LETTERS

edited by Jennifer Sills

Investing in Libya's Education

HIGH LEVELS OF UNEMPLOYMENT (20 TO 30%) (*1*), RAMPANT CORRUPtion, and social and intellectual oppression caused Libya's youth to revolt against the Gaddafi regime. They now hope to play a role in rebuilding the country. They can start by insisting that the Libyan government realign and scale up its education system.

Libya's education system faces serious challenges. The country's infrastructure has been extensively damaged (*2*). Primary and secondary education is outdated, poor quality, and not designed to generate free-thinkers and leaders. Furthermore, higher education planning has not been strategic (*3*). Libya has many low-quality physicians (*4*), for example, and medical research outputs have been abysmal (*5*). Finally, in the absence of skills and job prospects, a group of young revolutionaries are refusing to lay down their arms, thereby posing a security challenge to the country.

To reform the education system, a task force with national and international experts should be established to focus on short-term and long-term needs. In the short term, the young armed men should be provided with opportunities to transition from being the armed guardians of the revolution to builders of a new nation. Vocational training should be offered to them followed by job opportunities in areas such as construction, communication, and energy. In the long term, both lower and higher education systems must be redesigned to meet global standards and train a new generation of thought-leaders and professionals. The number of university seats in areas such as medicine, agriculture, and engineering should be planned in line with national needs. Science and technology should be prioritized to foster innovation and create new areas of economic development (*6*). Above all, families and civil society organizations have a critical role to play in educating the youth in the principles of democracy and in fostering a transformative culture of free speech and open discourse.

A new song. Children sing a new national anthem at their school in Tripoli.

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Invasive Species Unchecked by Climate

IN THE REPORT "THE PACE OF SHIFTING CLIMATE in marine and terrestrial ecosystems" (M. T. Burrows *et al.*, 4 November 2011, p. 652), the dispersal rates of many species were revealed to be as much as an order of magnitude lower than the velocity of climate change in terrestrial and marine ecosystems. Such evidence implies a widespread risk that biodiversity will fail to rapidly track changes in thermal conditions through shifts in individual species distributions (*1*). Yet, in almost perverse irony, invasive alien species that pose a threat to biodiversity, human health, and/or food security are less likely to have trouble keeping up with the fast pace of global warming. The spread rates of alien invasive species in terrestrial and marine ecosystems are between 20 and 30 times as high as the maximum velocities of climate change (*2*). Maximum spread rates vary among invasive plants (*3*), birds (*4*), and insects (*5*), but are often an order of magnitude higher than future estimates of the velocity of climate change (*6*). Even these impressive spread rates are dwarfed by those observed for plant and animal pathogens in terrestrial and marine ecosystems (*7*). Thus, native biodiversity will not only be under pressure from rapid spatial shifts in worldwide temperatures, but will also be exposed to greater risks from alien invasive pests, pathogens, and weeds that can disperse even faster (*8*). Alien invasive species also have the capacity to evolve enhanced dispersal efficiency in novel environments (*9*); hence, they are less likely to face extinction risks under climate change (*10*). Furthermore, the range expansions of alien invasive species are facilitated by increasing human trade, transport, and travel (*11*). This makes it even more important for governments to design robust policy and regulatory frameworks to combat both the current and potential future threats of biological invasions (*12*).

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Response

HULME POINTS OUT THAT OBSERVED RATES of range expansion by invasive alien species are higher than the median speed of isotherm movement over the past 50 years, which in turn has outpaced the rates of climate-associated range changes of marine and terrestrial species (*1*, *2*). This is not surprising, given the many ecological and anthropogenic processes that combine to facilitate the translocation of invasive species and the subsequent expansion of their populations (*3*, *4*). Successful alien species have been observed to rapidly expand their ranges until some limit, typically climate-imposed, is reached (*5*). Comparisons of climate-change–induced range shifts between native and alien species are meaningful only after the initial invasive spread has reached a stable range boundary.

A focus on regions with high velocities of climate change, and on regions such as the tropics where novel thermal niches are being created, should allow researchers to collect data to test hypotheses about the role of climate in driving range shifts of invasive and native species. It is important to remember that the distinctions among native and alien species will be blurred under rapid global change as both types expand their ranges into novel environments (*6*). This may be particularly true in the world's boreal oceans as melting sea ice facilitates new migratory passages between the Atlantic and Pacific Oceans. Moreover, as the ebb and flow of biodiversity intensifies under anthropogenic climate change, novel climates and communities of species will develop. Policy will not only have to address the threats of alien invasions, but also have to deal with rapid range shifts of native species and with the threats to species that are unable to adapt or move. Climate change is redefining management strategies and conservation goals and concepts (*7*).

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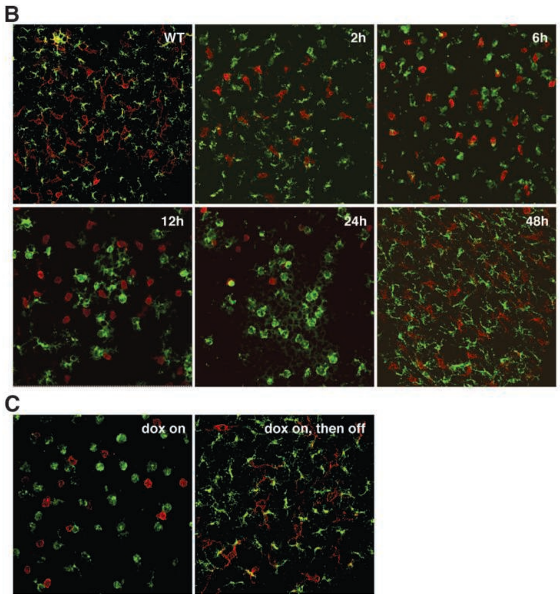
CORRECTIONS AND CLARIFICATIONS

Editors' Choice: "A layer-by-layer amplifier" by M. S. Lavine (20 January, p. 265). The accompanying illustration was of a poor coating generated in a negative control experiment (i.e., without the use of a surface amine amplification step). A conformal coating generated with the aid of a surface amine amplification step is shown in Figure 1f of the *J. Mater. Chem.* paper cited.

News of the Week: "Cannibalism on ice" (16 December 2011, p. 1479). The incident in the photograph occurred on 21 July 2010, not in August 2008, as stated.



Reports: "The intraepithelial T cell response to NKG2D-ligands links lymphoid stress surveillance to atopy" by J. Strid *et al*. (2 December 2011, p. 1293). Three confocal images printed in this Report contained minor artifacts. In an early version of the image processing software Imaris, individual z-stack planes were manually loaded for processing, as opposed to current versions in which they load directly from the microscope. Hence, imprecise usage of the early version had a potential for image misalignment and even duplication during subsequent z-stack compression that regrettably occurred in the images in question. They are the "WT" panel in Fig. 2B, the "dox on" panel in Fig. 2C, and the "BTg" panel in fig. S1B. The authors have provided appropriately compressed raw data files for these panels along with paired control images, and they apologize for any confusion caused by these errors. All other images in the Report were already presented as compressed raw data, accurately reflecting each image plane captured on the microscope. The artifacts in the three panels do not in any way affect the paper's findings. A labeling error in the "WT" panel of fig. S4 was also noted and the figure corrected. The Report's conclusions stand.

TECHNICAL COMMENT ABSTRACTS

Comment on "Abiotic Pyrite Formation Produces a Large Fe Isotope Fractionation"

Andrew D. Czaja, Clark M. Johnson, Kosei E. Yamaguchi, Brian L. Beard

Guilbaud *et al*. (Reports, 24 June 2011, p. 1548) suggest that the geologic record of Fe isotope fractionation can be explained by abiological precipitation of pyrite. We argue that a detailed understanding of the depositional setting, mineralogy, and geologic history of Precambrian sedimentary rocks indicates that the Fe isotope record dominantly reflects biological fractionations and Fe redox processes.

Full text at www.sciencemag.org/cgi/content/full/335/6068/538-c

Response to Comment on "Abiotic Pyrite Formation Produces a Large Fe Isotope Fractionation"

Romain Guilbaud, Ian B. Butler, Rob M. Ellam

Czaja *et al*. assert that Guilbaud *et al*. claim that "the geologic record of Fe isotope fractionation can be explained by abiological precipitation of pyrite." At no point did we suggest this. We reported a previously underestimated Fe isotope fractionation that contributes to the sedimentary Fe isotope signal.

Full text at www.sciencemag.org/cgi/content/full/335/6068/538-d

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Proceed with Planning Despite Multiple Models

IN HIS NEWS FOCUS STORY "TIME TO ADAPT TO A warming world, but where's the science?" (25 November 2011, p. 1052), R. A. Kerr reports on the frustration expressed at a recent meeting in Denver about the lack of "actionable science" that can be used as a basis for planning adaptation to climate change. Understandably, people planning new storm drain systems with a 75-year lifetime, for example, would like to know the maximum flow of water they will need to accommodate over that period. The general expectation seems to be that if we can just get more accurate and more granular climate models, then we can provide definitive answers to this type of question.

Unfortunately, even if we can deal with the tremendous complexity of the physical and biological mechanisms involved, as Lempert *et al.* have pointed out, predicting the future is fundamentally impossible, as it will be influenced by people's future actions, which are currently unknown (*1*). It is productive to consider multiple scenarios of plausible futures (as the Intergovernmental Panel on Climate Change has done) and formulate plans and strategies that provide acceptable outcomes across a broad range of possibilities, rather than to try to find an optimum solution based on a single forecast of future climate. Better climate models will certainly play a key role in making the scenarios more realistic, but we will not enjoy the luxury of having definitive forecasts on which to base our adaptation planning.

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