LETTERS

Edited by **Jennifer Sills**

Rethinking migration

WE APPLAUD THE Report by C. Montes *et al.* ("Middle Miocene closure of the Central American Seaway," 10 April, p. 226), whose geochemical analysis pushes back the timeframe of the shoaling of the Isthmus of Panama by 10 to 12 million years. This finding establishes a middle Miocene [13 to 15 million years ago (Ma)] completion of the land bridge between North and South America, marking a substantial shift in our understanding of the merger between these long-isolated landmasses. This has key implications for understanding the mass migration of organisms between these two continents—the so-called Great American Biotic Interchange (GABI).

In light of this new hypothesis, previous inferences about the GABI require a fresh reassessment. For example, although the majority of animal migrations appear to have taken place during the previous estimate of when the land bridge was thought to have been completed (~3.5 Ma), the new date better conforms with evidence of older migrations (10 to 5 Ma) involving flightless animals such as ground sloths, procyonids, gomphotheres, tapirs, peccaries, and flightless terror birds without invoking complicated island-hopping scenarios (*1*–*3*). For plants, however, the route of migration across the Isthmus region appears to have been used much earlier. In the Barbados cherries, for example, numerous independent migration events from South America to Mexico occurred as early as the middle Eocene (46 Ma) based on phylogenetic inference, but increased six-fold beginning in the lower Miocene (23 Ma), just before the newly estimated date (*4*). Thus, rates of plant migrations between North and South America appear to have been greatly stimulated by the formation of this land bridge, even before its completion.

This reassessment raises a new conundrum: Why does the migration of animals lag so dramatically behind that of plants? It could be that even if the habitat was suitable, there were geological impediments to reaching it (dispersal limitation). However, the migration of flying birds, which conceivably could have overcome such impediments, appears to be as delayed as that of other animals, relative to plants (*5*). Another possibility is sampling bias in the fossil record. Alternatively, these patterns may hint at ecological, as opposed to geological, barriers underlying biome assembly. Ecological barriers could have included Plio-Pleistocene global climate, as Montes *et al.* suggest, or the need for vegetative changes to establish suitable habitat before the arrival of the animals. To the extent that this scenario applies, it indicates that geological barriers are not the only factor influencing migration at geological time scales and opens exciting new possibilities for exploring the relative importance of ecological factors in the merger of two continental biotas.

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The Nobel pulsar

THE SPECIAL ISSUE of *Science* on "General Relativity turns 100" (6 March, p. 1082) gives a wonderful history of the successes of the theory, but I feel that it is important to make a correction pertaining to the binary pulsar PSR B1913+16 and the effect of gravitational waves. There has been no Nobel Prize for relativity. Russell Hulse and Joseph Taylor were deservedly awarded their Nobel Prize "for the discovery of a new type of pulsar, a discovery that has opened up new possibilities for the study of gravitation" (*1*). Hulse and Taylor clearly understood the importance of this system when it was discovered in 1974 (*2*), as well as its potential for "heretofore unavailable tests of gravitational theories" (*3*). The importance of this system was quickly recognized by others as well (*4*). However, the observation of the decay of the orbit, and the agreement with energy loss from gravitational wave emission, was due to Joseph Taylor and Joel Weisberg (*5*). Subsequent observations (*6*) have confirmed that the orbital decay of PSR B1913+16 is in remarkable agreement with predictions from general relativity, and further tests of gravity in the strong field regime are possible (*7*).

Whether from LIGO-Virgo, pulsar timing, or B-modes in the cosmic microwave background, the coming years should produce further remarkable observations of gravitational waves. ***Nelson Christensen***

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Preparing for disasters

THE NATIONAL INSTITUTE of Environmental Health Sciences (NIEHS) fully supports the development of "A community for disaster science" (M. McNutt, Editorial, 3 April, p. 11). Almost 2 years ago, we created the NIH Disaster Research Response (DR2) Project to facilitate the incorporation of "disaster science" into national response and recovery efforts (*1*). Key components of this project include improving accessibility to health data collection tools and Institutional Review Board (IRB)–approved research protocols, proactive engagement of diverse public and private stakeholders, and fostering the development of a trained cadre of academic researchers who can collect critical information and function in the immediate post-disaster environment without interfering with the emergency response.

The publicly accessible NIH DR2 website now includes more than 165 data collection tools and other information to support disaster science activities (*2*). We have

ILLUSTRATION: JULIUS CSOTONYI

also sponsored a national workshop and conducted two tabletop exercises that have brought together academia, local community representatives, private industry, emergency responders, and public health, emergency management, and volunteer organizations to discuss the challenges and benefits of conducting post-disaster research and the value of evidence-based decision-making (*3*).

It is clear that disaster response and recovery require an interdisciplinary effort supported by the best evidence available. As such, we have begun to develop a national "Environmental Health Sciences Network for Disaster Response" composed of interested academic centers with diverse expertise to enhance our ability to identify human health threats, prioritize research needs, provide expert consultation, and conduct disaster research. Research and response organizations must work jointly with community partners, first responders, local public health departments, and policymakers to anticipate threats and develop innovative methods to prevent being overwhelmed by unexpected cascading events, such as those following the Great East Japan earthquake, tsunami, and nuclear reactor meltdown in 2011. For a sustained effort, there also needs to be a national framework that supports disaster science research, timely funding that supports a science response, and an interdisciplinary disaster science career path within academic institutions and government entities that nurtures the next generation of disaster researchers.

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TECHNICAL COMMENT ABSTRACTS

Comment on "Morality in everyday life"

Manuel C. Voelkle

In examining morality in everyday life, Hofmann *et al.* (Reports, 12 September 2014, p. 1340) conclude that being the target of (im)moral deeds impacts happiness, whereas committing them primarily affects one's sense of purpose. I point to shortcomings in the analyses and interpretations and caution that, based on the methodological approach, conclusions about everyday life relationships between morality and happiness/purpose are premature.

Full text at http://dx.doi.org/10.1126/science.aaa2409

Response to Comment on "Morality in everyday life"

Wilhelm Hofmann, Daniel C. Wisneski, Mark J. Brandt, Linda J. Skitka

Voelkle challenges our conclusions regarding the relationship between morality and momentary happiness/sense of purpose based on methodological concerns. We show that our main conclusions are not affected by this methodological critique and clarify that the discrepancies between our and Voelkle's effect size estimates can be reconciled by the realization that two different (but compatible) research questions are being asked.

Full text at http://dx.doi.org/10.1126/science.aaa3053