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LETTERS

edited by Jennifer Sills

Shopping for Explanations

WE WERE SHOCKED BY THE RANDOM SAMPLE “BORN TO SHOP?” (7 September, p. 1301). Such a study hardly deserves the notice of a premier science journal.

The Random Sample summarizes a “study” of sex-based differences in the ability of modern city dwellers to remember the locations of particular foods at a farmers’ market. Given the social bias in American culture toward meal preparation by women and meal consumption by men, such a difference is not surprising, but neither is it indicative of “hard-wired” biological differences in brain function between women and men. Still less can such differences be attributed to an evolutionary past “when men were the hunters and women the gatherers.”

While this gendered division of labor prevails (but is not universal) among ethnographically known foraging groups, such a pattern cannot be assumed



Response

BRUMFIEL *ET AL.* CRITICIZE C. HOLDEN’S summary (Random Samples, 7 September, p. 1301) of our research (1); we welcome the opportunity to respond.

Many studies document men’s superior spatial performance (2). We found that women excel on a spatial task mimicking the cognitive demands of plant-food gathering, even when we used a measure that normally gives men an advantage. Brumfiel *et al.* suggest that ancestral sex differences in hunting may be small; however, this is irrelevant to our theory of gathering-related spatial adaptations. What is relevant is whether, statistically, ancestral women gathered more than men. If so, they could be the target of stronger selection for cognitive mechanisms supporting gathering. This sex difference in gathering is universal among described hunter-gatherers (3), and chimpanzee data suggest that it extends back to our pre-hominin ancestors (4).

Citing cultural biases in shopping and cooking, Brumfiel *et al.* present a social-learning explanation for our results. Their theory is contradicted by other studies and our

ed for the period of human evolution. Archaeologists argue that with the invention of spear-throwers, bows and arrows, and poison darts, Paleolithic hunting probably involved herd surrounds and game drives, such as those practiced by Native Americans in the western United States at the time of European contact. These surrounds and drives involved all camp members: men, women, and children.

An important trait that distinguishes modern humans from other species is their “hard-wired” ability to learn a wide variety of socially transmitted patterns of thinking and acting. Surely *Science* was premature in drawing public attention to a study that purports to say something about universal differences between women and men based on observations made in a single culture. Studies such as this reinforce the American inclination to explain our own culturally based gendered division of labor (e.g., women shop and cook, men are mathematicians) in terms of biology rather than patterns of socialization and discrimination.

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data. First, studies show either no sex difference or a male spatial advantage in nonfood shopping environments (5). Second, counter

to the social-learning hypothesis, individual differences in shopping experience, taste preferences, and consumption frequency did not predict spatial performance in our study; women outperformed men controlling for these experience factors. Moreover, both sexes showed better performance on high-calorie food items. This is the signature of an evolved mechanism for efficient gathering, not one socially learned in contemporary environments.

Finally, only those who insist upon egalitarianism depend on claims of biological identity. The sexes differ. Men never gestate offspring. On average they are larger, less articulate, shorter lived, and better at mental rotation tasks (2, 6). Denying these and other differences will not make them disappear. But the science that explores these differences provides tools to combat

discrimination. For decades, researchers uninformed about our evolutionary history unknowingly constructed spatial tasks that favor men’s skills. It is only when we take seriously men’s and women’s evolutionary heritages that we can break through this inadvertent sexism and expose women’s unique abilities.

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The ABCs of Multiple Bonding

IN A RECENT PERSPECTIVE (6 APRIL, P. 61) discussing high bond orders in metal-metal bonding and in the silicon homolog of acetylene $\text{HC}\equiv\text{CH}$, where $\text{C} = \text{Si}$, F. Weinhold and C. R. Landis state that “the first stable $\text{Si}\equiv\text{Si}$ species was reported to adopt a planar, but nonlinear, trans-bent geometry,” citing the work by Sekiguchi *et al.* (1). They show structure **C** (Fig. 1) for the parent compound HSiSiH and explain the difference to the bonding situation in linear acetylene $\text{HC}\equiv\text{CH}$ in terms of high preference for p-orbital character in the Si-Si σ bond (2). However, the compound HSiSiH was already synthesized in 1991 (3), 15 years earlier than Sekiguchi *et al.*, who isolated the substituted derivative RSiSiR

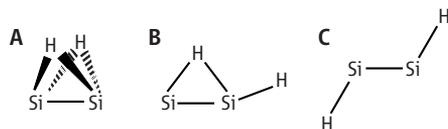


Fig. 1. Energetically lowest lying structures **A**, **B**, and **C** of HSiSiH . The lines indicate only the atomic connectivities but not the electron pairs of Lewis structures. Relative energies in kcal/mol are from (6).

where R is a bulky silyl group (1). Destombes and co-workers (3) showed that the equilibrium geometry of HSiSiH does not form structure **C**, but rather the doubly bridged structure **A** (Fig. 1) previously predicted by *ab initio* calculations (4). Photoexcitation of **A** yields another isomer of HSiSiH , identified as structure **B** (Fig. 1) (5). Quantum chemical calculations predict that structures **A** and **B** are lower in energy than structure **C** (6).

Thus, the silicon homolog of acetylene does not exhibit the Lewis-like bonding pattern discussed by Weinhold and Landis, who consider only the energetically high-lying form **C**. The trans-bent geometry of the RSiSiR compound of Sekiguchi *et al.* (1) comes from steric repulsion between the bulky R groups, which prevent the formation of the isomeric forms **A** and **B**. Sekiguchi's compound RSiSiR is chemically more stable than HSiSiH , which can only be isolated in a low-temperature plasma (3, 5), but this results not from more favorable Si-Si binding interactions but rather from the steric protection of the silicon atoms.

Why do the energetically lowest lying structures of the silicon homolog of acetylene exhibit the unusual hydrogen-bridged geometries **A** and **B** (Fig. 1)? We have analyzed the interactions between two EH fragments (where $\text{E} = \text{C}, \text{Si}, \text{Ge}, \text{Sn}, \text{Pb}$) in the electronic ground state and the first excited state (6). It is only the

combination of two EH fragments in the first excited state that leads to the standard Lewis-type structure with a linear arrangement $\text{HE}\equiv\text{EH}$, because each fragment has three unpaired electrons that yield a triple bond. In contrast, the interactions between EH fragments in the ground state—which has one electron pair, one empty orbital, and only one unpaired electron—explain the preference for **A** and **B** over **C**. Acetylene differs from its heavier homologs, because it takes much less energy to excite CH from the ground state to the excited state than for the heavier species EH . Only in the carbon compound does the stronger bonding in the linear form $\text{HC}\equiv\text{CH}$ compensate for the excitation energy of the fragments.

The experimental (1) and theoretical (6) studies do not agree with the conclusion of Weinhold and Landis that “[f]uture synthetic and computational explorations should be guided by closer attention to the maximally matched donor-acceptor interactions that lead to favorable Lewis-type bonding patterns.” Careful examination of the experimental and

theoretical findings for molecules that have high bond orders between metals clearly shows that the bonding in these compounds is not properly described by simple Lewis-type structures. Future work should use methods and ideas that are not confined to classical bonding models.

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Response

THE STRUCTURAL ISOMERS AT ISSUE CONTAIN Si-Si bonds with either one bridging H (C_s point group symmetry), two bridging H's

CORRECTIONS AND CLARIFICATIONS

News Focus: “Greening the meeting” by B. Lester (5 October, p. 36). The analyses of the AGU annual conference mentioned on page 36 and the ESA conference on page 37 were done by Lawrence Plug and Borden Scott of Dalhousie University, not David Scott. The abstract of their poster was published in *Eos Trans. AGU Fall Meet. Suppl.* **84** (2003). Also, the credit for the bottom image on p. 38 should read “NCSA ACCESS (Arlington, VA)/WNT Consulting LLC Architecture and Innovative Technology Design.”

Cover Caption: (28 September, p. 1821). In the credit line, Andrea Ottesen's name was misspelled.

Editorial: “Playing climate change poker” by C. Challen (20 July, p. 295). The phrase “intended to reduce average global warming by 2°C” was meant to signify that average global warming be limited to 2°C, not that the current average be reduced by 2°C.

TECHNICAL COMMENT ABSTRACTS

COMMENT ON “A Vestige of Earth's Oldest Ophiolite”

Allen P. Nutman and Clark R. L. Friend

Furnes *et al.* (Reports, 23 March 2007, p. 1704) reported the identification of an ophiolite sequence within the ~3.8-billion-year-old Isua supracrustal belt. However, they did not acknowledge that the belt contains supracrustal rocks and mafic dikes of different ages, nor did they demonstrate that the proposed components of the ophiolite are coeval.

Full text at www.sciencemag.org/cgi/content/full/318/5851/746c

COMMENT ON “A Vestige of Earth's Oldest Ophiolite”

Warren B. Hamilton

The claim by Furnes *et al.* (Reports, 23 March 2007, p. 1704) that Greenland metavolcanic rocks require Paleoproterozoic seafloor spreading is incompatible with their own data. The purported sheeted dikes have the composition of pyroxenitic komatiite and could not have fed the adjacent ferroandesitic pillow lavas. Neither type has ophiolitic analogs, and both are likely ensialic.

Full text at www.sciencemag.org/cgi/content/full/318/5851/746d

RESPONSE TO COMMENTS ON “A Vestige of Earth's Oldest Ophiolite”

Harald Furnes, Maarten de Wit, Hubert Staudigel, Minik Rosing, Karlis Muehlenbachs

The comments by Nutman and Friend, and Hamilton, question our evidence for the presence of the Isua ophiolite. Their critical remarks are particularly directed at the veracity of our inferred sheeted-dike complex, the cogenicity of pillow lavas and dikes, and the nonexistence of modern equivalents. Here, we expand on our explanations in response to each of their comments to better justify our arguments and interpretation.

Full text at www.sciencemag.org/cgi/content/full/318/5851/746e

(C_{2v} point group symmetry), or no bridging H's (trans-bent, C_{2h} point group symmetry), all of which are local minima. These alternative structures were duly noted in Sekiguchi *et al.*'s original *Science* Report of the first $\text{Si}\equiv\text{Si}$ triple bond (1), the accompanying Perspective (2), and in our own recent Research Article (3). However, in the context of our Perspective (6 April, p. 61), such H-bridged isomers are irrelevant: They do not contain $\text{Si}\equiv\text{Si}$ triple bonds. Natural bond orbital (NBO) and natural resonance theory (NRT) analysis of the H-bridged isomers yields leading Lewis structures with Si-Si single-bonding in the C_{2v} isomer and double-bonding in

the Cs isomer (additional shared density in Si-H-Si interactions gives net Si-Si NRT bond orders of 1.8 and 2.5, respectively), in contrast to the triple bonding (NRT bond order of 2.9) in the cited C_{2h} isomer (4). Fuller discussion of these alternative isomers and the interesting electronic origins of the preference for H-bridged versus unbridged bonding motifs was precluded by considerations of length and relevance to the main Perspective topic.

Our Perspective sought to address the fundamental question, "How many bonds can be made between two atoms?" For silicon, Sekiguchi's macroscopic-scale synthesis and crystallographic characterization of the persistent RSiSiR ($\text{R}=\text{CH}(\text{SiMe}_3)_2$) first suggested that the answer was three. Computational analysis of trans-bent Si_2H_2 , which bears strong geometric and electronic similarity to Sekiguchi's compound, supports this formulation. Ongoing synthetic studies to explore the upper limits of bonding between two atoms likely will feature bulky R substituents rather than H for two very different reasons. First, the steric protection provided by bulky attachments hinders alternate reaction pathways and eases isolation. Second,

such substituents disfavor bridging modes that necessarily lower the maximum achievable bond order. As stated in our Perspective, the highest achievable bond orders most likely will be realized by "interactions that lead to favorable Lewis-type bonding patterns," as clearly demonstrated in the theoretical logic that led to successful prediction (5, 6) of the Cr-Cr quintuple-bonding motif prior to its recent synthesis (7).

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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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