spective, respectively, in *Science*'s 12 October issue. However, the oceans already serve as a repository of anthropogenic CO_2, ingassing and storing ~2 picograms of carbon per year, an amount that could potentially have significant consequences for marine biota (*3*). The issue, therefore, is to reduce CO_2 emissions or their impacts in ways that provide a net environmental benefit. It remains to be shown if the negative consequences of the purposeful ocean CO_2 sequestration strategies are real and worse than other alternatives. Should the environmental and climatic effects of unmitigated CO_2 release to the atmosphere make CO_2 sequestration a necessity, the potential of the oceans for such a repository should not be ignored.

One way to avoid some of the negative chemical and biological effects of ocean CO_2 storage would be first to react waste CO_2 with water and a carbonate mineral (e.g., limestone) to form dissolved bicarbonate (*4*) for release into the sea. This would simply speed up part of Earth's natural carbon cycle (carbonate weathering), which is already central in modulating atmospheric CO_2, but over geologic time scales (*5*). The addition of alkalinity to the ocean resulting from this enhanced bicarbonate production would also help to buffer ocean acidification attributable to anthropogenic CO_2 from the atmosphere (*3*). In any case, there are other ways to diminish the impact of our energy economy on the environment (*6*), and it would be shortsighted not to evaluate our options carefully.

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Response

WE ARE FACED WITH SERIOUS DECISIONS concerning alternative strategies to mitigate climate warming. One such alternative is the purposeful sequestration of CO_2 in the ocean, with potentially severe environmental consequences. Rau and Caldeira justify this approach by pointing out that the oceans already act as a reservoir for CO_2 via passive diffusion from the atmosphere with associated impacts on some shallow-living organisms. However, the fact that human activities already unintentionally compromise the oceanic environment does not justify large-scale, purposeful interference with ocean ecosystems, as Chisolm *et al.* pointed out in their Policy Forum (12 Oct., p. 309). Our criticism of direct injection is not an endorsement of business-as-usual CO_2 emissions (Perspectives, "Potential impacts of CO_2 injection on deep-sea biota, 12 Oct., p. 319). It is well accepted that continued atmospheric accumulation of CO_2 is affecting Earth's climate. The acidification of surface waters through passive diffusion of atmospheric CO_2 is but one of a suite of problems associated with continued emissions. The challenge is to cure the root causes of atmospheric CO_2 accumulation, to reduce greatly or eliminate fossil fuel emissions through the development of alternative clean energy sources, rather than treating the symptoms.

The risks of direct injection to the deep ocean biota are real. The physiological mechanisms outlined in our Perspective are well characterized and suggest that large-scale sequestration, through deep-sea injection, would result in massive mortality of deep-sea organisms with potential disruption of the biogeochemical cycles dependent on their metabolism. The physiological capacity to buffer and compensate for ambient pH excursions is 10 to 100 times less in deep- compared with shallow-living organisms. Thus, direct CO_2 injection, in our estimation, is worse for marine biota than continued acidification of surface waters through passive atmospheric input. However, precise physiological thresholds and the spatial and temporal extent of the disruption to complex ecosystems cannot yet be predicted.

Rau and Caldeira's suggestion to react waste CO_2 with carbonate would minimize the perturbations in pH in the ocean relative to direct injection of CO_2 (although the associated elevation in seawater CO_2 partial pressure could still lead to physiological impairment in marine organisms). As such, it should be explored more fully. We also point out the need for careful definition of the spatio-temporal extent of direct CO_2 injection and additional biological data on deep-sea organisms, so long as such research does not displace efforts to reduce emissions through conservation, increased efficiency, and alternative energy.

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Taxonomists' Requiem?

THE NEED TO DOCUMENT AND UNDERSTAND the world's natural history, with the sixth great mass extinction caused by *Homo sapiens* seemingly on the way (*1*), is greater than ever, as J. McCarter and co-authors discuss in their Essay "Safeguarding the world's natural treasures" (*Science*'s Compass, 7 Dec., p. 2099). And we agree that museums and other centers of excellence on biodiversity matters have a prime role to play in objectively assessing the history and future of biological diversity.

Scientists today have the will and the technological means to quickly catalog the world's fauna and flora (*2*); however, young biologists are hardly encouraged to enter the narrow but rather competitive field of pure taxonomy because the possibilities to pursue an academic career are jeopardized by the current publication system. Indeed, description of new species and revisions at family or generic level are critical to provide a reliable estimate of biodiversity (*3*), yet this research is seldom

Taxonomists have identified about 1400 species of sea cucumbers in the class Holothuroidea.

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validated in terms of the widely (mis)-used impact factor system, and this is especially true for taxonomists working with certain invertebrate groups.

As an illustration, consider the papers published by the "big five" (*4*) holothurian taxonomists of the last century: 84% of their papers were published in journals with no impact factor at all, 15% were published in journals with an impact factor less than one, and only 1% appeared in journals with an impact factor higher than one. On the other hand, research relying on the work laid down by these taxonomists regularly appears in scientific journals with an impact factor comparable to that of *Science*.

Only if the publication system deters this malaise and promotes taxonomic and faunistical works will more scientists be attracted to taxonomy. Indeed, Robert May's bricks and cement (*5*) are necessary for constructing a solid building, but let's make sure we

have enough brick-makers and bricklayers to build a stable biodiversity house.

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4. By "big five," we mean the five holothurian taxonomists that have had the highest impact on the current taxonomy of the Holothuroidea, from 1921 to date: E. Deichmann, A. Panning, G. Cherbonnier, D. Pawson, and F. Rowe.
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The Development of Electroporation

IN HIS ARTICLE "GENE THERAPY: SAFER AND virus free?" (News Focus, 23 Nov., p. 1638), D. Ferber says that the method of electroporation was "developed by immunologist Richard Heller's team at the University of South Florida..," but this is incorrect. The first use of electroporation to deliver DNA to mammalian cells (that is, to transfect them) was reported by Eberhard Neumann's group in the early 1980s (*1*). This work was a culmination of studies performed in the 1960s and 1970s by several investigators. Since the 1980s, electroporation has become a relatively standard laboratory technique to transfect cells in culture (*2*), and during the past decade, this procedure has been adapted for use in vivo by several groups, including the South Florida team (*3*). The group at the University of South Florida has been working on the development of applicators and protocols to use electroporation in vivo as a means to deliver chemotherapeutic agents and plasmid DNA in preclinical and clinical studies.

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CORRECTIONS AND CLARIFICATIONS

REVIEW: "Oblique stepwise growth of the Tibet Plateau" by P. Tapponnier *et al.* (23 Nov., p. 1671). The authors would like to add to the acknowledgments (note 101) the French Ministry of Foreign Affairs to thank them for their support.

REPORTS: "Reversal of obesity- and diet-induced insulin resistance with salicylates or targeted disruption of *Ikk*β" by M. Yuan *et al.* (31 Aug., p. 1673). In Fig. 4C, the rightmost three columns of plus and minus signs under the gel were out of order and misaligned. The correctly labeled panel appears here.