most responsive fluxes were root respiration and exudation, which have little capacity for increasing carbon accumulation in the system.

This study, and similar attempts to understand the carbon balance of different ecosystems under current and future atmospheric conditions, are a key part of the endeavour to understand global change. A central, defining objective has been to balance the global carbon cycle or, as it is often stated, to "find the missing carbon". Only about 45 per cent of the carbon released through human activities (fossil-fuel combustion, cement manufacturing and deforestation) remains in the atmosphere[3]. Some of the remaining fraction is absorbed by the oceans; the rest is often assigned to the terrestrial biosphere, which is treated as a 'black box'.

The challenge to terrestrial ecologists has been to find that missing carbon, or at least to better describe the fluxes into and out of the biospheric black box. Most plant systems have increased rates of photosynthesis and productivity when grown under high-CO_2 conditions. This will affect the global carbon budget only if the carbon taken up in photosynthesis is sequestered; that is, if the increased influx is not matched by a similar increase in the efflux of carbon from the system through plant or soil respiration. Accounting for all the fluxes and documenting carbon sequestration, however, has proved to be very difficult[4]. Typically, any fraction of the net influx of carbon to a system that cannot be accounted for in plant biomass is simply assumed to have been allocated below ground.

But creating this new black box is very unsatisfactory. Carbon allocated below ground could be respired by roots and immediately lost from the system. Or it could contribute to increased root growth, either of short-lived roots that quickly decompose or, in woody perennial systems, of longer-lived roots that are part of the system's carbon storage. Some carbon may exude from or be excreted by roots as low-molecular-weight organic compounds, which are subsequently metabolized by soil microorganisms. Particulate soil organic matter can accumulate if it is sheltered from further decomposition by being physically protected in aggregates[5]. Some of the carbon entering the soil system may eventually end up as recalcitrant soil organic matter and contribute to a long-lived carbon storage pool. This flux is expected to be small and is very difficult to measure, but it may increase as the overall cycling rate increases.

We cannot judge whether an ecosystem is sequestering or cycling the additional carbon without knowing which of these possible pathways predominates. Hungate *et al.* were able to peer inside this below-ground black box by taking advantage of the annual turnover in their system and by incorporating an impressive array of complementary observations into their analysis.

Although these new results cast doubt on the capacity of the California grasslands to sequester much extra carbon, they cannot necessarily be broadly applied to other ecosystems. In particular, forests can store more carbon than grasslands. They sequester a substantial amount of carbon in woody stems and roots, a carbon pool completely absent from grasslands. Moreover, it appears that root exudation is quantitatively much less important in forests than in grasslands, and may not be a significant route for additional carbon loss in conditions of higher CO_2 (ref. 6). Leaf litter from trees may be slower to decompose and contain a larger recalcitrant fraction than grassland detritus. Attempts to construct carbon budgets for CO_2-enriched woody systems have been generally unsuccessful[4] — in future work to that end, it is especially important that the integrated, multifaceted approach of Hungate *et al.* should be employed.

The research emphasis on carbon pools and fluxes, and on the potential for ecosystems to sequester more carbon, stems from policy-driven questions and easily defined challenges such as "finding the missing carbon". But even as we follow the reductionist approach to measuring a gradually shrinking black box, a broader, system-level view is also required. The soil system is incredibly complex, with uncounted bacterial, fungal and microfaunal species living and interacting amidst a matrix of plant roots and organic and inorganic particles, and awash in a nutrient and organic bath. Even if increased CO_2 does not lead directly to carbon accumulation, a faster cycling rate could induce myriad changes in species diversity and functions. These fundamental shifts in ecosystem physiology could in the long run be the most important controllers of carbon pools. □

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Erratum

In the 10 July issue, an incorrect caption was given to the News and Views article 'How one Galaxy can be a cluster' by Richard Mushotzky (Vol. 388, pages 126–127). The caption referred to the 'dark' X-ray cluster MG2016, whereas the image shown was of a nearby, normal X-ray cluster, intended by the author to contrast with MG2016.

Daedalus

Counting on the truth

If the first major biological invention was communication, the very next was the lie. Lies are everywhere; from the harmless flies who imitate stinging wasps, to the forgers and confidence tricksters of human crime. One defence is to make the truth too costly or difficult to imitate. A big male toad can exploit his large resonant volume to make a deep, seductive croak, which a smaller, less desirable male cannot imitate. Similarly, a dominant communicator such as *Nature* can command belief by the costly presses and editorial staff needed for a printed journal. A lone scientific crank cannot afford such conspicuous authority.

But cheap electronic communication is changing all this. Any nerd with a modem and computer can have his own Web site, as seemingly authoritative as *Nature*'s own. Furthermore, computers simply invite mischief-makers, as proved by the hacking and computer-virus industries. Already the Internet is dense with lies and nonsense. On tomorrow's information superhighway, says Daedalus, all the frauds and deceptions which can be spread, will be spread. Tricksters will infiltrate and subvert all communications. They may falsify the *Nature* Web site, or copy it, insert some mad paper of their own, and present the result as a *Nature* mirror site. With old-fashioned print a distant memory, how will *Nature*, or anyone else, retain their integrity? If they cannot, nobody in the glorious electronic future will have any reason to believe anything they read.

In this connection, Daedalus recalls the self-referential problem of writing a true sentence of the form, 'This sentence contains eighteen 'a's, five 'b's ...' and on down the alphabet. It is almost impossible, because the letters in the names of the numbers are also part of the task. So, says Daedalus, let every electronic issue of *Nature* contain a sentence giving its total alphabetic count, including the letters in the check sentence itself. *Nature* will need a vastly expensive supercomputer to work it out in the one week available for each issue. Any reader will be able to validate the count. But the smallest change will wreck it, and no forger could afford the computer time to derive a new matching correct sentence.

This strategy will restore credibility to dominant, respectable publishers with reputations to defend, even in the coming electronic age. The mass of little forgers and liars waiting to infest the information superhighway will be frustrated. Only big, rich liars will survive; and we're used to them already.

David Jones