Letters

Mature Accelerators

Mark Crawford's article "Racing after the Z particle" (News & Comment, 26 Aug., p. 1031) caught my attention and deserves comment. The author contrasts Europe's LEP (large electron-position) accelerator with the Stanford Linear Accelerator Center's SLC (Stanford Linear Collider) and uses the following zinger: "Unlike SLC, Europe's LEP is a classic synchrotron storage ring built with new hardware and it is unlikely to encounter the kinds of delays that have afflicted researchers at Stanford." For your readers' information LEP is based on a series of machines that inject into it, the oldest of which is the PS, a 25-billion-electron-volt (GeV) machine constructed between 1956 and 1960 and delivering beam to their SPS, the 400-GeV machine (operating for protons) completed in 1976, which in turn injects into the "new hardware." An essential difference between the European way and the U.S. way is that Europe supports their machines in a style to which we would love to become accustomed. There is nothing wrong with mature accelerators if they are given the "TLC" they require. Like fine wine they may even work better. Examples of still productive and very reliable workhorses that are 20 years old and older are the Brookhaven AGS (1959), the Cornell Collider Injector (1965), the DESY (Hamburg) accelerators, and the circa-1970 Fermilab machines injecting into the new TEVATRON. Since Fermilab is considering whether or not to use its machines as injector to the (when-and-if) Superconducting Super Collider, all of this is intensively relevant.

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The Global Carbon Cycle

I applaud the attempt by R. P. Detwiler and Charles A. S. Hall (Articles, 1 Jan., p. 42) to reduce the uncertainty in estimates of the release of CO_2 from terrestrial ecosystems to the atmosphere; however, I do not find evidence that they have done so. Nor do I find that they have used data not already used in an almost identical analysis published in 1985 (*1*). Furthermore, even if the terms of the global carbon budget appear to balance in 1980, large discrepancies at other dates still remain.

Detwiler and Hall say their estimates of flux are lower than many previous ones because they included ecosystem recovery processes and because they used lower estimates of tropical forest biomass and slightly lower estimates of rates of land clearing than earlier studies. The implication of the first reason they give is that previous studies did not include recovery processes. In fact, every analysis cited by Detwiler and Hall did include them, although only the two more recent analyses cited (*1, 2*) included the recovery processes of shifting cultivation.

These two recent analyses (*1, 2*) also used the same sources of data for estimates of biomass (*3*) and clearing rates (*1, 4*) that Detwiler and Hall used and were almost identical in other aspects as well. It is, therefore, puzzling that the flux estimates of Detwiler and Hall are lower than those of Detwiler *et al.* (*2*) and Houghton et al. (*1*). A full documentation of the reasons for the difference would require detailed comparison of data and models. On the other hand, the values of biomass Detwiler and Hall used are lower than those used by Houghton *et al.* (*1*) despite the fact that both studies used the same sources of data. The most likely explanation would appear to be the methods of aggregation used to calculate means for various world regions or vegetation types. Thus, while the means used by Detwiler and Hall define one range of uncertainty in the estimated release of CO_2 from terrestrial ecosystems, the authors provide no evidence that the higher values obtained by Houghton *et al.* are less likely. The new range they report is a low subset of the possible range.

Another aspect of the analysis by Detwiler and Hall that deserves comment is their implication that if the accumulations and releases of carbon in various reservoirs can be made to balance in 1980, the global budget is balanced. On the contrary, several authors have pointed out the importance of past releases of carbon or past atmospheric CO_2 concentrations to the current balance of the carbon cycle (*5, 6*). For example, one reason why deconvolutions of ratios of ^{13}C to ^{12}C in tree rings gave a positive biotic release in 1980 (table 3 of Detwiler and Hall) is because the calculated release has been decreasing over the last decades. There is no evidence from records of land use that the release of carbon from terrestrial ecosystems, globally, was larger earlier in the 20th century than in 1980 (*7*). The rate of deforestation worldwide is greater now than it has ever been in the recorded past. Despite the conclusions offered by Detwiler and Hall, estimates of the biotic flux based on land-use data continue to remain incompatible with those based on past atmospheric CO_2 concentrations as measured in air bubbles trapped in glacial ice (*6, 8*).

Neither the statement by Detwiler and Hall that the global carbon cycle may now be balanced nor the statement that the range of the biotic release has been reduced is justified. On the contrary, because of the lower estimate they report, the range for the net flux in 1980 appears to have been increased from a new low of 0.4×10^{15} grams of carbon to the previously calculated high of 2.5×10^{15} grams of carbon (*1*). Even this range includes the releases of carbon only from the outright clearing of forests and not from degradation going on within tropical forests (*4*). Thus, the high estimate of 1.6×10^{15} grams given by Detwiler and Hall may underestimate the net flux of carbon due to changes in land use in the tropics by 1×10^{15} grams of carbon or more.

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The suggestion by Detwiler and Hall that the global carbon budget can be "balanced" on the basis of estimates of rates of deforestation alone is based on the assumption that there is no other net change under way in biotically controlled reservoirs of carbon, such as forests and soils. These pools are two to three times the amount in the atmosphere. They are maintained by gross fluxes of 90 or more gigatons (GT) of carbon annually through gross photosynthesis and total respiration (*1*). Small changes in these fluxes in the range of 1 to 2% would affect the carbon "balance" appreciably. It is reasonable to assume that such changes are under way. The approximately 0.5°C warming of the earth over the past century can be assumed to have increased rates of respiration of soils in high latitudes by 5 to 15%,