would be credited with the publication of results but would give credit to the idea-originator. Knowing that credit is assured for original ideas, scientists might be willing, perhaps even eager, to record meaningful project plans in a documentation system. The crediting of ideas could then be as matter of fact to scientists as today's literature citations.

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The Amazon Basin, Another Sahel?

Deforestation of the Amazon Basin is being accelerated by the Brazilian government. The reasons apparently include the desire to resettle refugees from populous northeastern Brazil, which often suffers from severe drought, and to open the territory for development, as was done in the North American "West" in the mid-1800's. The trans-Amazon highway is one of a number of projects intended to speed the development.

The removal of the Amazon jungle can be expected to produce extreme climatic effects. It could transform the basin, a region larger than the continental United States, into a dry savannah similar to northeastern Brazil or the African Sahel. Southern Brazil and Argentina, areas of rich agricultural land, would likely be affected also.

The area of the Amazon Basin is 7×10^6 square kilometers (*1*). The water outflow from the basin is 5.5×10^{12} cubic meters per year (*2*) and corresponds to only 80 centimeters of rainfall per year. Most of the net inflow apparently results from a few frontal storms that occur in the months from February to May, when Antarctic air occasionally reaches the basin. The remainder of the 2 to 5 meters of annual precipitation is derived from recycled transpired moisture. The jungle trees with their deep roots act like giant pumps taking water from the water table—often more than 2 meters below the ground surface—and transferring it into the air from which it falls again as rain.

Maranjo Island, at the mouth of the Amazon, strikingly shows the dependence of climate on tree cover. The eastern half of this low island, which is about 300 kilometers in diameter, lacks trees because of high soil salinity, which is due in turn to the presence of a lens of ocean salt water; trees grow only on the river levees, which are elevated so that the tree roots do not penetrate the saline substrate but are watered by the fresh surface flow of the Amazon (which is underlain by salt water). This eastern half of the island is dry savannah and has a long and severe dry season. The western half of the island is heavily forested and receives almost daily rain throughout the year. The control of weather by the jungle was apparent when I flew over the island during the dry season. While thunderstorms built up over the forested half of the island, none appeared over the treeless half. The buildups were sharply delineated by the line of jungle, a fact dramatized by the antics of our aircraft whenever we crossed the boundary between trees and savannah.

Mistakes made by removing the Amazon jungle could not soon be corrected. The jungle is a climax forest; once removed, it could take thousands of years to regenerate and a substantial part of its uniquely varied biota could be permanently destroyed.

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Mass Transit Versus Highways

As one who has always believed in viewing the rail versus highway issue with objectivity, I would like to make some remarks concerning a recent technical comment in *Science* (11 Feb., p. 595) by Charles A. Lave. Lave contends that rail transit is an energy waster compared to highways. He arrives at this conclusion by comparing the construction energy invested in San Francisco's Bay Area Rapid Transit (BART) system to the energy required to construct an urban freeway with an equivalent capacity, that is, 130,000 daily travelers. His analysis leads him to conclude that building BART required 25.2 times as much energy as would equivalent freeway construction, and that we should therefore refrain from building rail transit and encourage further highway construction. Lave's analysis contains highly questionable assumptions—both conceptual and technical.

First, BART is not "typical of other modern rail systems," as the author claims. It includes the longest underwater rail tunnel in existence (3.6 miles) with energy costs that represented almost 10 percent of the energy spent on the entire BART system. Furthermore, the cross-sectional tunnel area required to accommodate the wide-gauge BART cars increased the cost of tunneling above what would be normally required for a rapid transit system.

Second, BART and highway capital costs are inflated by Lave to 1974 dollars, while the factor he uses to convert invested dollars to Btu's is based on a 1963 dollar conversion rate. This has the effect of overstating BART's construction energy requirements. When the proper adjustment is made, the time at which BART begins to realize net energy savings is far sooner than that predicted by Lave: 15 to 40 years, depending on assumptions, compared with the 168 to 535 years estimated by Lave.

Third, a highway construction cost figure of $932,000 per lane-mile is not a realistic estimate for urban freeway construction. For example, the cost of providing another San Francisco Bay Bridge today would be far more (perhaps as much as 40 times) than the $47 million derived using Lave's estimate of highway cost per lane-mile. Current urban highway construction costs run closer to $4 million to $10 million per lane-mile or 5 to 10 times Lave's figure.

Finally, Lave does not mention light rail transit in his rail versus highway comparison. Yet a large percentage of world rail transit systems are of the light rail variety and are appreciably less costly than the main line commuter type of rail technology represented by BART. The cost of light rail systems—and their construction energy requirements—can be 50 to 75 percent less than the cost of a full heavy rail system.

Energy efficiency is an important, but not the sole, objective or criterion in the selection of a transportation mode. Service qualities such as speed, reliability, and comfort; environmental impact on urban neighborhoods and air quality; and the ability of a system to shape land use over long periods of time also enter into such decisions. It appears that some economists still do not accept that the relative merits and demerits of individual transportation modes (many of which cannot be translated into dollar values) must be studied in the context of specific site conditions and that conclusions derived from one site are rarely, if ever, generally applicable.

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