Continuing our systematic study of noble-gas host phases in primitive meteorites \((1,2,3)\), we have examined 4 chemically separated samples from the Orgueil C1 chondrite (Table 1). The parent sample A10.1 was an HF, HCl-insoluble residue of assorted silicate fractions from which magnetite had been removed \((4)\); A10.2 was a partially \((-50\%)\) successful attempt to remove the organic polymer without affecting other phases, whereas A10.3 was an "etched" sample, treated with strong oxidizing agents to remove Q and the polymer \((3)\). All samples were examined in 6 temperature steps for He, Ne, Ar, Kr, and Xe, but only the most essential data for Ne and Xe are summarized in Table 2. Our results and conclusions differ appreciably from those of Frick and Moniot \((5)\), who studied Orgueil by their variant of the Chicago procedure.

Neon. Even our unetched residue A10.1 contains substantial amounts of Ne-E, as shown by its position below the \((\text{Ne-A})\)-cosmogenic line (Fig. 1). Further chemical treatments seem to remove Ne-A (and solar Ne) selectively, as shown by the drift of the points toward the Ne-E corner. Only the colloidal sample A10.2* moves upward, as expected from the well-established preference of Ne-E for non-colloidal phases \((6)\).

The T-fractions of A10.3, though spaced 200° apart, trace out the bimodal release of Ne-E discovered by Eberhardt \((6)\), with minimum 20/22 ratios at 600° and 1400°. The 1400° point is right inside the Ne-E region defined by Eberhardt \((6)\), with lower 20/22 and 21/22 ratios than the most extreme samples previously known: Orgueil G4j 1230° \((6)\) and Murchison 1C10 1400° \((7)\). [But see also the companion abstract by Alaerts et al. \((8)\)].

The total concentration of excess Ne\(^{22}\) in Orgueil A10.3 (assuming that the total neon is a mixture of Ne-A and pure Ne\(^{22}\)) is \(48 \times 10^{-8}\) cc STP/g, an order
of magnitude higher than the value for G4j, 4 x 10^{-8} cc/g (6). SEM examination of A10.3 showed F and Cr as the most abundant elements. Because the F almost certainly represents teflon contamination from the magnetite separation (4), the pure host phase must be even richer in Ne-E. Apparently G4j still contained >90% extraneous phases, and so the heavy irradiation inferred from radiation damage of the silicate grains (9) may not apply to the actual host phase of Ne-E. Probable host phases for Ne-E in Murchison have been discussed by Alaerts et al. (8); since the bimodal release is similar, it is possible, though not certain, that the same phases are present in Orgueil.

Xenon (Fig. 2). Orgueil follows the pattern of other primitive meteorites: the unetched samples A10.1 and A10.2 are dominated by trapped Xe and lie near the left corner, whereas the etched sample A10.3, after removal of Q with its trapped component, moves along the mixing line toward CCFXe on the right. The 600°, 1200°, and 1400° fractions of A10.3 fall above the mixing line, however, and apparently contain "s-process Xe", enriched in isotopes 128, 130, and 132 (7,8). Interestingly, these are the same fractions that are enriched in Ne-E (Fig. 1), and so it seems that at least one Ne-E host phase in each release peak also contains s-process Xe. Yet the correspondence is not 1:1, because the 228Xe/130Xe ratio varies from $8 \times 10^2$ to $>10^4$ in different Murchison fractions (8), and is 1500 and 3500 in the 600° and 1200-1400° peaks of Orgueil A10.3.

Host Phases of Noble Gases in Orgueil. Frick and Moniot (5) found substantial enrichment of CCFXe in their nominally unetched samples W11A-2 (Table 2 and Fig. 2): 136/132 = 0.385 compared to 0.331 and 0.335 for our A10.1 and A10.2, or 0.325 for bulk Orgueil. They attribute this difference to "losses of ordinary [trapped] gases during sample preparation and storage", and note that temperatures could have exceeded 170°C after evaporation of acids. In our experience, an oxidizing agent is essential for removal of Q, and indeed, their procedure used LiNO₂ and dilute HNO₃ prior to treatment with hot HC1-HF (5). Owing to the low abundance of Q, only a trace of NO₃⁻ in strong HCl would suffice to oxidize it.

The Berkeley group (5,10,11) has repeatedly disputed our identification of noble-gas host phases (Q, chromite, amorphous carbon, organic polymer), and has contended that only the polymer and other, unspecified types of carbonaceous matter are involved (misleadingly called "carbon", a name reserved for the element itself). A chronic problem with the Berkeley work has been the low recovery of noble gases, owing to loss of important phases by harsh chemical treatments or inappropriate procedural steps. Examples are Ne-E and s-process Xe, which were missed entirely or almost entirely by Frick and Moniot (5), and chromite and spinel (11), as discussed in the companion abstract of Lewis et al. (12).
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This point is illustrated in Table 3, which compares the yields of 3 noble gas components in our and Frick and Moniot's Orgueil residues. Both are referenced to the bulk Orgueil analysis in Table 2. Such normalization is hard to do correctly for both samples, owing to heterogeneity of the meteorite and, especially, the NaOH-pretreatment of our material. Nonetheless, the evidence is strong that Frick and Moniot have lost phases that we were able to recover. The low $\text{I}^{32}$ value suggests that they lost much of the $Q$, presumably by inadvertent etching with $\text{NO}_3^-$. The low $20$ and $136^*$ suggests that they lost ferrichromite, presumably by dissolution in acid (12) and/or colloidal separation. The latter separation may also have caused the previously mentioned loss of the host phases of Ne-E and s-process Xe.

On the other hand, the low noble gas yield of our etched sample A10.3 also is striking. In other meteorites, Ne$^{20}$ and Xe$^{136^*}$ are mainly located in $\text{HNO}_3$-resistant phases (chromite and amorphous carbon), and hence are not greatly reduced by etching. Frick and Moniot's sample W11A-2 fits into this pattern, and shows about the right amount of 20 and 132, as well as 136/132 ratio, for an etched sample. Our sample A10.3, on the other hand, shows a far smaller recovery - about 10-15% that of W11A-2.

The reason may be the $\text{HClO}_4$ step (24 hours at 80°C, 1/2 hour at 100°C) added to our procedure in order to remove the polymer. As evidenced by the weight loss, it indeed destroyed much of the polymer, but in the process also removed most of the noble gases. Chromite should have survived this treatment (12), and so we conclude that a large part of the Ne$^{20}$ and Xe$^{136^*}$ in Orgueil either reside in a more oxidizable phase, perhaps carbonaceous - as argued by Frick and Moniot - or in very fine-grained chromite that was lost when its polymer "adhesive" was dissolved.

It is harder to prove that a certain phase does not contain noble gases than to prove that it does. One must either show that a representative sample of the phase is free of the noble gas component, or one must account for most of the component as being in other phases. We agree with Frick and Moniot that two or more kinds of carbonaceous material in Orgueil probably are major carriers of both primordial xenon and CCF xenon. We cannot agree with their unitary concept of carbonaceous material as the sole carrier, nor do we see their data as excluding $Q$, probably a sulfide, from being a principal carrier in the bulk meteorite and also in our residues.