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LETTERS

NASA Asteroid Report

I write in response to the ScienceScope item "Scientists collide on NASA comet report" (News & Comment, 13 Nov., p. 1075). As chairman of the Near Earth Object Interception Workshop held at Los Alamos National Laboratory last January, I must defend the work of this large, diverse, and highly talented group of scientists and engineers against the comments of Clark Chapman of Science Applications International Corporation's Planetary Science Institute.

Congress requested that NASA conduct an impartial workshop study on the interception of potential impacting cosmic bodies. Chapman's insistence that his views be adopted essentially verbatim and fully included in our workshop report led to extraordinary efforts by the steering committee to ensure that the final report gives a balanced and accurate representation of the findings of all 93 participants. The ScienceScope item implies that the views of a significant number of participants were ignored and that Chapman's position reflects the majority view. This is not true. Only 6 of the 93 participants did not endorse publication of the report, Chapman being the only one who requested that his name be removed. Most of the controversy dealt with the relative importance of the threat from large, rare objects versus smaller, frequent ones. The heart of the debate is actually whether a new system of Earth-based observatories could provide adequate warning leading to successful protection. Scientific evaluation and discussion of these topics will no doubt continue for many years.

Regarding Chapman's comments about my motivations and character, I see no point to his imputations. I will, of course, be glad to discuss the scientific merits of my position and the findings of the workshop before appropriately convened panels.

It seems particularly strange that the ScienceScope item should focus on Chapman's criticism of the workshop's creative forays into new technologies that were explored specifically to seek possible ways of eliminating dependence on nuclear explosives. Chapman's widely disseminated proposition that there was a hidden agenda by Strangelovian weaponeers to carry on the Cold War under an asteroid cover does not do justice to the true nature of the threat and the talents required to deal with it.

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Knuckle-Walking Ancestors

In his interesting paper "Miocene fossil hominids and the chimp-human clade" (Reports, 25 Sept., p. 1929), David Begun argues for a chimpanzee-human clade to the exclusion of gorillas. In an accompanying Research News article (p. 1864), Ann Gibbons reports suggestions that the lack of evidence in the fossil record of knuckle-walking in early hominids poses a major challenge to Begun's phylogenetic hypothesis. This challenge is based on two key observations: that "the chimpanzee and gorilla show identical adaptations" (*1*) to knuckle-walking in their anatomy, and that the absence of such morphology in early hominids provides definitive evidence against a knuckle-walking ancestry.

What has become received wisdom in review articles about the "uniform expression" and "identical adaptations" of the "knuckle-walking features" in chimpanzees and gorillas is a misinterpretation of the original data. Pygmy chimpanzees, common chimpanzees, and gorillas show variable expression of these features, which include flattened dorsal surfaces and raised articular ridges on the metacarpal heads. The degree of development and even the presence of such morphologies appear to be linked to overall size (*2*), which suggests an allometric component (perhaps among others) in the pattern of variance. R. L. Susman noted "a variable occurrence of a dorsal articular ridge" (*3*, p. 221), ranging from slight (in the pygmy chimpanzee) to marked (in the gorilla). Only 6 of 11 adult specimens of pygmy chimpanzees had even slight metacarpal ridges. The broad, flat dorsal surfaces of the metacarpal heads often present in gorillas were also lacking in the smaller pygmy chimpanzees. In a study of the *Homo habilis* (OH 7) hand, Susman and Creel (*4*, p. 312) point out that "although the metacarpals and phalanges of hand rays II–V of adult primates habitually engaging in knuckle-walking or suspensory activities have morphological features reflecting such behavior, these characters are generally poorly developed or absent in young animals." But if the

classic morphological features are absent in the smaller African apes that nonetheless habitually engage in knuckle-walking behavior, then clearly such morphologies are neither biomechanically required for that behavior, nor can their absence in comparably sized fossil forms be taken as definitive evidence of a lack of this locomotor behavior.

Why has this pattern of morphological variance become misconstrued into the frequently heard statement that the "knuckle-walking complex of features" are all functionally correlated and always occur together in identical expression in chimpanzees and gorillas? The problem may lie in poor character analysis and the difficulties inherent in describing features qualitatively, particularly when these features exhibit variable expression. Continuous features are better suited to a quantitative perspective such as that provided by allometry or other approaches (*5*).

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2. J. T. Stern and R. L. Susman, *Am. J. Phys. Anthropol.* **60**, 279 (1983).
3. R. L. Susman, *ibid.* **50**, 215 (1979).
4. _____ and N. Creel, *ibid.* **51**, 311 (1979).
5. P. S. Cranston and C. J. Humphries, *Cladistics* **4**, 72 (1988).

Response: Shea and Inouye provide interesting additional information relevant to the question of African ape-human relations. Knuckle-walking is a shared behavior of African apes, which, if my phylogenetic hypothesis is correct, must have evolved before the gorilla clade diverged from the chimp-human clade, or in parallel in each African ape. Shea, Inouye, and I agree that there is no evidence for the absence of knuckle-walking in the common ancestors of African apes and humans. That knuckle-walking "characters" are variable in their expression in extant knuckle-walkers means not only that the absence of these features in australopithecines does not rule out the possibility that they were knuckle-walkers, as Shea and Inouye suggest, it also reinforces the idea that knuckle-walking has a long ancestry and may have evolved idiosyncratically in separate lineages (*1*). However, it does not follow, in contrast to what Shea and Inouye seem to be suggesting, that knuckle-walking may have characterized the australopithecines. Variability in these traits simply means that they can be misleading as predictors of positional behavior. Much evidence exists indicating that australopithecines were not knuckle-walkers but bipeds, independent of the fact that they lack characters seen in some knuckle-walkers. I have suggested that some form of knuckle-walking or proto–knuckle-walking characterized the last common ancestor of African apes and humans. African apes diverged minimally but independently from this pattern, which could account for the variability in knuckle-walking characters Shea and Inouye note.

There are several reasons to think that humans evolved from knuckle-walkers. Humans and African apes share an os centrale fused to the scaphoid, more robust metacarpal and phalangeal shafts, larger and longer intermediate relative to proximal phalanges, and greater morphological and functional differentiation of manus and pes, all compared with orangs and most other primates. These characters are arguably synapomorphies and plausibly related functionally to both knuckle-walking and power grip. In addition, if one assumes that knuckle-walking is homologous at some level in African apes (the null hypothesis), it is more parsimonious to suggest that it is primitive for the African ape-human clade than to posit a third, unknown positional behavior from which both knuckle-walking and bipedalism arose independently.

A note of correction: In my report I cited a paper by J. Rogers (reference 6) in support of the conclusion that chimps are more closely related to humans than to gorillas. In fact, in this paper on molecular systematics, Rogers indicates that this trichotomy cannot currently be resolved (*2*). A sentence to that effect was inadvertently left out of the final manuscript. In addition, reference 35 should have read, "P. Andrews and L. Martin, *Philos. Trans. R. Soc. London Ser. B* **334** (1270), 199 (1991)."

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Conservation: Should Drug Companies Share in the Costs?

The argument has been made that pharmaceutical companies owe compensation to Third World countries for drugs derived from organisms initially provided by these