, stands well over three times as high as a Gemini stack. As a result, there could be a much greater effect from wind buffeting. Just to be on the safe side, NASA told three of its engineers to find out whether an astronaut, sitting in a spacecraft on top of the rocket, could actually fly the Saturn V "from the ground up," compensating for the effects of wind, fuel sloshing (which affects the center of gravity), and even bending of the rocket itself (since making a Saturn V completely rigid would mean making it so heavy that it would never get off the ground).

Not only would the idea work, the team concluded, but pilot control in

"emergency modes" could make the difference between completion of the flight and failure. Nevertheless, it is quite unlikely that NASA will decide that such a safeguard is necessary. Weather experts at Cape Kennedy give accurate enough warnings to prevent a launch during severe winds.

Despite all the investigation into modifications, future uses, uprating techniques and alternate control systems, no Saturn V has yet been launched, and it will be months before the first one is fired. When that day comes, unless the entire population of Florida is inside glued to its television set, observers 50 miles or more from the Cape may look up and cry, "It's a bird! It's a plane! It's the Moonbird!"

## Nature Note

### Jewel Wasp

► THE HEAD and thorax of the male jewel wasp are emerald green, while those of the female have a deep blue-black iridescence. These bright colors on the tiny wasps have given them their name.

The jewel wasp, *Mormoniella vitripennis*, is exceptionally useful as an experimental animal for scientists. Many have been used in studies of animal behavior, ecology, physiology and genetics.

For instance, the female wasp is a master of physiological economy. She uses the same tube at the tip of her tail for drilling, procuring her food and laying eggs—and she does not sting. She drills through the hard pupa case of a fly in order to suck the larva's blood, or to lay her eggs. As the baby jewel wasps grow and develop, they feed on the fly until it is completely destroyed. Scientists once hoped that the jewel wasp could be used to destroy blowflies, houseflies, and blue bottles in great quantities. But unfortunately many fly maggots turn into pupae too deep in the soil for the jewel wasps to reach.

The female wasp is about three millimeters long, somewhat larger than the male, with well-developed wings. The male's wings are so small they are useless for flight, though they are used in courtship and other activities.

The jewel wasp is found in many parts of the world—Australia, India, England, the United States and Chile.

### TELLS HOW TO SELL YOUR INVENTION

If you have an invention that you believe has merit, write us at once for copy of copyrighted booklet "How to Go About Selling Your Invention." We work with manufacturers, and booklet reveals present markets, qualities of a saleable invention, current royalty rates being paid by manufacturers. Booklet is FREE, is offered to encourage new ideas we might submit to manufacturers. Just send name (no drawings please) to Kessler Sales Corp., Dept. D-418, Fremont, Ohio 43420

Kessler Sales Corp., Dept. D-419, Fremont, Ohio 43420

## Do You Know?

When the *China Clipper* flew from San Francisco across the Pacific to Manila in 1935, a flight that now takes 16 hours, it took almost 60 hours flying time.

A new law prohibits *dolphin* fishing in the USSR.

*Nitric oxide*, an air pollutant that reacts in the presence of sunlight and other common air contaminants to form ozone, may make people feel unaccountably tired.

When a Japanese research professor reaches *retirement* age at 63, it is customary for his laboratory to be closed and research discontinued, no matter what stage it had reached.

## Chicago Man Reveals How to Make Money

—writing short paragraphs



Now anyone who can write a sentence in plain English can write for money without spending weary years "learning to write."

For many years now, thousands of amateur "spare time authors" have been selling contributions to magazines and earning 5-10 times *more* per word than famous writers.

Mr. Benson Barrett was one of those people. By using a method known to only a few people, he enjoyed a steady income and made enough money in spare time to pay for a fine farm near Chicago, Illinois. Finally, he decided to share his secret with others. Since then, he has shown a number of men and women how to write for money—*without tedious lessons or study or practice*. And many of these people started mailing contributions to magazines *less than two weeks* after starting with Mr. Barrett's plan! He simply showed them *what* to write, *what form* to put it in, *who to send it to*.

Mr. Barrett's plan also shows you a simple method for *getting ideas* by the hundreds, and a list of more than 200 magazines which will buy short paragraphs from beginners. In short, he shows you a method, an angle—a plan for starting to write right away for money.

If you would like to write 20 or 30 short paragraphs a week and get back a lot of small checks in the mail, send a card today for full particulars, Free. No salesman will call on you. Write: Mr. Benson Barrett, 6216 N. Clark Street, Dept. 163-H, Chicago, Ill. 60626

### FREE CATALOGUES OF SCIENCE BOOKS

State your interest! Mathematics, physics, history of science, general science, biology, social sciences, earth sciences, chemistry, languages, philosophy, engineering. Dover publishes over 100 books per year; quality production standards, priced for your budget. Dept. SNL, DOVER, 180 Varick St., New York, N. Y. 10014.