LETTERS

edited by Jennifer Sills

The Origins of Human Bipedalism

THE REPORT BY S. K. S. THORPE *ET AL.* ON HAND-ASSISTED ARBOREAL bipedalism in orangutans certainly deserves attention ("Origin of human bipedalism as an adaptation for locomotion on flexible branches," 1 June, p. 1328). But does the discovery of orangutans engaging in human-like straight-leg bipedalism actually mean that "[h]uman bipedalism is … less an innovation than an exploitation of a locomotor behavior retained from the common great ape ancestor"? Although embraced by P. O'Higgins and S. Elton in their accompanying Perspective ("Walking on trees," 1 June, p. 1292), this interpretation embodies the Lamarckian use-disuse expectation that the postcranial features unique to humans and their fossil relatives would have emerged because a common human-ape ancestor had originally stood bipedally. But no known ape—fossil or extant—possesses the postcranial features associated with human-like bipedalism, and to anticipate that any number of years of early apes standing up in trees would have led to the developmental reorganization that underlies such profoundly human morphological novelty (*1*), while engaging the imagination, unduly stretches the bounds of biology.

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Reference

1. C. O. Lovejoy, M. J. Cohn, T. D. White, *Proc. Natl. Acad. Sci. U.S.A.* **96**, 13247 (1999).

Response

SCHWARTZ IS INCORRECT TO CLAIM THAT OUR proposal is Lamarckian. We refer to selection eight times, and the main contribution of our paper is to identify a selective pressure that could have favored the adoption of upright, straight-legged bipedality in an arboreal context. That some of the postcranial features that facilitate such posture may be controlled by a limited number of developmental genes (*1*) is interesting, but unless Schwartz is proposing that natural selection cannot operate on such genes, it is not relevant to an assessment of our paper.

The most striking feature of modern human bipedalism compared with that of other vertebrates is that we walk with extended hips and knees (*2*), permitting substantial energy savings by exchange of potential and kinetic energies. In their facultative bipedalism, untrained captive orangutans and, as we show, wild orangutans (*3*) adopt trunk, hip, and knee postures much closer to those seen in human bipedalism than in untrained chimpanzees, bonobos, or gorillas. Even abnormally raised or trained chimpanzees that are habitually bipedal do not match the hip and knee extension seen in bipedalism of untrained orangutans (*3*). This strongly suggests that the anatomical features that permit erect, straight-legged bipedalism in orangutans, however controlled, have indeed been the subject of positive selection. These characteristics of orangutan bipedalism have almost certainly been selected for in an arboreal context, as part of a continuum of largely orthograde locomotor behaviors.

Because the common ancestor of crown hominoids is likely to have had a similar niche to orangutans—that is, to have been a ripe-fruit eater exploiting the peripheral canopy of tropical forest trees (*4*)—our findings are highly relevant to understanding the origins of human bipedalism. Features of the trunk and pelvis favoring upright walking were already present in early, arboreal, crown hominoids such as *Pierolapithecus* and *Hispanopithecus* (*Dryopithecus*) *laietanus* (*5*) [the latter also showing orangutan-like features of the hand (*6*)], and there is strong evidence for highly and habitually extended hips in the much later, partially or wholly arboreal crown hominoid *Orrorin* (*7*). These adaptations would certainly facilitate the adoption of habitual terrestrial bipedality by early hominins. Terrestrial bipedalism would then be expected to select for features of the hominin postcranium that enhance the effectiveness of human (terrestrial) bipedalism (*1*), e.g., adaptations limiting abduction of the thigh on the trunk (such as a short ilium) and a talocrural joint that favors parasagittal motion of the legs over the stance foot, also at the expense of abduction—as seen first in *Australopithecus anamensis* (*8*). Such selective forces eventually lead to the modern form of the human foot and pelvis, although this may not have been in place even in early *Homo*.

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1. C. O. Lovejoy, M. J. Cohn, T. D. White, *Proc. Natl. Acad. Sci. U.S.A.* **96**, 13247 (1999).
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4. D. Pilbeam, in *The Primate Fossil Record*, W. C. Hartwig, Ed. (Cambridge Univ. Press, Cambridge, 2002), pp. 303–310.
5. C. V. Ward, in *Handbook of Paleoanthropology Vol. 2: Primate Evolution and Human Origins*, W. Henke, I. Tattersall, Eds. (Springer, Heidelberg, Germany, 2007), pp. 1011–1030.
6. S. Almécija, D. M. Alba, S. Moyà-Solà, M. Köhler, *Proc. R. Soc. London Ser. B* **274**, 2375 (2007).
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What's in a Name?

IF THE NAME LUPA FOR THE EUROPEAN DOG genome study was chosen after the Roman she-wolf ("Europe going to the dogs," E. Pennisi, News Focus, 21 September, p. 1670), the choice is not a felicitous one. The she-wolf legend was dismissed even by the Roman historian Titus Livius, who explained that the mother of Romulus and Remus was a certain Acca Laurentia, a very prosperous sex worker (to use a Dutch expression)—so prosperous that she left a lot of money to the city founded by her sons. In popular Latin, lupa meant she-wolf, but it also meant whore. Even today, in certain languages, we speak of brothels as lupanari (in Italian; the French have a similar word). Obviously, no one wants to have a whore on their standards, and that is how the she-wolf legend came about. I am afraid that our European colleagues made the same mistake as Mussolini, who called the preschool Italian children *Figli della Lupa*, thus sending a collective insult to Italian mothers. If the LUPA consortium were to change their name, I suggest JASPER, the name of my German shepherd, who is, of course, the best specimen of the best of all possible breeds.

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The Carbon Benefits of Fuels and Forests

THE POLICY FORUM "CARBON MITIGATION BY biofuels or by saving and restoring forests?" by R. Righelato and D. V. Spracklen (17 August, p. 902) provides limited perspective as a result of a single, relatively short time horizon and a limited consideration of the options available. Righelato and Spracklen conclude that the carbon sequestered by saving or restoring forest is greater than the emissions avoided by the use of the liquid biofuels. Although they may be correct given current technology, the case studies they analyzed, and a 30-year time horizon, their conclusion is dependent on site, technology, and time, and it does not apply to biomass used for direct combustion or gasification. Marland and Schlamadinger (*1*) showed that the carbon balance between restoring forests and producing biofuels is site-specific and depends on biomass productivity, the efficiency with which harvested material is used, the initial state of the surface vegetation, and the fossil fuel to be displaced. When forest products are used efficiently to displace carbon-intensive fossil fuels, and when productivity is high, sustainable harvest yields the greater carbon benefit, especially over a longer time period. Current-technology liquid biofuels represent low-efficiency conversion of harvest to energy, but direct combustion or gasification is more efficient at displacing carbon from fossil fuels. Righelato and Spracklen show that, over 30 years, even producing diesel fuel from woody biomass can begin to look "compatible" to reforesting temperate cropland. As we wrote in 1997, "there is not a one-size-fits-all strategy for optimal management of all land available for forest management to mitigate CO_2 emissions" (*1*). However, in many circumstances, biomass can produce greater carbon benefit than saving or restoring forests.

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Reference

1. G. Marland, B. Schlamadinger, *Biomass Bioenergy* **13**, 389 (1997).

Response

IN OUR POLICY FORUM (17 AUGUST, P. 902), we explicitly considered only liquid biofuels, which substitute for petrol and diesel. Large-scale replacement of fossil fuels in transportation is a more intransigent problem than the substitution of fossil carbon for heat and power considered by Marland and Schlamadinger (*1*), for which a range of carbon-free options exist, such as nuclear, wind, and solar power. We took a window of 30 years for our comparison of biofuels and forest restoration because this is the time scale that will likely be needed to develop and implement carbon-free transport-fuel technology. On this time scale, the current biofuels reduce carbon dioxide emissions less effectively than restoration of forests. As Marland, Obersteiner, and Schlamadinger indicate, there may be net carbon benefits from biofuels if longer time periods and new technology are considered. However, these avoided emissions would be too small and too late to meet targets of 60% or more reduction in emissions by 2050.

We noted in our Policy Forum that under some circumstances, fuel use of woody biomass may be compatible with retention of forest carbon stocks and may provide net carbon benefits similar to forest restoration in temperate zones. This is consistent with the model of Marland and Schlamadinger (*1*). However, land resources for arable substitution of transport fuels on the scale required are not available without further extensive deforestation, which would cause massive carbon dioxide emissions. Further demand for forest land to provide biomass for burning or gasification would need to be on a similarly large scale to meet emissions reductions targets. It is becoming increasingly clear that the risks associated with these land-use changes may outweigh any benefits. In our view, biofuels cannot provide a

CORRECTIONS AND CLARIFICATIONS

News of the Week: "CDC director's message on risk runs afoul of White House edits" by E. Kintisch (2 November, p. 726). The photo caption should not have said that White House science adviser John Marburger wanted to remove parts of proposed testimony by CDC Director Julie Gerberding on the public health effects of global warming. Marburger raised questions about portions of her testimony but did not suggest any cuts.

TECHNICAL COMMENT ABSTRACTS

Comment on "Origin of Human Bipedalism As an Adaptation for Locomotion on Flexible Branches"

David R. Begun, Brian G. Richmond, David S. Strait

Thorpe *et al*. (Reports, 1 June 2007, p. 1328) concluded that human bipedalism evolved from a type of bipedal posture they observed in extant orangutans with seemingly human-like extended knees. However, humans share knuckle-walking characters with African apes that are absent in orangutans. These are most parsimoniously explained by positing a knuckle-walking precursor to human bipedalism.

Full text at www.sciencemag.org/cgi/content/full/318/5853/1066d

Response to Comment on "Origin of Human Bipedalism As an Adaptation for Locomotion on Flexible Branches"

Robin H. Crompton and Susannah K. S. Thorpe

Begun *et al*. purport to present technical concerns regarding our case for an arboreal origin for terrestrial bipedalism in early hominins, but merely reiterate their knuckle-walking hypothesis, which lacks support from the fossil record and is highly unparsimonious. The technical concerns are refuted by published studies cited in our study and thus do not affect our original conclusions.

Full text at www.sciencemag.org/cgi/content/full/318/5853/1066e

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solution to our energy needs, but by appearing to be a "quick fix," they may distract us from developing effective, long-term, carbon-free solutions in the time window available to us.

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Reference

1 G. Marland, B. Schlamadinger, *Biomass Bioenergy* **13**, 389 (1997).

Eyeing a New Network

I. S. KOHANE AND HIS COLLEAGUES' POLICY Forum (11 May, p. 836) on "Reestablishing the researcher-patient compact" should evoke a response from clinical researchers. Healthcare organizations are keen to use large databases of information that have accumulated through record-keeping for clinical care delivery. Unfortunately, the consent process did not necessarily allow the freedom to contact patients as research subjects. The authors propose a prospective approach in developing informed cohorts, with linked medical and genomic information, to enable clinical research and the ability to recontact patients. We provide one example of how clinicians, their patients, and researchers can fully participate in and benefit from research.

In 2003, the National Eye Institute convened a broadly representative group to envision a National Genotyping Network for inherited eye diseases with two goals: to provide a resource for ophthalmic research in inherited ocular disorders, and to allow access to genotyping for patients and their doctors. A network of certified laboratories (*1*) was organized with a coordinating center to which a secure Web-based database was linked. In September 2006, the eyeGENE™ Network received its first sample (*2*). Phenotypic information was entered by the patient's doctor with the understanding that the patient and physician would receive a molecular genetic test result and that the physician would provide genetic counseling for that result. The anonymous DNA sample, with the linked genotypic and phenotypic data, was then placed in an open-source repository to enable future research. To date, the repository has 205 samples representing a diverse collection of heritable ocular conditions. The Network has not encountered any issues related to breaches in patient confidentiality or concerns about employment or insurance discrimination. This research project has been enthusiastically received by the ophthalmic and optometric community and stands as an example of how genomic research can be translated to patients.

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References and Notes

1. Laboratories were certified according to the Clinical Laboratory Improvement Amendments (CLIA).
2. The National Ophthalmic Disease Genotyping Network, eyeGENE™ (www.nei.nih.gov/resources/eyegene.asp).

Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 3 months or issues of general interest. They can be submitted through the Web (www.submit2science.org) or by regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt, nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.

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