(*13*), play roles in the acquisition and performance of learned goal-oriented behaviors.

The 2-deoxy-D-[^{14}C]glucose method (compared with techniques that can sample only one pathway at a time) has allowed the simultaneous visualization of widespread yet highly selective neural circuits specific to a goal-oriented behavior. These findings provide a basis for isolating the critical patterns of neural activity uniquely associated with the rewarding dimension of the process of reinforcement.

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5. Rats were implanted with bipolar platinum electrodes (0.125 mm in diameter, Plastic Products) aimed at the VTA (stereotaxic coordinates: anterior, +3.4 mm; lateral, +1.0 mm; and ventral, +2.0 mm from interaural zero with the skull flat in the horizontal plane). Because of evidence for dopaminergic mediation of ICSS behavior [A. G. Phillips and H. C. Fibiger, *Can. J. Psychol.* **32**, 58 (1978)], this region, which contains dopaminergic cell bodies with a well-characterized efferent system, was chosen as the ICSS site.
6. The ICSS screening and training were conducted in a 20 by 20 by 40 cm Plexiglas box containing a single lever in one wall. Stimulation was delivered by a constant current stimulator (Nuclear-Chicago model 7150) and consisted of biphasic symmetrical rectangular waves with alternating 0.2-msec positive and negative pulses with a 0.2-msec delay between pulses, delivered at 100 Hz in 400-msec trains at current levels of 250 to 300 μA. Current was monitored by an oscilloscope. Training continued for 3 to 5 days until responding stabilized. After establishing preferred rates of ICSS at currents of 250 to 300 μA, the EAS and NS animals underwent extinction training by being placed in the experimental chamber with the electrode lead attached but the lever disconnected from the stimulator. During the experimental procedure, brain stimulation delivered to the EAS rats was randomly presented at rates at which these animals had previously stimulated themselves.
7. Optical density measurements were made with a manual densitometer (Sargent-Welch) or by means of a computerized image-processing system [C. Goochee, W. Rasband, L. Sokoloff, *Ann. Neurol.* **7**, 359 (1980)].
8. Data were analyzed by multivariate analysis of variance followed by appropriate Bonferroni *t*-statistics for multiple comparisons (double linear combinations—comparisons between groups of linear combinations within groups) with the NS control group as the referrant [R. G. Miller, *Simultaneous Statistical Inference* (McGraw-Hill, New York, 1966), p. 202].
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Multiple Microtektite Horizons in Upper Eocene Marine Sediments?

Keller *et al.* recently suggested (*1*) that there are several middle Eocene to middle Oligocene microtektite horizons and implied that these horizons indicate separate tektite events. Although there is no a priori reason why there could not be multiple tektite events during this period, Keller *et al.* do not provide any descriptive, petrographic, or compositional data to support their identification of microtektites from previously unreported stratigraphic layers. Furthermore, the lack of data on abundance versus depth and of compositional data does not allow the reader to decide if the microtektite occurrences are due to several events, as Keller *et al.* claim, or merely to one event with scattered younger occurrences attributable to reworking.

For example, Keller *et al.* show (*1*) three microtektite layers at site 292 (cores 29, 36, and 38). I have examined cores 36 and 38. The microtektites in core 36 are small (< 125 μm in diameter), rare, and scattered over most of the core. In core 38 the microtektites are generally larger (up to 1 mm in diameter), are more abundant, and occur in a well-defined layer. The microtektites from core 36 are petrographically and compositionally similar to those in core 38; thus the microtektites in core 36 are probably from the same event as those found in core 38, but they have been reworked into younger sediment. I have found similar results for site 94, cores 14 and 15, where Keller *et al.* also claim to have found two different events. Keller *et al.* further claim (*1*) to have found four layers of microtektites at site 242 (cores 10, 15, 18, and 19). I have searched for microtektites in 10-cm^3 samples taken at 20-cm intervals through cores 18 and 19 and did not find a single microtektite. If microtektites are present in these two cores, they must be rare and may therefore be reworked.

Keller *et al.* also conclude (*1*) that no faunal extinctions can be correlated with any of the late Eocene to middle Oligocene microtektite layers. However, it has been shown that the last abundant appearance of several species of Radiolaria (for example, *Thyrsocyrtis bromia*, *T. tetracantha*, *T. finalis*, and *Calocyclas turris*) is closely associated with a late Eocene microtektite layer at ten sites ranging from the Caribbean Sea to the Indian Ocean (*2*). Keller *et al.* suggest that the coincidence between the extinctions and the microtektite layer is due to a hiatus. Indeed, they suggest that most of the late Eocene to middle Oligocene microtektite occurrences are associated with a hiatus or dissolution zone. However, they discuss the evidence for a hiatus at only two of the sites and in both cases the evidence is at best ambiguous; the exact relation between the "hiatus" and the microtektite layer is not defined.

Another puzzling aspect of the report of Keller *et al.* (*1*) is their discussion of the age of the North American tektite-strewn field, which they say is 37.5 to 38.0 million years. They fail to mention the potassium-argon and ^{40}Ar-^{39}Ar data for the North American tektites, which confirm an age of 34 to 35 million years.

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Glass comments that the two late Eocene and middle Oligocene microtektite layers represent a single meteorite impact (this conclusion is based on petrographic and chemical analyses) and that the multiple layers are due to reworking of sediments. We maintain that (i) available chemical analyses of microtektites are inconclusive and (ii) it is unlikely that random reworking of sediments produced microtektite layers at coeval stratigraphic horizons in the Pacific, Atlantic, and Indian oceans.

Glass suggests that microtektites from Deep-Sea Drilling Project cores 292-36 and 292-38 are petrographically and chemically similar and concludes that they represent the same event. On the basis of chemical analyses that he sent us (*1*) (four from core 36-2 and three from core 38-2), there are complete overlaps in MgO, Al_2O_3, K_2O, Na_2O, and TiO_2 when plotted against the weight percentage of SiO_2. There are differences in FeO and CaO (core 38-2 has lower FeO and higher CaO). Seven analyses, we admit, are not sufficient to permit a statistical comparison, and microprobe analyses are presently being carried out on the microtektites (*2*).

Glass *et al.* also observed two separate microtektite layers in piston core RC9-58 and obtained chemical analyses on ten microtektites of each layer (*3*). They observed overlaps in SiO_2, FeO, Na_2O, and TiO_2 contents but, as at site 292-38, the lower layer is consistently higher in CaO than the upper layer. Their chemical data also indicate higher MgO and lower Al_2O_3 in the lower layer; the three analyses at site 292-38 are insufficient to permit a comparison of these elements. Glass *et al.* interpreted the two layers in core RC9-58 as one event, although they admit that the evidence strongly suggests two events (*3*). However, they prefer to explain the two layers as "the result of differential settling in the sediment column due to density differences among the spherules" (*3*, p. A428). It is unlikely, if not physically impossible, that the density difference between microtektites could have resulted in the differential settling of a second layer 25 cm lower in the sediment. Moreover, the entire interval which contains the microtektites at site RC9-58 consists of mixed late-middle to late Eocene sediments (nannofossil zones CP14 and CP15) (*4*), which indicates sediment mixing by bottom current activity; hence, reworking of sediments would exclude differential settling of microtektites through the sediment column.

We question, however, the appropriateness of using major element oxide chemistry to distinguish microtektite horizons when it has been concluded (*5*, p. 123) that "when careful studies are made, including microtektites and rare types of macrotektites, it is seen that the range within one strewn field is often much greater than the range from one strewn field to another." To check this conclusion, we plotted major element oxide values versus SiO_2 for Australasian and North American microtektites and found almost complete overlap in Al_2O_3, FeO, Na_2O, and K_2O in the SiO_2 range of 62 to 75 percent; the North American microtektites are lower in MgO and CaO than the Australasian microtektites. Further chemical analyses are needed on each microtektite layer to determine whether independent strewn fields are chemically related. However, the stratigraphic position of each microtektite layer in the sediment column will have to be determined by careful age dating based on the use of microfossil analyses.

Our stratigraphic analyses have shown that microtektite layers occur at stratigraphically distinct intervals in the late Eocene in the upper part of the *Globigerinatheka semiinvoluta* zone (foraminifer zone P15) at about 39.5 to 38.5 million years ago [site 292, core 32–2; site E67-128 (*4, 6*)] or, if a hiatus is present, at the *G. semiinvoluta–Globorotalia cerroazulensis* zone boundary (P15/P16, sites 94, 167, and 216). The hiatus at this interval generally spans the upper part of the *G. semiinvoluta* zone and most of zone P16, representing less than 1 million years (*4, 6*). The second late Eocene microtektite layer occurs in the upper part of the *G. cerroazulensis* zone (P17) at about 38.0 to 37.5 million years ago and is best seen at site 292 [core 36-2 (*7*)] and Gulf of Mexico site 94 (*4*). Thus, the microtektite layers occur at stratigraphically distinct horizons which are frequently associated with hiatuses or carbonate dissolution, or both (*4, 6*).

Glass cites the coincidence of the last abundant occurrences of four radiolarian species with the early-late Eocene microtektite layer as evidence of major faunal extinctions. The last abundant occurrences of species, however, are usually associated with major paleoclimatic events or hiatuses (*4, 6*) and are not extinctions. As discussed above, the microtektite layer frequently coincides with a hiatus, and a general cooling trend occurs throughout the late Eocene and early Oligocene (*6*). We have quantitatively analyzed Eocene-Oligocene foraminifers from 18 sites in the world ocean and failed to find any evidence of major extinctions except those artificially created at hiatuses (*6*). Throughout the late Eocene and into the middle Oligocene, the rate of species evolutions and extinctions remains constant at about one to two species evolving or disappearing every 200,000 to 400,000 years. Increases to four to six species extinctions are found at hiatuses (*8*).

We dated microtektite layers in deep-sea sediments at 39.5 to 38.5 million years and 38.0 to 37.5 million years ago, based on paleomagnetic and biostratigraphic correlations (*4, 6*). These ages appear to conflict with ^{39}Ar-^{40}Ar and potassium-argon data for North American land tektites. Glass maintains that the fission track, potassium-argon, and ^{39}Ar-^{40}Ar ages of the North American tektites found in displaced land sediments provide a more accurate age of 34 to 35 million years (*7*) for deep-sea microtektites. However, as far as we know, no stratigraphic correlation has ever been made between the North American tektite field and the late Eocene deep-sea microtektite layers. Thus, it is not known whether they represent the same event or events. If they do, the discrepancy in the ages is hard to explain but may be due in part to the use of the old decay constant in dates determined prior to 1977 (*9*), which makes these dates around 35 million years ago about 1 million years younger. Even without considering the age discrepancy in the use of the decay constants, the older age limits of the fission track ages ranging from 34.5 to 35.5 ($\pm$1.5 to 8.3) million years, potassium-argon ages of 33.7 to 34.5 ($\pm$2.2) million years, and one ^{39}Ar-^{40}Ar age of 34 million years [no confidence limit (*7*)], are well within the limits of our paleomagnetic age determination.

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