# Letters

## Origin of Noctilucent Clouds

Noctilucent clouds have in some cases been related to missile launchings (*1*), and aurorae have been found to occur following some nuclear explosions (*2*). Such observations show that some of the colossal natural phenomena can be partially reproduced by processes associated with missiles or with nuclear explosions in space. This provides clues to the possible mechanisms of some of these geophysical phenomena.

I have occasionally noticed a phenomenon fitting the description of noctilucent clouds, and observations of these clouds over Canada by several persons in recent years have been reported by Currie (*3*). There is apparently no doubt that noctilucent clouds can be observed without reference to any missile launching. For example, instructions for observation of noctilucent clouds are available (*4*). An excellent account of the clouds is also given by Soberman (*5*).

Between 10 and 30 annual occurrences are reported for some districts of the U.S.S.R. The clouds are classified, according to the observed features, as veils and sheets, bands, crests, and whirls. Their heights are estimated to vary from about 78 to about 90 km. In the Northern Hemisphere they have been observed between April and September, with greatest frequency in July. They are never said to be seen earlier than April or later than September. They have not been reported in latitudes lower than 45°N and rarely in latitudes below 50°N. Similar patterns of occurrence are reported for the Southern Hemisphere. Some of these facts make the Arizona clouds especially interesting, particularly in relation to the missile-exhaust hypothesis.

Temperatures favorable to the condensation of water vapor (around −110°C) seem to be found near the 80-km level by some rocket-grenade observations of atmospheric heating in the Arctic (*6*). Humidity conditions would have to be fulfilled, although it is difficult to say how, since evidences of ice coating on solid particles (nickel) have been obtained (*5*). Particles from noctilucent clouds have been collected by rockets penetrating through them (*5*) and have been chemically examined. From the same regions of the upper atmosphere without clouds the collecting surface shows 100 to 1000 times fewer particles per square inch. Thus large local density fluctuations are evidenced by rocket techniques (*5*). Indications of solid particles 0.05 to 5.0 $\mu$ in size, with a coating of ice that might have evaporated later, are found. Although dust particles of extraterrestrial origin are suggested as condensation nuclei, the exact mode of formation of these clouds is still to be settled. If missile exhaust processes can produce noctilucent clouds, some of the requisites of these formations are perhaps fulfilled by such processes.

R. S. IYENGAR
*University of Saskatchewan, Saskatoon, Canada*

### References

1. A. B. Meinel and C. P. Meinel, *Science* **143**, 38 (1964); but see also A. Margoshes, *ibid.* **144**, 1158 (1964).
2. J. B. Gregory, *Nature* **196**, 508 (1962).
3. B. W. Currie, *Can. J. Phys.* **41**, 1745 (1963); *J. Roy. Astron. Soc. Can.* **56**, 141 (1962).
4. N. I. Grishin, "Instructions for observations of noctilucent clouds" (in Russian), *Izv. Akad. Nauk SSSR, Moscow* (1957).
5. R. K. Soberman, *Sci. Am.* **208**, 51 (1963).
6. W. G. Stroud, W. Nordberg, W. R. Bandeen, *J. Geophys. Res.* **64**, 1342 (1959).

## Word Origins

In his interesting article "Prehistory of the West Indies" (1 May, p. 499), Rouse says that the words *canoe* and *hammock* have come into the English language from the languages of the West Indian aboriginals. This statement, I fear, is premature; the origins of both words are open to further consideration and research. The word *canoe* has a long etymological history on the centum side of the Indo-European language family, and its roots may be seen in both the Germanic and Latin (Italic) branches. The root *can* or *kan* ("boat") existed in all the languages with which English has had contact; the root *can* was in the Spanish language of the pre-Columbian period.

The etymology of *hammock* must be considered in two parts—the origin of the orthography, and the origin of the basic meaning. The spelling is from the nautical term *hammock* (or *hummock*, "knoll used as a navigational landmark"). The origin of the meaning is basically Germanic, from the old High German *himil* or the Dutch *hemel* (meaning "heaven, canopy"), through the 14th-century English *hammercloth* ("canopy"), to the 16th-century English *hammercl'* or *hammock*. Both *hammock* and *hammercloth* have the meaning of a cloth or fibre mat stretched between two supports.

CHARLES F. FROMME, JR.
*Battersea College, London*

## Sciences ≠ Science

To show that I was not offended by the sobriquet "cheap and preoccupied labor," which Sears uses in his editorial (12 June, p. 1297) to designate one of the causes of lack of interest in science on the part of undergraduates, I shall begin by agreeing that graduate-student lab instructors are all too often "preoccupied"—mostly with getting some record of teaching experience on their dossiers.

But I believe the problem needs a different solution from the one Sears recommends. It doesn't seem realistic to me to ask that "specialists in the fields of science must broaden the perspective of their teaching." Why not turn the teaching of science qua science over to the philosophers of science? Why should a student be required to take some fixed number of specific science-department courses in order to fulfill the "science requirement" when, in many cases, the various scientific departments haven't the necessary sophistication to go beyond their own respective methodologies and data for a proper presentation of science in general? A series of such more or less idiosyncratic instances of science often fails to give the student a grasp of science per se.

At Minnesota, there is at least the opportunity for students to take courses devoted to science per se. These courses are taught by members of the Minnesota Center for the Philosophy of Science and are offered to both graduates and undergraduates. By using empirical data for illustrative pur-

poses only, these teachers avoid a deadening teaching technique that is now discouraging students from taking science courses. I fear that a 2-year sequence of science courses such as Sears recommends would only give further opportunity for each department to pass on to the students in an endless flow the empirical findings that most professors mistake for an understanding of the science they are teaching. What is needed is a situation in which the teacher does not have emotional investment in a body of data and is therefore (one would hope) free to get on with the teaching of science as a method of investigation.

WILLIAM MYERS
*Department of Psychology, University of Minnesota, Minneapolis*

Sears's editorial focuses on an important problem that has received only peripheral attention. One important reason for its neglect is that instruction in science for liberal education is at best a part-time activity for the academic scientist. True, there are dozens of textbooks in both the physical and biological sciences for the student not majoring in science; pioneering educational programs have been described and evaluated by Cohen, Schwab, and others; conferences on science in general education are held occasionally; and someone with the standing of Sears speaks out once in a while. But promotions and other emoluments are generally lost to the scientist who devotes himself to this area of education; professional society meetings do not consider the topic; the departmental organization of universities ignore it. Perhaps if Sears and others of his prominence were to found and develop a Society for Science in General Education a forum to investigate his and other suggestions would be more readily available; and the neophyte in the field would have a pillar for support.

MORRIS GORAN
*Roosevelt University, Chicago 5*

## Human Experimentation

The News and Comment item on "Human experimentation" (7 Feb., p. 551) has not provoked a discussion in *Science* as yet. As far as scientists are concerned it involves only a minority group: physicians. Yet obviously the issues raised are of broad interest. I would like to comment on the question of the obligation of physicians to submit themselves to the same procedures that they carry out on their experimental subjects (*1*).

There is a profound difference between physicians and other scientists which, in the zeal for scientific conquest, is apparently easily overlooked. In medicine, the experimenter and the subject—whether patient or healthy person—are on an identical level of being; they are *fellow* beings in the strict sense of the term. The engineer and his experimental subject, the machine, and the biologist and his, the animal, are not. Medical history is full of accounts of investigating physicians who demonstrated their awareness of this difference by sharing in the experimental situation of their design. In recent American medical history, for instance, Ivy, Sabin, and Salk have done so. Ivy flew frequently to an altitude of 40,000 feet to study the symptoms of bends and to 18,000 feet without supplemental oxygen to study the effect of lack of oxygen (*2*). Sabin was the first to swallow his oral vaccine (*3*). Salk injected himself, his wife, and his three sons with his vaccine (*4*).

Certainly, from the scientific point of view such self-experiments may be irrelevant and serve no "useful" purpose. But if the physician—or, in case he is for scientific reasons unsuitable, a member of his family—does not serve as subject in experiments done for the general welfare, that is, not done for the immediate benefit of a patient, then he creates a hierarchy, a difference between the value of his existence and that of his fellow beings, which is not inherent in his position; conscientious as he may be, he is then plaintiff and judge in one person. The general-soldier relationship—cited by an experimenter quoted in the article—is quite different. Here, the hierarchical structure and the general's freedom of choice "to march behind or in front of his troops" are established by military law. Both parties know the situation precisely even before they come in contact with each other. To see these cases as similar is to disregard the foundation of the physician-patient relationship as visualized in Western culture and as expressed annually in the administration of the Hippocratic oath or similar ceremonies at medical schools' commencement exercises.

The "false heroism" and the "stupidity" of physicians who subject themselves to their experiments are manifestations of a more profound insight into the nature of the experimenter-subject relation in medical research and of the place of scientific endeavor in our culture than is the rationalism that the New York investigators invoke. Those who rationalize their lack of participation by pointing to the benefit to humanity resulting from their experiments may be reminded of the story of Charlie Brown in "Peanuts." When he turns a garden hose against men who are planting trees, Charlie is scolded by Lucy—"What these people do is good for humanity." Whereupon Charlie replies, "I love humanity, but I hate people." Charlie may have this privilege; yet significant as his answer is, it is equally significant that he has never—as far as I know—made application to enter medical school.

OTTO E. GUTTENTAG
*University of California Medical Center, San Francisco*

**References and Note**

1. The problems of volunteering and consent, also discussed in the news items, have been treated recently in an excellent monograph, *Clinical Investigation in Medicine: Legal, Ethical and Moral Aspects*, I. Ladimer and R. W. Newman, Eds. (Boston Univ. Law Medicine Research Institute, 1963).
2. *Trials of War Criminals before the Nuernberg Military Tribunals under Control Council Law No. 10*, vol. 2 (Government Printing Office, Washington, D.C., 1949), p. 112.
3. *Ann. N.Y. Acad. Sci.* **61**, 1055 (1955).
4. *Britannica Book of the Year 1956*, p. 610.

## Alphabetical Oblivion

It's all very well for a man whose name begins with B to suggest ever so softly (Letters, 17 July, p. 232) that alphabetical listing of authors' names can do away with tender feelings over who is principally responsible for the integrity of the data. It would have been more seemly to have the suggestion from a man whose name begins with W—but, oddly enough, it didn't occur to him.

WALTER L. WILKINS
*Navy Medical Neuropsychiatric Research Unit, San Diego 52, California*

. . . may we not expect a rash of name changes among knowledgeable young scientists? Thus, a Zygmund Zyzomus might profitably become an Aaron Aardvaark.

ARDEN R. BENSON
*3031 Southeast 150 Avenue, Portland, Oregon 97236*