characterize various aspects of sensory functioning. Their use reflects in part the apparent similarity of thresholds to "null measures." Adjusting the stimulus parameters to produce a constant effect (some criterion level of detectability) appears to minimize the need to make assumptions about the properties of the metric used by the observer to measure his sensation. The experiments described above emphasize the caution one must exercise in the interpretation of the results from this kind of null experiment. The situation is no different, in principle, from an experiment in which Krauskopf and Srebro (*9*) demonstrated that equally but imperfectly detectable flashes of different wavelengths were nearly perfectly discriminable. The empirical data attest only to the similarity of the *measured* effects of the assorted stimuli. If it is desired to determine that two or more stimuli produce identical effects in all respects it is necessary to demonstrate that the stimuli cannot be discriminated from each other. Where stimuli are discriminable from each other, but equally detectable, it requires a stronger model (more assumptions) to be able to conclude which aspects of the neural responses to the various stimuli are the same (if any) when the stimuli are equally detectable. Thus total temporal summation in the determination of the detectability of brief flashes implies only that those aspects of the responses to brief flashes which determine their detectability are equivalent.

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3. This assumes, as many have, that the visual system can be characterized as a linear system for near-threshold intensities. Thus the response to a temporally extended stimulus can be derived, knowing the impulse response, by decomposing the stimulus into a series of impulses of heights proportional to the amplitude of the stimulus at that time, computing the response to each impulse, and summing these responses. If the stimulus duration is short with respect to the duration of the impulse response, the response to the brief stimulus will be only slightly longer and slightly lower in peak amplitude than the response to an impulse of the same energy.
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5. With this method a flash is presented either to the right or to the left of the fixation point on each trial, and the observer must say on which side it occurred. After each trial he was told if he was correct. The flash intensity was varied from trial to trial in the manner described by Cornsweet [*Amer. J. Physiol.* **75**, 485 (1962)] by using the rule that for each staircase the luminance will be increased 0.1 log unit after each incorrect response, and decreased 0.1 log unit after two consecutive correct responses.
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10. I thank J. Nachmias for his helpful advice and comments on this manuscript, and T. N. Cornsweet for discussions which led to this experiment. This research was supported in part by grant NB06050-04 from NIH, and NSF Institutional grant for 1968 to the University of Pennsylvania.

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Tektite Glass Not in Apollo 12 Sample

O'Keefe (*1*) has reported the supposed discovery of tektite glass in lunar sample 12013 on the basis of information from the Apollo 12 preliminary examination (*2*) and other communications. This report is based on faulty data and assumptions, and the major conclusion is incorrect. Although portions of the sample might appear to be vitreous by cursory examination, neither fragment of sample 12013 analyzed during the preliminary examination was glass. X-ray diffraction analyses of both fragments (Fig. 1) were performed prior to chemical analysis and gave the following mineral identi-

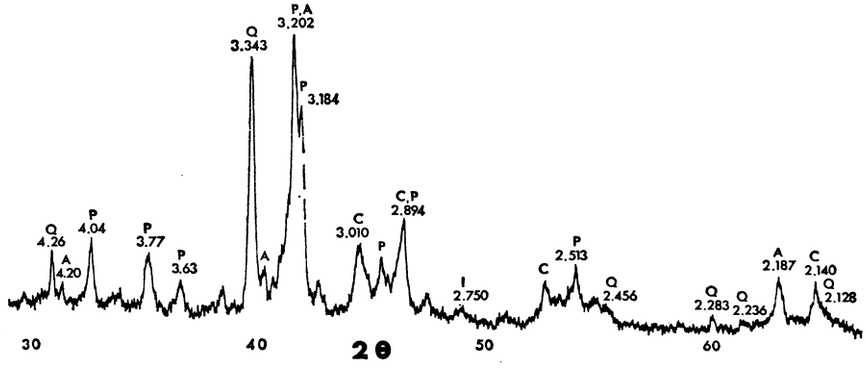

Fig. 1. A portion of the x-ray diffractogram of one of the analyzed fragments of lunar sample 12013. The fragment is obviously not glass. Peaks are identified as follows: *A*, alkali feldspar; *C*, clinopyroxene; *I*, ilmenite; *P*, plagioclase; *Q*, quartz. This diffractogram is approximately the same as the one obtained for the second fragment. (CrKα radiation).

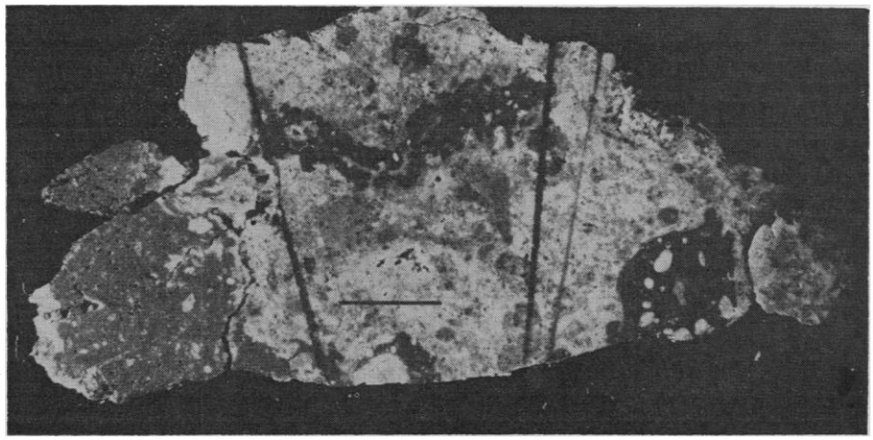

Fig. 2. Sawed slab of lunar sample 12013, in which the heterogeneity and complex petrography of the sample are illustrated. The scale is 0.5 cm [NASA, Manned Spacecraft Center photograph No. S-70-40833, sample No. 12013,9].

fications and estimated modal mineral percentages: calcic plagioclase, 35 percent; clinopyroxene, 20 percent; alkali feldspar, 15 percent; low (alpha) quartz, 12 percent; tridymite, < 1 percent; ilmenite, 3 percent. O'Keefe further implies that the analysis of sample 12013 (*2*) is somehow representative of the sample or is some distinct lithologic portion of sample 12013. This sample is an extremely complex and heterogeneous breccia (Fig. 2). Individual mineral grains and included fragments range in size from more than 3 mm to less than 10 μm. The analyzed samples weighed only 30 and 25 mg, respectively. Examinations of two thin sections (12013,5 and 12013,7), as well as low magnification examination of the main mass of this sample (*3*), indicate that it is not probable that samples of this size were representative of any major or distinct lithologic portion of sample 12013. In fact, it seems likely that similarly sized fragments from various parts of the sample will have a wide range of major element compositions, because the modal mineralogy shows a wide range at the scale of a few millimeters and less. Glass is only a minor phase in the thin sections examined, and minor glass is indicated by the higher than usual background of the diffractogram. Moreover, the relative refractive indices of the glass observed and comparison of the estimated mineral modal percentages with the analysis (Table 1) indicate a pyroxene-like composition.

Table 1. Composition of two fragments (total weight of both fragments combined is 55 mg) from lunar sample 12013. These values should not be taken as representative of the total sample or of any lithologically distinct portion of the sample.

Oxide or element	Percent by weight	
	A*	B†
SiO_2	61.2	62
Al_2O_3	12.0	10
Total Fe as FeO	12.6	10
MgO	8.0	6.0
CaO	6.3	6.2
TiO_2	1.17	1.2
Na_2O	1.20	0.9
K_2O	1.96	2.0
MnO	0.19	0.16
Cr		0.12
Ni		0.012
Zr		0.15
Co		0.0018
Y		0.006
Sc		0.005
Ba		0.45
V		0.022
Cu		0.0040
Nb		0.018
Total	104.62	99.24

* (A) John Allen, analyst; silica by light absorption spectroscopy; other values by atomic absorption spectroscopy. † (B) R. Martin, analyst; optical emission spectrograph.

Refinements of the preliminary analytical data have resulted in minor revisions of the data originally reported and in the determination of additional elements (Table 1). Chemical inhomogeneities between the two fragments may be responsible in part for the discrepancies in values between the different analytical techniques. These analyses are no more similar to tektites than they are to possible mixtures of common terrestrial minerals or rock types. They do not resemble either tektites or common terrestrial rocks very closely. Furthermore, the comparison of compositions of fragments of lunar sample 12013 with rare chemical varieties of tektites (*1*) does not adequately treat the abundant isotopic, minor and trace element data (*4*) that seem to be characteristic of all lunar samples now analyzed. These data are overwhelmingly striking for their *contrasts* with all published tektite analyses. However, such analyses have not yet been performed on lunar sample 12013 or these rare tektites. With so little data now available on this petrographically and mineralogically complex sample, the significance of sample 12013 is not yet known.

There is *no* existing chemical or mineralogical observation or data that uniquely support the idea that tektites originate from the moon. There *are* abundant chemical data that support a close genetic relationship between tektites and terrestrial rock materials. These data have been presented or summarized by numerous authors (*5*). Tektite glass has not been found in samples from Apollo 12 (or Apollo 11).

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13 July 1970

The comments of King *et al.* come at a time when a considerable amount of new information is about to be published concerning this interesting specimen. Detailed discussion of the specimen is therefore premature; I include only a few remarks.

The data of King *et al.*, though preliminary, tend to support the two assumptions made in my paper—namely, that sample 12013 would be found to resemble tektites rather than granites in the matter of low water content and low ferric-ferrous ratio. I deduce the low water content from the absence of micas or amphiboles in their x-ray analysis, and the low ferric-ferrous ratio from the absence of magnetite.

They find that the material is crystalline rather than glassy. The crystals are, however, evidently rather fine; from statistical considerations it can be judged that the agreement of the two major-element analyses given for samples of only a few tens of milligrams is likely only if the crystals are of the order of 100 μm or smaller in diameter. This raises the question whether they are the products of devitrification. In any case, the former existence of a liquid of this composition seems to be implied. Evidence of somewhat similar liquids was found in the Apollo 11 sample (*1*) despite King *et al.*'s concluding remark.

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