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J. F. HUGHES

Department of Electrical Engineering, University of Southampton

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Are Microtektites the Result of Cometary Impacts with the Earth?

Durrani and Khan[1] suggest that microtektites obtained from ocean sediments near Australia and the Ivory Coast may be the result of impacts of comets with the Earth. They measured the ages of the microtektites obtained from the two regions and determined the ages at 0.71 ± 0.1 and 0.88 ± 0.13 m.y., respectively, for Australasian and Ivory Coast tektites. These ages agree closely with the dates of two of the reversals of the geomagnetic field, and this close agreement is interpreted by them as suggesting that the microtektites and magnetic reversals have resulted from impacts of comets with the Earth.

Interesting as the idea may be, we wish to point out that there seems to be a difficulty regarding the frequency of cometary impacts with the Earth. The frequency was estimated by Russel, Dugan and Stewart and it seems best to quote their statement. They write[2]: "It may readily be computed that a small rapidly moving body which approaches the Sun within one astronomical unit stands about one chance in 400 million of hitting the Earth. Because roughly five comets come within this distance every year, the nucleus of a comet should hit the Earth, on the average, once in about 80 million years. Collisions with the outer parts of the head should be many times more frequent".

For the suggestion by Durrani and Khan to be valid, the frequency of the cometary impact would have to be about one in a million years, while the frequency given by Russel *et al.* is some 80 times smaller. It is true that not all comets that come within one astronomical unit from the Sun are detected. Nevertheless, it seems that the discrepancy by the factor of 80 cannot easily be explained by taking into account comets that escape detection.

H. A. KELLNER
S. YABUSHITA

European Space Operations Centre, 61 Darmstadt

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DR DURRANI writes: If the orbits of approaching comets were completely random, the probability[1] that one of them, having arrived at about 1 AU (Earth–Sun distance) from the Sun, would hit the Earth would be related to the solid angle presented by the Earth, that is, $\pi r^2/4\pi R^2$, where r is the radius of the Earth and R is the Earth–Sun distance. Certain additional factors must, however, be taken into account: first, a factor of 2 to allow for collisions during the return journey of the comet; second, the Earth's influence in deflecting a passing comet (which depends on the initial velocity and orbit of the comet); this increases the collision cross section by a factor of about 3 (ref. 2). On taking these factors into account, the probability of a comet at 1 AU from the Sun hitting the Earth is seen to be approximately 1 in 360 million (which is not far off the estimate given in ref. 3 and quoted by Drs Kellner and Yabushita).

The number of comets arriving in the vicinity of the Sun, however, is taken by Urey[1] to be 10 per year, as opposed to 5 per year assumed by Russel *et al.*[3]. Urey's estimate leads to a collision probability per year of 1 in 36 million. As Kellner and Yabushita point out, not all comets that come to within 1 AU of the Sun are detected. Indeed, according to Russel *et al.* (ref. 3, page 425), "If allowance is made for the fact that comets of smaller perihelion distances may be unfavourably placed and so miss discovery, it is probable that not more than 1/8 of those which come within 5 astronomical units of the Sun are picked up". Thus, one would not be surprised if the above figure of 1 in 36 million were increased by a factor of 3 or 4 (to 1 collision in, say, every 10 m.y.). Urey[4] quotes a personal communication from Z. Kopal to the effect that one collision of a comet head with the Earth every 50 million years "was much too low an estimate of such events".

With the above conclusions in mind, I shall examine the data. Four distinct tektite falls have been observed during the past 35 million years (Australasian, approximately 0.7 m.y.; Ivory Coast, 0.9 m.y.; Czechoslovakian, 14 m.y.; and North American, 35 m.y.). Cometary collisions are such rare events that they obey Poisson distribution. What is the probability, then, of observing four falls during the past 35 million years if the expected frequency was (*a*) 1; (*b*) 2; (*c*) 3 and (*d*) 4, as indicated above? The answers are: (*a*) 1.5%; (*b*) 9.0%; (*c*) 16.9%; and (*d*) 19.5%. (Note that even when four falls were expected over the 35 m.y., the probability of actually finding nothing but four falls is given, by Poisson distribution, as roughly 20%.) Thus the probability of finding four tektite falls through cometary collisions over the past 35 m.y. is (contrary to the expectation of Drs Kellner and Yabushita) not a negligible quantity even when the expected frequency was only one or two over this period.

S. A. DURRANI

Department of Physics, University of Birmingham, Birmingham B15 2TT

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BIOLOGICAL SCIENCES

Adenylic Acid-rich Sequence in RNAs of Rous Sarcoma Virus and Rauscher Mouse Leukaemia Virus

ADENYLIC ACID (A)-rich sequences have been found in some mRNAs of animal cells[1,2] and DNA viruses[3] but not in the RNAs of cytocidal or oncogenic RNA viruses. These sequences have been proposed to be involved in the transport of mRNA to the cytoplasm from the nucleus or vaccinia virus core[2,3], or in the association of mRNA with proteins necessary for translation[1].

In certain conditions, however, the DNA polymerase of Rous sarcoma virus (RSV) transcribes a T-rich polynucleotide from RSV RNA[4], implying that an A-rich region exists in RSV RNA[4]. Previous hybridization experiments by Harel *et al.*[5] with 60–70S RNA of avian myeloblastosis virus and chicken