course of the entire process is thereby facilitated.

Although this investigation began with the premise that noradrenergic neurons were involved in the lateral hypothalamic syndrome (*3*), evidence suggests that the same syndrome may be all, or in part, attributable to interruption of a dopaminergic pathway involving the substantia nigra and the corpus striatum (*13*). Evidence implying that denervation supersensitivity follows lesions of this pathway has also been reported (*14*). Our data may, therefore, have also demonstrated the significance of supersensitivity for recovery of a dopaminergic system. Further studies should help to clarify the relative importance of noradrenergic and dopaminergic neurons in the early deficits as well as the later recovery after lateral hypothalamic lesions.

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1. P. Teitelbaum and A. N. Epstein, *Psychol. Rev.* **69**, 74 (1962).
2. Whether recovery occurs or not appears to depend on the size and the lateral extent of the lesions [see P. J. Morgane, *Amer. J. Physiol.* **201**, 420 (1961); G. D. Ellison, C. A. Sorenson, B. L. Jacobs, *J. Comp. Physiol. Psychol.* **70**, 173 (1970)].
3. B. D. Berger, C. D. Wise, L. Stein, *Science* **172**, 281 (1971). It should also be noted that lateral hypothalamic lesions reduce the telencephalic concentration of norepinephrine [see M. J. Zigmond, J. P. Chalmers, J. R. Simpson, R. J. Wurtman, *J. Pharmacol. Exp. Ther.* **179**, 20 (1971)].
4. S. K. Sharpless, *Annu. Rev. Physiol.* **26**, 357 (1964).
5. S. D. Glick and B. Zimmerberg, *J. Comp. Physiol. Psychol.*, in press.
6. The rats (220 to 280 g) were female albinos (Sprague-Dawley).
7. The skull was inclined according to the atlas of L. J. Pellegrino and A. J. Cushman [*A Stereotaxic Atlas of the Rat Brain* (Appleton-Century-Crofts, New York, 1967)]. Far-lateral coordinates were purposely chosen to ensure that lack of treatment of rats with lateral hypothalamic lesions would result in death by starvation. See (*2*) and also S. Balagura, R. H. Wilcox, D. V. Coscina, *Physiol. Behav.* **4**, 629 (1969).
8. Two rats treated with saline and one rat treated with 10 mg/kg of αMT prior to surgery died before being killed. When death was considered imminent, rats were killed so that adequate perfusion with formalin and more accurate histology could be performed. Brains were sectioned at 40 μm. This report includes only rats with bilaterally symmetrical lesions in the lateral hypothalamus at the level of the posterior part of the anterior hypothalamus and the ventromedial hypothalamic nucleus. Damage to the medial border of the internal capsule and to the ventral subthalamus was also observed.
9. Reducing the body weight of rats by 20 percent at the time of lateral hypothalamic surgery has been found to shorten the duration of aphagia after the operation; see T. L. Powley and R. E. Keesey, *J. Comp. Physiol. Psychol.* **70**, 25 (1970). Rats pretreated with either 75 or 100 mg/kg of αMT typically lost 5 to 10 g of body weight after the first day of drug administration and then gained weight normally. At the time of surgery, the mean body weights of all groups were within a range of 7 g. The recovery results cannot, therefore, be attributed to weight changes prior to surgery, per se.
10. Rats began eating, drinking, and gaining weight spontaneously and simultaneously; the mean duration for this to occur was 3.8 days. No intermediate steps, for example, consumption of very palatable foods, were necessary for recovery to occur. This indicates that the four classical stages of lateral hypothalamic recovery (*1*) are not sequentially necessary. That is, eating wet palatable food does not necessarily have to precede eating dry food and water. Our data have no bearing, however, on whether the four stages can be elicited during this facilitated recovery. It is indeed possible that rats showing recovery would have consumed palatable food during the earlier period of apparent aphagia and adipsia.
11. After the first day, all differences between the groups pretreated with 75 or 100 mg/kg of αMT and the groups pretreated with either 10 mg/kg of αMT or saline were significant (*t*-tests, $P < .01$ to .001).
12. The rats were decapitated, the whole brain was removed, and the cerebellum was dissected out and discarded. The brains were homogenized (1 g/10 ml) in cold 0.4*N* perchloric acid and were centrifuged at 15,000 rev/min for 15 minutes. Samples (5 ml) of each brain supernatant were then removed and 0.5 ml of 10 percent ethylenediametetraacetic acid were added to each. The *p*H of the supernatants was then adjusted to *p*H 8.4 with 5*N* NaOH, 1*N* NaOH, and dilute 1*N* NaOH. Each supernatant was then passed over an alumina column. Norepinephrine concentrations were measured by the fluorimetric method of H. Weil-Malherbe [*Methods Biochem. Anal.* **16**, 293 (1968)]. Emission spectra were read from 450 to 490 nm. The results (average microgram of norepinephrine per gram of brain) were as follows: saline, 0.627; αMT, 0.325. The difference was significant (*t*-test) at $P < .05$.
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14. ———, *ibid.*, p. 69.
15. Supported by NIMH grant 1 RO1 MH21156-01 to S.D.G. We thank S. Wilk for his help in conducting the norepinephrine assays.

20 March 1972; revised 5 May 1972

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Reflection Spectra of Lunar Dust Grains with Amorphous Coatings

Bibring *et al.* (*1*) report that a significant fraction of grains of lunar fines are coated with a low-density, amorphous substance about 500 Å thick, which is probably host grain material metamictized by solar wind bombardment. In one portion of their report Bibring *et al.* suggest that the low albedos and reddish spectra of the fines may be due in part to the coatings. In support of this suggestion they calculate the Fresnel reflection coefficient as a function of wavelength for an electromagnetic wave vertically incident on the plane surface of a semi-infinite, nonabsorbing substance with index of refraction $n_2 = 1.98$, coated with a layer of material 500 Å thick with $n_1 = 1.80$. The calculated reflection spectrum superficially resembles the lunar spectrum. Unfortunately, the calculation is irrelevant to the problem of the lunar albedo because it ignores the refracted ray. Although the coatings are very interesting, it can be shown that they have only a marginal effect on the lunar reflectivity.

The reflectivity R of an optically thick powder, consisting of grains with single-scattering abedos w_0, is given to a first approximation by the Kubelka-Munk, or two-stream, expression (*2*):

$$R = [1 - (1 - w_0)^{1/2}]/[1 + (1 - w_0)^{1/2}]$$

For the moon, R is .07, so that the effective, average, grain albedo is $w_0 = .25$. Contributing to w_0 are both rays that are reflected directly from the surface of the grain (the so-called regular or specular component of reflection) and rays that are refracted into the grain to be partially absorbed and volume-scattered so that they leave the grain in arbitrary directions. For silicates, with typical indexes of refraction around 1.6, the rays reflected from the surface contribute only about .06 to w_0, and thus the refracted rays must account for the remaining .19. Coating the grains will decrease the intensity of the rays reflected from the surface in the manner discussed by Bibring *et al.*, but will increase the intensity of the refracted rays because of smaller internal reflection on exiting, so that R will be only slightly affected.

The relative contributions of the surface-reflected and volume-scattered rays may also be estimated from polarization measurements on the lunar fines. In green light the maximum polarization of Apollo 11 fines is approximately 16 percent (*3*). Since the diffusely scattered ray is only weakly polarized, the polarization is due primarily to the surface ray, which is almost completely polarized near the Brewster angle. Thus, it may be deduced that surface scattering can account for only about 16 percent of the light reflected by the fines.

The minor role of the specular component can be further illustrated by the following example: TiO_2 and H_2O ice have indexes of refraction of 2.6 and 1.3, respectively, and thus specular reflection coefficients of 20 percent and 2 percent, respectively. Yet in powder form both materials have very high albedos because the volume-scattered rays are weakly absorbed.

If the coatings were metallic they could decrease R appreciably by absorption; however, apparently they are nonmetallic. Only strong, wavelength-dependent, volume absorption of the refracted rays can account for the lunar spectrum. Hapke *et al.* (*4*) have suggested that the large absorbing power of grains of lunar fines is primarily due to a vapor-deposited component of the soil, while Conel and Nash (*5*) and Adams and McCord (*6*) have emphasized the importance of shock-melted glass.

The following additional considerations are relevant to the discussion: (i) Bibring *et al.* state that the coatings recrystallize at 800°C. However, heating lunar fines in a vacuum to 900°C causes a negligible change in albedo (*4*). (ii) The calculated spectrum of the coated interface (*1*) has a minimum at 3500 Å, below which the reflectivity rises again. However, the spectra of lunar soils continue to decrease below 3000 Å (*4*). (iii) The indexes of refraction used by Bibring *et al.* are 1.80 and 1.98, whereas values of the order of 1.5 to 1.7 would be much more representative of the major components of lunar soil (anorthite, augite, olivine, ilmenite, and glass).

The interesting correlation between albedo and fraction of grains coated (*1*) is undoubtedly due to the fact that both phenomena are associated with exposure at the surface of the moon.

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6. J. Adams and T. McCord, *ibid.* **3** (Suppl. 2), 2183 (1971).

22 March 1972; revised 14 June 1972 ■

Mercury and Lead in the Greenland Ice Sheet: A Reexamination of the Data

It is imperative that the natural background content of mercury in the environment be determined. Examination of the Greenland ice sheet offers the opportunity to determine if the concentration of mercury in the atmosphere correlates with human industrial activity (*1*). Weiss *et al.* have recently reported such a measurement (*2*). Figure 1 is a plot of the data given in their table 1. The sites were identified by reference to the original work for which the samples were collected (*3*, *4*). The pre- and post-1952 data are from different sites with no overlap in dates to make possible an intersite calibration. Weiss *et al.* conclude from their data that there has been a recent increase in the mercury content of the atmosphere. This conclusion is not unambiguously justified.

Indeed, I propose that the only justifiable conclusion is that no trend is apparent in either the pre- or post-1952 data (although seasonal variations are revealed in the latter). Since in 1952 there was a change of sample collection sites, the post-1952 data are larger than all the pre-1952 data, and, since there is no overlap in dates between the two sites, it seems very likely that there is a systematic difference between these sites, perhaps the result of vehicular contamination (*3*). It is enlightening to refer to the original work on these samples in which an effort was made to measure the time dependence of lead in the atmosphere (*3*).

Table 1. Density of air and mercury in the atmosphere as a function of altitude.

Altitude (km)	Density		
	Air (g/m³)		Mercury (calc.) (ng/m³)
	Obs.*	Calc.	
0	1226	1226	1.00
1	1112	1121	0.45
2	1007	972	.20
3	909	865	.09
4	819	770	.04
5	736	686	.02
10	413	384	
20	88	120	

* For a U.S. standard atmosphere. For example, see (*11*).

The data for the lead content of the parent samples are shown in Fig. 2 and were obtained from table 7 of Murozumi *et al.* (*3*). In contrast to the data on mercury, a trend is clearly apparent in the pre-1946 lead data, but again interpretation of later data is open to debate. One could argue for a smooth curve from 800 B.C. right up to 1965, or argue, along with Murozumi *et al.* that between the 1933 and 1946 points there is a rapid increase, perhaps due to the increased use of lead additives in gasolines. However, examination of the data shows that there is a third alternative: There could very well be a systematic difference between pre- and post-1952 sites with no rapid increase around 1940. In either case, the burden of interpretation falls upon the 1946 point since its relative largeness appears to fit smoothly with the post-1952 data. In the absence of an actual date overlap between the sites, this smooth fit could contribute confidence that the sites yield consistent data. In the investigation of Murozumi *et al.* (*3*) the sea salt content of the snow was also measured and the time series for magnesium shows no discrepancy among the several sites. However, even though the arduous sample collection procedure involved many safeguards against contamination, Murozumi *et al.* stated (with respect to the post-1952 site) that "drifted winter snow from regions contaminated by vehicle traverse may provide the greatest source of locally contaminated snow in samples from the virgin trench site. There can be no question but that some of the winter snows we collected drifted in from great distances away. It is emphasized that dilution effects, after a few tens of km, *should* make snow contaminated by vehicle traverse indistinguishable from background snow in this region" (emphasis mine). It is worrisome that contamination by exhaust from gasoline-burning vehicles would contribute to an elevation of both the lead and mercury contents of the atmosphere. The validity of the mercury data depends on one's confidence in the compatibility of the data from the two sites, and this confidence rests upon the validity of the lead data, which in turn depends almost entirely upon the single data point of 1946.

Because the time dependence of both the lead and mercury contents in the atmosphere have immediate implications for public health policy, I suggest that, at the very least, additional samples be collected spanning the time from 1930 to 1970 from a single site, and prefer-