nificant cause of this imbalance between numbers of people and food supplies seems to be the dispossession of the world peasantry by capital-intensive agriculture that produces for export, not to feed local people (*1*). We cannot manage krill wisely in a socioeconomic vacuum.

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References

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Social Cost

The article by Earl Cook, "Limits to exploitation of nonrenewable resources" (20 Feb. 1976, p. 677), is extremely informative. In fact, I should like to assign it to my class except that it is marred by an egregious fallacy. Since this fallacy has been turning up repeatedly in writings about environmental and natural resource problems, I wish to call it to the attention of *Science* readers.

The mistake has to do with the nature of social cost. Cook, for example, writes "To society . . . the profit from mining (including oil and gas extraction) can be defined either as an energy surplus, as from the exploitation of fossil and nuclear fuel deposits, or as a work saving, as in the lessened expenditure of human energy and time when steel is used in place of wood. . . ." A number of other authors also equate social cost with the expenditure of energy.

For better or for worse, neither kilocalories nor man-hours nor any other directly observable, unidimensional, physical input is an adequate measure of social cost. A moment's thought should make this compelling. Consider a very simple self-contained economy where coal is extracted by surface mining and the coal seams lie under the only land suitable for growing hops. The greater the amount of coal that is surface-mined the less the amount of beer that can be brewed. In these circumstances surface mining may be a loser, socially speaking, even though it requires the expenditure of far less than 12,000 Btu's per pound of coal; and subsurface mining may be advisable even though it requires more energy per pound extracted than surface mining, particularly if there is a beer shortage. The social cost of surface-mined coal includes the reduction in the availability of beer along with the expenditure of man-hours, capital investment, and other things too numerous to mention.

Clearly, then, social costs cannot be measured in calories or any other simple physical units. The only adequate measure is what economists call "social opportunity costs," meaning the social value of the alternative commodities that have to be foregone in order to obtain the commodity being produced. Under certain idealized conditions this opportunity cost is measured by the dollars-and-cents cost of producing the commodity. Under realistic conditions the dollars-and-cents production cost is a fair approximation to the social cost. Under almost any conceivable conditions the dollars-and-cents cost is a much better approximation to social cost than the amounts of energy expended or any other simple physical measure.

Huettner, in his article, "Net energy analysis: An economic assessment" (9 Apr. 1976, p. 101), points out at greater length the inadequacy of energy costs and surpluses as measures of social or economic worth.

It is a great pity that so much valuable work, including Cook's article on the exploitation of mineral resources, is hung up on the fascination with energy problems. Energy is indeed a scarce and valuable resource; but it is only one of many, and there is a good deal more to life and the economy than British thermal units.

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The assault of outraged economist Dorfman leaves me unabashed in my "egregious fallacy." I wrote of energy surplus and worksaving, not of social cost. Energy surplus can be measured in kilojoules. Worksaving can be measured in man-hours. Social cost can be measured adequately in neither, nor even by "social opportunity costs," because the sound of wild birds at dawn and the dignity of man are not measurable commodities.

What is a social benefit to one society may be a social cost to another. If mining is allowed at all, there is an anticipated social profit, an excess of benefits over costs. The primary benefits—unlike the primary costs—are those of energy, whether surplus or saving.

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