ured on the prints of the Palomar Sky Survey relative to AGK2 stars: the accuracy achieved was estimated from the distribution of radio-optical position differences obtained in a large number of similar measurements.

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Discontinuous Change in Earth's Spin Rate following Great Solar Storm of August 1972

THE question of a link between changes in the Earth's spin rate and the activity of the Sun is of topical interest, and there is good evidence that the changing length of day is influenced by the mean level of solar activity[1,2]. The possibility of a one-to-one correlation between specific events on the Sun and specific changes in the length of day has remained more controversial, however, although there was a suggestion of such an effect associated with the great solar storm of 1959 (refs. 3–5) Specifically, Danjon suggested[3–5] that there was an increase in the length of day when the nucleonic component of solar cosmic rays increased ; this was in addition to the usual steady increase in the length of day. Other observers questioned the reality of this effect (for a discussion of the controversy see ref. 6), and because the 1959 solar storm was the greatest recorded since the time of Galileo, there was no immediate hope of an independent test of Danjon's claim. In August 1972, however, an even greater disturbance occurred on the Sun[7–9]. It seemed to us that this might provide the ideal opportunity to resolve the controversy, and we have indeed found a discontinuous change in the length of day, and a change in the rate of change of the length of day (a glitch) immediately after that event. Changes in the length of day, and thus in the spin rate of the Earth, are revealed by regular measurements of Universal Time (UT) carried out at many observatories around the world. For our purpose, we are interested in UT2, the version of Universal Time with the effects of the Chandler Wobble and seasonal variations removed. The difference between Atomic Time (AT) and UT2 shows, on average, a monotonic increase as the Earth's spin slows down and the length of day increases.

In Fig. 1 we plot AT–UT2 for a period of one month on either side of the great solar storm of August 1972. The spot group associated with the flare activity built up from July 29, reaching a maximum size (covering 17° in longitude) on August 4. In Fig. 1, we have marked August 3 (JD 41532), the last day before the series of Forbush decreases which marked the solar activity[7], by an arrow. The expected change in spin rate and length of day is clearly visible ; a similar plot using data for the six month period May to October 1972 shows (Fig. 2) that the jump is the largest such event recorded over that period. The change in slope indicated by the data of Fig. 2 is equally significant ; this is qualitatively similar to the changes seen in pulsar spin rates during glitches, and we therefore borrow the term from the pulsar literature to describe this terrestrial process. At the time of the flare and sunspot activity, the slope flattens slightly, subsequently trending back towards a slope more typical of the data of the preceding three months over a period of several weeks.

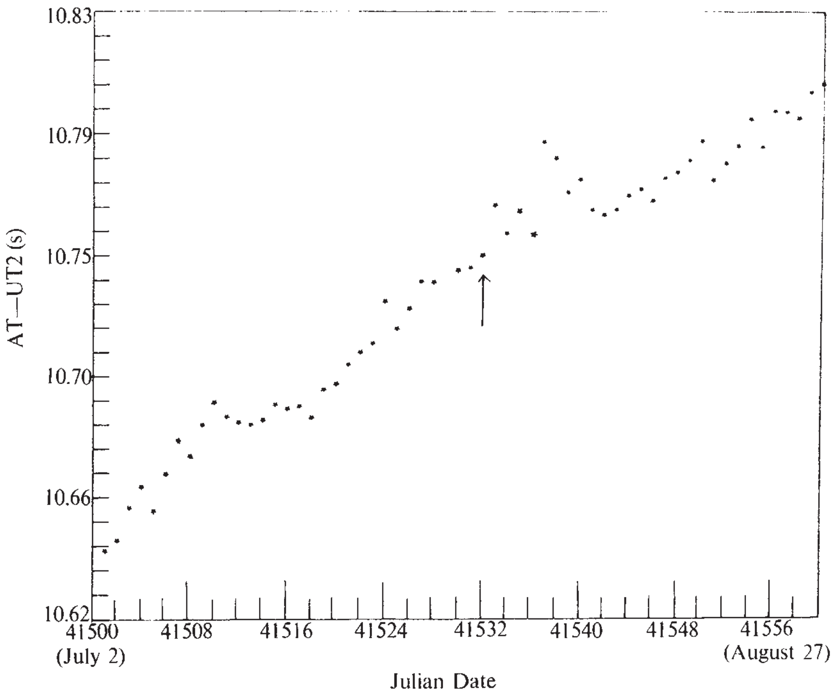

Fig. 1 Change in length of day for a period of one month on either side of date of great solar flare activity of August 1972. Arrow marks August 3, the last day before the flare activity. Large discontinuous change in AT–UT2 occurs on August 8.

These effects are not so dramatic that one would necessarily attribute them to an outside cause on the basis of these data alone, but they take on a greater significance in the light of our prediction, following Danjon, that just such a change should occur soon after a great solar flare. We are confident that the effect is real, and that the glitch was indeed caused by events associated with the solar activity of early August 1972.

It is not difficult to envisage models which explain the delay of 5 days between commencement of the flare activity and the glitch. We will not discuss detailed mechanisms here, except to point out that solar phenomena are known to influence the large scale circulation of the Earth's atmosphere. For example, troughs in the circulation pattern at high latitudes are amplified when the level of solar cosmic rays reaching

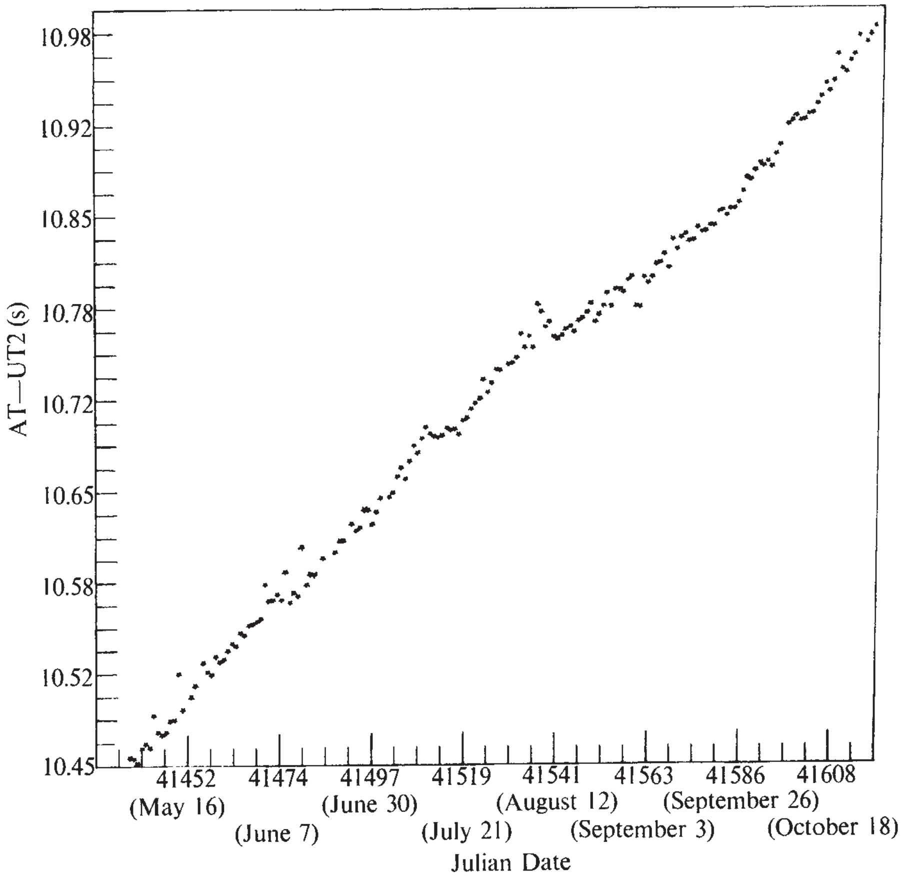

Fig. 2 As Fig. 1, for May to October 1972. The change in slope after the time of the great solar activity, and subsequent return towards the pre-flare slope, emphasize the importance of the event.

the Earth is high[10,11]. Like Schatzman[6], we believe that sudden variations in the length of day may be produced by meteorological phenomena induced by solar activity; in that case, it would be most unreasonable if it did not take a few days for these effects to show themselves in the AT–UT2 measurements.

We will discuss details of such a mechanism and further consequences of this discovery elsewhere. We thank the US Naval Observatory, Washington, for suppling the raw data used in the preparation of Figs. 1 and 2.

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Viscous Remanent Magnetization in Oceanic Basalts

THE magnetic properties of the basalts which form layer 2 of the oceanic lithosphere are important because of their relevance to the hypothesis[1] of seafloor spreading. Most studies of these magnetic properties have been carried out on basalts obtained from dredge hauls taken predominantly from ocean ridge systems and fracture zones. These constitute special areas of the oceanic crust where the sediment cover is negligible. It is of interest to compare the magnetic properties of the dredged basalts with samples recovered from holes drilled through the overlying sediments into the basaltic layer at places distant from ridge axes. Samples obtained from the abandoned Mohole project and, more recently, from the Deep Sea Drilling Project (DSDP) possessed magnetic properties similar to those of dredged basalts[2,3]. Here I describe highly unstable magnetic characteristics found in basalts from DSDP hole 57.

In a study of basalts from DSDP holes in the Atlantic Ocean[3] the natural remanent magnetizations (NRM) were found to be very stable, requiring alternating fields of 200–400 oersted to destroy 50% of the original remanence. The NRM directions and intensities were invariant in storage tests in the Earth's magnetic field lasting several months. High Königsberger ratios, averaging about 11, imply that the remanent magnetizations were much more important than magnetizations isothermally induced by the ambient geomagnetic field. The remanent intensities were considerably lower than those found in dredged basalts (1×10^{-3} gauss compared to about 5×10^{-3} gauss), but were strong enough to account for the observed magnetic anomalies if a thickness of 2.5 km is assumed for a uniformly magnetized layer 2. Palaeolatitudes deduced from the remanent inclinations of extrusive basalts agreed with palaeolatitudes derived from a model reconstruction of the opening of the Atlantic Ocean[4]. The basalt magnetic pro-