

In any case, I believe that the lattice constant of the garnet found in the meteorite precludes its being $\text{Mg}_3\text{Fe}_2\text{Si}_3\text{O}_{12}$ as suggested by Mason *et al.* (1); to account for its low value requires the presence of Si^{4+} ions in octahedral sites if no other cations than Mg^{2+} , Fe^{2+} , Fe^{3+} , and Si^{4+} are present.

S. GELLER

Science Center, North
American Rockwell Corporation,
Thousand Oaks, California

References and Notes

1. B. Mason, J. Nelen, J. S. White, Jr., *Science* **160**, 66 (1968).
2. S. Geller, *Z. Kristallogr.* **125**, 1 (1967), and appropriate references therein.
3. L. Coes, *J. Amer. Ceram. Soc.* **38**, 298 (1955).
4. S. Geller and C. E. Miller, *Amer. Min.* **44**, 665 (1959).
5. A. E. Ringwood, *Earth Planet. Sci. Lett.* **2**, 255 (1967).
6. S. M. Stishov and S. V. Popova, *Geophimya* **10**, 837 (1961); E. C. T. Chao, J. J. Fahey, J. Littler, D. J. Milton, *J. Geophys. Res.* **67**, 419 (1962).
7. A. E. Ringwood and A. Major, *Earth Planet. Sci. Lett.* **1**, 241 (1966).
8. I thank M. Blander for discussions and B. Mason for his kind remarks on the manuscript.

4 November 1968

Size-Frequency Distributions of Two Intertidal Species

In Jackson's (1) paper on the distribution and size frequency of the two intertidal clams *Gemma gemma* and *Mulinia lateralis* the date (November?) of the collections is omitted, and it is not even quite clear whether the clams were collected on one or several occasions. When comparing size frequencies of living and dead populations it is important to know the exact time of the year when the living population was sampled. Because many mollusks have different growth rates from one year to another, one would also like to know the year of collection.

In comparing the distributions of size frequencies of living and dead (complete shells) of *Gemma gemma* Jackson concludes that the two peaks in the dead population correspond to the period in summer when growth of both the 1- and 2-year-old animals is most rapid and mortality (apparently) is at its highest. It is much more likely that the peaks represent deaths during the winter period (September through March) (2) when growth is virtually at a standstill. Periodic cessation of growth by itself, even without an increased rate of mortality, is sufficient to translate size-frequency peaks, caused by periodic

recruitment to a living population, into similar peaks in the dead population (3). The left shift noticed by Jackson in the peaks of the dead population as compared with those in the living population could be the result of either the time of sampling or a slower rate of growth during life of the shells of the dead population, compared with those of the living population. Sellmer (2) emphasizes the variability in the average size attained by *Gemma gemma* in its 1st year of growth (1956 cohort 1.8 mm; 1957 cohort 1.3 mm).

A positively skewed size-frequency distribution of single valves of *Mulinia lateralis*, according to Jackson, indicates very high juvenile mortality. Such distribution might equally well be the result of sorting of a particular size of valve by currents.

Jackson's conclusions that "size-frequency distributions of bivalves, even roughly similar forms from the same environment, may differ greatly because of simple and basic variations in their life histories . . ." and that "generalizations on the paleoecological significance of one sort of size-frequency distribution or another seem inappropriate without some idea of the life histories of both species involved . . ." are undoubtedly true. However, they do not seem to be substantiated by his study of a reworked sample of *Mulinia lateralis* and of a collection of *Gemma gemma* which may or may not have been *in situ*.

G. Y. CRAIG

Department of Geology, University of
Edinburgh, Edinburgh, Scotland

G. OERTEL

Department of Geology,
University of California, Los Angeles

References

1. J. B. C. Jackson, *Science* **161**, 479 (1968).
2. G. P. Sellmer, *Malacologia* **5**, 137 (1967).
3. G. Y. Craig and G. Oertel, *Quart. J. Geol. Soc. London* **122** (487, part 3), 315 (1966).

20 September 1968; revised 6 November 1968

Craig and Oertel are correct in pointing out the importance of the time of sampling, which was unfortunately omitted in the revision of my paper. The samples were collected on 9 November 1967. However, if variation in molluscan growth rates from one year to the next is significant for the formation of a size-frequency distribution for a dead assemblage, then hopes for paleontological application of size-frequency data must be slim indeed.

It is difficult to understand how Craig and Oertel can refer to Sellmer (1) in stating that the peaks in the size-

frequency distribution of dead *Gemma gemma* represent deaths during the winter period. Examination of Sellmer's life table for *Gemma gemma* (1, p. 201) shows maximum mortality in summer months (nearly 80 percent in the 1st month after release), a considerable decrease in the winter, and a subsequent rise the following summer at the time of release of a new crop of juveniles. Craig and Oertel's deterministic models (2) are interesting but do not seem to apply in this case.

Craig and Oertel are concerned about the slight left shifts in the size-frequency peaks for dead *Gemma gemma* relative to the live population. Their concern is inappropriate, however, inasmuch as Sellmer (1) and I (3) have shown that the size-frequency distribution for dead *Gemma gemma* should be fairly stable and therefore more indicative of the life history of the species than the rapidly changing (1) live size-frequency distribution.

After stating in one paragraph that the size-frequency distribution for dead *Mulinia lateralis* might "well be the result of current sorting," Craig and Oertel conclude that the *Mulinia* were reworked and the *Gemma* "possibly *in situ*." Such a statement seems a bit strong, since, to the best of my knowledge, neither of the authors has visited the collecting locality. More to the point, however, it is true that size-frequency distributions can be generated by either current sorting phenomena or biological factors, and therefore size-frequency distributions do not alone provide a reliable basis for interpretation of fossil assemblages or of my Recent assemblage. Instead, as pointed out by Johnson (4) and supported by the results of my own study (3), the only reliable approach is to consider all available lines of evidence for analysis of assemblages *in situ* as compared to those transported. The fact that the same type of size-frequency distribution can be generated by a variety of biologic and selective factors is the critical difficulty in the paleontological application of size-frequency analysis.

JEREMY B. C. JACKSON

Kline Geology Laboratory, Yale
University, New Haven, Connecticut

References

1. G. P. Sellmer, *Malacologia* **5**, 137 (1967).
2. G. Y. Craig and G. Oertel, *Quart. J. Geol. Soc. London* **122** (487, part 3), 315 (1966).
3. J. B. C. Jackson, *Science* **161**, 479 (1968).
4. R. G. Johnson, *Bull. Geol. Soc. Amer.* **71**, 1075 (1960).

18 December 1968