close phylogenetic ties of *Oreopithecus* with either pongids or hominids. The cranial features of *Oreopithecus* are unique, and by themselves are not proof for close phylogenetic ties with cercopithecoids either. Aside from the character complex of the masticatory apparatus, the various estimates for the cranial capacity of *Oreopithecus* have to be reconsidered. Some previous braincase volumes, based on plaster reconstructions, are exaggerated. Based on a scrutiny of the crushed skull, a sheer, almost arbitrary, estimate of 200 cm^3 or slightly more for the brain volume of *Oreopithecus bambolii* appears to be generous.

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References and Notes

1. H. G. Lorenz, *Riv. Ital. Paleont. Stratigr.* **74**, 307 (1968).
2. A monographic account of this catarrhine, based on work begun during the summer of 1972 in Basel and Florence, is being prepared by F. S. Szalay and R. L. Decker.
3. P. M. Butler and J. R. E. Mills, *Bull. Brit. Mus. Natur. Hist.* **4**, 1 (1959); J. Hürzeler, *Schweiz. Palaeont. Abh.* **66**, 1 (1949); *Eclogae Geol. Helv.* **44**, 2 (1951); *Verh. Naturforsch. Ges. Basel* **65**, 88 (1954); *ibid.* **69**, 1 (1958); E. L. Simons, *Nature* **186**, 4727 (1960).
4. J. Hürzeler, *Colloq. Int. Centre Nat. Rech. Sci. 1961* (1962).
5. ———, *Ann. Paléont.* **54**, 2 (1968).
6. W. L. Strauss, Jr., in *Classification and Human Evolution*, S. L. Washburn, Ed. (Aldine, Chicago, 1963), pp. 164–177.
7. J. Hürzeler, *Triangle* **4**, 5 (1960).
8. W. L. Strauss, Jr., *Science* **126**, 345 (1957); *Anat. Rec.* **132**, 3 (1958).
9. ——— and M. A. Schon, *Science* **132**, 670 (1960).
10. E. L. Simons, *Sci. Amer.* **211**, 50 (July 1964).
11. D. Pilbeam, *The Ascent of Man* (Macmillan, New York, 1972).
12. C. S. Coon, *The Origin of Races* (Knopf, New York, 1962), pp. 210–211.
13. Some years ago A. Azzaroli pointed this out to one of us (A.B.).
14. Cost of this research was partly defrayed by Wenner-Gren grant 2916 and by NSF grant GS 32315 (both to F.S.S.). We are deeply grateful to A. Azzaroli of the University of Florence, Italy, for his kindness and permission to study *Oreopithecus*. We are grateful to M. Siroky for technical assistance with the manuscript, and to A. J. Cleary for the figures.

7 November 1972; revised 21 December 1972

Solar Magnetic Sector Structure: Relation to Circulation of the Earth's Atmosphere

Abstract. *The solar magnetic sector structure appears to be related to the average area of high positive vorticity centers (low-pressure troughs) observed during winter in the Northern Hemisphere at the 300-millibar level. The average area of high vorticity decreases (low-pressure troughs become less intense) during a few days near the times at which sector boundaries are carried past the earth by the solar wind. The amplitude of the effect is about 10 percent.*

The solar magnetic sector structure appears to be related to the integrated area of regions of high positive absolute vorticity observed during the winter in the Northern Hemisphere at the 300-mbar level (a height of approximately 9000 m). The average area of high vorticity decreases during a few days surrounding the times at which sector boundaries are carried past the earth by the solar wind, the amplitude of the effect being about 10 percent.

The solar magnetic sector structure (*1*) is extended outward from the sun by the radially flowing solar wind. As viewed from the earth, the resulting interplanetary magnetic field can be divided into sectors such that within each sector the field polarity is either toward the sun or away from the sun. Adjacent sectors having opposite field polarities are separated by an exceedingly narrow boundary. Most commonly there are four such sectors, each having a width of approximately 90° in solar longitude, and the sector structure rotates past the earth with a period of about 27 days, corresponding to the synodic solar rotation.

The integrated vorticity area was measured by the vorticity area index of Roberts and Olson (*2*), which is calculated as follows. Absolute pressure–height contour maps for the portion of the Northern Hemisphere north of 20°N were used to compute absolute vorticity maps contoured at selected vorticity levels. These maps were prepared twice each day for the interval 1964 to 1970. A prominent feature of these vorticity maps was the association of regions of high positive vorticity with low-pressure troughs. The vorticity area index was defined as the sum of the area (in square kilometers) over which the absolute vorticity exceeded 20×10^{-5} sec^{-1} plus the area over which the vorticity exceeded 24×10^{-5} sec^{-1}. For virtually all the troughs there was some area over which the vorticity exceeded the lower value, and for the major troughs there was nearly always some area over which the higher value was exceeded. On each map the vorticity area index was summed to give one number (area) representing the integrated value for the Northern Hemisphere north of 20°N.

The average response of this hemispheric vorticity area index to the passage of a sector boundary by the earth was investigated by using the technique of superposed epochs. The zero days were defined as the times at which the sector boundaries tabulated by Wilcox and Colburn (*3*) swept past the earth. These are boundaries in which the polarity of the interplanetary magnetic field observed by spacecraft near the earth was in one direction (away from or toward the sun) for at least 4 days before the boundary, and in the opposite direction for at least 4 days after the boundary. The width of the boundary, as measured by the time required for it to sweep past the spacecraft, varied from a fraction of an hour to several hours. [Similarly defined sector boundaries during the year 1970 were added to the list of well-defined sector boundaries (*4*).] Boundaries observed during the winter months, November to March, were used in this analysis; a similar analysis has shown that the results

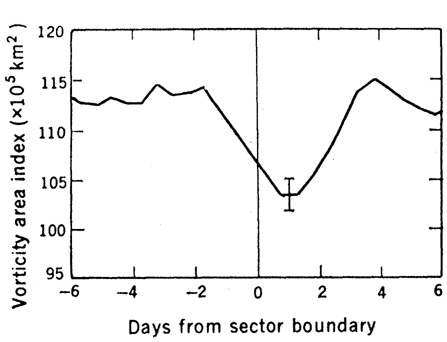
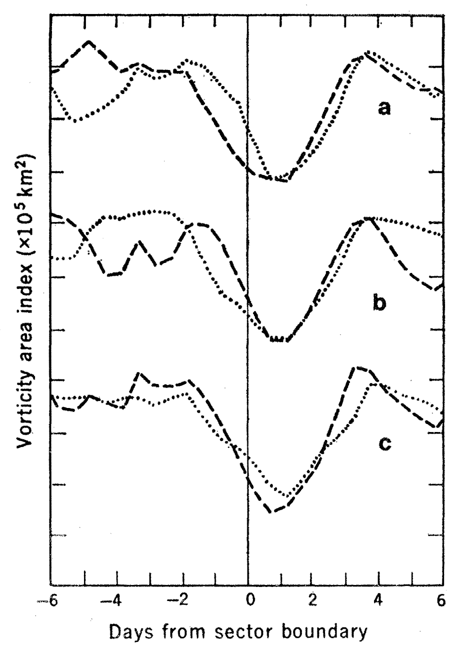


Fig. 1. Average response of the vorticity area index to the solar magnetic sector structure. Sector boundaries were carried past the earth by the solar wind on day 0. The analysis includes 53 boundaries during the winter months November to March in the years 1964 to 1970. The standard error of the mean (error bar) was calculated after subtracting a 27-day mean centered on each sector boundary, to remove long-term trends. The deviations corresponding to the individual boundaries are consistent with a normal distribution about the mean.

Fig. 2. Same format as Fig. 1; the list of boundaries used in Fig. 1 was divided into two parts according to (a) the magnetic polarity change at the boundary, (b) the first or last half of winter, and (c) the yearly intervals 1964 to 1966 and 1967 to 1970. (a) The dotted curve represents 24 boundaries in which the interplanetary magnetic field polarity changed from toward the sun to away, and the dashed curve 29 boundaries in which the polarity changed from away to toward. (b) The dotted curve represents 31 boundaries in the interval 1 November to 15 January, and the dashed curve 22 boundaries in the interval 16 January to 31 March. (c) The dotted curve represents 26 boundaries in the interval 1964 to 1966, and the dashed curve 27 boundaries in the interval 1967 to 1970. The curves have been arbitrarily displaced in the vertical direction, but the scale of the ordinate is the same as in Fig. 1, that is, each interval is 5×10^5 km^2.



described below do not appear in the summer.

Figure 1 shows the average response of the hemispheric vorticity area index to the sector structure sweeping past the earth. We emphasize that although the times at which well-defined sector boundaries passed the earth have been used as the phase signals, the response of the vorticity index is influenced by the sector structure for several days on each side of the boundary, and not only by the sector boundary. On the average, the vorticity index begins to decrease about 1½ days before the sector boundary passes the earth, reaching a minimum about 1 day after the boundary and then increasing during the next 2½ days.

The vorticity index is influenced by many physical effects. In this analysis we seek to discover the influence of one particular physical effect—the solar magnetic sector. Since the phase (zero day) of the analysis is fixed by the time at which a sector boundary passes the earth, physical effects on the vorticity index related to the sector structure will tend to be reinforced in this analysis, and other physical effects on the vorticity index not related to the sector structure will tend to occur at random phases and therefore to be averaged out. The physical mechanism causing the results described here is not revealed by the present analysis; however, we anticipate that extensions of this analysis may help us to discover possible physical mechanisms.

The significance and reproducibility of the results shown in Fig. 1 have been investigated by dividing the data sample into two parts and performing the same superposed epoch analysis separately on each part. Figure 2 shows the results for analyzing separately the boundaries in which the field polarity changed from toward the sun to away from the sun and the boundaries in which the field polarity changed from away to toward. Also shown are the results of separate analyses of the boundaries occurring between 1 November and 15 January and those occurring between 16 January and 31 March. Finally, the boundaries occurring during the years 1964 to 1966 and those occurring during the years 1967 to 1970 have been analyzed separately. We note that the analyses performed on these various subsets of the data gave essentially the same results, so that the results shown in Fig. 1 are independent of the magnetic polarity change at the sector boundary, the portion (first half or last half) of the winter interval analyzed, and the yearly interval (1964 to 1966 or 1967 to 1970) analyzed.

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References and Notes

1. J. M. Wilcox, *Space Sci. Rev.* **8**, 258 (1968).
2. W. O. Roberts and R. H. Olson, *J. Atmos. Sci.* **30**, 135 (1973).
3. J. M. Wilcox and D. S. Colburn, *J. Geophys. Res.* **77**, 751 (1972).
4. ———, in preparation.

5. Supported in part by ONR contract N00014-67-A-0112-0068, by NASA grant NGR 05-020-559, and by the Atmospheric Sciences Section of the National Science Foundation under grant GA-31138. It was also suported in part by the National Center for Atmospheric Research, which is sponsored by the National Science Foundation, and by the National Oceanic and Atmospheric Administration.

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8 January 1973

Cotton Remains from Archeological Sites in Central Coastal Peru

Abstract. *Cotton remains from four archeological sites in central coastal Peru, representing a time sequence from about 2500 to 1000 B.C., were compared with similar materials obtained from living wild and cultivated forms of* Gossypium barbadense *L. The comparison revealed that the archeological cotton samples were primitive forms of* Gossypium barbadense, *differing little from present-day wild forms of the same species. Although not the earliest cottons recorded for the New World, they appear to represent the earliest stages of cotton domestication yet recorded.*

We report here on a recent analysis of archeological cotton remains, in central coastal Peru, which may be of general interest to crop plant evolutionists and anthropologists. A more extensive treatment of the data will be published elsewhere (*1*).

Cotton was one of the first plants to be domesticated on the northern and central coasts of Peru (*2*). Today, all primitive cotton cultivars (the so-called "dooryard types") which are found in coastal Peru and Ecuador belong to one species, *Gossypium barbadense* L. Wild forms of the same species occur in dry coastal areas north and south of the Gulf of Guayaquil, on Isla de la Plata (an island offshore from Manta, Ecuador), and on several Galápagos islands (*G. barbadense* var. *darwinii* Hutchinson). The wild forms possess a number of morphological criteria