Colonizing Mars.

Enhanced by a third stage employing the same kind of nuclear thermal rocket technology that was demonstrated in the United States in the 1960's a single heavy lift booster would be able to send 24 people one way directly to Mars. If eight such boosters are launched per year, (the same rate that the U.S. now launches space shuttles) the Martian population would grow at a rate comparable to that of colonial North America during the 17th Century. Thus, from the point of view of transportation technology, Mars is as viable a target for colonization today as North America was in 1600.

The question of colonizing Mars is thus not one of transportation, but of the ability to use Martian resources to support an expanding population. The technologies required to do this will be developed at the first Mars base, which will thus act as the beachhead for the wave of immigrants to follow. Initial Mars Direct exploration missions approach Mars in an manner analogous to terrestrial hunter-gatherers, and utilize only its most readily available resource, the atmosphere, to meet the basic needs of fuel and oxygen. In contrast, a permanently staffed base will approach Mars from the standpoint of agricultural and industrial society. It will develop techniques for extracting water out of the soil, for conducting increasingly large scale greenhouse agriculture, for making ceramics, metals, glasses and plastics out of local materials, and constructing large pressurized structures for human habitation and industrial and agricultural activity.

Over time, the base will transform itself into a small town. The high cost of transportation between Earth and Mars will put a strong financial incentive to find astronauts willing to extend their surface stay beyond the basic one and a half year tour of duty, to four years, six years, and more. Experiments have already been done showing that plants can be grown in greenhouses filled with CO_2 at Martian pressures; the Martian settlers will thus be able to set up large inflatable greenhouses to provide the food required to feed an expanding resident population. Mobile microwave units will be used to extract water from Mars' permafrost amd soil, supporting such agriculture and making possible the manufacture of large amounts of brick and concrete, the key materials required for building of large pressurized structures. While the base will start as an interconnected network of Mars Direct style “tuna can” habitats, by its second decade much larger pressurized structures of native brick and concrete will be available.

But the future of Martian colonists will not be to live in dark tunnels. Because the Martian atmosphere provides adequate protection against solar flares, living on the surface in the light of day will be possible. Moreover, the ability to manufacture brick and concrete will allow colonists to greatly expand their living space by providing foundation material for pressurized domes. The first such domes could be imported from Earth. If made of high strength plastic like kevlar, a 50 meter diameter inflatable dome would only have to be 1 mm thick to contain a skylab-like 5 psi atmosphere with a large safety factor, and would only weigh about 4 tonnes. An additional 4 tonnes of plexiglass cut into equilateral triangles to form a pre-fabricated geodesic dome would also have to be sent. This would be erected as a non-pressurized shield above the inflated pressurized dome to protect it from wind blown dust abrasion and material degradation caused by solar ultra violet light. A hundred meter diameter dome would require 32 tons of kevlar and 16 tonnes of plexiglass; a 200 meter diameter dome would need 256 tonnes of kevlar and 64 tonnes of plexiglass. Importing construction material on these scales would be impractical, but it would not be necessary, as all the raw materials needed to manufacture high strength plastics exist on Mars. As a succession of ever larger domes are built, they will be linked by brick and concrete tunnels. The domes will also create a greenhouse effect, providing a spacious temperate shirt-sleeve residential environment. Within the domes, the colonists will live in red brick or perhaps New Mexico style stucco houses, and plant their gardens. Each new reactor landed will add to the power supply, as will locally produced solar panels and windmills, and as more people steadily arrive and stay longer before they leave, the population of the town will grow. In the course of things, children will be born, and families raised on Mars, the first true colonists of a new branch of human civilization.

While the initial exploration and base building activities on Mars can be supported by government largess, a true colony must eventually become economically self supporting. The Mars colony will be able to do this by exporting both ideas and materials. Just as the labor shortage prevalent in colonial and 19th century America drove the creation of Yankee Ingenuity's flood of inventions, so the conditions of extreme labor shortage combined with a technological culture and the unacceptability of impractical legislative constraints against innovation will drive Martian ingenuity to produce wave after wave of invention in energy production, automation and robotics, biotechnology, and other areas. These inventions, licensed on Earth, will finance Mars even as they revolutionize and advance terrestrial living standards as forcefully as 19th Century American invention changed Europe and ultimately the rest of the world as well.

In addition to inventions though, Mars may also be able to export minerals. Like the Earth, Mars has had a complex geologic history, sufficient to form rich mineral ores. Unlike the Earth, however, Mars has not had people on it for the past 5000 years scavenging all the readily available rich mineral deposits to be found on its surface. Rich, untapped mineral deposits of gold, silver, uranium, platinum, palladium, and other precious metals may all exist on the Martian surface.

If Mars has valuable minerals, the colonists will be able to use rocket hoppers using locally produced propellants to lift them from the Martian surface to Phobos, where an electromagnetic catapult can be emplaced capable of firing the cargo off to Earth for export. Alternatively, on Mars it will also be possible to build a "skyhook" consisting of a cable whose center of mass is located at a distance from which it will orbit the planet in synchrony with Mars' daily rotation. To an observer on the Martian surface such cables will appear to stand motionless, allowing payloads to be delivered to space via cable car. Because of strength of materials limits, such systems cannot be built on Earth, but in Mars' 3/8 gravity they may well be feasible. If so, they would give the Mars colonists unique ability not merely to transport goods to Earth, but to access the resources present throughout the rest of the solar system. Mars will become the central base and port of call for exploration and commerce heading out to the asteroid belt, the outer solar system, and beyond.

Life in the initial Mars settlements will be harder than life on Earth for most people, but life in the first North American colonies was much harder than life in Europe as well. People will go to Mars for many of the same reasons they went to colonial America: because they want to make a mark, or to make a new start, or because they are members of groups who are persecuted on Earth, or because they are members of groups who want to create a society according to their own principles. Many kinds of people will go, with many kinds of skills, but all who go will be people who are willing to take a chance to do something important with their lives. Out of such people are great projects made and great causes won. Aided by ever advancing technology, such people can transform a planet and bring a dead world to life.