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**THE CHALLENGE OF THE
SPACESHIP**

Previews of Tomorrow's World

by
ARTHUR C. CLARKE



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THE PLANETS ARE NOT ENOUGH

ALTOGETHER apart from its scientific value, space travel has one justification which transcends all others. It is probably the only way in which we can hope to answer one of the supreme questions of philosophy: Is Man alone in the Universe? It seems incredible that ours should be the only inhabited planet among the millions of worlds that must exist among the stars, but we cannot solve this problem by speculating about it. If it can be solved at all, it will be by visiting other planets to see for ourselves.

The Solar System, comprising the nine known worlds of our Sun and their numerous satellites, is a relatively compact structure, a snug little celestial oasis in an endless desert. It is true that millions of miles separate Earth from its neighbors, but such distances are cosmically trivial. They will even be trivial in terms of human engineering before another hundred years—a mere moment in historical time—have elapsed. However, the distances which sunder us from the possible worlds of other stars are of a totally different order of magnitude

and there are fundamental reasons for thinking that nothing—no scientific discovery or technical achievement—will ever make *them* trivial.

When today's chemical fuels have been developed to the ultimate, and such tricks as refueling in space have been fully exploited, we will have spaceships which can attain speeds of about ten miles a second. That means that the Moon will be reached in two or three days and the nearer planets in about half a year. (I am deliberately rounding these numbers off, and anyone who tries to check my arithmetic had better remember that spaceships will never travel in straight lines or at uniform speeds.) The remoter planets, such as Jupiter and Saturn, could be reached only after many years of travel, and so the trio Moon-Mars-Venus marks the practical limit of exploration for chemically propelled spaceships. Even for these cases, it is all too easy to demonstrate that hundreds of tons of fuel would be needed for each ton of payload that would make the round trip.

This situation, which used to depress the pre-atomic-energy astronauts, will not last for long. Since we are not concerned here with engineering details, we can take it for granted that eventually nuclear power, in some form or other, will be harnessed for the purposes of space flight. With energies a millionfold greater than those available from chemical fuels, speeds of hundreds, and ultimately thousands, of miles a second will be attainable. Against such speeds, the Solar System will shrink until the inner planets are no more than a few hours apart, and even Pluto will be only a week or two from Earth. Moreover, there should be no reasonable limit to the amount of equipment and material that could be taken on an interplanetary expedition. Anyone who doubts this may ponder the fact that the energy released by a single H-bomb is sufficient to carry about a million tons to Mars. It is true that we cannot as yet tap even a fraction of that energy for such a purpose, but there are already hints of how this may be done.