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 μ 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.

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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.

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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-