containers to be rolled in and out in a few minutes.

Intermodal containerization is another technique that will cut air terminal delays and handling costs. The loading of refrigerated and insulated van containers at the shipper's plant allows his products to be carried direct to the receiver's loading dock without any rehandling or transfer of individual packages.

Controlled temperatures, humidities, and atmospheric makeup will be maintained inside the containers. This controlled environment puts many perishables to sleep to keep them at the peak of freshness. Handling damage, spoilage, and quality losses will be minimized.

Special types of containers such as those for livestock, with food and water in each of several compartments, will allow live animals to be carried with the same comfort and care as airline passengers.

All transportation, especially international shipments, requires paperwork. Paperwork can be more time consuming and costly than cargo handling, and sometimes the movement of shipments is delayed until the necessary paperwork can be completed.

Plans for cutting through the paperwork jungle cover many fronts. They include simplification of shipping documents, and computerization and automation of many steps in handling and processing. Computers also will process reservations for cargo, days and weeks in advance, thereby assuring the shipper that a plane will be waiting for his shipment when it reaches the airport.

Ground transport of shipments to and from the airports is also receiving attention. Mathematical simulation and systems analysis techniques will be used to find the fastest, lowest cost routing for trucks picking up and delivering air shipments. Such sophisticated analytical techniques also will be used to coordinate cargo flight schedules and pick-up and delivery schedules with the shipper's and the market's requirements.

These are but a few of the many steps which will be taken to speed shipments of agricultural products to market by air in the 1970's. But what about the decade beyond?

Already in the planning stage are such developments as the SST (Supersonic Transport); a six-engine giant subsonic air freighter capable of carrying half a million pounds; a new type of jet freighter made lighter with helium gas; and helicopters with lifting capacities of 25,000 pounds, which could be used to pick up and deliver containers in a few minutes.

MORE AND BETTER, BUT HOW? A RECAP OF OUR NATURAL RESOURCE CHOICES

AFFLUENT AMERICANS will demand more and higher quality natural resources in the future. Provision of more natural resources or their products will present difficult but not insurmountable problems. Meeting the probable demand for higher quality natural resources will require greater technological and social adjustments—and may, in fact, require substantial modification of popular attitudes and prevailing life styles.

So much popular discussion concerns "natural resources" that the term has come to have many meanings, and hence sometimes to be ambiguous. I use it, in this chapter, to include literally any attribute or characteristic of Nature that Man can and does use to his profit or enjoyment.

Thus, I include not only such obvious candidates as minerals and fuels, and forests, land, water, but also such aspects of Nature as a favorable

climate which attracts a labor force which in turn is the basis for an electronics industry. I include also the beauty of a natural or man-made scene and clean water and clear air.

The arguments to support my assertion that more natural resources will be demanded in the future are easily stated. In fact, implicitly they have been provided in earlier chapters. For one basic fact, there will be more Americans in the future than there are today. In every year of our national history, total population has risen; barring some catastrophic war, it will continue to rise in every foreseeable future year.

The instinct to reproduce and the fundamental desire to have a family are basic to the whole of our society. More people will demand more natural resources—it is as simple as that.

But the average citizen of the future will also have a higher real income than his mythical counterpart of today. We older folk need only recall the conditions of life in our youth to realize how dramatic has been the increase in living standards during our lifetimes. Younger people demand today as their rightful due articles of consumption of which we did not dream in our youth. They in turn are going to discover how quickly their standards of living and of consumption get out of date.

If real incomes per capita in the next generation are double those of the present—as many sober economists think probable—then consumption patterns will differ substantially from those of today. And as a result the demands upon natural resources of nearly every kind will increase.

Partly as a result of higher real incomes, but perhaps partly as a result of new standards and concepts, the life style of the average American is changing and will change. For instance, more and more families will possess a second or a third home. It will be increasingly difficult to say where they "live," for some parts of their lives will be in one place, other aspects elsewhere. Some of these additional homes will be mobile.

On Labor Day 1969, my son and I drove through the mountains of Utah and Colorado. Fully half of all the many cars we met on the road were campers—marvelously compact and convenient houses in pickup trucks, for vacation and other second home living. As recently as a decade ago, such campers were relatively uncommon. In another decade or so, nearly every family in the middle and upper income brackets, located near enjoyable outdoor country, will own one, I think.

Or, to take another instance, ownership of high quality sound reproduction equipment (stereos, hi-fi's, tape recorders, etc.) will become nearly universal for every *individual*, not merely for every family. Millions of teenagers today possess such equipment; one need only visit a record shop to see how much it is the young people who buy such equipment and the necessary records or tapes.

At the same time, there are some counter forces which will diminish the need for natural resources, at least relative to the gross national product (GNP). That is, though average incomes may double, average per capita demand for natural resources of all kinds may increase only by half or some other fraction. For one thing, increasingly our total national output is made up of services of many kinds, rather than goods. The beauty shop requires a lot less natural resources than does the manufacture of radios.

It is also true that the average unit of natural resources is processed today to a far greater degree than was the average unit a generation or more ago. Consider, for example, the difference between the iron used for steel rails to build the railroads a century or

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more ago, and the machined and finished metals in present-day space rockets. The one had a very high content of natural resources with a modest complement of labor and capital; the other has a limited component of resources and a very large input of highly skilled labor and of complex machines.

Moreover, the sheer efficiency of natural resource use has risen. This is perhaps most marked in the case of fuels; a pound of coal today produces far more electricity, or far more productive energy at the factory machine, than did a pound of coal a generation ago.

These trends toward more emphasis upon services and less upon goods, toward more processing of average units of natural resources, and toward greater efficiency in resource use will continue in the future. They will temper, but not fully offset, the increasing demands for natural resources growing out of more people, higher incomes, and changing life styles.

It is here that modern technology plays such a large role. Ours is clearly the age of Man most influenced by technology—up to now; but the future will almost certainly be increasingly technological.

One of the major effects of rising technology has been to develop substitutes for scarcer or more expensive resources. The development of a wide variety of versatile plastics, to serve many needs, has taken much of the pressure off of the supply of many minerals and also of some agricultural commodities, such as cotton.

Using coal, oil, limestone, and other common materials, a great variety of plastics has been developed for clothing, packaging, and numerous other uses. In my memory, artificial rubber has developed from an impractical suggestion to a vast industry; and the natural rubber-producing lands of the world have surely felt the impact of this technological development.

Technology can make a previously unusable natural resource usable and valuable. Geologists and others have known for many decades of the vast oil shale deposits of the Western United States and of the vast deposits of tar sands in Canada. The latter have begun to be used commercially; the oil shales are still on the horizon, but constitute a vast reservoir of potential oil for the inevitable day when other deposits of oil and gas are inadequate to meet the demand.

Technology underlies the increases in efficiency of natural resource use described earlier. Indeed, the greatest asset of our country, or any other, is likely to be its institutions of higher learning and research laboratories. With them, adequate natural resources can be found, or invented, or developed; without them, an otherwise generous natural resource endowment may have dubious usefulness.

My colleagues at Resources for the Future and I for 15 years have conducted intensive research on these problems of natural resource supply and demand. We have drawn upon the research of government agencies, universities, and industry; and we have, I think, stimulated some such research by others.

The results of our research can be summarized, somewhat over-simplified, by saying that for the foreseeable future the material well-being of the American people will not be jeopardized by absolute scarcities or seriously rising prices of raw materials. There will be problems in providing enough natural resources of the kinds sought in the time and place demanded, at what seem to be reasonable prices; but the problems are far from insurmountable.

This is a comforting conclusion, in sharp contrast to the viewers-with-alarm who have predicted famine and disaster, from the time of Malthus on down. There is no reason to relax, to assume that the apples will fall from the tree into our laps or our mouths, but no reason to predict doom. These are the bases of my opening statement about the supply of natural resources being sufficient to meet our needs.

Left, signs along highway in a suburban county. Right, after lecture from a State trooper for littering highway, these motorists were given chance to retrieve litter.

But the quality of the available natural resources is something else again. There will be enough water (at a price), but how polluted? There will be as much air as there has ever been, but how polluted? There can be an adequate park acreage, but how littered will be the parks and how cluttered with billboards will the highways be? And so on, one could go through the whole range of natural resources, contrasting the quantity and quality aspects of the situation.

I think it clear that people are going to demand higher quality natural resources in the future. There has been a mounting tide of criticism about air pollution, for instance. Whereas 30 years ago, in the Great Depression of the 1930's, almost any city would have been delighted to have a factory pouring smoke into the air, for that would have evidenced some jobs, today many cities are beginning to enact ordinances and otherwise to control air pollution. Once a stream was looked upon as a cheap outlet for industrial and municipal wastes; today we have Federal, State, and local legislation to control waste discharges and to maintain or improve water quality.

In my youth, we thought it natural to dump our tin cans and other garbage at some convenient spot at the edge of town and were not concerned if a little spilled onto the streets as we hauled our garbage to the dump; today, every State has highway litter laws, with stiff penalties for those who litter the roads. Once upon a time, we felt little demand for parks, depending upon the natural countryside to supply our limited outdoor recreation demands; today, there are National, State, and local programs to acquire and develop more park acreage.

"Beauty" has become a national program or issue, and many persons have become conscious of the scars and blots upon the natural landscape. A Wilderness Act has been passed, and many areas have been or likely will be designated as wilderness, to have no commercial development. These and other recent actions or popular outcries are evidence of powerful public attitudes which will condition natural resource use in the future.

Much of the concern over natural resource quality of the past decade has been more notable for the indignation it has expressed than for the action it has produced. Thus, though every State has a highway antilitter law, most highways are lined with beer and soft drink cans, and facial tissue has been described as our national weed.

Everybody fulminates about air pollution, yet mighty little effective

action to control pollution has yet been taken. The demand for more parks is very vocal, and indeed the voters in many States have approved bond issues to increase park acreage, yet Federal and other commitments to expend funds for this purpose have repeatedly been postponed.

I do not wish to sound cynical. The first step is to arouse people to the need for action; this has been, at least partially, achieved. The problems are stubborn; they did not arise yesterday, and they cannot be solved quickly and cheaply. Persistent action will be called for, and costs must be met some way. One can admire the progress made, and yet be realistic about what is yet to be done.

There is a fundamental inconsistency between our demands or requirements for *more* natural resources, and our rising demand for *better* resources. If we are to have more electricity for myriad consumption uses in our homes then in some way the smoke, or nuclear radiation, or excess heat "pollution" inevitable in generation of electricity must be absorbed, discharged, or dissipated somewhere. If we are to have an automobile per person, and if each of us is to drive to work or to shop when and as he pleases, then air pollution is inevitable with present technology.

The whole range of consumption goods that flows into a city must somehow flow out again, as "waste" or "residuals." Thus, the water, fuel, food, building materials, and scores of other production or consumption goods must show up as air, water, or solid waste residuals. The tonnage of the outflow must be equal to the tonnage of the inflow; this is the law of the conservation of Nature which scientists long ago formulated and which most of us learned in our youth but overlooked in our concern with some specific form of pollution.

We can scrub the stack gases from the electric power plant, and thus reduce the air pollution; but do we dump the ash in the streams, thus creating water pollution, or do we bury it, thus creating a solid waste disposal problem? We can burn household trash, thus adding to air pollution; or we can run it through the disposal, thus adding to water-borne wastes; or we can have it hauled to the city dump, thus increasing the solid waste disposal problem.

The inconsistency in our demands for natural resources runs still deeper than the foregoing illustrations suggest. Life is, in many ways, an inconsistency. Birth itself implies death; if people are born but no one ever died, an inexorable accumulation of human beings would result. We wish to preserve and lengthen life, and to enrich its quality; and, in this as in nearly every other country, we also wish to have more children and to increase population, as families and as a nation. Yet one cannot have both more people and a higher level of living per person, without paying a price of some kind.

Our accumulated knowledge, our research, our accumulated material resources, our government and other institutions, the energy and skill of our people—all these, and other aspects of our modern life can be mobilized to cope with the resource problems inherent in a rising demand for both more and better natural resources. But let us not delude ourselves that the answers will come easily or without some sacrifices.

Like the fairy tale that ended with "they were married and lived happily ever after," we have assumed that delivery to the consumer was the end. Every young married couple has to wake up to the fact that marriage is just the beginning of a long series of adjustments and changes, many pleasurable and some less so. Likewise, those of us concerned with national production and consumption are just beginning to realize that delivery to the consumer is not the end but only the first step in a new round of processes.

Our manufacturing industries have designed autos, refrigerators, washing machines, and a thousand other

consumer goods to meet the needs of the consumer; no one has yet designed an auto or a refrigerator that would be efficient to scrap and from which the metal and other production materials could easily be salvaged.

Our food processing industries have concentrated on getting food and drink to the consumer in an unpolluted, hygienic, and attractive condition; but little concern has been directed to the ultimate disposal of the containers in which that food and drink was packaged. We need a faster rotting beer can, for instance, which will at the same time preserve the beer adequately until it is consumed.

It seems clear to me that Americans in the future must learn a great deal more about production, consumption, and residual management processes than we have generally known in the past. We will be, I think, forced increasingly to choose among or between essentially incompatible desires and demands. Costs will have to be incurred to dispose of wastes in acceptable ways; one cannot have both the lowest cost electricity or other goods or services and also the purest air and cleanest streams.

If we choose a degree of improved resource quality, then we must restrain those productive mechanisms which would produce cheaper products at the expense of more pollution, or we must provide new incentives for producers to reduce pollution as well as to produce more cheaply. The competitive business system has put great rewards on efficiency in production, but few or no rewards to minimizing pollution. Government action has increasingly intervened, to provide new controls or new incentives. I see no reason to expect that public action will not be necessary in the future.

We can do a great many things to preserve or create a world we want, but we cannot have everything—some situations or outputs are mutually incompatible. What do we, as a people, really want?

THE YEARS AHEAD IN AGRICULTURE

FARMING OPERATIONS will be increasingly coordinated with related industries into a broad and dynamic food and fiber industry. By 1980–85 farms may number at least a third fewer than today. And a larger share of them will be the more specialized and highly commercialized operations.

These projections reflect prospects for continued advances in technology, rising costs for labor and land, demand growth, and extensive demand shifts among commodities. They also reflect the prospects that farming will become more factory-like and coordinated in a complex of related agribusinesses.

Today's food and fiber industry is made up of a group of closely related industries. They produce and move to the final users, mostly consumer households, a volume of food and fiber products valued at nearly a fifth of the total value of goods and services produced (Gross National Product) by the economy.

Expected growth in economic activity and population provide a basis for appraising demands on farming and the agricultural industry. Although economic growth will continue small in 1970, growth potential is favorable for the decade, in view of prospects for a rapid increase in the labor force and continued advances in production technology.

Population of the United States totaled more than 205 million in 1970. The projected rise to about 230 million people by 1980 probably will not quite match the 14 percent increase in the 1960's.

During the seventies the most vital and fertile 25-to-34-year age group will increase by 50 percent. The number