

drogen combustion is water—not exactly a pollutant. We can conserve the fossil fuels for use as a petrochemical stock for industry. The combination of new materials, of non-polluting nuclear energy, and the non-polluting hydrogen mode for vehicular power, is the means for rendering urban centers once again desirable centers of both residence and industrial production, and an indispensable response to the continued growth of the world's population.

These examples merely illustrate the point: a private initiative in support of the intermediate phase of a Moon-Mars mission-assignment will in and of itself inevitably produce an array of by-products readily suited to immediate large-scale production within the economy.

Not only is private initiative implicitly an economical proposition; it is also more or less indispensable. A summary of certain highlights of the history of industrial capitalism in Western Europe and the United States is most relevant.

Beginning with the collaboration between Cosimo de Medici and Plethon, the Golden Renaissance was both a moral and cultural revolution, and a directed shift of European culture toward a "science driver" mode of development of economy. In order to free mankind from feudal socialism, the socialism of feudal agriculture and urban guilds, enlightened monarchs, including France's Louis XI and the English Tudors, used the royal power to issue patents, to grant limited monopolies (patents) to consortia of inventors and their partners; out of this came the modern industrial-capitalist firm. Out of this, the independent entrepreneurial farmer replaced the feudal peasant, the technologically progressive manufacturer replaced the progress-resistant guilds, and the free citi-

zen as employed operative replaced the emmiserated "proletariat" of the feudal urban centers.

Those creative powers of mind, by means of which individuals discover or assimilate and apply scientific principles, are, by their nature, uniquely the powers of individuals. Progress is sustained, therefore, by those who run ahead of, and often contrary to existing habits and prevailing opinion, by those who always appear initially as the few.

Science itself is characterized by great rigor. No scientist is a scientist if he pits his "free opinion" against the laws of the universe. Yet, as long as the scientist enslaves his judgment to such rigor, it is the nature of all scientific progress, that each important discovery opposes and overthrows previously prevailing opinion among scientists. It is the right of the scientist to be free, as long as he is also rigorous, which is indispensable to scientific progress.

True, there are certain aspects of economy which must never be left to random choices of private investors. Whenever the state fails to exert a monopoly of responsibility for issuance and regulation of its currency, disaster ensues. Basic economic infrastructure, such as large-scale water-management, general transportation, production and distribution of energy, general communications, and essential urban-industrial common services, must be either provided by the government, or provided by governmentally-regulated utilities. Otherwise, disaster ensues. On this point, President George Washington and other leading architects of the 1787 Federal Constitution were emphatically persuaded, and rightly so.

However, governmental bureaucracy is usually an abomination on several counts. As a collectivity, a bureaucracy

Space exploration: the need for a grand vision

Forrest Tierson, professor at the University of Colorado and member of the Space Foundation, Inc., contributed the following discussion of the requirements for a crash program for strategic defense and space exploration, at the Krafft A. Ehrlicke Memorial Conference, in Washington on June 16:

There are two things to make this program work. The first is to make the [Soviet] threat visible to the populations of the Western world. . . . The second aspect of getting this crash program to work is to provide some vision. It's not just a question of responding to Soviet provocation and some Soviet military construction programs.

We have to point out two things. First, what are the very short-term economic advantages to this particular

reindustrialization and movement into space, in the sense of Moon colonies, colonies on Mars, and that sort of thing? That kind of point could be made very easily, when you tie that to the development of power satellites for beaming power to earth, when you talk about metallurgical and crystal-growing experiments that can be done that can provide tremendous new impetus in the area of crystals and micro-electronics. There are crystals that can be taken to produce devices that have tremendous numbers of units per surface area.

One of the ways we can get industry interested is to demonstrate this to them. You get paid back very quickly.

But even more than that, there has to be almost a philosophical sort of Renaissance. It has to do with movement from place to place. I'll speak just for a moment as a biological anthropologist, talking about human evolution in general. Life has existed probably on this planet for three and a half billion years. When that life first arose, the planet was nothing like it is today. It had an atmosphere which was full of ammonia, carbon dioxide, and methade:

reduces the net behavior of its members to a lowest common denominator, stifling creativity. Only military institutions tend to be an exception to this, and those effectively so only under capable leaderships, and under the passion of determination not to lose whatever wars might be foreseen as possible. In agriculture and in industry, most emphatically, governmental bureaucracies, both the politicians and the permanent bureaucracies, are traditionally a disaster in every area but the management of arsenals.

Hence, outside of currency, of banking, of military affairs, of regulation of foreign and interstate commerce, and of provision and maintenance of basic economic infrastructure, a prudent nation prefers private entrepreneurship: wherever government's role in the economy is not indispensable, wise nations prefer that government and politicians not be present. This is not always possible, notably in developing economies, where the state sector performs an irreplaceable role in the industrial sector; but it is most desirable wherever feasible.

This has been shown in the recent years experience with entrepreneurship which has taken up the challenge, while the politicians and governmental bureaucracies either seek to sabotage the efforts or vacillate. The enlightened private sector recognizes readily, that a technological revolution is urgently needed, if economies are to recover from the "post-industrial" decay destroying our civilization today. Governments, which tend to prefer the rhetoric of assumedly popular ideologies to reality, are more concerned with the sound of the words in a policy than the practical consequences of either implementing or refusing to implement such a policy.

just wonderful stuff that we'd all love to step outside now and get a nice big smell of. Over a period of several billion years, those organisms made the Earth as it is today. They purified it. We were mentioning doing something like that with Mars earlier today. But these organisms did that to this planet. We share a history with those organisms, we have some of their genetic material in us today.

There was a period when life existed in the sea and moved out of the sea into a new environment, the land environment. And now we're facing another step in our development. We've reached a point where this planet is not big enough for us and we're facing another move out. We can leave this planet which has been our home for, if you want to talk in an evolutionary sense, perhaps three and a half billion years; if you want to talk in terms of us, ourselves, as a species, perhaps a couple of million years, or less. We can leave that now. It's like leaving home. Leaving home requires growing up, it forces growing up and if we intend to survive, that's certainly one of the things that we have to do as well.

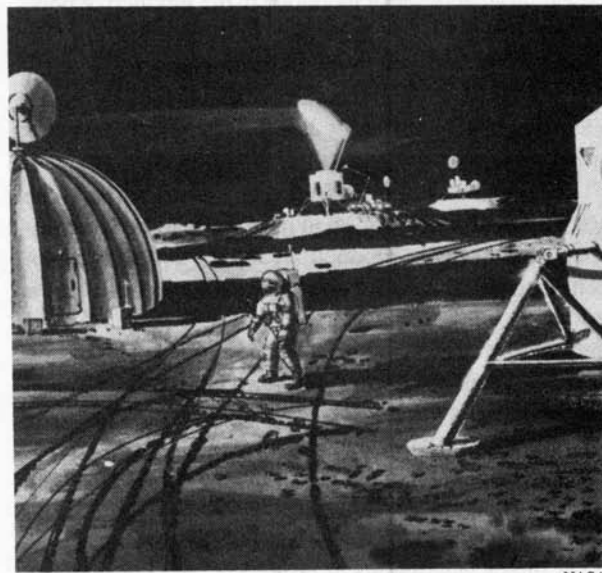
It is the minority of dedicated professionals and industrialists, who are either already taking the lead in the general implementation of the SDI's technologies, or are seriously considering such steps. If those private forces are brought into international cooperation, the aggregations of those persons and of relatively small corners of industrial capacity allotted to development, add up to the order of several billions of dollars in effective impact. For the initial and intermediate phases of a "crash program," cooperation on such a scale promises very impressive results.

We must also consider the important fact, that various nations not part of the Atlantic Alliance do not have the political option of participating in the SDI as nations, although some among these do desire to have use of such technologies for their sovereign purposes. It were an error, to delimit the development of SDI technologies to the U.S.'s own SDI program; this excludes the valuable contribution from nations not part of the Atlantic Alliance.

No matter, the adoption of a Moon-Mars mission-assignment subsumes implicitly every technology required by the SDI, and more. It provides each participating nation the "spill-over" benefits otherwise peculiar to SDI development. It bypasses the political obstacles to participation in SDI development. It puts the research and development in the task-oriented form which coincides with the fundamental interests of each and every nation.

Economic feasibility

It is a commonplace error, to attempt to judge the merits of investment in a new technology in terms of one specific



Artist's depiction of a lunar manned base.