lenge Einstein directly on the speed of light issue, the Achilles' heel may already have been exposed in the application of electrodynamic law to electrochemical processes. Relativity, in its classical sense, will undoubtedly survive, but the real question is whether the test of time will continue to support Einstein's requirement that each and every relatively-moving observer constitutes his own personal reference frame for the locally-applicable laws of physics.

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Structure and activity of barbiturates

SIR—It has long been a puzzle that caffeine and other purines should be stimulants while the chemically similar barbiturates are sedatives[1]. I suggest that the latter are no longer planar in solution, being hydrated to the *gem*-diols and having the molecule folded about its principal axis (boat configuration).

Hydration of the central carbonyl can reasonably be expected because of the high positive charge on each of the neighbouring amide nitrogens. The result of electron-withdrawal near a carbonyl group is most familiar as chloral hydrate. Such *gem*-diols are known to catalyse the hydration of carbon dioxide, if the *p*H is high enough for partial ionization of the diol[2]. Most barbiturates would then be fully ionized as amides, unless they were substituted at both nitrogens. Veronal, therefore, should be inactive, and eterobarbital active, in promoting the hydration of dissolved carbon dioxide to carbonate.

As for biological activity, *gem*-diols are ideally constituted to bind the ionized carboxyl of GABA and other amino acids.

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Linking impacts and plant extinctions

SIR—The discovery of shock-metamorphosed quartz grains[1], in addition to earlier evidence from siderophile enhancements[2] and microtektite-like spheroids[3-5] appears to confirm the existence of a bolide event at the Cretaceous-Tertiary (K/T) boundary, but a causual connection between this event and the extinctions of many plants and animals remains in dispute. The pattern of extinctions in the marine realm[6-10] generally conforms to the hypothesized effects of an asteroid impact, but evidence from the terrestrial biota has been somewhat paradoxical. Though the situation for land animals remains equivocal (because some of their fossils are suspected to have been reworked), recent evidence collected from both fossil pollen and palaeosols appears to support the marine data for a sudden, catastrophic change at the K/T boundary.

Latest Cretaceous pollen sequences recovered from many sites in Montana[11,12], Colorado[13] and New Mexico[13] display dramatic shifts in the ratio of fern spores to angiosperm pollen at the K/T boundary. These widespread palynofloral disruptions suggest that the terrestrial flora suffered a profound ecological shock at the boundary, and the close proximity of these pollen breaks to Ir anomalies and highly shocked quartz grains implicate an asteroid impact. The pattern of plant destruction and renewal is similar to that observed at Tunguska[14], Krakatau[12] and Mount St Helens[15]. Initial devastation might have been produced by the shockwave[16] that would have resulted from a terrestrial impact[17].

In addition, information collected from palaeosols (M.D.S. and G.J.R., unpublished data) in Montana tends to support the pollen evidence for a change in the flora at the K/T boundary. Palaeosols from the Hell Creek Formation are well developed, weakly calcareous and have a microstructure indicative of warm, oxidizing conditions. These Cretaceous palaeosols combined with pollen data are suggestive of a well drained closed-canopy forest of subtropical aspect, dominated by broadleaf angiosperms. Mean annual rainfall was subhumid, but periodic, possibly monsoonal. The presence of mummified dinosaur corpses, as well as "growth rings" in the teeth of some endothermic vertebrates[18], provides evidence for seasonally dry conditions. By contrast the palaeosols of the Tullock formation have a weak microstructure, and tend to be poorly developed with thick organic layers and abundant siderite nodules, suggestive of a cooler climate and poor drainage. In combination with pollen data these palaeosols are indicative of a temperate flora dominated by conifers and situated in a swamp environment. A modern analogue would be bald cypress swamps that presently exist over portions of southeastern North America. Coals are thicker and better developed in the Tullock formations, consistent with the hypothesized existence of poorly drained, widespread wetlands.

The change in palaeosols is abrupt and occurs directly above the pollen break at the K/T boundary, although it is difficult to say how sudden the palaeosol change was because of a complex erosional hiatus at the boundary. The palaeosol change is generally consistent with an interpretation made by Smit and van der Kaars[19] for palaeochannels in the Bug Creek area. Evidence from both pollen and palaeosols suggest a change across the boundary to unstable conditions in the early Palaeocene, shown by channel downcutting and followed by the establishment of a new geomorphic equilibrium. Long-term palaeosol and pollen changes are compatible with base-level adjustments, possibly related to a drop, then a rise in sea level. The synchronous occurrence of an Ir anomaly, spheroids, pollen breaks and shocked quartz at the boundary is suggestive of an additional catastrophic destabilization.

The presence of abundant palaeosols places constraints on the degree of resorting of fossils within the Hell Creek Formation. For example, it has been suggested[20] that nearly all fossil material contained in the Hell Creek faunal-facies was reworked and transported. This is an overstatement, as palaeosols would be destroyed in frequently disturbed environments, and the widespread occurrence of palaeosols in association with large fossils (less commonly with microfossils) suggests that much, if not most of this facies was formed in place. The truncation and strong development of palaeosols at the K/T boundary, together with the lack of palaeosols associated with fossils of the Bug Creek faunal-facies is consistent with the suggestion[19] that some of these fossils were transported.

A more detailed picture of the Hell Creek-Tullock palaeoecological transition awaits further analysis of data. We believe, however, that at the moment the asteroid impact hypothesis provides the most parsimonious explanation for changes in plant communities across the K/T boundary.

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