only one additional vegetation type, grassland tundra, which is hypothetical at this point and of secondary areal importance. The new map indicates that considerable detail in the distribution of known vegetation types may be mapped more economically using ERTS imagery than by conventional methods. Also, it shows that areas of recent fires may be delineated and suggests that phenological developments and active vegetation fires may be monitored with ERTS imagery. The new map does not, however, supersede the earlier one, which covers the entire state. The line tracing which we made for comparative purposes and which is reproduced with the new map in figure 1 does not do justice to the beauty and utility of the original map.

4) The caption for figure 1 implies that the black and white image of the Seward Peninsula was used for the vegetation interpretations and mapping. Actually, a reconstituted, simulated, color-infrared, 164 by 173 millimeter print, which provided considerably more vegetation information, was used.

5) Credit for the discovery of the unmapped radial drainage pattern mentioned in the text of Maugh's report should go to my colleague and coauthor, L. Shapiro, instead of to me.

Our studies of the western Seward Peninsula scene and of numerous subsequent scenes show that, with adequate ground data, more vegetation types than are shown on existing maps may be identified; an amazing amount of information is available from some of the better ERTS scenes. Therefore, existing Alaskan vegetation maps may eventually be superseded. However, current funding levels would preclude our preparation of new and properly finished maps for more than a small portion of the state for some time to come.

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Implementation of Technology

Amitai Etzioni's editorial "Humane technology" (9 Mar., p. 959) surely has the right title, but the content goes a bit awry. Etzioni advises us that "The task before us is to marshal more of technology to the service of *human* purposes." (Italics added.) The confusing of "human" and "humane"—which is doubtless unintentional—is curiously consonant with Etzioni's argument. Within the range of human purposes one can of course find purposes which are humane; the thrust of the editorial is that, within the inventory of man's tools, there are similarly to be found technologies which are certifiably good. Thus Etzioni lists a series of inventions—including automatic switchboards and car seat belts—all of which have undoubtedly contributed to

preserving, and perhaps enlarging, the locus of the humane in contemporary society. Such rosters notwithstanding, the argument is defective. One hunts in vain for that which is good about a technology *as a technology*. What is noble about Etzioni's exemplars is that they are employed humanely; no more. There are still crank calls, and some people still drive irresponsibly. In his attack on "cocktail party sociology," in short, Etzioni has grabbed the wrong end of the (swizzle) stick: He notes, correctly, that the popular debate has been over whether technology is evil or ethically neutral; he concludes, too hastily, that a sound case can be made for technology's being good.

Etzioni would have done better to take instead that academic path to perdition, the subtle distinction. It is useful to distinguish between the capacities of a technology and the ways in which that technology is implemented. A technology can be described as a bundle of capacities—a set of abilities or ways to do something. The principal capacity of an automobile is to transport people and goods; a secondary capacity, to emit air pollutants. Traditionally, successful technologies have catered to or created tastes related to the principal capacity, which was thus invariably perceived as desirable by its users. But one buys the entire bundle, and sometimes secondary capacities become sufficiently undesirable to challenge the bundle as a whole—as in the case of the automobile. Often, too, problems arise in the implementation, in the way the technical capacities are distributed. Public projects such as highways are often controversial, not because they are poorly designed from a technical or engineering standpoint, but because they reallocate resources, such as housing, in ways alleged to be inequitable. Even if the principal capacity of a technology is universally desired, therefore, its bundle of capacities, implemented in a particular pattern spatially, socially, and economically, may still defeat the achievement of any humane purpose.

The task before us is indeed to marshal technology to the service of humane purposes. But to assume that that must inevitably be a marshaling of *more* technology is to foreclose a choice which can be humane in a world of human and social imperatives.

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One way to assess a tool is to explore the merits of the purposes it serves. Another way, suggested by Lee, is to evaluate its *intrinsic* qualities. I suggest that technologies serve human purposes *and* have humane qualities.

1) Machines do monotonous, dirty, heavy-duty, in short, alienating work which most people would rather not do. And, there is a lot of such work that needs to be done.

2) Machines do work that is humanly necessary *and* cannot be done otherwise; here purpose and means are inseparable. For example, most medical technologies *cannot* be replaced by insight, hands, training, or whatnot.

3) Often technological means are significantly more economical *per unit of use* than other means. They are, hence, a prerequisite for coping with a wide spectrum of human needs in the face of scarcity.

Thus, when the purpose is right and the technology appropriate, and when its often undesirable side effects are either small or correctable, technological tools are often the most human *and* humane way to proceed.

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Modeling the World

The conclusion stated in Robert Boyd's abstract of his critique of Forrester's world model (11 Aug. 1972, p. 516) would be correct upon the addition of a single word. The abstract would then read: "The results of Forrester's world model are shown to be very sensitive to *absurd* changes in assumptions." Changes in Forrester's assumptions should not violate the second law of thermodynamics.

Boyd's "technological-optimist view" includes two obviously invalid assumptions. These are multiplier 2, "a fourfold increase in technology over the 1970 level decreases pollution output per unit of material standard of living to zero," and multiplier 3, "NRTM [natural resource technological multiplier] reduces the natural resources input per unit material standard of living to zero when technology quadruples." Both of these assumptions contradict the second