In the footsteps of dinosaurs?

SIR—It is impossible to work on dinosaur footprints in Texas[1,2], without becoming involved in the "man track" controversy. I have seen most of the alleged human ichnites, but have been reluctant to publish interpretations without a thorough understanding of the details of formation of unquestioned dinosaur tracks, and the gaits of the trackmakers. Now Kuban and Hastings have sparked a revival of interest in this topic with their publications on the "colour distinction" of the Palauxy River "man tracks"[3,4]. I am prompted to alter my approach to this matter by John D. Morris's recent letter to *Nature*[5].

Most of the structures identified as "man tracks" in Lower Cretaceous rocks at Glen Rose and elsewhere in Texas are not footprints of any kind, let alone human tracks, but are simply solution features and/or scour marks of the kind that can be seen in riverbeds throughout central Texas, and even on exposed rock surfaces well away from river valley. Some of the "man tracks" do occur in good trackways, however, and clearly represent the footprints of bipedal animals. The Taylor trackway, featured in much of the creationist literature, is a good example, and I have examined a similar trail in Hondo Creek, Bandera County. The footprints in these trackways are generally elongated depressions rather lacking in detailed morphology. If one looks at enough bipedal dinosaur footprints, at enough sites in Texas, it is possible to find footprints intermediate in shape between the elongate depressions of the "human" trackways and more normal tridactyl footprints of typical bipedal dinosaur trails.

I have measured stride, pace and footprint lengths of over 70 bipedal dinosaur trails in Texas, and supplemented these data with measurements from the literature of more than 650 additional bipedal dinosaur trails[2]; the "human" trails match typical dinosaur trails in the relationship between footprint size and pace or stride length, and also show similar step angles. Thus even before the "colour distinctions" were recognized, there was ample reason for regarding the Paluxy River "human" trackways as the poor end of the impression/preservation spectrum of theropod or ornithopod trails[6,7].

Kuban corroborates this interpretation by making a good case[4] that many of the "humanoid" footprints were formed by bipedal dinosaurs walking in an unusual, "flat-footed" fashion, with their metatarsals pressed against the substrate. Similar metatarsal tracks have been reported from a Cretaceous site in Queensland[8], and perhaps elsewhere. If the toe marks of such footprints were to collapse, as sometime happens during footprint formation, very human-like tracks would be formed. In the case of the Taylor trackway, however, the toe impressions apparently did not collapse. Weathering of the rock surface has resulted in the development of more or less non-impressed or irregularly impressed, coloured toe marks and a larger track outline associated with the more deeply impressed, originally discovered "man tracks"[4]. Although unusual, the phenomenon is not "unprecedented," as Morrison states; an ornithopod trail with footprints delimited mainly by such colour distinctions occurs in the Dakota Group (Cretaceous) along the Alameda Parkway near Denver, and some of the sauropod footprints from the Purgatory River (Morrison Formation, Jurassic) of Colorado are distinguishable from the surrounding rock mainly by their colour (M.G. Lockley, personal communication).

The origin of such colour-delimited footprints was much discussed by participants on the field trip of the recent First International Symposium on Dinosaur Tracks and Traces (Albuquerque, May 1986). The tracks were perhaps filled with sediment of a contrasting type from that in which the footprints were impressed; this inhomogeneity may have led to the colour distinctions in response to modern weathering. Alternatively, as dinosaurs crossed mud flats, their weight may have squeezed pore water from the sediments beneath their feet, resulting in subtle chemical differences from the surrounding sediments; the coloured tracks may thus have formed as "ghost tracks" some distance below the sediment/water interface.

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Greenhouse cure

SIR—Those who are concerned about the consequences of the "greenhouse effect" overlook the benefits that would follow from the general adoption of a vegetarian diet. If there were a halt to the consumption of grain-fed livestock products (while retaining the present pasture lands to support animals for meat and milk), at a *per capita* grain consumption of 200 kg per year for a healthy vegetarian diet, only about 60 per cent of the present land under cultivation would be needed to feed the world population. With the further modernization of techniques in developing countries, that 60 per cent would be more than sufficient to feed the projected world population in the next century. This would not only stop the deforestation that contributes substantially to the increase in atmospheric CO_2, but would enable us to reforest 40 per cent of the present agricultural land, leading to large-scale absorption of atmospheric CO_2. Such an extensive mopping-up of carbon dioxide by young growing forests may be the only way to prevent the worrying consequences of the greenhouse effect, at least until alternative energy sources can effectively replace fossil fuels.

Legislation to effect a change in our dietary habits may be difficult to achieve. But fortunately, it is a step that we could fruitfully take at the individual level without having to wait for government action, the laws of supply and demand would go a long way towards making sure that reduced meat demands would decrease the pressure on land and pave the way for rapid afforestation.

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Damadian defended

SIR—It is disturbing that you should publish such a prejudiced review (*Nature* **320**, 318; 1986) of Sonny Kleinfield's book, *A Machine Called Indomitable*, containing derogatory remarks about Raymond Damadian, whose struggles have given the world a powerful tool for medical diagnosis. The reference to Damadian as a "misfit" does harm to a journal with a reputation for even-handedness and fair play. In his review Peter Newmark seems to take popular acceptance as the sole criterion for scientific excellence. If this were true, Copernicus, Lavoisier, Darwin, Planck and Einstein were all "misfits", rejected by their contemporary peers.

Newmark's comment that I, though successful in casting a spell over Damadian, nevertheless "remain a voice in the wilderness", is also uncalled for. I suggest he reads the review (*Nature* **311**, 682; 1984) of my book, *In Search of the Physical Basis of Life*, where the reviewer, Dick, though a long-time scientific opponent of mine, stated with fairness and general accuracy: "Since the 1950s majority views of the cell have moved significantly nearer to those of Dr Ling...".

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