Estimating Biomass (Response)

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Joachim Guenther (1), Sergio Gloor (2), Jurg Sommer (3), Melitta Dihanich (4), and Hana Suidan (5), who are past or present collaborators at the Friedrich Miescher Institute, and Marie-Charlotte Hoffmann (6), who is associated with Cordula Nitsch's group at the University of Basel. The demonstration that thrombin acts on neuronal cells by activation of a specific receptor (5), initiating still unknown cascades, possibly through a linkage with a G protein (7), indicates that the classical coagulation pathway may not be the primary mode of action in the nervous system, as Marx points out. These novel aspects will render research in this field even more exciting in the years to come.

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Estimating Biomass

Estimates of global and continental biomass and carbon storage are rarely based on data intended for that purpose. This is the case with the data used as a baseline by Pekka E. Kauppi et al. (Articles, 3 Apr., p. 70). The source they cite for baseline biomass estimates of European forests (1) is a compilation of many unrelated estimates of timber stocks. They convert these estimates to assess biomass and carbon storage and include no estimates of error, without which it is difficult to evaluate discrepancies among estimates or test the significance of suggested trends. Examination of this source and others (2) cited by Kauppi et al. reveals that the data they contain are not well documented, and it is difficult to evaluate their merit.

Under the heading of "Universal-global tendencies" Kauppi et al. cite a source (3) that states that growing stock and timber growth potential in the United States have been repeatedly underestimated. M. Clawson, however, states at the outset of (3) that his study, like many other historical reviews, is "limited by the paucity, suspected inaccuracy, and noncomparability of available data." Kauppi et al. cite this study and conclude that underestimated may be common. On the contrary, it has been shown recently that the biomass and carbon storage of North American boreal and Eastern deciduous forests have been vastly overestimated (4). Whether this is true for Europe we do not know, but it is a question that should be examined. In addition, a recent publication about North American forests (5) from the source of the authors' primary data (1, 2) suggests that Canada growing stock is declining, which apparently contradicts the same data source. How valid are the results and conclusions of a study that depends on questionable data with no independent measures or confirmation?

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Response: We appreciate the comment by Botkin et al., which we think supports the recommendation we made in our article about research priorities with regard to estimating the carbon budget of ecosystems. Confidence limits can only be calculated when the primary measurements are taken from sample plots located randomly or with a systematic grid.

Botkin and Simpson have estimated the carbon storage of aboveground forest vegetation on a continental scale with unbiased sampling (1). Their study area covered 5.1 million square kilometers. Y. Ilvessalo published an early corresponding national study, an unbiased forest inventory covering 0.38 million square kilometers (2). Although his study and subsequent forest resource surveys in Europe were not designed for carbon assessments, they can be used and is concerning because all trees reaching breast height (1.3 m) are included in the samples. The large pool of belowground carbon was not measured in either (1) or (2).

It is useful to distinguish between carbon storage and the change of carbon storage. It is the change that counts in budget calculations. Therefore, we need periodically repeated, statistically representative measurements. Forest inventories have been repeated periodically since the 1920s and are probably the only relevant studies providing unbiased time series data for carbon storage in forest vegetation. The sampling grid in these inventories has extended at best to national geographic scale.

In Europe, forest inventories have been carried out and repeated in Finland, Sweden, and Austria and, with some interruptions, in France. They cover a total of 14% of the European forest area (18% if France is included). The growing stock, an indicator of aboveground carbon storage, increased from 1971 to 1990 by 28 ± 20% in Finland, 14 ± 20% in Sweden, and 24 ± 25% in Austria (3). The development was similar in France.

Our conclusions were based on five kinds of references: (i) complete forest inventory records (from Finland, Sweden, Austria, and, with reservation, France); (ii) incomplete forest inventory records (from Germany and Switzerland); (iii) official statistics on forest resources from the remaining countries; (iv) reviews and primary research articles on growth and yield; and (v) forest products statistics. The data consistently showed a trend of increasing forest biomass, forest growth potential, and accumulation of forest products. The criticism of Botkin et al. applies only to category (iii).

Official forestry statistics can be biased. For some countries (in the worst cases) the information is based on expert opinion. However, we believe that listing and reviewing results from different studies from different countries represents scientific progress as compared with the state of the
in the 1970s. Others have concluded, the basis of limited and inconsistent, that nontropical forests would act as sources of atmospheric carbon (4).

This century, land use in Europe has aged markedly. Cattle grazing on forest land has decreased, the use of small-sized d for fuel has also decreased, fire control improved, andloggings have shifted from a primary to secondary forests. Some villages have acted as fertilizers. These changes have contributed to the trend of easing forest biomass.

The development in other continents beyond the scope of our paper. However, we presented a hypothesis that "life has been similar development in other continents, biomass accumulation in tropical forests can account for a large portion of the estimated mismatch between sinks and sources of atmospheric carbon on dioxides." We look forward to a report of a second periodic measurement of "Borkin and Simpson grid" (1) after 50 years, which will test our hypothesis.

We might approach a solution to the term of the so-called "missing carbon."

Previous Sol-Gel Enzymes

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Oct-3 and Mammalian Development: Correction of Discussion

In our Perspective of 12 July 1991 (p. 144) [Science 253, 144 (1991)], we discussed the role of the POU domain protein Oct-3 in mouse development. One of the papers to which we referred, by M. H. Rosner, R. J. De Santo, H. Arnheiter, and L. M. Staudt (1), which dealt with the role of Oct-3 in the one-cell embryo, has since been retracted because the experimental evidence was fabricated by M. H. Rosner without any knowledge by the other authors. It therefore follows that our discussions of this Cell paper should be disregarded. We emphasize that no doubt attaches to any of the other work we reviewed.

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Corrections and Clarifications

The title of the 5 June report on page 1445 by R. C. deL. Milton et al. should have been "Total chemical synthesis of a D-enzyme: The enantiomers of HIV-1 protease show reciprocal chiral substrate specificity." Figure 3 in the same report (p. 1447) was inadvertently printed upside down. The labels "L-HIV protease" and "D-HIV protease" were therefore under the wrong illustrations. The correct figure is printed below.

L-HIV protease

D-HIV protease

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