distribution would bring in negligible amounts of Al^{26}, while the "flat" distribution would experience a reduction of $30 \times 6 \times 2 = 360$ (the factor of 6 is for undersaturation and the factor of 2 for recoil loss).

Similarly, the existence of Al^{26} supports the existence of a substantial stony component in interplanetary dust, as opposed to a mixture of pure Fe and H_2O [assumed by Giese (*9*) for computational purposes], or only carbon grains. This result may appear trivial, but we have no other evidence for the chemical composition of zodiacal dust.

Before drawing a final conclusion, however, some caution must be exercised because the portion of the distribution which contributes to the mass inflow overlaps only partially with the portion which produces the bulk of zodiacal light. It is conceivable, but unlikely, that two quite dissimilar distributions coexist. It will be important to obtain confirmation with the other methods currently used to study interplanetary dust.

S. FRED SINGER*

School of Environmental and Planetary Sciences, University of Miami, Coral Gables, Florida 33124

References and Notes

1. H. C. van de Hulst, *Astrophys. J.* **105**, 471 (1947).
2. C. W. Allen, *Monthly Notices Roy. Astron. Soc.* **106**, 137 (1946).
3. E. J. Öpik, *Irish Astron. J.* **4**, 84 (1956).
4. H. Elsässer, *Planetary Space Sci.* **11**, 1015 (1963).
5. H. Siedentopf, *Z. Astrophys.* **36**, 240 (1955).
6. D. E. Blackwell and M. F. Ingham, *Monthly Notices Roy. Astron. Soc.* **122**, 129 (1961).
7. A. J. Dessler, *Rev. Geophys.* **5**, 1 (1967).
8. M. F. Ingham, *Space Sci. Rev.* **1**, 576 (1962).
9. R. H. Giese, *ibid.*, p. 585. The model shown in Table 1 is a three-component model; in his paper, he also presents two quite different models, but they require electron densities > 300 cm^{-3}.
10. J. L. Weinberg, *Ann. Astrophys.* **27**, 718 (1964). This model is equivalent to the second component of Giese's model and is adequate, according to Weinberg, to account for the zodiacal light observations.
11. M. Dubin and C. W. McCracken, *Astrophys. J.* **67**, 248 (1962). W. M. Alexander, O. E. Berg, C. W. McCracken, L. Secretan, in *Space Research*, W. Priester, Ed. (North-Holland, Amsterdam, 1963), vol. 3, p. 891.
12. C. Nilsson, *Science* **153**, 1242 (1966).
13. C. L. Hemenway, R. K. Soberman, G. Witt, *Smithsonian Contrib. Astrophys.* **7**, 93 (1963); N. H. Farlow, M. B. Blanchard, G. V. Ferry, "Sampling with a luster sounding rocket during a leonid meteor shower" (Preliminary Report, NASA Ames Research Center, 1966).
14. G. Fiocco and L. D. Smullin, *Nature* **199**, 1275 (1964).
15. B. R. Clemesha, G. S. Kent, R. W. H. Wright, *ibid.* **209**, 184 (1966).
16. R. A. Schmidt, *NASA Tech. Note D-2719* (March 1965).
17. D. Lal and V. S. Venkatavaradan, *Science* **151**, 1381 (1966). The core samples which were taken to depths of about 1 meter are typically 100,000 years old; a sedimentation rate of 4 millimeters per 10^3 years was deduced from the measured Be^{10} activity and calculated production rate of $4.5 \times 10^{-2}/cm^2$ sec. The Al^{26} was detected through the annihilation photons produced by the positron from beta-decay.
18. J. T. Wasson, *Icarus* **2**, 54 (1963).
19. S. F. Singer, *Nature* **192**, 321 (1961). The accretion rates (in tons per day) cited in Table 1 of this reference should be divided by 100.
20. An application of electromagnetic scattering theory [see for example, J. D. Jackson, *Classical Electrodynamics* (Wiley, New York, 1962), chap. 9] shows that "optical activity" varies $\sim \alpha$ for elongation angles of 2°–30° (outer F-corona), and as $\sim \alpha^2$ for elongation angles $> 30°$ (zodiacal light). Details are given in *25*.
21. H. P. Robertson, *Monthly Notice Roy. Astron. Soc.* **97**, 423 (1937).
22. Both references *17* and *18* overestimate the undersaturation. On this basis, the accretion values given in *17* should be reduced from 10^4 tons per day to 2×10^3 tons per day.
23. J. Marion, private communication.
24. D. Tilles, *Science* **153**, 981 (1966). The formula represents an approximation to the experimental points shown in Fig. 2.
25. S. F. Singer and L. W. Bandermann, *Symposium on the Zodiacal Light and Interplanetary Medium*, J. Weinberg, Ed. (Univ. of Hawaii, Honolulu, 1967).
26. R. J. Naumann, *NASA Tech. Note D-3717* (Nov. 1966).
27. The result of *17* has just been independently confirmed. J. T. Wasson, B. Alder, H. Oeschger, *Science* **155**, 446 (1967).
28. See, for example, S. F. Singer, in *Scientific Uses of Earth Satellites*, J. A. Van Allen, Ed. (Univ. of Michigan Press, Ann Arbor, 1956).
29. I thank M. Dubin, D. Lal, J. T. Wasson, L. Bandermann, and Dr. W. Libby for discussion. The research was supported in part by NASA grant NGR-10-007-011.
* Present address: U.S. Department of Interior, Washington, D.C. 20240.

25 November 1966; revised 6 April 1967

Geomagnetic Polarity Change and Faunal Extinction in the Southern Ocean

Abstract. *Paleomagnetic polarity changes have been detected in nine deep-sea sedimentary cores (from the Pacific-Antarctic Basin) in which an extinction horizon of a radiolarian assemblage was previously independently determined. The depths of the polarity change 0.7 million years ago and the faunal boundary are closely correlated, confirming that the faunal extinction was locally virtually synchronous. Although the reason for the faunal extinction is unknown, the possibility of causal relationships between faunal extinction and factors directly involved with sedimentation rate, sedimentation rate variation, and sediment type appears to be excluded.*

Uffen (*1*) suggested that during a geomagnetic polarity reversal the loss of magnetic shielding during the possible zero dipole field condition (*2*) and consequent excessive cosmic radiation at the earth's surface could lead to increased rates of genetic mutation. Although Simpson (*3*) believes that macropaleontological data, when combined with paleomagnetic polarity observations, support this possibility for the past 600 million years, the evidence is not convincing in view of lack of coverage and depth of appropriate data. At present the most promising sources for investigation of the hypothesis are microfossils and paleomagnetic data in deep-sea sedimentary cores.

Harrison and Funnell (*4*) noted that extinction of the radiolarian species *Pterocanium prismatium* and evidence for a geomagnetic polarity reversal occurred together in an equatorial Pacific core. Hays (*5, 6*) studied the distribution of radiolaria in the submarine sediments of the Southern Ocean and found four widespread well-defined successive assemblage zones, which he named, in order of increasing age, Ω, Ψ, χ, and Φ. On the basis of isotope data for the upper parts of a single core and on extrapolation, he inferred that boundaries between these four zones occurred at 0.4, 0.9, and 1.6 million years, respectively. Opdyke *et al.* (*7*) observed that the upper part of Hays's χ radiolarian zone, which is marked by the local extinction of several species (especially *Pterocanium tribolum*, *Saturnalus planetes*, and *Sethocorys* sp.) and the appearance of *Stylatractus* sp., *Lacopyle* sp., and *Prunopyle buspinigernum*, occurred in close association with a change in the magnetic polarity in four cores. Because of relatively low sedimentation rates in the cores concerned, it is not clear whether the observed faunal extinction horizon is associated with the polarity change at the Brunhes-Matuyama epoch boundary (*8*) 0.7 million years ago, or with the change marking the end of the Jaramillo event (*9*) about 0.85 million years ago (Figs. 1 and 3). The faunal horizon is apparently geologically synchronous. Opdyke *et al.* (*7*) did not dismiss the possibility that, in harmony with Uffen's hypothesis (*1*), there may exist a causal relationship between these extinctions and magnetic reversals. Much additional information is needed concerning this possibility (*7, 10*).

We have measured paleomagnetic polarity changes in the "Eltanin" core collection, primarily for use in marine stratigraphic studies (*11*). In this work, an astatic magnetometer with a maximum sensitivity of 10^{-7} emu/mm was used (*12*). Four measurements of the vertical component of NRM (natural remanent magnetism) yield reliable polarity determinations, due to the fact that the present ambient magnetic field direction in the area surveyed is as little as 20° from the vertical. In the particular cores concerned, minimizing of unstable magnetic components by application of an alternating magnetic field of 200 oersteds (*13*) to all specimens has not led to modification of the polarity data from untreated specimens. Such high magnetic stability is apparently characteristic of siliceous oozes, whereas our limited examination of brown silts ("red clays") has revealed magnetic instability.

Hays (*6*) gave the radiolarian assemblage data for a traverse of 13 "Eltanin" cores along the 115°W longitude, between 55° and 68° south latitudes, in the Pacific-Antarctic Basin (Fig. 1, inset). To extend the previous limited observations of the magnetic and faunal variations and to maximize the value of the available data, it is essential to compare our observations of the depth of the Brunhes-Matuyama and Matuyama-Jaramillo polarity changes in these cores with Hays' Ψ-χ faunal boundary. Although the geomagnetic polarity changes preceding the polarity change 0.7 million years ago may be far more complex than was at first realized (*14*), the general consensus is that no geomagnetic polarity change since that time would have gone undetected (*15*). Therefore, we feel that the first major polarity break in these very high magnetic latitude sedimentary cores can be identified as the base of the Brunhes epoch. Our correlation line between the cores, at the base of the Brunhes epoch, is included in Fig. 1, in which we present the NRM polarity logs of the cores in the traverse. Data points for each specimen, taken at 10-cm intervals, are not shown individually, but presentation is completely nonsubjective in that all polarity changes are indicated, even if only one specimen is involved. Intensities of magnetization for these sediments, which are dominantly siliceous oozes or clayey silts, are of the order of 10^{-5} emu gm^{-1}.

Figure 2 gives the result of the comparison of our determinations of the depth of the Brunhes-Matuyama boundary and Hays' (*6*) Ψ-χ faunal boundary depths in the nine cores where both

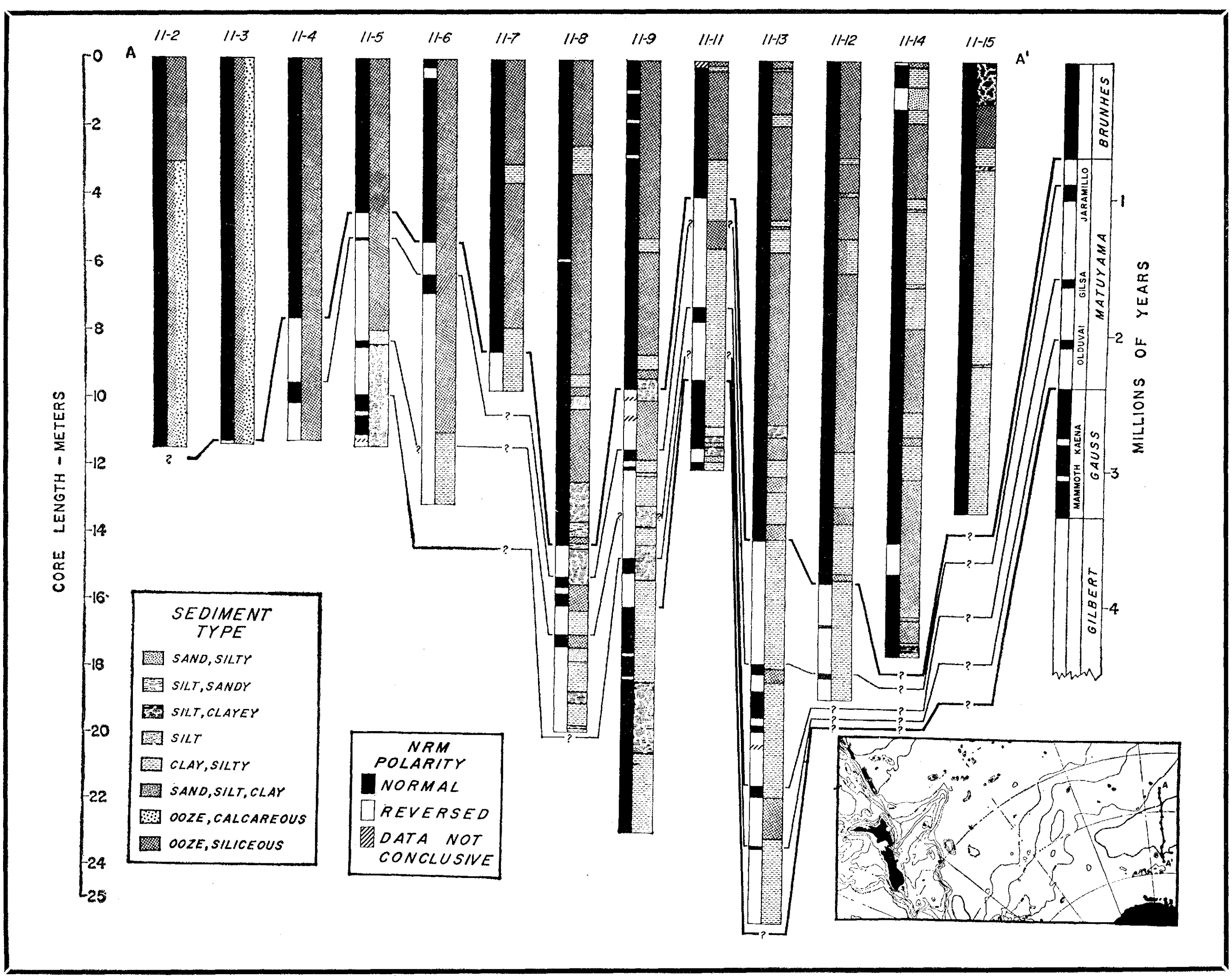

Fig. 1. Magnetic polarity and sedimentary variation in traverse E11. (Inset) Core locations. The line of traverse (*A-A'*) extends from 58°S to 68°S along the 150°W longitude. The ordinate is the most recently defined geomagnetic polarity time scale (*14*).

boundaries occur. Four of the 13 cores do not provide sufficient data: in cores E11-2 and E11-15 the faunal and magnetic boundaries are both presumably below the maximum depth reached by the recovered cores; in core E11-12 no definite Ψ-χ faunal boundary is detected by Hays; in core E11-14 the faunal boundary is again absent, and in addition the magnetic data in this core are inconclusive because the long normal polarity sequence at the base severely weakens the possibility that the core penetrates material from the Jaramillo event. For various reasons, spurious data may result from limited parts of cores; such data are more likely to exist at the bottom (*16*) and top of a core or core section because of the nature of the coring operation. The strong correlation existing between the faunal extinction and the Brunhes-Matuyama polarity boundary, which ranges from 4 to 14 m in depth, is obvious. Comparison of appropriate data from the cores of higher sedimentation rate (in which the Brunhes epoch and Jaramillo event are separated by up to 2 m of sediment) demonstrates without question that the polarity changes due to the Jaramillo event are not correlated with the Ψ-χ faunal horizon. We conclude that the previous suspicion of a correlation between the geomagnetic polarity change 0.7 million years ago and the Ψ-χ radiolarian boundary (*7*) is confirmed. Therefore, Hays' (*6*) assumption of a geologically isochronous local faunal extinction is valid.

Because it is evident that the radiolarian assemblage was affected catastrophically 0.7 million years ago, we must consider the possibility of a direct connection between the geomagnetic polarity and faunal changes. The direct approach would demand a search for proof that the specific faunal species involved are anomalously susceptible to the hypothetical excess radiation at the earth's surface during dipole collapse, but the number of variables involved is probably great (*17*). We can only suggest an indirect approach to this problem: if the geomagnetic polarity change is not in any way connected with the faunal extinction, then it is reasonable to expect that a third variable might show a strong time correlation with the resulting faunal extinction and, only by coincidence, with the time of the magnetic polarity change. Of course, it is also possible that a dipole collapse may cause faunal extinction through another dependent effect rather than through the suggested excessive radiation. Initial evidence for either of these two possibilities would be a correlation between the faunal extinction and a third variable. Sedimentation rate and sediment type provide the only pertinent evidence which is available at this time.

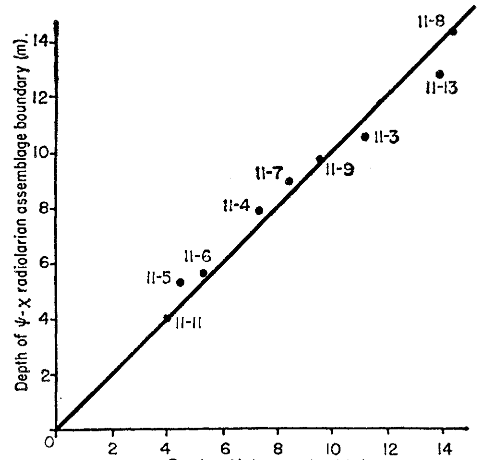

Fig. 2. Comparison of the depth of the Brunhes-Matuyama geomagnetic polarity change and the Ψ-χ radiolarian boundary in cores from traverse E11. Both axes are in meters below the top of the core. The faunal data is due to Hays (*6*). Core numbers correspond to the numbers shown in Figs. 1 and 3. The line corresponds to a 1 : 1 relationship (or the line of perfect correlation).

The sedimentation rates in the cores examined have been determined by the use of paleomagnetic data (Fig. 3). Watkins and Goodell (*12*) presented data from some marine sedimentary cores strongly consistent with the reality of the Gilsa event, but the Kaena event has not been reliably detected in material other than the single Hawaiian lava which provided the first evidence of the event (*14*). The Brunhes-Matuyama depths, occurring in nine cores, are shown at the terrestrially defined age. We consider that the second major polarity boundary (the Matuyama-Gauss transition), which is found only in cores E11-11 and E11-9, is also reliably identified. These epoch boundaries establish average epoch sedimentation rates which are then used to date polarity events within the epoch. Considerable doubt obviously exists about the specific identification of an apparent event (which could be spurious for a number of reasons) if a significant change in sedimentation rate within an epoch must be proposed in order to force an apparent event to equivalence with an established (terrestrially dated) event. Such an apparent event may be real, but the specific identification would involve circular reasoning, particularly because it is possible that the relevant part of the geomagnetic polarity scale may be incompletely known. We therefore rely heavily on the acceptability of the

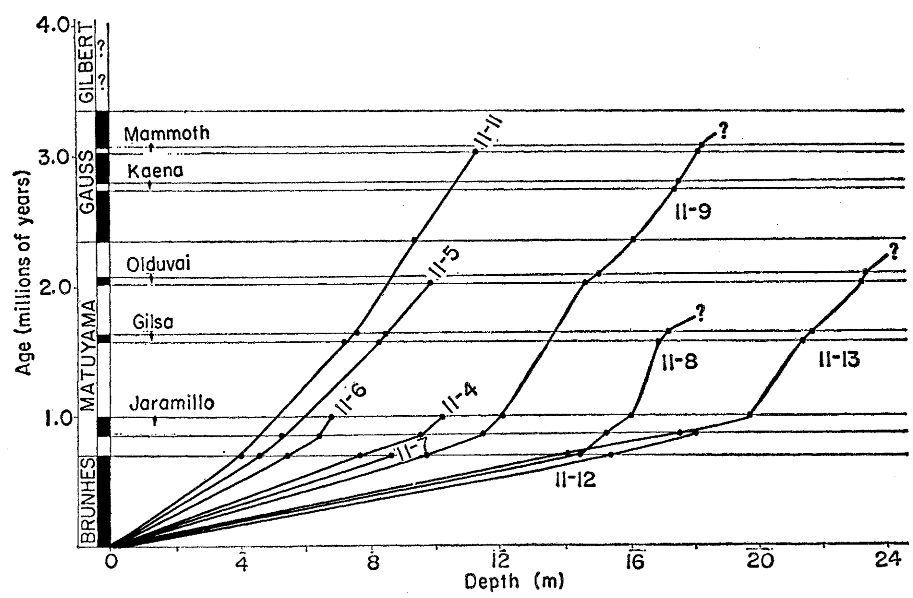

Fig. 3. Sedimentation rate analyses of cores which include the Brunhes-Matuyama boundary, in traverse E11 (A-A' in Fig. 1). Ordinate: geomagnetic polarity time scale of McDougall and Chamalaun (*14*); polarity epochs are in vertical print; polarity events are in horizontal print; normal polarity is shown in black; reversed polarity is shown in clear. Abscissa: depth from the top of the core in meters. Question marks are included where assigned identifications older than the Jaramillo event are tentative. The bottom 2 m of cores 11-8 and 11-9 are possibly "sucked" (*16*).

sedimentation rates and changes of sedimentation rate inferred by the data, because specific identification is compelling if a relatively constant sedimentation rate between the reliably chosen epoch boundaries incorporates an apparent event at the ages of known events. Of the known events during the Matuyama, the Jaramillo will be the least susceptible to misidentification, by virtue of its close relationship with the base of the Brunhes. A spacing of 10 cm between specimens may result in only partial delineation (or even omission) of events.

In seven of the eight cores which we interpret as having reached material deposited during the Jaramillo event, the sedimentation rate has not varied since at least the end of the Jaramillo event, although the actual sedimentation rate across the traverse ranges from 0.57 cm per 1000 years in core E11-11 (*18*) to 2.18 cm per 1000 years in core E11-12 (Fig. 3). Reliable determination of earlier average sedimentation rates is only possible in cores E11-9 and E11-11, which reach Gauss epoch sediments. The data strongly suggest a drop in average sedimentation rate to 0.3 cm per 1000 years for the period of 0.8 to 2.4 million years. Estimates of sedimentation rate could be made for at least part of this period in the other cores if the polarity events could be identified, but without the presence of the Matuyama-Gauss boundary, such identifications are not rigorously possible. The same problem exists for the possible Gauss events in E11-9 and E11-11 because no Gauss-Gilbert boundary is detected. We interpret the data in Fig. 3 to show identification of the Gilsa event in E11-11. In core E11-5, despite the absence of the base of the Matuyama, the apparent Gilsa and Olduvai events are convincingly distributed, as is the apparent Mammoth event in core E11-11. In all other cores, for several reasons, the apparent events are, at the very best, only tentatively identified (*19*). Despite the problems involved, however, we believe that a general characteristic of the area is a marked increase in sedimentation rate either during or shortly after the Jaramillo event (*7*): we also propose that there existed far less variation of sedimentation rate across the traverse prior to the Jaramillo event compared to the last 0.8 million years. Neither the time of the change in sedimentation rate nor the drop in the variation of sedimentation rate across the traverse occurred within 0.1 million years of the χ faunal extinction. There is apparently no connection between sedimentation rate or regional sedimentation rate variation and the observed faunal extinction.

Our observation of a marked change in sedimentation rate emphasizes that, in the absence of a known defined polarity scale, the extrapolation into the subsurface of sedimentation rates based on near-surface data could yield very misleading interpretations of the earth's history.

A pronounced change of sediment type, from clay to diatomaceous ooze, occurs close to Hays' χ-Φ boundary (*20*). Hays thinks that this sediment change accompanies a relatively sudden increased vertical movement of water resulting from the initiation of iceberg production from the Antarctic ice cap. No sediment change occurs close to the Ψ-χ faunal boundary. There is apparently no relation between sediment type and the χ faunal extinction horizon.

Our data show some evidence, however meager, that the magnetic polarity change occurs slightly later than the faunal change. If the sedimentation rates for the interval between 0 and 0.8 million years are used to calculate any time differential between the faunal and magnetic change in each core, the average differential is close to 13,000 years, with the faunal change preceding the magnetic change. This difference is statistical only and is on the fringes of the resolution of the methods, which depends dominantly on the sample spacing and cannot therefore be considered significant. Apparently, however, the precise time relationship of the faunal and magnetic boundaries, as well as the geographic limits of the correlation, must be accurately determined, because, if the hypothetical dipole collapse occurs after the faunal change or if the extinction becomes diachronous elsewhere, then the geomagnetic polarity change cannot be the cause of the faunal extinction. One must realize, however, that the detailed mechanism and duration of the effect of a polarity reversal is not known.

An independently determined faunal boundary has been confirmed as a geologically synchronous phenomenon, correlating strongly with the Brunhes-Matuyama geomagnetic polarity change. The sedimentation rate, although variable across the core traverse, has not varied significantly since at least 0.8 million years ago, shortly before which the sedimentation rate was lower by a minimum factor of 2 to 3 and probably much less variable between cores. No correlation exists between the sedimentation rate changes (or changes of sediment type) and the faunal extinction. If the faunal extinction is not directly due to the increased radiation from dipole collapse during polarity change, then the cause must lie in factors other than those that we have examined.

N. D. WATKINS
H. G. GOODELL

Department of Geology, Florida State University, Tallahassee 32306

References and Notes

1. R. J. Uffen, *Nature* **198**, 143 (1963).
2. T. Rikitake, *Electromagnetism and the Earth's Interior* (Elsevier, Amsterdam, 1966), p. 81.
3. J. F. Simpson, *Geol. Soc. Amer. Bull.* **77**, 197 (1966).
4. C. G. A. Harrison and B. M. Funnell, *Nature* **204**, 556 (1964).
5. J. D. Hays, *Ant. Res. Ser.* (Am. Geophys. Un.) **5**, 125 (1965).
6. ———, *Progress in Oceanography* (Pergamon, London, in press).
7. N. D. Opdyke, B. Glass, J. D. Hays, J. Foster, *Science* **154**, 349 (1966).
8. A. Cox, R. R. Doell, G. B. Dalrymple, *ibid.* **144**, 1537 (1964).
9. R. R. Doell and G. B. Dalrymple, *ibid.* **152**, 1060 (1966).
10. A. Cox, G. B. Dalrymple, R. R. Doell, *Sci. Amer.* **216**(2), 54 (1967).
11. N. D. Watkins and H. G. Goodell, *Trans. Am. Geophys. Un.* **47**, 478 (1966); H. G. Goodell and N. D. Watkins, in *Abstracts*, Annual Meeting Geol. Soc. Am., 1966, p. 78; manuscript in preparation.
12. N. D. Watkins and H. G. Goodell, *Earth Planet Sci. Lett.* **2**, 123 (1967).
13. M. W. McElhinny, *Geophys. J.* **10**, 375 (1966).
14. I. McDougall and F. H. Chamalaun, *Nature* **212**, 1415 (1966).
15. ———, *ibid.*, p. 1416.
16. G. O. Dickson and J. H. Foster, *Earth Planet. Sci. Lett.* **1**, 460 (1966). This article describes a very large fluctuation of the NRM declination in the bottom 100 cm or so of a marine sedimentary core (V21-65) from 40° magnetic latitude. Dickson and Foster see this as an indication of true flow-in (or "sucking") of the sediments during coring. Presumably no sedimentary features indicated this flow-in, emphasizing the possible magnitude of the problem in paleomagnetic studies. The NRM declination in our 70° (or higher) magnetic latitude cores is a virtually meaningless parameter and cannot be used in the same fashion.
17. Hays (*6*) has pointed out that the radiolaria comprising the χ assemblage are usually thin-walled compared to those species in the Φ zone: it is conceivable that this is relevant.
18. Hays (*6*) refers to a personal communication from Dr. T. Ku who obtained an average sedimentation rate of 0.5 cm per 1000 years for the top 3 meters of core E11-11, using excess Th^{230} measurements. This agrees reasonably well with the figure of 0.57 cm per 1000 years from our paleomagnetic data.
19. We stress the tentative nature of our assignment of the normal polarity event at 1465 cm in core E11-9 to the Olduvai by pointing out that the apparent event could equally as well be assigned to the Gilsa event in Fig. 3.
20. Opdyke *et al.* (*7*) suspect that the χ-Φ faunal boundary may also be correlative with a magnetic polarity change. Their study indicates that the Olduvai event occurs close to the χ-Φ horizon. A comparison of Hays' χ-Φ boundary and our magnetic events cannot be satisfactorily made because of our difficulty in identifying specific events. We can state, however, that compared with the correlation in Fig. 2, the χ-Φ boundary is

only poorly correlated with a polarity change due to any events, whether the event is idenfied or only apparent.

21. Supported by grants GA 523 and GA 602 from NSF. We thank Dr. J. D. Hays of Lamont Geological Observatory of Columbia University for a preprint of one of his papers (*6*).

30 March 1967

Observations of the Andromeda Galaxy at 11-Centimeter Wavelength

Abstract. *Observations of the Andromeda galaxy (M31) at 2695 megahertz reveal more detail than do earlier measurements at lower frequency. The region is highly confused but there is apparently a more dense clustering of sources within the optical outline of the galaxy than without. One source (OA33) near M31 has an interesting, flat spectrum.*

During August 1966, the 140-foot (42.7-m) radio telescope (*1*) at Green Bank was used to observe M31, the Andromeda galaxy, at a frequency of 2695 Mhz. The principal result of these observations is the map of Fig. 1, in which the discrete sources are superimposed upon a simplified optical isophote derived from the dimensions given by Holmberg (*2*). The general background radiation has not been drawn in; at 0.02°K antenna temperature and below, the radio isophotes become very difficult to describe because of noise and complex low-level radiation from the region of M31. Derived fluxes of the discrete sources have a corresponding uncertainty of 0.05 flux unit.

Comparison of this map with earlier maps at lower frequencies shows only general similarity. The 1415-Mhz map by Kraus *et al.* (*3*) was made with a fan-shaped beam which blends sources with the same right ascension and small declination differences. Similarly, the map by MacLeod (*4*) and by Dickel *et al.* (*5*) at 610 Mhz was made with an antenna beamwidth of 16′ (arc) which blends sources in a different way than does the 11′ beam used in the present survey. Comparison of the source positions obtained at these three frequencies shows good agreement for sources outside the optical outline of the galaxy and rather poor agreement within the optical outline. This discrepancy is presumably due to the different ways in which multiple sources are blended by the various telescopes. Outside the galaxy, the sources tend to be isolated. This fact suggests that some, at least, of the "interior" sources may actually be associated with M31. Beam blending of the complex of sources near and within the optical image of M31 may also account for the appearance of a "halo" in those radio maps (*6*) derived from wide-beam observations.

Spectral indices have been computed from the 610- and 2695-Mhz flux densities. These are termed "composite indices" in Table 1 to emphasize the possibility that confusion may have biased the flux densities, especially at the lower frequency. The generally broader beamwidths obtained at the lower frequencies would tend to result in steeper spectra than would be obtained were confusion not present. This reasoning follows from the fact that more sources are included in the beam at lower than at higher frequencies. One would thus expect to find steeper spectra in a region with a high density of sources than in a region with a low density, provided that all sources are measured with respect to the background of the low-density re-

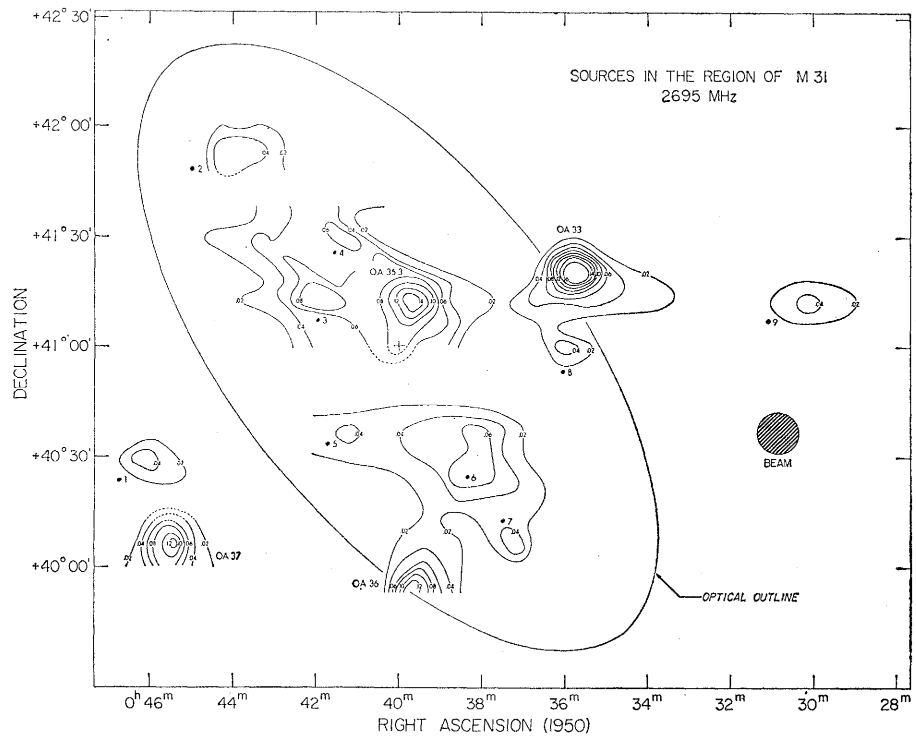

Fig. 1. Contours of constant antenna temperature at 2680 Mhz in the region of M31. Contours are labeled in degrees Kelvin.

Table 1. Characteristics of radio sources in the vicinity of M31.

Source No.	2695-Mhz position (1950.0)		Flux density (10^{26} watt m^{-1} hz^{-1})				Composite spectral index
	Right ascension	Declination	178 Mhz (*8*)	610 Mhz (*5*)	1415 Mhz (*3*)	2695 Mhz	
1	00^h $46.^m1$	40°29′		0.6		0.1	−1.0
2	44.0	41°52′				.2	
3	42.0	41°13′				.3	
4	41.3	41°30′				.2	
5	41.2	40°36′		1.6		.1	−1.7
6	38.3	40°26′		1.7		.2	−1.3
7	37.2	40°07′				.1	
8	35.9	41°00′				.1	
9	30.1	41°12′				.1	
OA28.1*(*3*)			2.5	1.0	0.3		−1.4†
OA33	35.7	41°20′		0.6	.4	.5	−0.1
OA35.3	39.7	41°12′		1.9	.4	.4	−1.0
OA35.5				1.3	.3		−1.6†
OA36	39.7	39°53′		1.6	.7	.4	−1.0
OA37‡	45.4	40°06′	3.2	1.3	.8	.4	−0.9
OA38§			3.2	2.0	.8		−1.0†

* Identified with VRO 40.00.02, SRH; VRO determined by MacLeod *et al.* (7) and SRH determined by Scott *et al.* (*8*). † Spectral index determined between 610 and 1415 Mhz. ‡ Identified with VRO 40.00.03, SRH. § Identified with VRO 40.00.05, 3C24, SRH.