SECTION II

Concepts of energy

As this book is being assembled, the world can be considered as being in the throes of an energy revolution. The industrial revolution which transpired from the early part of the nineteenth century through the middle of the twentieth century is described by Webster as "The change following and resulting from the introduction of power-driven machinery to replace hand labor, ..." The substitution of such machinery for hand labor has had the direct effect of amplifying by many orders of magnitude man's productivity, and has been the absolute foundation of the world's economic development for these past two centuries. Like population patterns left unchecked, the progression of such "power-driven machinery" follows a geometric pattern leading to a point which in population growth is called an explosion. In industrial development, the progression curve reached this point in the mid-twentieth century, and the pressure points manifested themselves in unexpected ways. The early signs were those of atmospheric and water pollution. In earlier times the problems of pollutants were much more localized, and were solved by physical separation between places of habitat and points of pollution, or by changing from the polluting process to a "cleaner" one. The energy conversion processes are now so extensive and universal, that the pollution problem is virtually unsolvable. The financial burden associated with the solutions that have been attempted has the effect of reducing productivity thus damaging the very economy that is being supported by the energy conversion.

The other pressure point which has been recognized by some scientists and business leaders for some time, but only became evident to the major sectors of the populace during the decade of the 1970s is that of energy resource limitations. The geometric progression of the power-driven machinery put enormous strains upon the supplies of energy that fueled that machinery—fossil fuels. The process of controlled combustion—fire—has been used by mankind since his earliest existence on earth, and it is still the process that we use to motivate our industrial revolution. Efforts at replacing the combustion process with more sophisticated (nuclear) or continually replenishing (solar) processes are providing a small portion of the needs, but in comparison to the whole these are quite limited.

Thus, it appears that we are approaching the point of diminishing returns in energy. This is the point where the human efforts and resource efforts required to extract, transport, refine, and convert the energy requires greater productivity than the productivity increase provided by the last increment. If this is truly the case, the productivity benefits of the industrial revolution will cease. It is for this reason that the energy dilemma of the 1970s is referred to in the opening sentence as the energy revolution.

The chapters in this section are directed not at specific aspects of the energy situation or any proposed solutions, but simply are intended to provide some food for thought—perhaps giving the reader a new or different viewpoint. The chapter, "A Primer on Energy" is an elementary discussion on energy and power which was initially published for a nontechnical readership. It is sometimes beneficial, though, for all of us to go

back to the beginning to reestablish our foundation for such complex topics as energy. The chapters on "A Definition of Energy," "Energy Is a Unique Commodity," "Energy Transportation," and "Infinite Source," are intended to provide some food for thought.

The closing chapter, "An Energy Resource Standard," is worthy of a brief introductory discussion. At the time this work was originally published in May 1977, The American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE) had been working for about three years trying to achieve consensus on a consensus standard (see Section V) for the design of energy-efficient building systems. The chore appeared quite straightforward at the outset. However, as the authors attempted to address the fact that building systems commonly can and do receive their energy from more than a single source and in more than a single form, it was necessary to seek a common denominator. As discussed in that chapter, this problem had not at the time of publication been resolved. This is an extremely complex problem to which many people, institutions, and agencies have been addressing themselves since the issue first came to public attention through ASHRAE's efforts. At the time of this writing, an acceptable solution has still eluded us.