Chapter 3

Combining Stratigraphic Sections and Museum Collections to Increase Biostratigraphic Resolution

Application to Lower Cambrian Trilobites from Southern California

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1. QUESTIONS OF PRECISION AND THOROUGHNESS

Range charts are the critical limiting factor for biostratigraphic resolution. High-resolution biostratigraphy requires detailed local range charts that resolve the first and last appearances of numerous fossil species with centimeter precision. Unless the fossil collecting is also extraordinarily thorough, range charts underestimate the full length of taxon ranges and miss rare taxa altogether. High precision involves collecting fossils from thin rock intervals and recording precisely the stratigraphic separation of these intervals. Thoroughness has two components: 1) collecting at many stratigraphic levels; and 2) processing enough rock at each level to find the local highest and lowest occurrences of both the abundant taxa and the rare taxa.

Field projects with realistic deadlines achieve precision more easily than thoroughness, especially in the collection of macrofossils. It may be feasible to excavate clean, continuous exposures and carefully measure the position of each sampled interval. Time will likely be inadequate, however, to examine as much rock as one would wish. Museum collections appear to offer an easy means to increase the thoroughness of a measured section. They often house rich faunas that combine decades of collecting by many individuals. Although museums might not retain all the mediocre specimens of common taxa, their selectivity may be expected to include several kinds of specimen that are important for range charts: rare taxa not seen in all measured sections; individual finds that extend the known taxon range; and fossils from nearly barren rock intervals. Unfortunately, the attractive taxonomic richness in museum collections is likely to be offset by accompanying records that are of variable quality and typically lack detail concerning the precise provenance of the specimens.

This chapter explores options for using rich, but loosely documented, museum collections to test and augment range charts from more precisely measured stratigraphic sections. After reviewing the types of essential information that range charts contain, we categorize museum specimens according to the aspects of this information that they can augment. Then we turn to computer-assisted methods of combining the information from museum collections and measured sections.

At each step, we illustrate the dilemma of precision and thoroughness with the real example of olenelloid trilobites from Lower Cambrian outcrops in two neighboring mountain ranges in the eastern Mojave Desert of southern California (Fig. 1), and from the reference collections of the Geology Museum at the University of California, Riverside (UCR). We