



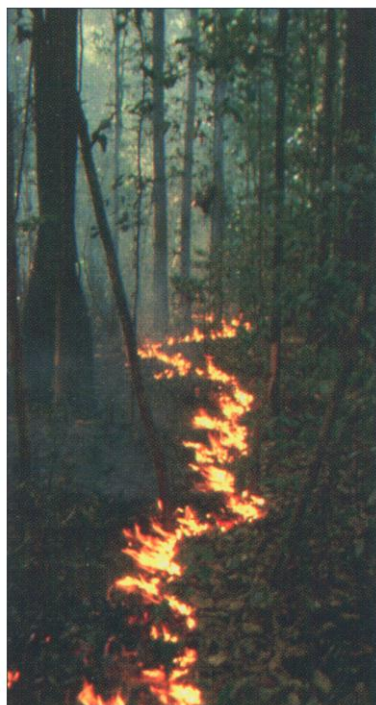
Issues in Amazonian Development

DANIEL NEPSTAD AND COLLEAGUES HIGHLIGHT some laudable improvements in environmental protection, legislation, and public attitudes in Brazilian Amazonia in their Policy Forum "Frontier governance in Amazonia" (25 Jan., p. 629), and they say that such efforts hold the key to sustainable development in the region. Although the authors provide an important perspective on a complex and contentious issue, some of their assertions are misleading and perhaps even dangerous.

Our greatest concern is that, by suggesting that many of the planned infrastructure developments in the region—including an unprecedented expansion of paved highways and river channelization projects—are "inevitable," Nepstad *et al.* could be creating a self-fulfilling prophesy. Many proposed projects are far from inevitable and are likely to have enormous environmental costs. For example, the two largest river channelization projects (the Tocantins-Araguaia and Tapajós waterways) are the subject of ongoing legal battles and could have severe impacts on aquatic habitats and indigenous peoples (1).

Nepstad *et al.* correctly emphasize that many gains in Amazonian environmental protection are fragile, but we believe that they go too far in implying that such improvements could realistically control the impacts of massive new infrastructure developments. Our view is supported by negative trends like the significant acceleration of Amazonian deforestation during the past decade (2), rampant illegal logging and gold mining (3), and a panoply of destructive ac-

tivities in southern Pará (4). Several proposed projects, including major highways that would bisect large forest tracts, are likely to promote large-scale invasions by farmers, loggers, and hunters and dramatically increase rates of forest loss and fragmentation (5–7). Such projects could easily open a Pandora's box of exploitive activities that are beyond the government's capacity to control.



When logged or fragmented, Amazonian forests become highly vulnerable to destructive fires.

Economic development is indeed needed in Amazonia, but many proposed megaprojects, such as paving the Cuiabá-Santarém highway, would mainly benefit wealthy soybean exporters in central Brazil, not the Amazonian poor (1). Nepstad *et al.* also stretch plausibility to suggest that much of the US\$70 million that the soybean exporters expect to save annually would find its way, through highway tolls or taxes, to frontier governance in Amazonia.

Finally, Nepstad *et al.* suggest that recent interministerial seminars in the Brazilian Congress could signal a shift in government attitudes toward Amazonian infrastructure development. However, there is no compelling evidence that

the planning process has fundamentally changed (1, 2), and the threats to Amazonian ecosystems remain very real.

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Response

LAURANCE AND FEARNSIDE ARE CORRECT IN restating the difficulty of regulating land use along new Amazon corridors. However, their comments misrepresent several aspects of this issue and potentially undermine a historical opportunity for science to strengthen Brazil's fragile steps toward frontier governance.

Many transportation infrastructure projects are, indeed, inevitable (or complete), as we confirmed during recent expeditions along 5000 km of proposed highway corridors. For example, the Manaus-Caribbean corridor was completed in 1998, and the Transamazon highway paving will reach Altamira later this year (400 km), as will the first corridor linking Brazil to the Peruvian Amazon. Three paving companies are working on the Cuiabá-Santarém highway, and the Capim River has already been channelized.

Research is needed to compare the potential costs and benefits of alternative economic corridor investments, to help design regional planning approaches that reconcile forest conservation with socioeconomic development, and to identify those planned investments that should not be made (1–3). This opportunity is lost when investments in new economic corridors are condemned generally (3, 4). As a working example of this process, the government's railway, highway, and river channelization proposals for moving soybeans to the Amazon port of Santarém are economically redundant. Paving of the existing road, along which 170,000 people reside, holds the greatest potential to maximize social and economic benefits while minimizing environmental and social costs under a scenario of frontier governance. It is the only alternative that has moved beyond the planning stages.

Regarding deforestation trends, Brazil's satellite-based deforestation estimates provide no information on the occurrence of fire, which dropped sharply since 1999, or on logging, as we reported previously (5). Moreover, to interpret the "acceleration of Amazonian deforestation during the past decade" as evidence that frontier governance is unrealistic seems to ignore the simplest explanation

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of this trend, which is the economic recession that preceded the Brazilian economic plan Real of 1994 (6). The highest deforestation was in 1995. The best measure of frontier governance is the enforcement of Brazil's ambitious environmental regulations on the active agricultural frontier, as Mato Grosso state has begun to achieve in the target areas of its deforestation regulation program.

As for Laurance and Fearnside's comment that the idea of a highway toll on the Cuiabá-Santarém highway does "stretch plausibility," this idea comes from soy producers themselves. We have discussed with them the possibility of using part of such a toll to finance conservation and development activities along the corridor.

In conclusion, the Brazilian government has taken historical steps toward frontier governance that must be evaluated and reported by the scientific community, even as continuing environmental and social problems are analyzed and documented. The scientific challenge is to move beyond sweeping condemnation of infrastructure investments that are already made, and being made, or risk fostering a self-fulfilling prophecy of business-as-usual forest destruction.

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Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 6 months or issues of general interest. They can be submitted by e-mail (science_letters@aaas.org), the Web (www.letter2science.org), or regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt, nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.

IN HIS DISCUSSION OF THE NATIONAL Research Council's ongoing prioritization of solar system missions, Andrew Lawler says that some Washington observers see the discipline as being in disarray (News Focus, "Planetary science's defining moment," 4 Jan., p. 32). To the contrary, we are a community having ardent, but entirely appropriate and healthy, debates about our long-term goals.

To choose the most productive missions for the next decade is a substantial challenge: Exciting opportunities for significant advances abound, from torrid Mercury to

"Is exploration of mysterious Pluto to be preferred over revisiting enigmatic Venus or the rich Neptune system?"

the icy Kuiper Belt. Should the space program strive to better understand Earth, or to explore new worlds, or to learn how sentient beings came to be? Do we focus on surfaces, atmospheres, or magnetospheres to truly comprehend a planet's workings? Is exploration of mysterious Pluto to be preferred over revisiting enigmatic Venus or the rich Neptune system? Is Mars, Europa, or Titan a better choice to seek insights into life's origins? Should we retrieve martian surface samples soon or wait until further reconnaissance is completed?

Each is a defensible objective, but with diminished federal discretionary funds, just a few can be attempted. Thus, community consensus is essential before bold initiatives can be undertaken. Fortunately, the whole planetary community—from novices to popes—has been deeply involved as future objectives have been defined and refined. Our tradition of lively debates about scientific priorities, balanced with realism about cost and technical feasibility, is leading to a decadal survey that will make both scientific and political sense.

Planetary scientists are welcoming this opportunity to recall our accomplishments, to carefully select our most important objectives, and to then speak with one voice to policy-makers. Now, as the open debate ends, we are solidifying ranks, just as we have done previously.

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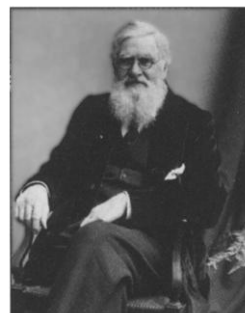
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The Nationality of a Naturalist

THE LETTER FROM W. H. EVANS AND D. LLOYD regarding the nationality of Alfred Russel Wallace as given on my Web site (1) is accurate as far as it goes, but it does not go far enough (1 Feb., p. 797). Wallace's mother and father were of English and English-Scottish descent, respectively. They moved from St. Georges, South-



wark, to Usk in southern Wales about 1820, probably for financial reasons. At that time Usk was part of the area

known as Monmouthshire, nominally an administrative division of England.

Wallace himself was born in Usk in 1823, but in 1828, a death in the extended family allowed Wallace's family to move again, this time to Hertford. They never returned to Wales as a family. Wallace did, however, re-

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