FACT

COSMIC BUTTERFLY

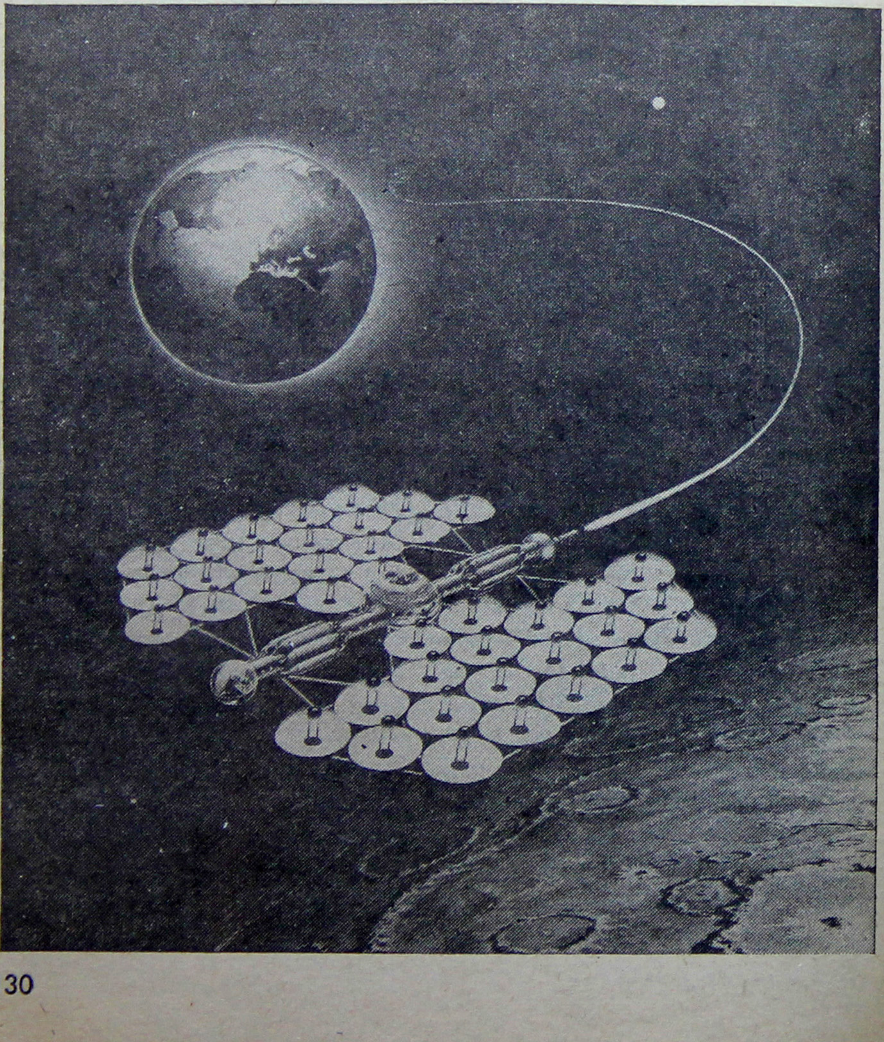
By FRANK TINSLEY

The Stuhlinger concept of a solar powered, interplanetary vehicle, was one of the first, true, spaceship designs . . .

IN current usage, the terms "spaceship" and "space travel" are being kicked around rather loosely. Accustomed by now to the launchings, lift-offs and men in orbit, the public tends more and more to accent headline terminology—to think of today's Redstone and Atlas rockets as "Spaceships." Actually, as you and I well know, these outsize fireworks are merely first-stage boosters—cosmic tugboats that lift the exploratory vehicles off their pads and build up their initial speeds. Dropped ignominiously when their part of the job is done, the big pushers almost never rise beyond the earth's atmosphere. As a rule, only the final stage or two of the vehicle ever gets into orbit, and even these can hardly be called "spaceships" with any degree of accuracy.

In time to come, such craft will be dismissed as workaday ferries or local satellites, operating as routine maintenance machines or earthbound observation stations. Only the cosmic Queens, the manned and controlled interplanetary vehicles, will be classed as true "spaceships." To earn that proud designation, they must be independent entities, capable of entering or leaving orbits at will and changing course and destination at the direction of their pilots. Operating only in the weightless, frictionless areas of our solar system, the powerplants of these craft will differ completely from today's gravity conquering rockets, and their unusual forms and design features will seem odd indeed to earth habituated eyes. All our age-old engineering knowledge, predicated on the weight and strength requirements of our gravitational pull, will have to be tossed aside by tomorrow's spacemen. These builders of the future will have to start from scratch—reorient their ideas to a whole new spectrum of engineering criteria, methods and materials. The problems presented by this new frontier, have intrigued a few of our more farsighted and imaginative minds and already, a scattering of theoretical spaceship designs have appeared.

ONE of the earliest of these was envisioned by the German astro-engineer, Dr. Ernst Stuhlinger. A leading light of the famous Peenemunde V-2 group, brought to the U.S. after the fall



Reprinted by Courtesy of American-Bosch Arma Corp.

of Hitler, Dr. Stuhlinger now heads N.A.S.A's Marshall Space Flight Center at Huntsville, Alabama. Based on his expert knowledge of space physics and experimental powerplants, the Cosmic Butterfly was the first soundly engineered vehicle to develop electric power from solar heat, and employ an "ion engine" for propulsive thrust. This huge machine, named for its plan-form resemblance to a fluttering butterfly, weighs far less than any chemical-fuel ship of its capacity and develops but a fraction of its power. Yet in space, where even the slightest nudge can move a mountain, its overall efficiency is vastly superior.

Back of the Butterfly's unique design is a thorough understanding of the logistics of cosmic flight. Dr. Stuhlinger was convinced that the enormous amounts of fuel required to break free from the earth's gravitational grip made earth launchings far too expensive in ship size, weight and cost. It seemed obvious to him that economical spaceships must be assembled at and launched from a gravity-free earth satellite, and that they must terminate their flights at similar stations orbiting around the destination planets. It meant that the ship's component parts, plus its fuel, supplies and passengers, must first be shuttled from earth to the satellite base—and that a like ferry system is necessary at the other end of the trip. This set-up is now generally accepted as the most efficient method possible.

AT THIS point, however, Stuhlinger parted company with proponents of conventional propulsion. If chemical rockets were used on the interplanetary leg, he pointed out, some 170 pounds of fuel must be ferried up to the satellite base for every pound of the spaceship's payload—and each of the 170 will require half a ton of ferry fuel to hoist it through the earth's gravitational field! The staggering cost and difficulty of such a project is apparent. The Doctor considered it obvious therefore, that chemical fuels were out as far as interplanetary cruises were concerned. While technically possible, the excessive cost makes it a poor bargain. Instead, he proposed something new—a combination of the Saenger system of electro-particle propulsion, and Dr. Abbot's solar steam plant as a power source. It has been computed that around a kilowatt of radiant energy falls upon each square meter of space throughout the solar system. Stuhlinger determined to put this free sunpower to use.

His spaceship design, capable of carrying ten passengers, plus fifty tons of cargo, weighs only

250 tons—as compared with 1,100 tons for a chemically fuelled rocketship of similar capacity. Flight time from an earth satellite to one orbiting around Mars is approximately one year. Even more remarkable savings would result on longer journeys. On a two year flight of some 780 million miles the Butterfly would have a take-off weight of only 275 tons, whereas the chemically fuelled job would tip the scales at no less than 7,500! Furthermore, the rocket fuel would have to be laboriously trucked up to the starting point at enormous cost. The Butterfly, on the other hand, would use free solar energy, picked up as she went along. Altogether, it was a rather attractive notion. Let's sign up for a Martian cruise aboard one of these Butterflies and see what interplanetary travel a la Stuhlinger would be like.

HAVING staggered through our tests and had all the necessary shots, briefings and sessions of hypnotic suggestion, we board a Ferryship. Sitting atop a huge, multi-chambered booster, it towers into the air like a slim, silvery skyscraper. Checked through the gantry gates, we ascend in an enclosed elevator, cross a glassed-in platform and squeeze through the ship's pressure-tight hatchway. There is no need to go into the details of our ferry flight. It is routine and was fully described in an earlier article of this series. So was the wheel-like satellite station at which we land. The trip had all the smoothness of long practice and our cabin aboard the space station left nothing to be desired.

Approaching the satellite on the previous afternoon, we had caught a glimpse of the Butterfly's long, slim body and acreage of shining solar mirrors. Now we seat ourselves in the station lounge to be briefed on the machine's design and operation. Our Skipper, a veteran of the interplanetary service, takes the floor and illustrates his talk with animated movies and a series of breakaway models. After describing the vehicle's general layout and overall design philosophy, he goes on to her unique propulsive system, starting with her basic power source.

This is a space adaptation of Dr. Charles G. Abbot's old solar powerplant, a dish shaped, parabolic mirror that gathers the sun's heat rays and focusses them on a small, spherical boiler mounted above its center. These concentrated rays reach enormous temperatures and water, fed into the boiler's black, heat absorbing surfaces, is instantly transformed into high pressure steam. This is piped to a conventional turbine which, in turn, whirls a generator and produces electric power. Thus Abbot has translated solar heat into motion and then electricity.

In Stuhlinger's version of the system, a lightweight turbogenerator of 200 kilowatt capacity, is mounted below the mirror bowl. Two disc shaped heat diffusers are placed below it in the cold shadow of the mirror. One of these cools the generator and the other condenses the used steam exhausted from the turbine. The entire power package revolves around a central axle, developing sufficient centrifugal force to trickle the generator coolant and steam toward the outer rims of the discs. On the way, they transfer their heat to frigid outer space and the steam reverts to water. From the rims, both are then pumped back into their closed systems, to be used over and over again. The complete powerplant is made up of forty such individual units, mounted together in two groups on either side of the spaceship's body. In plan form, they resemble the wings of a gigantic butterfly and give the ship its name. Each unit is self-contained and continues functioning even if its neighbors are smashed by flying meteoric fragments. Acting together, they produce a total of 8,000 kilowatts, ample to propel the ship and power its auxiliary equipment.

The electricity thus obtained, the Skipper then explained, is carried to a propulsion assembly at the rear of the spaceship body. This, too, consists of a number of individual units. In each of these, Cesium vapor is introduced into a hexagon shaped, ceramic chamber. There, its atoms strike a grid of incandescent platinum plates, which absorbs their outermost electrons. This leaves a stream of positively charged ions which pass through the grid and into a thrust chamber. Here, the ion stream is accelerated to extremely high velocities by a collar of negatively charged electrodes placed around the chamber's rear nozzle. Passing these, it is discharged in the form of a high speed electrical jet exhaust. This jet propels the ship in exactly the same manner as does the gas exhaust from a conventional reaction engine.

THERE were several serious bugs in Stuhlinger's system, but at the cost of some electronic complication the Doctor eliminated them. First, to prevent the spaceship from building up a negative charge from the split-off electrons, these, too, must be ejected simultaneously and at the same rate of speed as the ions. This he accomplished through the use of supplementary electron thrust chambers, surrounding the ion nozzles.

Then came a second difficulty. Unless the ions' accumulated charge is neutralized immediately upon leaving the thrust chamber, it will tend to repel the following ions in the discharge stream, thus slowing down the overall jet velocity. This is the "space charge effect" familiar to designers of electronic tubes. To counter it, the Doctor crossed his separate streams of ions and electrons and combined them about an inch outside their nozzles. This cancels off the objectionable charge and permits the engine's full designed velocity to develop.

Approximately a thousand of these propulsion units are used, each measuring two inches across. They are clustered in a honeycomb arrangement to obtain the total thrust needed. This is comparatively low—on the order of one ten-thousandth of the force of earthly gravity. In the vacuum of space however, the Butterfly is weightless and frictional drag nonexistent, so even the tiniest push will start her moving, and a continual push will build up a constant acceleration. So unlike chemical rockets which burn their fuel fast and then coast through most of their journey, the Butterfly's thrust is employed throughout the voyage. During the first half, it is used to accelerate to maximum speed. Then, at the halfway point, the ship's tail is reversed in a 180 degree turn and the thrust, acting in the opposite direction, gradually slows her down and brakes her to a halt.

Having been briefed on our argosy's general form and propulsion system, we are ushered into a small space tender and rocketed out to the ship. Our little craft is hardly bigger than one of the Butterfly's power units and as we chug beneath a wing to reach the airlock in her belly, the expanse of forty-foot cooling discs hangs above us like an endless ceiling of inverted mushrooms. Only a few of them are spinning—just enough, we later learn, to feed the lights and air-conditioning circuits. Arriving at the entry port, our tender locks on and we float up through an airlock chamber and into a large, circular room. I say "float" because with the ship motionless in orbit, we are in a completely weightless state.

A TOUR of the Butterfly's environmental equipment reveals it to be much like the set-up developed for space stations. A system of hydroponic gardens absorbs the carbon-dioxide exhaled by the crew and by the process of vegetable growth, transforms it into fresh, bracing oxygen. The fast growing algae also provide a high protein food additive, with the excess crop consigned to biochemical fuel cells where they develop reserve electrical power. This plant-propagation gear, together with its allied air-conditioning apparatus, power facilities and shops, are installed in the rear extension of the fuselage, which terminates in the ion engine-room. The cabins and living quarters are forward. Cargo and supply holds, subject to a gradual lightening en route, are placed low and as near the ship's center of gravity as possible.

A few hours after we come aboard, the Butterfly's engines begin to push and the big spaceship takes off according to schedule. Her long spiral flight has been pre-calculated and programmed to the minute, timed to take every advantage of the confluence of Earthly and Martian orbits. The actual journey is uneventful and, toward its end, boring. For the first few days we all relax in an easygoing vacation mood. The constant forward acceleration has restored normal gravity and we laze around the public rooms much as we would in a resort hotel. After awhile, we drift into a round of jobs in our specialties—lab work, astronomical studies, etc. Unlike the explorers of earlier ages we encounter no hardships and our adventures are all those of the mind.

THE END

WE ARE GROWING . . .

and you can grow with us by placing a small classified ad in **AMAZING's** Shopping Guide.

For as little as $2.50 (25¢ per word; 10 word minimum) your classified message will be read by more than 50,000 active buyers each month.

Test them today! You'll be delighted with the results!

For complete details, write:
Martin Lincoln,

Classied Advertising Manager

AMAZING

One Park Avenue
New York 16, New York

Free to WRITERS
seeking a book publisher

Two illustrated brochures reveal how we can publish, promote and sell your book; tips to writers; facts and figures on how we published over 3000 authors. All types of books wanted. Write Dept. AMZ-3

Exposition Press, 386 Park Ave. S., N.Y. 16

HOW TO PUBLISH YOUR BOOK

Join our successful authors in a complete and reliable publishing program: publicity, advertising, handsome books. Speedy, efficient service. Send for FREE manuscript report & copy of Publish Your Book.

CARLTON PRESS Dept. TF1
84 Fifth Ave., New York 11, N. Y.

UNUSUAL BOOKS

Flying Saucers, Occult, Herbs, Manipulation, Health, Spiritualism, Theosophy etc. **Lists Free!** We can supply any book — in or out of print.

HEALTH RESEARCH
MOKELUMNE HILL 15, CALIFORNIA