FACT

The Mars Snooper

By FRANK TINSLEY

Get ready for the latest thing in space transportation—the convertible Mars rocketship, model 1971.

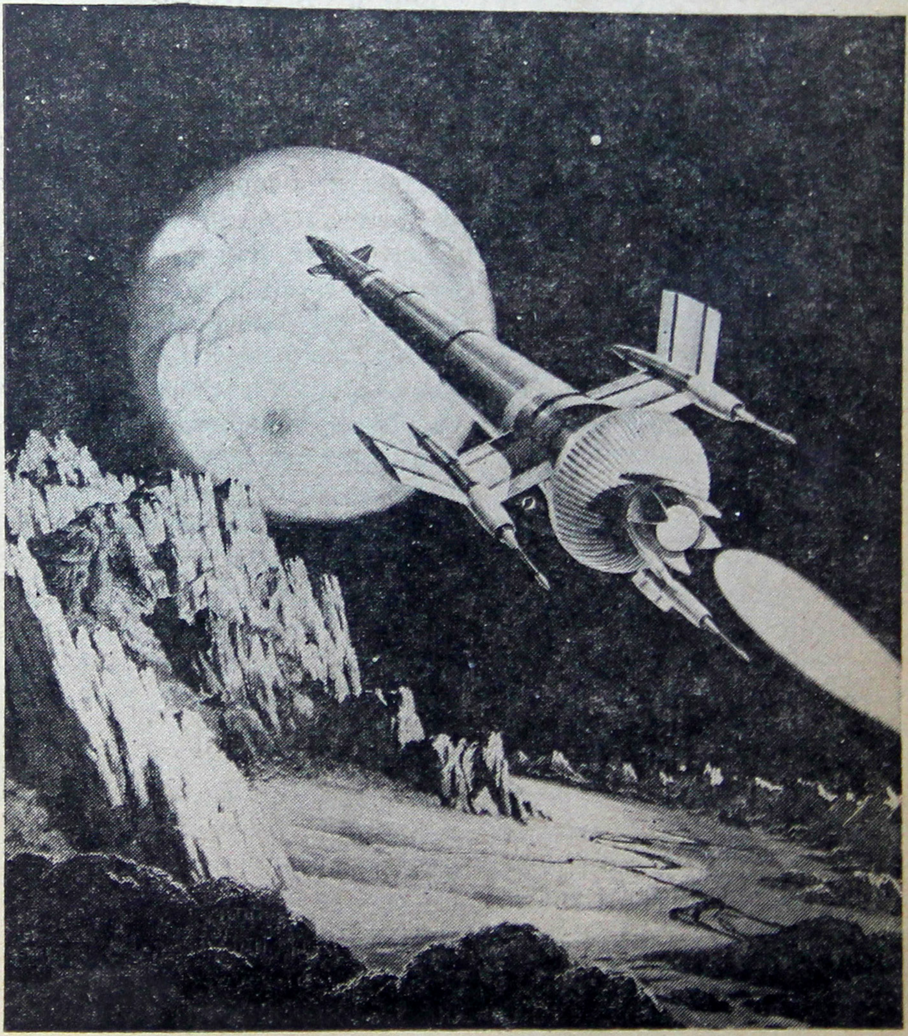
MANY students of space travel believe that in making the Moon our primary objective we are fooling around with the wrong heavenly body. Mars, they contend, offers a far more rewarding study. And, they say, in her closely circling twin satellites—Phobos and Deimos—Nature has provided perfect box-seats for the show.

Actually, the performance put on by our nearest planetary neighbor could be a lot more interesting and profitable than the Lunar one. For Martian conditions parallel Earth's far more closely than do those on the Moon.

For instance, the red planet's day is only a half-hour longer than ours; due to the similar inclination of Mars axis, she has a full range of Earth-like seasons. Mars' gravity is slightly more than one-third of ours, as compared with the Moon's one-sixth. Martian temperatures are more equable, too—noon-hour readings of 50 degrees F. have been recorded in the equatorial regions—and there is even a tenuous trace of atmosphere. As a result, the presence of lichen-like life is probable. With the advent of spring warmth, a green sheen that may well be vegetation replaces the retreating polar ice cap. All in all, therefore, Mars seems a far more likely spot than the Moon for a first stopover on our pioneering space trips.

According to Astronomy Professor Jan Schilt of Columbia University, the 35-million-mile hop to Mars requires only slightly more fuel than our present projects for circumnavigating the Moon. In both cases, the principal expenditure occurs in breaking out of our Earthly gravitational field. Should a Lunar landing be made, more fuel is burnt in setting down, and still more—one-sixth of the Earth escape requirement—in the homeward take-off. While a similar touch-down on Mars, itself, is twice as expensive in fuel, a landing made on either of her miniature moons would be almost fuel-free.

DEIMOS, the outer satellite, is only 12,500 miles from the mother planet, which looms in the Deiman sky almost nine times as large as our Moon appears to us. If we prefer a still closer observation post, the nearer moon, Phobos, is a scant 3,700 miles away from Mars. From this vantage point, Mars' mass virtu-



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ally fills the sky, and the most detailed views and photos are possible. Both of these satellites are tiny—only about ten miles in diameter—and consequently, have a negligible magnetic field. A spaceship could float in to a feather-like landing, and take off again with little more than a shove of the pilot's foot. At Deimos' orbital speed, this ten-pound push would start the ship back toward Earth at 3,000 miles an hour!

Such a trip is not, however, as easy as it may sound. Proper timing is essential and much intricate planning must be done due to the celestial mechanics of the two planets. While Mars' speed around the Sun is roughly equal to Earth's, it revolves at a greater distance. Therefore, its orbital path is almost twice as long as ours. As a result, the two planets line up on the same side of the Sun every two years and two months. The ellipses they describe are such that at its apogee, Mars is 60,000,000 miles away from Earth and at its perigee, around 23,500,000. The Martian orbit is quite eccentric however, and every 15 years when both planets' perigees coincide, they come much closer and are only a little over 35,000,000 miles apart. The last of these neighborly nods occured in September, 1956. The next is due in 1971. So you see that there must be a definite time element involved in planning the most economical trip. Predicted on fuel expenditure and elapsed time, a medium-priced visit would require a two-year stop-over. The really cheap, tourist-class excursion, entails a between rocket wait of 15 years!

While more costly in fuel, the two-year version is perfectly practical for preliminary voyages of exploration. It does, however, pose a host of presently unanswered technical problems. Our spaceship must escape from Earth and travel to Mars during the brief period of orbital incidence. There, its crew must land safely and eke out a rather precarious existence during a complete, 26-month orbital circuit (less, of course, transit time.) As Mars approaches perigee, they must then take off again and return to home base.

All this requires a nicety of astrogation and load calculation. The ship must carry enough fuel to attain Earth and Martian escape velocities, and for power-on landings. To this must be added further allotments for flight, maneuvering, and a reserve supply. The physical and psychological reactions of the crew constitutes a formidable problem in itself. They will be exposed to severe accelerations, periods of weightlessness, long confinement and the strains of survival in an alien environment. Of course, we have already amassed a certain amount of experience in these fields—Arctic and Antarctic winter camps, long submarine voyages, etc. But while atomic sub crews have weathered several months of submersion at a time, on Mars, a minimum of two years is involved!

Then come the multiplicity of engineering headaches connected with such a flight. We have to find worakable answers to problems of countering frictional heat, armoring the ship against solar radiation, developing dependable interplanetary guidance equipment and techniques for safe landings in varying gravitational fields. Add to these the million and one bottlenecks of air supply and circulation, food production, structural and landing gear design, auxiliary and primary powerplants, and you can easily see why we don't start tomorrow.

A VARIETY of methods have been proposed to overcome these difficulties, most of them involving a breakdown of the voyage into a number of stages and vehicles. The first stage is usually a ferry hop in a conventional chemical rocket to an Earth satellite station. There, our astronauts transfer to a true "spaceship" for the interplanetary leg of their trip. This cosmic craft may be propelled by chemical fuels, atomic energy, or several types of electro-rockets drawing their power from solar heat or light. Upon arriving in the neighborhood of Mars the spaceship circles the planet in a high orbit while the explorers descend to their destination in still another ferry which has been towed along like a ship's tender. All in all, the round trip involves two planetary take-offs, two landings, and four changes of vehicles!

The illustration on page 125 shows a simpler concept of interplanetary travel based upon current developments in atomic propulsion. Instead of a number of vehicles employing a variety of powerplants, this concept calls for two distinct types of propulsion to be combined in a single vehicle and fed by a single atomic heat source. These are a nuclear-fueled rocket for space cruising, and a trio of nuclear ramjets for Earth take-off and airplane type flight upon return to our terrestrial atmosphere. Let's take a look at how this team is harnessed together.

As you know, a rocket or jet engine works on the reaction principle, ejecting a continuous, rearward flow of gas under pressure. It is the reverse, gun-like kick of this constant explosion that produces forward thrust. Back in 1687, Sir Isaac Newton first published this principle in his celebrated "Laws of Motion", stating that "every action has an equal and opposite reaction". Thus, the forward thrust generated by a rocket exactly equals the foot-pounds of its exhaust gases. Jet engines provide the gas flow by gulping in vast quantities of air and then passing them through a compresser. This stream of air, containing large amounts of oxygen, is fed into a combustion chamber, mixed with fuel and the mixture is ignited. Tremendously expanded by the ensuing explosion, the gas vents itself at high speed through an exhaust nozzle. Chemical rockets follow a similar procedure, except that lacking air in their passage through space they must carry their own oxygen for combustion. Or, in the case of solid-fuel rockets, the necessary oxygen is combined with the fuel in advance.

THE atomic reactor, on the other hand, does not rely on the combustion of fuel and oxygen. It produces only flameless heat. As a gas exhaust is necessary to make a rocket work, some form of "operating fluid" must be provided. One of the lightest and most compactly storable mediums for this purpose is hydrogen, and our spaceship carries a large supply in liquified form. This is stored in a long, cylindrical tank that separates the tail reactor from the crew cabins in the nose, and forms the body of the ship. Thus, in addition to its propulsive function, the hydrogen doubles in brass as a protective radiation shield. When the throttle is opened, its own pressure forces the hydrogen into the rocket's "combustion" chamber. Here it is expanded by the intense heat of fission and exhausted through a rearward nozzle in conventional style.

The advantages of this system are apparent. Instead of a heavy fuel load, plus oxydizer, we carry only a pound or two of plutonium, good for several years of continuous "fizzing". The saved tankage can be given over to more hydrogen. Even this may eventually become renewable in flight, as current research indicates the presence of considerable free hydrogen in space. If this proves to be true, the gas can be scooped up and compressed to provide unlimited propulsive power.

So much for the space leg of our Martian journey. An entirely different set of conditions are encountered in taking off and landing at our Earth base. Inside the mantle of terrestrial atmosphere, oxygen-laden air is available as an operating fluid and there is no need to sacrifice our precious hydrogen supply. Under these circumstances we switch to a secondary propulsive system—our ramjets. Returning to Earth, these are used as flight engines in circling the globe for a landing. Coupled with a set of ultrasonic, W-shaped wings, they permit our ship to fly like a high-speed airliner. Under complete pilot control, it can proceed to its specially equipped home base and make its approach run. Then, with the ship positioned in a vertical attitude above its pad, we pop stabilizing parachutes and switch back to the rocket to brake our decent. The switch is easy. Equipped with separate sets of plumbing for rocket and ram-jets, the heat exchanging medium can be valved from one to the other. Both operate from a central atomic pile which provides heat for both space and atmospheric flight. While the system may sound complicated, it really is simple.

OUR spaceship is designed to fly in two directions—nose first as a space rocket, and tail first as an ultrasonic airplane. To avoid contaminating its Earth base, the vehicle is launched nose up, by an outsize chemical fuel booster of the Saturn type. When the first stage burns out and returns to Earth, a second stage ignites. This consists of three, solid-fuel units mounted on the spaceship's wing-tips. These bring the ship to escape velocity and are dropped in turn. With its main fuel load of hydrogen intact, the vehicle heads for its destination, coasting on a pre-set course. En route, it tumbles end for end at a calculated rate, generating a degree of centrifugal force approximating Earthly gravity.

Nearing Mars, gyroscopes check this rotation and the ship approaches the planet tail first. Several options now present themselves. Using its rocket in reverse, the spaceship can brake its cruising speed and fall into an orbit around Mars, itself. Or it can brake still more and come in for a landing on either of the Martian moons. Tripod legs, extending downward from the ram-jet intake cones, serve as a self-levelling landing gear. A third option, more expensive in hydrogen consumption, is to land on Mars for immediate exploration of its surface.

On the return voyage to Earth our spaceship takes off under rocket power and accelerates to cruise velocity. Power is then cut off and the vehicle coasts for the major part of the journey. Approaching Earth, the gravity-inducing rotation is again checked and a tail-first attitude assumed. Again the rocket comes into play, braking the ship to a safe re-entry speed. This can be fairly high, due to the design of its "tail cone." The latter is a blunt, heat-shedding shield of the ablative type, corrugated to double its effective area. As the ship gradually slows down and the atmosphere thickens enough to use, the atomic heat is switched from rocket to ram-jets. "Petal" doors now fold inward to enclose the rocket nozzle in a streamlined housing and our spaceship becomes a heat resistant, high speed airplane, whose ultrasonic, M-shaped wings are also fitted with ablative leading-edges. The three small control fins projecting from the nose end of the vehicle function as flippers and rudder, and permit the plane to head for its base under normal flight controls. There the rocket is switched on again to brake vertical decent.

So our first Snooper will return from Mars and her moons, laden with invaluable data, geologic and atmospheric samples, and photographs of a clarity that is literally out-of-this-world. The long debated questions of canals, life forms and environment have been resolved and we can plan intelligently for the succeeding steps of Martian exploration. The voyage has taken anywhere from one to three years, depending on the power and speeds available.

Time is now of the essence. The Russians have taken advantage of celestial mechanics and have recently launched a vehicle to probe Venus. The orbits of Earth and Mars will approach a state of favorable opposition in 1971. Let's make sure that by then, American ships and powerplants will be ready to take advantage of it.

THE END