workers have pointed out since at least 1917, the chemistry of tektites resembles nothing so much as continental sediments, especially sandstones. There are no known lunar rocks having major and trace element compositions similar to those of tektites, and there are no known meteorites with these compositions.

The second important discovery made by Shaw and Wasserburg is that within each tektite group ε^{Nd} (0) is uniform whereas ε^{Sr} (0) is highly variable. This reflects what earth scientists already suppose about the different types of information provided by the Sm-Nd and Rb-Sr systems. Assuming that concentrations are high enough to measure, any radioactive decay system will give an age for the rock concerned, but the term 'age' needs careful interpretation. The major fractionation of Sm and Nd appears to occur during the partial melting of mantle material to produce crust, and the Sm-Nd system is relatively undisturbed by such processes as weathering and sedimentation. Moreover, Sm and Nd are refractory and thus not readily fractionated by differential volatilization on impact melting. The Sm-Nd age of a tektite should therefore represent the time of formation of the crustal material from which the tektite was ultimately derived, and uniformity of ε^{Nd} (0) within a single tektite group inspires confidence that the Sm-Nd system is dating precisely that event. The Rb-Sr system, by contrast, can be severely disturbed by sedimentation, volatilization, weathering and diagenesis. It is only to be expected, therefore, that a tektite group will provide a range of ε^{Sr} (0) values and Rb-Sr ages reflecting the varied history of the tektite source rocks and descending to the last major parent-daughter fractionation event. In short, if nature is behaving itself, all tektites within a group should have a common Sm-Nd age, a range of younger Rb-Sr ages and, of course, a common and even younger K-Ar age representing the time at which the tektite themselves formed.

And thus it turns out. The Sm-Nd ages obtained by Shaw and Wasserburg for the North American, European, Ivory Coast and Australasian tektites are, respectively, about 650, 900, 1,900 and 1,150 million years. In other words, all the ages are consistent with the tektites' having been formed from Precambrian crust. The Rb-Sr data then indicate what happened between the formation of that crust and its conversion to tektite. The European tektites, for example, were derived from sediments laid down only about 20 million years ago. Interestingly, sediments in the nearby Ries Crater have ε values and isotopic compositions similar to those of the tektites themselves. Moreover, the age of the oldest basement in the crater area agrees well with the Sm-Nd age of the tektites. The new data thus support an earlier suggestion that the Ries Crater was formed by the impacting body that also gave rise to the tektites.

The Ivory Coast strewnfield has also been associated with an impact structure, namely, the Bosumtwi Crater. The rocks around this crater have ages comparable with the Sm-Nd age of the tektites. The Rb-Sr systematics indicate that the tektites were formed from Precambrian sediments about 950 million years old, although the sediments have not been identified yet. The North American tektites, by contrast, have no known source crater. Moreover, the fact that the material that went to form the tektites was derived from the mantle as recently as the late Precambrian rules out most of the North American Precambrian shield, and the sediments derived therefrom, as a source region. Similar age criteria refute the recent suggestion from Dietz (*Meteoritics* **12**, 145; 1977) that the Popigai astrobleme of Siberia is the source of the North American strewnfield. The only known continental material of the required age is the late Precambrian crust constituting the east-southeast margin of the Appalachian orogenic belt, although no suitable crater has been identified within it.

Little more can be said about the origin of the North American tektites, except that the immediate source material was sedimentary, for the Rb-Sr proved unsuitable for the determination of an age of sedimentation. Not the least interesting conclusion to be drawn from the work of Shaw and Wasserburg, however, is that an oceanic impact for the origin of tektites is not ruled out by the restriction that tektite source material cannot be oceanic crust. Although the effects of the impact at the Ries Crater extend to depths of about 2 km, the tektites supposedly produced by the impact were formed from sediments which appear to have been only a few tens of metres thick at the time. The implication of this is that an oceanic impact could well generate tektites simply by sampling thin continentally derived sediments lying on top of the basaltic oceanic crust. In other words, an impact origin of tektitites is not precluded by failure to discover a suitable impact structure on land.

In the case of the Australasian strewnfield there are several candidate craters on land — the Zhamanshin and Elgygytgyn Craters of the USSR and an unnamed crater-like structure in Cambodia. Nothing much is know of the Cambodian crater and the Elgygytgyn Crater can be ruled out on age grounds. The most touted possibility is the Zhamanshin Crater, but the case for it is weak, if not nonexistent. For example, this crater is associated with tektite-like objects known as irghizites, which have chemical compositions similar to, but Nd isotopic compositions quite different from, those of the tektites of the Australasian strewnfield. It is possible in principle that both the irghzites and the Australasian tektites were produced at the same crater but that the irghizites managed to take up a proportion of the impacting meteoritic material, although Shaw and Waserburg show that it is impossible in practice to obtain the correct ε values for the irghizites simply by adding chondritic material to the tektitic. It seems much more likely that the impact body that supposedly gave rise to the Australasian tektites fell in the ocean; but wherever it struck, it generated tektites from continentally derived sediment about 250 million years old.

What is impressive about the story pieced together by Shaw and Wasserburg is its overall coherence and internal consistency. So can we take it that the tektite issue is now settled? Or will the lunar volcanologists fight back, as they have so often done before, with a quite different interpretation of the same data? We shall see. In the meantime, it could well be objected that, coherent or not, the cometary impact hypothesis is no less exotic a mechanism for the production of tektites than is lunar volcanism. But somehow it does seem less so these days. Recent calculations on the frequency with which comets large and small might be expected to reach the Earth's surface, and the remarkably cool way in which the earth science community has been willing to consider seriously the suggestion by Alvarez *et al.* (*Science* **208**, 1095; 1980) that cometary impact may have been responsible for the Cretaceous-Tertiary extinctions, suggest that the rigid anti-catastrophism characteristic of geological thinking since the time of Hutton and Lyell is now dead.

Yet at least one puzzle remains, and remains unremarked. If cometary impacts have been responsible for biological extinctions throughout the Phanerozoic, why have they apparently only generated tektites during the past 35 million years? Curious. □

NATURE

WHILE watching the grand display of aurora on Friday night from our roof, at about 6h. 7m., my wife and I saw a strange gleam of light rising above a bank of cloud on the eastern horizon, nearly vertically below the Pleiades, like the gleam of another moon rising in a haze. It grew out slowly, as we watched it, into a strong beam of white light slanting towards the south, and we stood in wonderment as it lengthend out making straight towards the moon. Presently its tail was dis-engaged from the cloud, and it stole through the sky like a long luminous nebulous "cigar ship" exactly across the moon, and away down into the west, sinking as slowly as it had risen. You will probably receive many accounts of this strange apparition. It will be interesting to know the position relative to the moon in which it was seen by different observers. Was it clear of the earth's atmosphere or not?

HUBERT AIRY

Woodbridge, November 19, 1882.