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LETTERS

Magnetic Storm Predictions

Tim Appenzeller's article "Hope for magnetic storm warnings" (Research News, 21 Feb., p. 922) was an excellent overview of coronal mass ejections (CMEs) and their possible effects at Earth, one of the best that has been published on the topic. There is, however, a clarification that should be made.

Although it is well known that intense magnetic storms are strongly associated with CMEs (up to an 80% level of confidence), the opposite association, the one that is actually needed for storm predictability, is weak. Only one out of every six CMEs causes intense storms. We do understand the reason for this poor association. To have an intense storm, a strong southwardly directed interplanetary magnetic field with a long duration (hours) is required to impinge upon the Earth's magnetosphere. The CMEs that do not cause intense storms are composed either of northwardly directed fields or of intense southward fields that are of short duration (fluctuating fields).

At this time, we do not know how to predict the intensity of the field, its direction, or the duration in a particular direction. However, several colleagues are working on this problem, including T. Hoeksema and X. Zhao at Stanford University, N. Crooker at the University of California, Los Angeles, E. Cliver at the Phillips Laboratory in Massachusetts, and D. McComas at the Los Alamos National Laboratory.

We also do not know how to predict a storm's intensity given its interplanetary features, as physical processes within the magnetosphere are not fully understood. As one example, fundamental time scales for the growth and saturation of the Van Allen radiation belt (ring current) are governed by both the amplitude and the duration of the southward interplanetary magnetic field.

It is hoped that a great deal more will be understood within the next few years, so that predictions for magnetic storms can be made and power grids and satellites can be protected.

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Dinosaur Diversity and Extinction

In their report "Sudden extinction of the dinosaurs: Latest Cretaceous, upper Great Plains, U.S.A." (8 Nov., p. 835) Sheehan *et al.* assert that the lack of decrease in *familial* diversity of dinosaurs supports the hypothesis that the effects of an asteroid impact were the sole or dominant cause of dinosaurian extinction. This does not account for the considerable body of evidence of decrease in *generic* diversity and change in structure of dinosaurian faunas (*1*, *2*) before their demise.

Familial and generic diversity have been extensively analyzed (*1*, *2*) in Campanian and Maastrichtian faunas of the northern western interior (NWI) of North America. This region includes the area studied by Sheehan *et al.* These studies (*1*, *2*) have different results because interpretations of familial and generic classifications differ, but general patterns have emerged.

From the Campanian through the Maastrichtian (a period of at least 10 million years), the maximum number of families represented in regional samples from the NWI has remained relatively stable at between 11 to 14 (*2*, *3*). In contrast, the number of genera decreased from approximately 32 to 19. This decrease appears to have been particularly marked among the ornithischian dinosaurs (*2*, *3*).

A major goal for future research is to clarify the evolutionary pattern. Was it one of gradual dwindling, step-wise modifications, or abrupt change long before the end of the Cretaceous? Any viable hypothesis of the causal factors of dinosaurian extinction must account for the evidence of decrease in generic diversity and change in structure of dinosaurian faunas.

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