Are published theories of lunar petrogenesis developing too rapidly on the basis of too few data?

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Photoreception in Sparrows

We have reported (*1*) exposing blind and normal house sparrows to several different stimulatory photoperiods and intensities and assaying the testis response of both groups. We concluded that an extraretinal photoreceptor exists in the sparrow which is fully capable of mediating the gonadal response to photoperiodic stimuli. Lott (*2*) has pointed out what he considers to be several weaknesses in our experimental design and analysis. He further suggests that an appropriate statistic would show that, in fact, the eyes *are* involved in the photoperiodic response of the house sparrow.

Lott's published comment (*2*) included some criticisms that were not included in the comment submitted to us by *Science* for our simultaneous reply. Those criticisms to which we did not have access at the time we prepared our original reply are dealt with here.

Table 1. The number of blinded and normal birds falling above (larger) or below (smaller) the mean testis weight in each sample. The birds categorized in this way for each sample were combined to give this table.

	Birds	
	Blind	Normal
Larger	64	76
Smaller	81	90

Table 2. The number of blinded and normal birds falling above (larger) or below (smaller) the median testis weight in each sample. The birds categorized in this way for each sample were combined to give this table. The total number of birds in this table is 304 (instead of 311) because in seven samples there were an odd total number of blind and normal birds. In each of these seven cases the testis weight which fell at the median value was excluded from the table as it could not justifiably be categorized.

	Birds	
	Blind	Normal
Larger	71	81
Smaller	71	81

Lott states that a one-tailed *t*-test would have been more appropriate in the analysis of our data. We must assume that his reasoning is that if a difference existed between blind and normal birds, it could be in only one direction (that is, the normal birds would have the larger testes). However, there is no a priori reason to make this assumption. The eyes could be inhibitory to the photoperiodic response; or if the route by which light reached the extraretinal receptor is via the orbit, removal of the eyes might actually enhance the penetration of light to these receptors, causing a more marked response. The possibilities are numerous. Since it is not possible to predict the direction of a difference, should one exist, a two-tailed test is appropriate.

Lott also states that "the experimental design had far too few animals in each condition." It is quite true, of course, that the experimenter should make every attempt to maximize the size of samples. Our experiments were necessarily limited by the availability of wild house sparrows. Even so, the total number of birds used was large (414) relative to most other studies in this field.

Lott claims that an alternative conclusion (that is, that the retina is involved in the testis response) can be drawn from our data by use of a χ^2 test. He suggests that the best technique would be to calculate the mean testis weight for each condition and then to determine how many sighted and blinded subjects fell above this mean and how many below it. The number of sighted and blinded birds in each category could then be compared by χ^2. Lott was unable to perform this analysis since he did not have the original data, but he did attempt to estimate it [see (*2*), table 1]. He obtained a value which was highly significant and concluded that the retina was involved in the photoperiodic response of the sparrow. In our previous reply we showed in detail that Lott's estimated χ^2 was inappropriate. Nonetheless, if the χ^2 described above is performed on the original data the χ^2 is insignificant—$\chi^2 = .082$, $.75 < P < .9$ (Table 1).

In our previous reply we described a χ^2 in which the median testis weight of all 311 birds in the 18 samples was used as the dividing line between "larger" and "smaller" [see (*3*), table 2]. However, this test is an insensitive one. If the data are dichotomized by using the median testis weight *in each sample* as the dividing line between "larger" and "smaller," a more sensitive χ^2 can be performed. Table 2 shows that when this test is performed $\chi^2 = 0$.

Both tests (mean and median) clearly support our hypothesis that no differences exist between the testis responses of blind and sighted house sparrows. We see no reason to alter our original conclusion that "an extraretinal photoreceptor exists in the sparrow which is fully capable of mediating the gonadal response to photoperiodic stimuli." Our data offer no support for the hypothesis that the retina is involved in this response.

The interested reader should refer to Menaker *et al.* (*4*), who reported further experiments in which a technically different approach was used. These experiments, taken together with those we described (*1*), seem to us to demonstrate that the eyes do not participate in the photoperiodic testis response of house sparrows.

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