the occurrence of a typical alcohol withdrawal syndrome. Naloxone, at doses up to the convulsive range, caused no opiate-withdrawal jumping in any of the animals; nor did naloxone modify the course of the alcohol withdrawal syndrome. Since even a mild degree of opiate dependence can be detected by the naloxone test, we conclude that alcohol dependence is not a manifestation of dependence upon any endogenous opiate, as proposed by Davis and Walsh (*3*).

AVRAM GOLDSTEIN
BARBARA A. JUDSON
Department of Pharmacology,
Stanford University,
Stanford, California 94305

References and Notes

1. P. Holtz, K. Stock, E. Westermann, *Arch. Exp. Pathol. Pharmakol.* **246**, 133 (1963); P. Holtz, K. Stock, E. Westermann, *ibid.* **248**, 387 (1964).
2. G. W. Kirby, *Science* **155**, 170 (1967).
3. V. E. Davis and M. J. Walsh, *ibid.* **167**, 1005 (1970).
4. P. V. Halushka and P. C. Hoffmann, *ibid.* **169**, 1104 (1970); M. H. Seevers, *ibid.* **170**, 1113 (1970).
5. E. Majchrowicz and J. H. Mendelson, *ibid.* **168**, 1100 (1970).
6. D. B. Goldstein and N. Pal, *ibid.*, this issue.
7. C. Maggiolo and F. Huidobro, *Acta Physiol. Latinoamer.* **11**, 70 (1961).
8. E. L. Way, H. H. Loh, F. Shen, *J. Pharmacol. Exp. Ther.* **167**, 1 (1969).
9. F. Lundquist, *Methods Biochem. Anal.* **7**, 217 (1959).
10. D. L. Cheney and A. Goldstein, *J. Pharmacol. Exp. Ther.*, in press.
11. Supported by grant 13963 from the National Institute of Mental Health, Public Health Service.

7 August 1970; revised 8 February 1971

Lunar "Anorthosite"?

The origin of terrestrial anorthosite is highly controversial (*1*), and the discovery of anorthosite on the moon (*2–4*) could help to answer many questions about the origin of many large terrestrial anorthosite bodies and the early history of the earth, such as the following: Does the existence of "anorthosite" on the surface of the moon lead to the conclusion that the upper parts of the early crust of the earth comprised large masses of anorthosite? Does the observation that all major terrestrial anorthosite bodies are Precambrian in age support this view and the view that anorthosite is a "primitive" rock formed only in the early stages of the earth's development as a planet? Is it correct to conclude that no anorthosite is now forming at great depth below the surface of the earth?

Windley (*5*) has suggested that the lunar "anorthosite" has certain similarities to what he calls "Group III' terrestrial anorthosites, as opposed to the commonly described massif-type anorthosite (typified by the Adirondack, Labrador, and southern Norwegian anorthosite bodies) and stratiform-type anorthosite (typified by the Bushveld and Stillwater complexes) (*1*, *6*). The main similarities Windley points out between Group III terrestrial anorthosite and lunar "anorthosite" are that both have calcic plagioclase, a low Ti content, high Ca and Al contents, and a relatively high Cr content. He points out that the Group III terrestrial anorthosites, like the lunar "anorthosites," are "fine-grained," but he does not give actual grain-size measurements for the Group III anorthosites to allow proper comparison with the lunar material (*5*, *7*).

An examination of the reports of Wakita and Schmitt (*2*) and Wood *et al.* (*3*) on lunar "anorthosite," and many data on terrestrial anorthosite bodies (*1*, *5–8*), left me unconvinced that these lunar rocks are anorthosite at all. The main differences between terrestrial anorthosite and lunar "anorthosite" involve grain size and anorthite content. Lunar "anorthosite" is very fine grained. Although Wood *et al.* (*3*) do not give grain-size measurements, the rock fragments they studied ranged in size from 1 to 5 mm. Fragments were all polycrystalline, and the photomicrograph they provide shows that the size of an individual grain is 0.1 mm or less. The anorthite content of the plagioclase in the lunar "anorthosite" is mainly 96 to 98 percent, although some anorthite contents as low as 75 percent have been reported. Terrestrial anorthosite, on the other hand, is generally a coarse-grained, plutonic rock in which individual plagioclase crystals generally exceed the size of the complete rock fragments described by Wood *et al.*

As a field geologist who specializes in the study of anorthosite, I would not feel justified in identifying such small fragments as coming from an anorthosite body. Individual crystals in even the finer grained terrestrial anorthosite bodies are on the order of 10 to 100 times larger than those in the lunar rocks. The anorthite content of terrestrial anorthosite ranges from about 30 percent to between 85 and 90 percent, and, except for Windley's Group III anorthosite (in which the anorthite content may be as high as 90 percent), averages in the range from 55 to 70 percent anorthite for stratiform anorthosite bodies and from 45 to 55 percent anorthite for massif-type bodies (*1*).

The term "anorthosite" has always been restricted to plutonic rocks. When fine-grained rocks of generally anorthositic chemical composition were found in northern Sweden, Von Eckermann invented a new rock name (kenningite) to characterize them (*8*). A fine-grained rock, like the lunar "anorthosite," consisting almost entirely of anorthite (96 to 98 percent) (*2*, *3*), does not resemble anorthosite, kenningite, or any other widely distributed terrestrial rock that I know of.

Turner (*9*) has commented on the compulsion felt by many petrologists to speculate on possible analogies between lunar and terrestrial rocks. To go too far is, in Turner's view, "to indulge in free speculation of the kind that is generally considered permissible in more serious types of science fiction." Many of the conclusions and predictions seem to imply, in Turner's words, "that the lunar and terrestrial systems of petrogenesis must be closely similar, and that common lunar rocks must resemble common rocks of our own planet." Turner urged petrologists to pay more attention to the possibility of the uniqueness of lunar rocks rather than to succumb to the tendency to overgeneralize on the basis of inadequate information.

An immense amount of analytical work has been done on the small samples of rock collected on the moon (*10*, *11*). However, I shall personally need to know of large fragments (at least several centimeters in diameter) of coarse-grained, lunar plagioclase rock before I am convinced by the descriptions of Wakita and Schmitt (*2*), Wood *et al.* (*3*), and others (*11*) that the rocks they have studied warrant the name "anorthosite" and can be logically compared with terrestrial anorthosites. The petrogenetic schemes they propose, based on models developed for terrestrial rocks unlike the lunar ones, must also be questioned. Detailed examination of the relationships of these rocks to each other in outcrop is needed before acceptable petrogenetic models can be established.

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

WILLIAM D. ROMEY
Earth Science Educational Program,
Post Office Box 1559,
Boulder, Colorado 80302

References

1. W. D. Romey, *Lithos* **1**, 230 (1968); Y. W. Isachsen, Ed., "The Origin of Anorthosite and Related Rocks" [*N.Y. State Mus. Sci. Serv. Mem. 18* (1969)].
2. H. Wakita and R. A. Schmitt, *Science* **170**, 969 (1970).
→ J. A. Wood, J. S. Dickey, Jr., U. B. Marvin, B. N. Powell, *ibid.* **167**, 602 (1970).
→ R. B. Baldwin, *ibid.* **170**, 1297 (1970).
5. B. F. Windley, *Nature* **226**, 333 (1970).
6. J. P. Berrangé, *Geol. Rundsch.* **55**, 617 (1966).
7. B. F. Windley, *Amer. Ass. Petrol. Geol. Mem.* **12**, 899 (1969).
8. H. Von Eckermann, *Geol. Fören. Stockholm Förhandl.* **60**, 243 (1938).
9. F. J. Turner, *Amer. Mineral.* **55**, 339 (1970).
10. Lunar Sample Preliminary Examination Team, *Science* **165**, 1211 (1969); *ibid.* **167**, 1325 (1970).
11. D. H. Anderson, *Earth Planet. Sci. Lett.* **9**, 94 (1970); M. J. Drake, I. S. McCallum, G. A. McKay, D. F. Weill, *ibid.*, p. 103; A. L. Albee and A. A. Chodos, *Geochim. Cosmochim. Acta* **1** (Suppl. 1), 135 (1970); J. A. Wood, J. S. Dickey, U. B. Marvin, B. N. Powell, *ibid.*, p. 965.

21 December 1970; revised 25 January 1971 ■

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.

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.

HERBERT UNDERWOOD
MICHAEL MENAKER
Department of Zoology,
University of Texas, Austin 78712

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

References

1. H. Underwood and M. Menaker, *Science* **167**, 298 (1970).
2. D. F. Lott, *ibid.* **169**, 892 (1970).
3. H. Underwood and M. Menaker, *ibid.*, p. 893.
4. M. Menaker, R. Roberts, J. Elliott, H. Underwood, *Proc. Nat. Acad. Sci. U.S.* **67**, 320 (1970).

15 January 1971