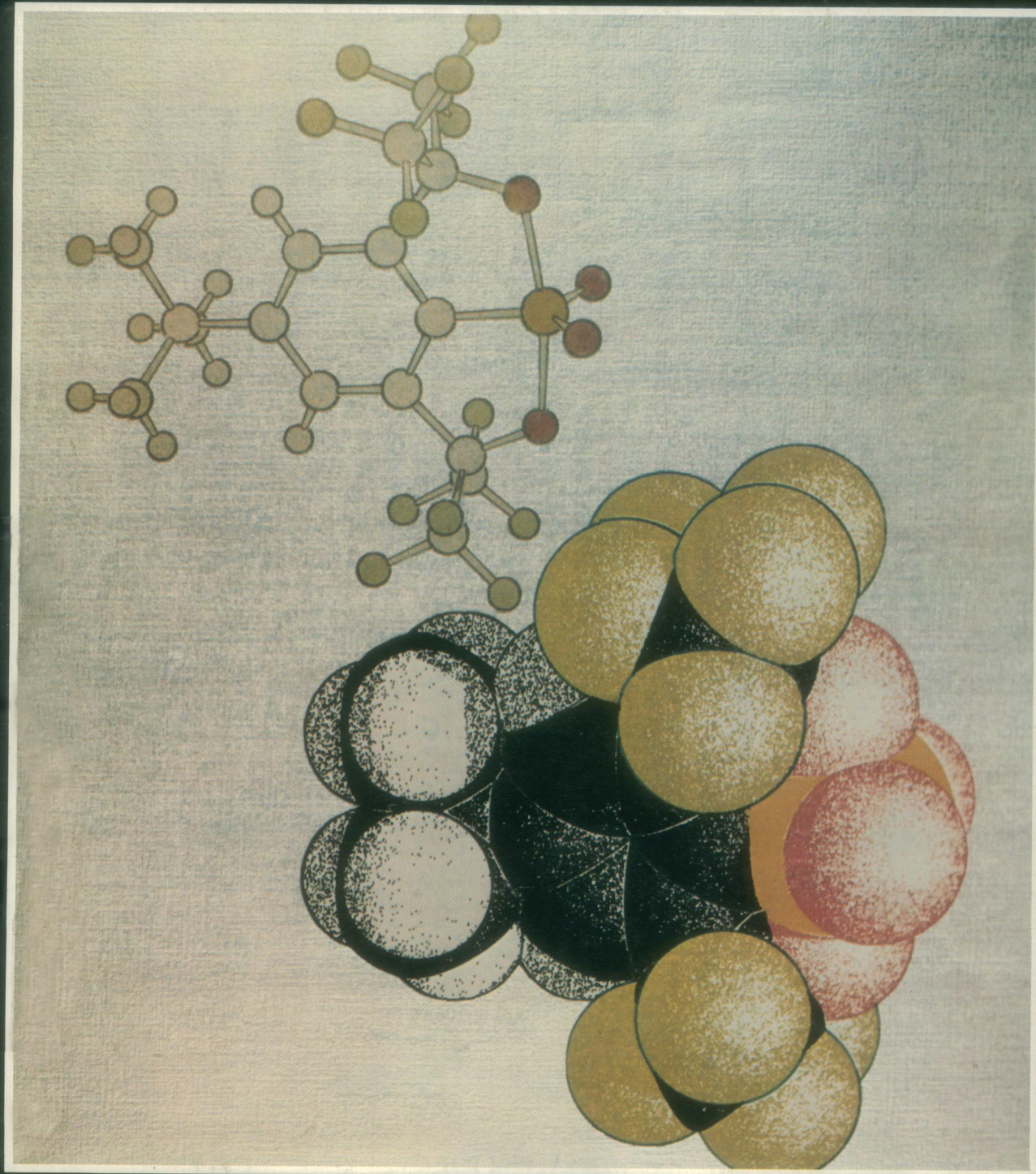


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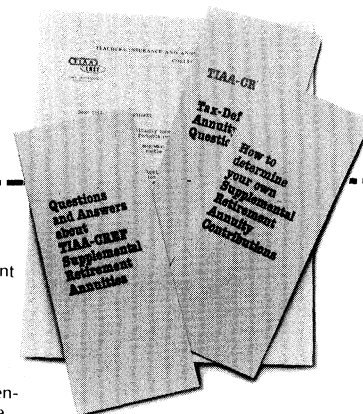
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LETTERS	Academic Freedom: <i>D. Doverspike</i> ; Genetic Engineering: <i>D. E. Comings</i> ; <i>J. R. Nelson</i> ; Hamster Chromosome: <i>S. M. Gollin</i> ; Primates and Malaria: <i>C. Amsbury</i>	506
EDITORIAL	Rain Forests of Amazonia	507
ARTICLES	"Frozen" Transition States: Pentavalent Carbon <i>et al.</i> : <i>J. C. Martin</i>	509
	Ribonucleotide Reductase—A Radical Enzyme: <i>P. Reichard</i> and <i>A. Ehrenberg</i>	514
	Acid Rain on Acid Soil: A New Perspective: <i>E. C. Krug</i> and <i>C. R. Fink</i>	520
NEWS AND COMMENT	Yellow Rain Experts Battle Over Corn Mold	526
	CEQ Staggering Under Latest Budget Cut	529
	Delaware Battles Hughes Institute	530
	Critics Dispute India-U.S. Nuclear Trade-off	531
	<i>Briefing</i> : Sun Sets at RCA, Rises at Solarex; Peace at Hand for Nuclear Physics; Oak Ridge Retracts Reprimand of Biologist	532
RESEARCH NEWS	Space Telescope (II): A Science Institute	534
	Do Ape-Size Legs Mean Ape-Like Gait?	537
	Cell Surgery to Reconnect Nerves	538
AAAS NEWS	Environmental and Media Fellows at Work; Changes in AAAS Insurance Program Announced; Logan Hosts Joint Division Meeting; Arctic Division to Meet in Yukon; Science Museum Update; Obituaries	540
BOOK REVIEWS	The Montgolfier Brothers and the Invention of Aviation, 1783–1784, <i>reviewed by S. L. Chapin</i> ; Oxygenases and Oxygen Metabolism, <i>D. P. Ballou</i> ; Stability of	

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Biological Communities, *R. M. May*; Reprints of Books Previously Reviewed in *Science*; Books Received 542

REPORTS	Origin of Española Island and the Age of Terrestrial Life on the Galápagos Islands: <i>M. L. Hall</i>	545
	Boron in Sillimanite: <i>E. S. Grew and J. R. Hinthorne</i>	547
	The Start of Sulfur Oxidation in Continental Environments: About 2.2×10^9 Years Ago: <i>K. Hattori, H. R. Krouse, F.A. Campbell</i>	549
	High Efficiency DNA-Mediated Transformation of Primate Cells: <i>C. Gorman, R. Padmanabhan, B. H. Howard</i>	551
	Expression of the Major Neurofilament Subunit in Chicken Erythrocytes: <i>B. L. Granger and E. Lazarides</i>	553
	Potent Interaction Between Glucocorticoids and Growth Hormone-Releasing Factor in vivo: <i>W. B. Wehrenberg, A. Baird, N. Ling</i>	556
	Intraspecific Deception by Bluffing: A Defense Strategy of Newly Molted Stomatopods (Arthropoda: Crustacea): <i>R. Steger and R. L. Caldwell</i>	558
	Coronary Artery Spasm Induced in Atherosclerotic Miniature Swine: <i>H. Shimokawa et al.</i>	560
	Deformed Whiskers in Mice Infected with Certain Exogenous Murine Leukemia Viruses: <i>W. P. Rowe</i>	562
	The Immune Response Evokes Changes in Brain Noradrenergic Neurons: <i>H. Besedovsky et al.</i>	564
	Thrombin Stimulation of Guanosine 3',5'-Monophosphate Formation in Murine Neuroblastoma Cells (Clone N1E-115): <i>R. M. Snider and E. Richelson</i>	566
	Coping and Immunosuppression: Inescapable but Not Escapable Shock Suppresses Lymphocyte Proliferation: <i>M. L. Laudenslager et al.</i>	568
	Population Density of Tropical Forest Frogs: Relation to Retreat Sites: <i>M. M. Stewart and F. H. Pough</i>	570
	Rate of Synaptic Replacement in Denervated Rat Hippocampus Declines Precipitously from the Juvenile Period to Adulthood: <i>J. R. McWilliams and G. Lynch</i>	572
	Sex Change in a Coral-Reef Fish: Dependence of Stimulation and Inhibition on Relative Size: <i>R. M. Ross, G. S. Losey, M. Diamond</i>	574
	Local Cerebral Blood Flow Increases During Auditory and Emotional Processing in the Conscious Rat: <i>J. E. LeDoux et al.</i>	576
	Epstein-Barr Virus: Inhibition of Replication by Three New Drugs: <i>J.-C. Lin et al.</i>	578

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COVER

Sulfurane dioxide anion, a "frozen transition state" for nucleophilic attack at sulfonyl sulfur. The x-ray crystallographic structure is shown in computer-generated drawings produced by a version of the SCHAKAL program. See page 509. [Structure obtained by C. W. Perkins, S. E. Wilson, and J. C. Martin (University of Illinois, Urbana); program of E. Keller and A. J. Arduengo III (University of Illinois, Urbana)]

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Rain Forests of Amazonia

Much of the tropics is favored with tillable soils, abundant sunshine, and adequate rainfall, but vast areas have been little used. This is particularly true of Amazonia, which constitutes the world's greatest frontier area. However, an increasing tempo of exploitation of its rain forests is now making management of the region a controversial issue. Some ecologists have taken the position that the wilderness should be left intact, and they can cite mistakes that have been made. Thus far, the damage is relatively limited when account is taken of the vast area of the Amazon Basin. But it is clear that large-scale attempts at exploitation will occur and that unless these are based on scientific knowledge, an inferior outcome will ensue.

Much of Amazonia is covered by luxuriant forests. But for the most part the trees cover a very poor soil. Over millions of years warm, naturally acid rain has leached nutrients from the soil, leaving such barren materials as kaolinite, sand, and aluminum and ferric oxides. The pH of the soil is low, cation exchange capacity is small, and toxic ionic aluminum is usually present. In a typical rain forest, 70 to 90 percent of the phosphorus, potassium, calcium, and magnesium present in the ecosystem is located in living phytomass. As leaves or other materials fall to the ground, they are soon mineralized, and the product is quickly taken up by roots. Areas of the rain forests have been exploited for crop growth, pasture, and logging.

Subsistence farmers make a poor living from slash-and-burn agriculture. This involves cutting down a patch of the forest and burning the wood in situ. The ash contains most of the nutrient minerals, and its alkalinity raises the pH of the soil. A crop of upland rice can be obtained. However, many of the nutrients are lost by leaching, and after a year the patch is usually abandoned. The succeeding vegetation is inferior. Typically, 20 years elapse before the slash-and-burn cycle is repeated. That kind of practice depletes the soil and cannot support a prosperous economy. In contrast, immediately following slash and burn, the land can be successfully used for cropping or pasture provided good management and fertilizers are available. In a region of tropical rain forests of the Amazon Basin in eastern Peru, fertilization permitted a continuous three-crop-a-year agriculture. Rotation of crops held down damage from pests, and yields were excellent. Soils were monitored, and after 7 years a marked improvement was noted.

Experience in Brazil has shown some of the consequences of converting forests into pastures. If appropriate grass seed is sown in the year following slash and burn, a pasture can be established. However, unless fertilizer (particularly phosphate) is applied, the quality of the pasture deteriorates, and substantial areas have been abandoned.

Of a total of about 1700 species of trees found in Amazon forests, only eight have a commercial market. This makes harvesting costly and destructive. At the same time, the natural forests are senile. They produce only 1 to 5 cubic meters of biomass per hectare per year. In contrast, managed forests could produce 30 to 80 cubic meters per hectare per year.

For the use of fertilizers to be practical, it is necessary to have cash crops, markets, and transportation. Successful large-scale development is most likely to occur in the limited areas where soils are relatively fertile and accessible to transportation, as on the floodplains of rivers. An important constraint on satisfactory development is lack of enough expert scientists versed in the special problems of tropical soils and agriculture. At a recent symposium on Amazonia at Belém, Brazil*, it was clear that there are first-class scientists in the region. However, there are large gaps in knowledge about crops that require minimal fertilization, and the governments are decreasing support for research. To achieve some measure of the productive potential of the region will require a much more intensive scientific effort coupled with many agricultural and silvicultural demonstration farms and corresponding extension services.—PHILIP H. ABELSON

*International Symposium on Amazonia, 7 to 13 July 1983, sponsored by the Sociedade Brasileira para o Progresso da Ciência, the Interciencia Association, and the Fundação de Amparo e Desenvolvimento da Pesquisa da Universidade Federal do Pará.

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