tants, as well as impacts on human health, damage to buildings and infrastructure, and effects on various biological systems.

Three main factors were identified in this study as contributing most to the overall *economic* loss from the damage caused by airborne sulphur pollution on forests, namely:

1) The value of losses in commercial-wood harvest due to air pollution; the total value of the lost timber is estimated to be $6.3 thousand millions per year.

2) The losses in value added through industrial processing of wood, amounting to an annual total of $7.2 thousand millions.

3) The value of lost non-timber and social benefits on estimated total annual loss (tourism, recreation, wildlife habitat, protection of soil and water, etc.) amounting to $16.9 thousand millions.

'Our conservative estimate is that sulphur pollution alone is costing Europe $30.4 [thousand millions] per year in forest losses', said Professor Nilsson. 'This economic argument for urgent action on the part of governments represents only one aspect of the losses from air pollution, since in addition to their commercial value the forests that are being damaged have an environmental and social value that is incalculable'.

Studies by IIASA further indicate that investments of US $9 thousand millions per year, agreed to by European countries to curtail air pollution, will not achieve their objective. An effective approach would require agreement by European policymakers to increase greatly investments to cut continent-wide emissions of sulphur and nitrogen gases, through additional measures to install scrubbers and emission-control equipment, to increase efficiency and reduce burning of fossil fuels. The accompanying Table I gives details, and further information may be obtained from the undersigned.

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Leading Conclusions of the (first) International Conference on River Conservation and Management

This Conference, which was organized by the British Nature Conservancy Council and held at the University of York, England, UK, during 10–13 September 1990*, provided for the first time an opportunity for global exchange of information, experience, and ideas, concerning its widely significant but too-often-neglected subject. Research scientists and managers who are concerned with static water in lakes and reservoirs have had previous international and regional discussions; but flowing water is more complex, and in spite of its enormous importance as a natural resource, the study has lagged behind many other aspects of the environmental movement. It is hoped by the undersigned participants of this auspicious Conference that such lagging will be remedied henceforth through updating conferences of similar nature at suitable time-intervals of a few years.

Rivers, as understood by this Conference, range from the largest in the world to little tributaries and brooks. Their study, conservation, and uses by and for Mankind, range through pertinent physical, chemical, and biological, factors which need to be integrated into plans for conservation and wise use. To help in this, all normally-inhabited continents of the world were represented by some 300 delegates assembled from 29 different countries of whom a large proportion addressed the meeting or displayed their experience and exhibited their problems by means of posters.

Although there was no attempt at this pioneering Conference to formulate resolutions or pass a general statement or imperative, the vast store of information that was presented and discussed led to general agreement on a number of points which include the following twelve chosen and elaborated by the undersigned.

1) *Flowing-water ecocomplexes exist in a matrix* of terrestrial and more or less dynamic aquatic environments which impress upon the river or stream their own characteristics — to the extent that river conservation is largely a problem of conservation of catchment areas, some of which should be preserved as a whole whereas others are insufficiently notable.

2) Conservation of a river should be related to conservation of its *entire catchment area*. This is difficult and sometimes impossible with large international rivers of which the catchment is shared by several countries; but it is usually possible for small rivers and streams where the quantity and quality of water-flow can be related to local geological and/or edaphic features, plant and/or animal populations, and human activities.

3) The *supply of water* carried in many rivers has shrunk in recent years as a result of extraction, while the quality of the water which they carry has been affected — often extremely seriously — by pollution; these factors, and foreseeable future changes in them, need to be taken into account in all river and stream management.

4) Although *floodplains* are often of great importance, their study has been widely neglected — especially as to how their advantages and disadvantages for Nature may be involved most advantageously in river management.

5) Policies for regulating activities within river basins tend to be conditioned mainly by the *high economic potential* of water and the energy which it carries when flowing and falling: here again all local economic and political interests should be subservient to long-term conservational ones. Particularly to be borne in mind are the effects of large dams on the river systems and floodplains lying downstream of them.

6) To the aesthetic and academic objectives of conservation that are usually cited should be added *utilitarian values* of aquatic resources such as those of fisheries, drawdown agriculture, and floodplain forestry — noting, however, that all of these have the capacity to alter the nature of the ecocomplex very substantially if pursued incorrectly.

7) In engineering projects that are intended to increase flow in rivers, and/or to drain wetlands which are related to rivers, there are many opportunities for *ecological*

* as described on page 376 of this issue. It is expected that 'an edited book, based on the Conference', will be published in 1991 (P.J. Boon, *in litt.*). — Ed.

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considerations to be incorporated, as there are also in the many projects for storing water or regulating river-flow by impoundments. Such opportunities should be obvious to qualified ecologists and should never be neglected.

8) There is need for much more volume and freedom-of-flow of *information* than is commonly available about projects for improvement of rivers and streams before decisions are made to proceed with management activities such as straightening or impoundment.

9) There has been insufficient work on follow-up activities to *monitor the results* — both successes and failures — of projects for conservation of rivers and streams of all types and sizes.

10) There is needed a *hierarchical structure of responsibility* for conservation of rivers — from the global concept to the regional level, thereafter from the regional to the national level, then from the national to local authorities' level, and finally to the individual land- and water-owners. At all of these and any involved intermediate levels of administration, the need of the aquatic environment itself is liable to be forgotten, or to be overridden by economic considerations or political objectives, which must be resisted whenever and wherever the long-term interest is at stake.

11) If rivers are to be conserved successfully in potential perpetuity and their resources managed constructively, the greatest possible effort must be made to *involve the local public directly* in the decision-making process and, wherever practicable, effective execution. For ultimate success in this the basic need will be due understanding through effective environmental education.

12) While the theme of rivers attracting populations which are growing rapidly was not debated in detail, nor its relationship to river conservation and management specifically, there was unopposed support for the expressed belief that what our unique but beleaguered Planet really needs for its salvation is control of the threat of too many people and the evolution of a new dominant cult of Mankind that will place due consideration on welfare of The Biosphere before all selfish personal, economic, national, and other, interests.

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The Cambridge Columbus Botanical Study, Venezuela 1990

The principal centres for endemic and relict taxa in Venezuela are to be found in the Andes, the Coastal Cordillera, the Interior Coastal Range, and the Pantepui Region. This study will be based on the Peninsula de Paria, which forms the easternmost tip of the Coastal Cordillera (*cf.* Fig. 1). It is a plant refuge that is notable for the large number of species which are common only to the Peninsula and Trinidad & Tobago, and for harbouring relict Amazonian–Guayanan elements (Steyermark & Agostini, 1966).

The ecostasis of the Peninsula is under threat from deforestation. The natives of the Peninsula are responsible, as they use the cleared ground to grow coffee and cocoa. The present rate of deforestation has been recognized as unsustainable by Venezuelan Conservation bodies such as Fundacion Vuelta Larga and The Columbus 500 Project, and The Cambridge Columbus Botanical Study is working closely with these organizations. The Study team comprises four graduates from the University of Cambridge, and four students from the University of Caracas. Work will be restricted to the highest peak in the area, Cerro Humo — until now largely unstudied.

The team will:

1) Compile a comprehensive plant collection from Cerro Humo, paying particular attention to the endemic and endangered species.
2) Compare that collection with similar studies of Steyermark & Agostini (1966), Grubb & Tanner (1976), Sugden (1982, 1986), and Milliken (1984).
3) Study the effects of deforestation around Cerro Humo on the flora of the region.

Separate studies will be made of primary and secondary forest, the degree of deforestation, and the altitudinal distribution of species across the Peninsula. This will reveal which species and which regions of the Peninsula are most threatened, and will then permit evaluation of possible conservation measures, such as the extension of the National Park's boundaries.

A preliminary report will be prepared in Caracas, which will merely give an account of the deforestation observed

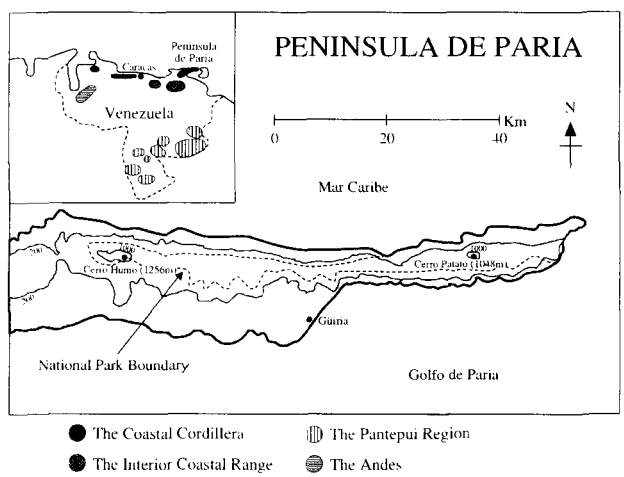

FIG. 1. *Sketch-map of the Peninsula de Paria, on the Caribbean Sea coast of Venezuela* (see *also inset maplet*).

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