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THE INFINITE VARIETY OF LAND RESOURCES--II

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"What are the important issues that face us as we approach the year 2000? I believe that it will be the way in which man interacts with his environment. That really is the major problem. If we do it properly, then we will be able to conserve the natural environment for future generations and still manage to fulfill our needs. If we fail, then we will suffer the serious consequences (Singer, 1967)."¹

Assessment of man's impact on his environment requires timely repetitive surveys, first to establish an inventory of environmental factors, later to assess changes in the distribution or quality of these factors.

The demand for survey information on a regional and national basis is far outstripping our ability to gather this information and reduce it to map form. This is especially true of surveys of dynamic features, such as the growth or decay of our cities, the distributions of solid, liquid, and gaseous pollutants and other factors of man's impact on his environment.

Today, 70% of the world's maps (at scales of 1:600,000 and smaller) are judged inadequate and 30% are obsolete (Doyle, 1967).² Except for surveys of selected agricultural areas and some urban areas, air photographic coverage is hopelessly obsolete, and some areas of the United States have not been photographed in over 20 years (Udall, 1967).³ The most modern of national land use maps are at least ten years out of date. This obsolescence of fundamental survey data bespeaks the inadequacy of present survey techniques, especially as applied to regional and national surveys.

To match the acceleration in demand then, means must be found to accelerate acquisition of survey data. The development of aerial photography and of airborne geophysical surveying techniques has already increased the rate at which new knowledge of the earth can be acquired, but even with far wider use of presently available methods, the work cannot progress in pace with needs. Fortunately, it appears that the acceleration required can be obtained through the use of "remote-sensing" devices mounted in satellites, provided that means may be found to reduce the data in an efficient and expeditious manner.

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Photographs of the earth, taken from orbit, can be acquired at scales commensurate with mapping requirements. Of greater importance, however, is that "orbital" photographs of proper design, are near-orthographic -- in effect, they are "instant planimetric maps" and require no complex photogrammetric processing. It is this quality of near-orthography, coupled with the great speed of spacecraft that opens to the earth scientist a new vista of resources surveys.

It is not unusual for compilation of a 1:1,000,000 scale map to take ten years or longer; assembly of "space photos" (from a properly designed system) into an equivalent-area map format would take perhaps--ten minutes, and the space-photo map would contain much more detail, be more accurate, and up to date. These qualities are not achievable for conventional maps as they are prepared today.

The quality of near-orthography, coupled with the great speed of spacecraft, makes it possible for earth scientists to have up-to-date base maps, to include distributions of dynamic features, and to readily assess changes in distributions by comparing repetitive coverages.

Maps of dynamic features and changes in these features are the key to most benefits that will befall the resources community from our space program. They will include:

---maps of urban and rural land use--compiled on an annual (or monthly) basis--for analysis of changes in land use and for land-use planning

---hydrologic maps showing the distribution of water and snow--as required for municipal water supply, hydroelectric, irrigation, and water-fowl management.

---maps of vegetation distributions and vigor for assessment of "green-space compression" and stress air pollution and other factors place on vegetation.

---maps of effluent discharge into lakes and estuaries to aid the shellfish industry and help in design of pollution abatement systems.

---maps of agricultural crops to aid in agricultural management and crop yield predictions.

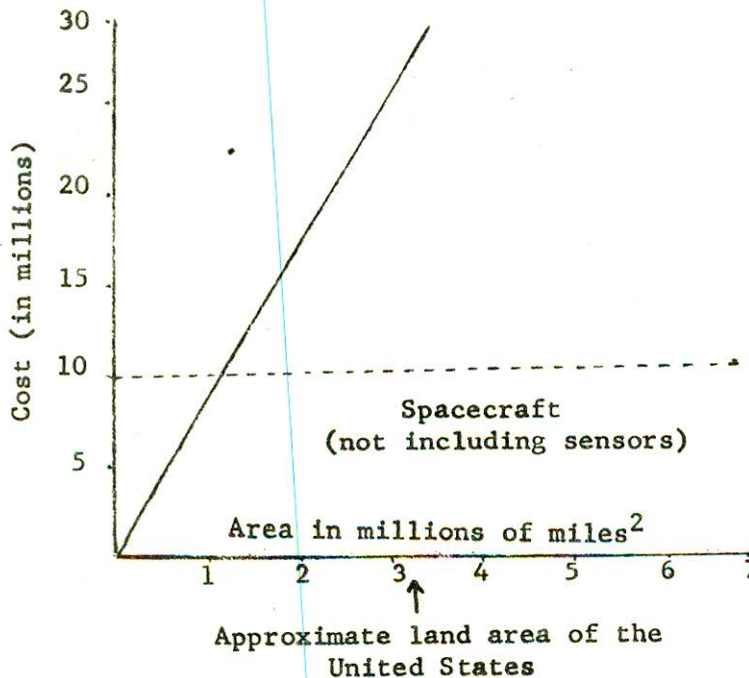
---maps of wilderness areas, National Parks, National Seashores, and other recreation areas, to aid in assessing their use and in their conservation.

---maps of range condition to help in range management and conservation, and

---maps of earth structures to help guide minerals exploration.

From a purely technical standpoint, all of these resource products, and more, are possible. Most, but not all, could be accomplished from aircraft data as well as spacecraft data. From an economic standpoint, however, space systems are the only practical way to meet the need for timely small-scale maps. Table 1 contrasts the costs of acquiring, converting to map form, and interpreting data acquired from aircraft with data acquired from spacecraft.

Step/Unit Costs	COSTS	
	Aircraft	Spacecraft
Acquisition		
Space-\$0.10/sq.mi.*		**
A/C -\$4.00/sq.mi.	4,000,000	10,000,000
Convert to map form		
Space-\$10/photo		
A/C -\$60/photo	6,000,000	1,000
Interpret (for a single purpose)		
Space-\$1.50/photo		
A/C -\$1.50/photo	150,000	150



* Based on 900,000,000/sq.mi. (3-yr) lifetime
 ** Non-recurring cost during lifetime of satellite

