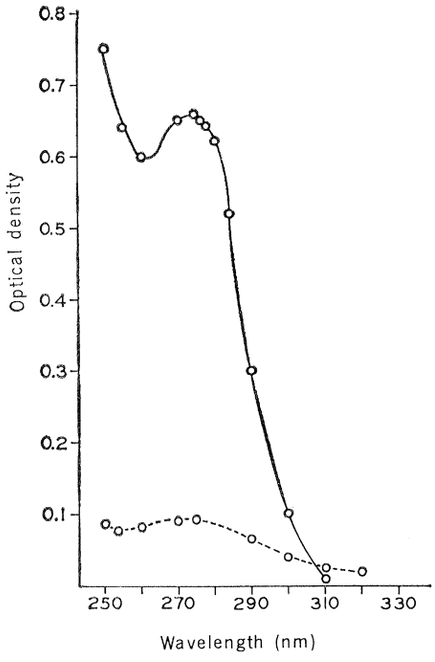

Fig. 1. Absorption spectra of sweat diluted 1:10 in phosphate buffer (*p*H 7.4). Solid line, sweat collected on filter paper; dotted line, sweat collected under mineral oil.

The mean concentrations of urocanic acid in sweat collected under oil and by filter paper are, respectively (milligrams per 100 ml of sweat): 0.76 (range < 0.2 to 1.8) and 5.4 (range 2.7 to 9.6). Secretory rates were comparable. In all cases, sweat collected under oil had much less urocanic acid than sweat which had been in contact with skin.

In an attempt to recover urocanic acid from nonsweating skin, further studies were performed with filter paper (saturated with phosphate buffer) applied to the skin surface. In these studies, amounts of urocanic acid similar to those found in sweat collected on filter paper were eluted both from the skin of volunteers who had been exposed to low ambient temperatures (< 5°C) and from cadaver skin.

These results show that urocanic acid, hitherto thought to be a constituent of sweat, is not a true constituent of sweat, but is a consequence of elution of urocanic acid from the epidermis by sweat. These findings suggest that this phenomenon may account for the presence of other organic compounds reported to be in sweat (*6*).

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References

1. J. M. Vandenbelt, C. E. Child, D. Lundquest, J. Saladonis, *Science* **119**, 514 (1954). A. Zenisek, J. A. Kral, *Biochim. Biophys. Acta* **12**, 479 (1953).
2. B. N. La Du, R. Howell, G. A. Jacoby, J. E. Seegmiller, E. K. Sober, V. G. Zannoni, J. P. Canby, L. K. Ziegler, *Pediatrics* **32**, 216 (1963).
3. H. P. Baden and M. A. Pathek, *Clin. Res.* **13**, 225 (1965).
4. J. Tabachnick, *Arch. Biochim. Biophys.* **70**, 295 (1957).
5. S. W. Brusilow, *J. Lab. Clin. Med.* **65**, 513 (1965).
6. S. W. Hier, T. Cornbleet, O. Bergeim, *J. Biol. Chem.* **116**, 326 (1946).
7. Supported in part by PHS grants AM06278 and 5-K3-GM-7324-08 from NIH.

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Lunar Soil: Should This Term Be Used?

In past months the authors of several reports which appeared in *Science* (*1*) have used the term lunar soil as a surrogate for a term for the blanket of material that covers the lunar surface. On behalf of all earthbound investigators engaged in research on soils and in geomorphic studies, I feel compelled to remind selenologists (and martianologists, venusologists) that usage of the term soil other than in reference to that of the earth is not in keeping with past and present conventions and is in fact incorrect. Misapplication of the term soil could lead to confusion and may endanger the present usefulness of the term. The practice should be discontinued.

I have recently reviewed three definitions of soil taken from three important reference books on soils. One of the books is old and time-honored (*2*), another is new and in wide use as a college text (*3*), and the third is recognized in North America as the standard reference on pedology (*4*). An examination of these definitions brings to light certain characteristics of soil that, in our present state of knowledge, sets it unequivocally apart from the material which blankets the moon. The characteristics are (i) that soil is a natural body which supports and sustains plants; and (ii) that soil contains —and in part consists of—organic matter, air, and water in variable proportions (*5*).

Thus, until it is satisfactorily shown that the debris blanket on the lunar surface is indeed a natural body which consists in part of organic matter, air, and water and which supports and sustains plants, selenologists should defer using the term lunar soil. Perhaps the term *epilith* (compare with regolith), analogous to epidermis, would be a satisfactory word to mean all loose lunar debris. We would then speak of the lunar epilith, much as we now refer to the earth's regolith, but remembering that regolith includes soil whereas the epilith does not.

The admonition presented here is directed to all investigators of the solar system who borrow earth-conceived terms for soils or geomorphology and apply them when not referring to the earth. In short, space researchers should either use existing terminology properly or begin coining their own terms, as the circumstances demand.

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References and Notes

1. L. D. Jaffee and R. H. Steinbacher, *Science* **158**, 631 (1967); J. N. de Wys, *ibid.*, p. 632; E. M. Christensen, R. Choate, L. D. Jaffee, R. L. Spencer, F. B. Sperling, S. A. Batterson, H. E. Benson, R. E. Hutton, R. H. Jones, H. Y. Ko, F. N. Schmidt, R. F. Scott, G. H. Sutton, *ibid.*, p. 637; J. A. O'Keefe and R. F. Scott, *ibid.*, p. 1174; M. J. Campbell and J. U. T. Gold, *ibid.* **159**, 973 (1968).
2. E. W. Hilgard, *Soils* (Macmillan, London, 1907), pp. xxiii, xxvi–xxvii.
3. H. O. Buckman and N. C. Brady, *The Nature and Properties of Soils* (Macmillan, New York, 1960), pp. 2–9.
4. Soil Survey Staff, *Soil Survey Manual* (U.S. Government Printing Office, Washington, D.C., 1962), pp. 6–8.
5. For a perceptive and comprehensive discussion of the nature and origin of soil, see C. C. Nikiforoff, *Science* **129**, 186 (1959).

1 March 1968

Photographic Sky Coverage for the Detection of UFO's

The following estimates were made in connection with my course on "Flying Saucers" (*1*). Over a period of 20 years, during which there have been at least 11,000 visual sightings of unidentified flying objects (UFO's) in the United States, no astronomical photograph has recorded one (*1a*), even though artificial satellites, meteors, and asteroids are frequently noted. In nighttime sightings, UFO's are usually quite luminous; the question is, what frequency of random UFO tracks could be missed by astronomical telescopes now in use.

Each telescope used photographically covers a solid angle ω for an average exposure time t and obtains an average of N photos per year. The photos are usually taken with-

in 30° of the zenith, so the average coverage of this vertical cone of about 900 square degrees is

$$C = \omega Nt/900\,\pi(8766) \simeq 4\omega Nt \times 10^{-8}$$

where t is time in hours, and 8766 is the number of hours per year.

The pamphlet *Observatories of the World* (*2*) lists seven categories of telescopes used in nighttime observations, ranging from three large Schmidt—or Maksutov—types with $\omega = 36$ square degrees, to over 200 refractors and reflectors with $\omega = 0.1$ square degree. The number n of telescopes in each class that are in active use, and rough (conservative) estimates of ω, N, and t are given in Table 1, together with the resulting values of nC, which total 0.0146.

That is, if UFO's move at random in the atmosphere, we can consider that all the photographic telescopes in regular professional use cover a 30° cone 1.46 percent of the time. It seems likely that visual observers cover a much larger portion of the sky much more thoroughly, at least for bright objects. An average individual may glance at the clear sky only two or three times per 24-hour day and comprehend a solid angle of about $900\,\pi$ square degrees, usually near the horizon, but there are millions of people able to report UFO's for each telescope in photographic use. Hence, visual observation is probably limited only by cloud cover, here assumed to average 70 percent. In the same terms, unaided visual observation covers an 80° cone 30 percent of the time—about 125 times more than the professional photographic coverage. That is, for every 125 visual sightings there should be one astronomical photograph.

In the 3,550,000 square miles (1 square mile is equal to 2.6 square kilometers) of the U.S., some 600 UFO reports since 1947 remain unidentified by the Air Force (*3*) which has presumably excluded reports of meteors and other astronomical objects as well as aircraft, balloons, artificial satellites, auroras, and hoaxes. If reports were accumulated at the same rate over the remainder of the world's land masses (53,500,000 more square miles), the total number of true UFO's would number about 10,000, and about 80 should have been recorded on astronomical photographs. Unless these flying saucers systematically avoid observatories, it seems likely that over nine-tenths of them are "unphotographable."

Table 1. Astronomical telescopes of the world.

Class of telescope	n	ω (square degrees)	N/yr	t (hr)	10^3nC
Large Schmidts	3	36	3000	0.4	5.18
Medium Schmidts	27	20	3000	.1	6.49
Small Schmidts	17	15	2000	.1	2.04
Smithsonian net	12	100	5000	.002	0.48
Astrometric	39	1	1000	.1	.16
Other (photo only)	211	0.1	500	.5	.21
					Sum 14.56

These statistics are admittedly rough, but they are systematically biased in such a direction as to weaken the case for "real" (photographable) flying saucers. For instance, the ocean areas add another 140,000,000 square miles or 24,000 true UFO reports. If the U.S. Air Force records are incomplete, the total number should be further increased. Professional telescopes certainly photograph fainter objects than visible to the naked eye (unless the object moves at a very high angular velocity).

J. E. McDonald has claimed in several recent lectures and articles (*4*) that the 5-percent residue of true UFO reports can only be explained by extraterrestrial visitors. It seems fairly certain that a space vehicle entering our atmosphere at near circular velocity (5 mile/sec, or 8 km/sec) would be detected on astronomical photographs during deceleration (either by retrorockets or hot nose cone) over a track some 500 to 1000 miles long at an altitude of about 75 miles. The probability (P) of a random track 1000 miles long and about 75 miles high crossing a telescope beam of solid angle ω is $7\,\omega^{1/2} \times 10^{-6}$, and the probability for n telescopes each exposing Nt hours per year is

$$nP = 7\,nNt\,(\omega)^{1/2} \times 10^{-6}/8766 = 0.8\,nNt\,(\omega)^{1/2} \times 10^{-9}$$

The sum of nP for telescopes listed in Table 1 is 0.74×10^{-4}, or about 0.01 percent, showing that professional telescopes are not an efficient patrol net for extraterrestrial visitors. In any case, their photographs could not readily distinguish between space probes, artificial satellites illuminated by the sun, and meteors. (The latter two types are fairly common on wide-angle astronomical photographs, even though they move at 2° to 5° per second.)

A far more effective patrol net is the Smithsonian Prairie Meteorite Network of 16 stations, each equipped with four 1-inch (2.54-cm) T-11 cameras of 15-cm focal length in a 300,000 square-mile area centered near Steinauer, Nebraska (*5*). Each station covers most of the cone 10° to 70° from the zenith (13,300 square degrees) between sunset and sunrise on all nights that are not completely cloudy. The network was designed for accurate three-dimensional tracking of large meteors, and should record all brighter than −4 photographic magnitude—that is, the two or three brightest seen each night. It has been in continuous operation for the past 30 months, and has recorded over 3000 bright meteors. Starting about 1 hour after sunset, 3-hour exposures are taken on 9- by 9-inch film by each of the 64 cameras throughout the dark nighttime hours. One night's film from the network averages about 200 feet (60 m) in length or 150 square feet in area, and three or four meteors are recorded. A mechanical "switching shutter" interrupts all exposures with coded blanks in such a way that any moving light source can be timed to ±10 seconds. A fixed light source would not show the coded gaps and could only be timed to ±1.5 hour by the exposure on which it appears.

Aside from the Echo satellite, airplanes, and auto headlights, the Prairie Meteorite Network films show no moving sources (*5a*) other than about 100 stars brighter than 4th magnitude. Such a star is about 30 times brighter than the faintest stars visible to the naked eye, but a good deal fainter than most reported UFO's. It is about the same as a 25-watt bulb (3 candle power) at 75 miles. Since the 16 stations of the network are about 150 miles apart, it is fair to say that they cover an area about 750 miles in diameter, or 440,000 square miles, or 0.0022 of the earth's surface. With an average of 10 hours per night, 200 nights per year (23 percent of the 8766 hours per year), the Prairie Meteorite Network has $P =$

$(0.23)(0.0022) = 0.05$ percent chance of photographing a single, fixed UFO of 3 candle power. If the UFO moves as much as 1000 miles this probability is increased to 0.07 percent; if it is fixed at low altitude between the cameras, the probability is less.

The Dominion Observatory (Ottawa) is building a similar meteor network in western Canada, using shorter focus lenses (53 mm) at stations 120 miles apart, expected to be in full operation in 1969. The Czechs have had a photographic network operating for several years covering the sky over Czechoslovakia with single wide-angle lenses at each site, focal lengths about 1 cm. No UFO's have been reported. The worldwide photographic detection probability therefore seems to be about 0.1 percent, and the probability of F UFO's per year escaping detection is $(0.999)^F \simeq \exp(-0.001\ F)$. It is therefore unlikely that F can be more than 500 luminous UFO's per year, worldwide. In fact, if only sightings in the United States are considered (an area of more than 3,550,000 square miles), the Prairie Meteorite Network has detection probability $P = (0.23)(0.12) = 2.8$ percent, and the probability of no detection is $\exp(-0.028\ F)$, limiting F to 18 luminous UFO's or less per year in the U.S.

Although these estimates do not rule out the residual of truly unidentified objects in the U.S. Air Force file for 1966 and 1967, they cast some doubt on the claim that UFO sightings indicate extraterrestrial visitors, and such estimates should be improved by authors (*6*) who criticize UFO theories. As an avenue of further discussion on both sides, I have proposed that several sections of the AAAS (Physics, Astronomy, Biology, and Meteorology) sponsor a special symposium on UFO's at the Dallas meeting this December.

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References and Note

1. T. Page, *Science* **158**, 1397 (1967).
1a. After this note was written, W. T. Powers of Northwestern University Astronomy Department informed me that "several" of the Smithsonian-net photographs show "anomalous trails."
2. T. Page, *Observatories of the World* (Smithsonian Astrophysical Observatory, Cambridge, Mass., 1967), 40 pp.
3. J. A. Hynek, *Science* **156**, 329 (1966); also *Look Magazine*, 1967; R. M. L. Baker, *J. Astronaut. Sci.* **15**, 31 (1968).
4. J. E. McDonald, "UFO's Greatest Scientific Problem of our Times," Pittsburgh NICAP Subcommittee (P.O. Box 701), 1967.
5. R. E. McCrosky and A. Boeschenstein, Smithsonian Astronomical Observatory, Special Report 173, (24 May 1965).
5a. After this note was written, R. E. McCrosky of the Smithsonian Astrophysical Observatory informed me that no thorough search has been carried out.
6. W. Markowitz, *Science* **157**, 1274 (1967); D. H. Menzel and L. G. Boyd, *The World of Flying Saucers* (Doubleday, Garden City, N.Y., 1963); P. J. Klass, *UFOs—Identified* (Random House, New York, 1968).

15 April 1968

UFO in 1800: Meteor?

In gently mocking the UFO controversy, Cannon (*1*) informed us of a sighting by William Dunbar in the year 1800; he reported that Dunbar's object was in the shape of a *house*, and suggested that since Dunbar saw square UFO's and we see round ones, the next stage should be triangles. I have consulted the source given by Cannon, and it seems that he was misinformed about the nature of the Dunbar report. The following is a reprint of Dunbar's original manuscript, with one added paragraph, which appeared in *Transactions of the American Philosophical Society* (*2*).

A phenomenon was seen to pass Baton Rouge on the night of the 5th April 1800, of which the following is the best description I have been able to obtain.

It was first seen in the South West, and moved so rapidly, passing over the heads of the spectators, as to disappear in the North East in about a quarter of a minute.

It appeared to be of the size of a large house, 70 to 80 feet long and of a form nearly resembling Fig. 5 in Plate, IV.

It appeared to be about 200 yards above the surface of the earth, wholly luminous, but not emitting sparks; of a colour resembling the sun near the horizon in a cold frosty evening, which may be called a crimson red. When passing right over the heads of the spectators, the light on the surface of the earth, was little short of the effect of sun-beams, though at the same time, looking another way, the stars were visible, which appears to be a confirmation of the opinion formed of its moderate elevation. In passing, a considerable degree of heat was felt but no electric sensation. Immediately after it disappeared in the North East, a violent rushing noise was heard, as if the phenomenon was bearing down the forest before it, and in a few seconds a tremendous crash was heard similar to that of the largest piece of ordnance, causing a very sensible earthquake.

I have been informed, that search has been made in the place where the burning body fell, and that a considerable portion of the surface of the earth was found broken up, and every vegetable body burned or greatly scorched. I have not yet received answers to a number of queries I have sent on, which may perhaps bring to light more particulars.

Hynek (*3*) has suggested that there may be scientific paydirt of many kinds buried under mountains of UFO trash. The Dunbar report may represent an example, the possibility of a very unusual meteorite impacted near Baton Rouge and large enough to make recovery of fragments conceivable. Dunbar's drawing is not greatly different in shape from some of the "phenomena" that are reported in modern times; we cannot yet be certain that Dunbar's object was in fact a meteor. I suggest that, here as in other UFO cases, mockery, however gentle and well-phrased, is not going to answer our questions.

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References

1. W. F. Cannon, *Science* **154**, 1503 (1967).
2. W. Dunbar, *Trans. Amer. Phil. Soc.* **6**, 25 (1804).
3. J. A. Hynek, *Science* **156**, 329 (1966).

11 April 1968

The original publication of William Dunbar's report fortifies my primary contention very well. I should not have said that the phenomenon was in the form of a house, nor that it was square, but that it was the size of a house and was sketched as being more rectangular than any other regular shape except for protrusions fore and aft. As Dunbar did not see the event himself, it is interesting that he integrated the reports of observers into a more or less rectangular shape and used the word "house" as his first verbal image. I suggested that perhaps persons of that day had a culturally conditioned unconscious partiality for imposing square (now read "rectangular") shapes to order disparate phenomena; and that in the 1950's our culture had shifted to favor circles, or saucers, among certain groups. I still believe that triangles are the coming thing, although my reasoning, being more Freudian than documentable, is not such as to convince a skeptical astronomer.

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