null
Black Steer Knoll”—used to support this correlation varies considerably in lithology, thickness, and exact stratigraphic position and cannot be directly traced (Anderson and Lucas, 1992, p. 89, Black Steer Knoll”-used to support this correlation varies contemporaneous with the f-3 unconformity. This correlation is further that the pebbly zone at the base of the Todilto is penecontemporaneous, positions, and paleogeography, all suggest stratigraphic relationships, position in facies tract, and paleogeography, all suggest that transgressive surface. Both lie at the top of the Entrada Sandstone; so stratigraphic position, regional stratigraphic relations, position in facies tract, and paleogeography, all suggest that the pebbly zone at the base of the Todilto is penecontemporaneous with the J-3 unconformity. This correlation is further discussed below with regard to the U.S. Geological Survey’s perception of the Cow Springs Sandstone.

Condon calls on other evidence to support the Summerville–Curtis correlation. He cites O’Sullivan’s interpretation been known to me earlier, I wouldn’t have gone ahead with the name change in the San Juan Basin.” The “revisions” alluded to by Condon are those of O’Sullivan in which he acknowledged that the Summerville was not cut out entirely by pre-Morrison erosion in the four-corners area. The “name change,” of course, refers to the change from Summerville to Wanakah. A subsequent written communication from Condon to Anderson (February, 1988) includes the following: “Although the interpretation now is that the Summerville is not cut out entirely in areas as far south as Uxarum, the fact remains that the nomenclature was formally changed in much of south-central and southeast Utah by O’Sullivan (1980a).” From this we conclude that an unnecessary name change was made, and Condon and Petersen (1986) saw some utility in honoring the change.

The rejection of the name Wanakah by us (Anderson and Lucas, 1992) is not the first nor the most significant rejection. We merely pointed out that it was a preoccupied name, and that it was inappropriate and superfluous in New Mexico. In fact “Zuni Formation” would have been a more enlightened choice if a name change were needed, and it most definitely has precedence over Wanakah. The first and most significant rejections of the name Wanakah in New Mexico were the mappers of the ’50s, ’60s, ’70s and ’80s who used Todilto-Summerville-Bluff for these strata, nearly unanimously.

**The Todilto is a separate formation**

Gregory (1916) introduced the term Todilto Limestone as a unit of formational rank. As presently mapped, the Todilto Formation is present across much of northern New Mexico, from the Arizona/ New Mexico state line to as far east as western Quay County and in southwestern Colorado as far north as Montrose, an area of approximately 88,000 km². Virtually all mappers, especially those of the U.S. Geological Survey, have mapped the Todilto across this area as a unit of formational rank. Condon’s assertion that the Todilto should instead be regarded as a member of the Wanakah Formation is similar to his assertions about the invalidity of Grabau’s Wanakah; it indicates a lack of understanding of basic stratigraphic principles and an apparent lack of knowledge of the relevant practice.

To all those familiar with the Todilto Formation, its carbonates and evaporites present a striking contrast to the adjacent San Rafael Group strata that are mostly siliciclastic eolianites (Entrada) and tidal flat-sabkha deposits (Summerville). This contrast makes the Todilto a readily mappable and traceable unit throughout its outcrop belt, and also one easily recognized from subsurface data. For these reasons a vast majority of workers have long recognized and readily mapped the Todilto as a unit of formational rank. We agree with Condon and the Code of Stratigraphic Nomenclature that “formations are fundamental units in lithostratigraphic classification.” The Todilto Formation is in fact the most unique, fundamental, and readily mappable lithologic unit in the San Rafael Group.
Eolianites in the Upper San Rafael Group

Horse Mesa is a redundant name

Eolianites in the Upper San Rafael Group on the Colorado Plateau have been given a bewildering array of names: Bluff, "Cow Springs," Junction Creek, Zuni, Mesita, and Horse Mesa. In northwestern New Mexico most of the eolianites represent a single lithosome to which the name Bluff Sandstone of Gregory (1938) is properly applied (Anderson and Lucas, 1992). The Horse Mesa Member of Condon and Huffman (1988) is a redundant name for the Bluff Sandstone. The "subtle" differences between it and the Bluff Sandstone elsewhere referred to by Condon to justify recognition of the Horse Mesa as a distinct unit are very subtle indeed. They are minor sedimentological differences that do not merit recognition of the Horse Mesa as a separate unit.

Just as the Horse Mesa is superfluous, so also is the Beclabito Member of the Wanakah Formation which Condon and Huffman (1988) applied to the Summerville Formation. An important point, obvious to all, is that too much nomenclature has been created for Middle and Upper Jurassic in the southwestern interior mostly by workers of the U.S. Geological Survey. Our work has been designed to present reproducible lithostratigraphic correlations of the Middle and Upper Jurassic strata. These correlations (Anderson and Lucas, 1992) demonstrate that a variety of recently introduced names, including the Horse Mesa and Beclabito Members of the Wanakah, are unnecessary. Condon's arguments to preserve these and other names are based on correlations that we (and others) cannot replicate.

Cow Springs is a superfluous name in New Mexico

In addition to introducing unnecessary nomenclature, Condon continues to advocate the use of obsolete and superfluous nomenclature in the San Juan Basin. He and his colleagues would recognize the Cow Springs Sandstone, even though previous U.S. Geological Survey authors (Dane 1956; Dane and Bachman, 1965; Maxwell, 1976, 1979, 1982) have indicated their preference for the name Zuni Sandstone. Zuni has precedence over Cow Springs, having been introduced by Dutton (1885) for strata overlying the Wingate (=Entrada) near Fort Wingate, New Mexico, and underlying the Dakota Sandstone. However, when Dutton extended his type Wingate (=Entrada) from Fort Wingate southward to Zuni Pueblo, he misconstrued it with the older Rock Point Formation of the Chinle Group. At this locale he thus erroneously included the Wingate (=Entrada) with the overlying Zuni Sandstone.

Our definition of the Zuni Sandstone as a post-Entrada unit (Anderson and Lucas, 1992) takes into account the Dutton-miscorrelation plus the fact that Harshbarger et. al. (1957) chose to recognize the Entrada Sandstone as a distinct unit underlying their Cow Springs Sandstone at Zuni Pueblo (Cow Springs was a new name that they used to describe eolian strata above the Entrada at Black Mesa, Arizona). These two factors plus the presence of a depositional break at the top of the Entrada (the local expression of the J-3 unconformity, or the "Todilto notch") make it proper, if not imperative, that two Middle Jurassic units, Entrada and Zuni, be recognized in the Zuni Basin south of the Todilto pinch-out (Anderson, 1993). Most of this is apparently unknown to Condon, who refers to our usage of the Zuni Sandstone as a corruption of Dutton's original definition. This assertion is incorrect. Current usage represents the type of refinement that comes with a better understanding of stratigraphic relationships. Progressive refinement has indeed resulted in the Todilto, Summerville, and Bluff Formations being recognized within the original Zuni interval; where all three are present, the Zuni Sandstone locally consists of only the overlying crossbedded sandstone called the Acoma Tongue of the Zuni, because genetically and lithologically these upper strata are related to the type Zuni. This constitutes progressive refinement of a valid lithostratigraphic concept. Progressive deterioration results when lithostratigraphy is abandoned and "unrecognized time boundaries" are used to establish formation contacts, as Condon and Peterson (1986) advocated and continue to advocate. The concept of a Morrison Formation, which locally overlies the Zuni, has suffered progressive deterioration as a result of chronostratigraphy being substituted for lithostratigraphy (see section on Morrison Formation below).

With the usage of the name Zuni Sandstone well established and defined (it overlies the Entrada and grades northward into the Summerville and Bluff Formations or their equivalents) it is obvious that the Zuni Sandstone is the same unit which Harshbarger et. al. (1957) projected into western New Mexico as the Cow Springs Sandstone. The Cow Springs was a superfluous name the day it was introduced in New Mexico, and we are at pains to understand why the U.S. Geological Survey did not at the time offer an explanation of the relationship between the two units. The failure to do so has thoroughly confused subsequent workers such as Condon and his colleagues. One example of this confusion is brought to the fore by Peterson (1988, p. 19) who clearly illustrates the type Cow Springs as a member of the Entrada Sandstone in a stratigraphic position below the J-3 transgressive unconformity, exactly as stated by us (Anderson and Lucas, 1992, p. 88). Condon in his reply quotes us out of context, neglecting to mention that we correctly presented Peterson's concept of the type Cow Springs as a pre-J-3 unit. Condon instead chose to focus on the supplementary information we included, i.e. that Peterson's type Cow Springs was in addition older than the Todilto. Conventional wisdom as well as sound stratigraphic principles place the Todilto above the J-3 transgressive surface, and hence our inference that pre-J-3 is pre-Todilto. The J-3 surface at the base of the Curtis Formation in southeastern Utah is a transgressive unconformity developed on the Entrada Sandstone, which is precisely what is seen at the base of the Todilto in the San Juan Basin, albeit with the unconformity or diastem marked only by a zone of floating pebbles.

We thus maintain that Peterson's assertion that the type Cow Springs is pre-J-3 also includes the assertion that it is pre-Todilto. The confusing aspect of his work derives from his statement that the type Cow Springs appears to correlate with the Cow Springs at Zuni Pueblo where it is demonstrably post-Todilto (post-J-3). If, as Peterson suggests, the two do correlate, then the J-3 unconformity has been misidentified by him in the type Cow Springs area; this unconformity, if it exists at all in the type area, would be at the base of the Cow Springs rather than at the top. We thus believe the sandstones in the two areas do correlate for the following reasons:

1) They have similar lithologies and occupy the same stratigraphic position.
2) They both are eolian in origin.
3) The Cow Springs section at Zuni grades northward into Summerville and Bluff Formations (=Condon's Wanakah).
4) The type Cow Springs grades northeastward into Wanakah beds (Peterson, 1988).

We nonetheless reject Cow Springs as a stratigraphic name in New Mexico because the name Zuni has precedence and because the excellent development and exposures of the unit at Zuni Pueblo justify a local name.

It is illuminating to go back and further pursue the implications of 3) and 4) above. Given that the Cow Springs strata from both areas correlate with strata of the "Wanakah," they must correlate with each other (logically, if $a = c$ and $b = c$, then $a = b$). We also know that both the type Summerville and type Curtis lie above the J-3 unconformity, so arguing whether the "Wanakah" correlates with the Curtis or the Summerville loses significance. Either correlation results in a "Wanakah" that is post-J-3, and therefore a Cow Springs Sandstone that is post-J-3. And it follows that the
Fuan Basin must be done via southeastern Utah. If this correlation "ary" as the San Rafael GroupMorrison contact. We assert this is confusing, untenable regional correlations proposed by Peterson. The Morrison Formation does not include eolianites in Utah, eolianites would surely not be included in the Morrison; the eolianites would be correctly included with the underlying San Rafael Group on the basis of sandstone type and lithogenesis.

We also exclude eolianites from the Morrison Formation because "the observed interbedding of eolian rocks with the Morrison referred to by Condon does not exist in the southern San Juan Basin. The interbedding referred to by Condon consists of thin (maximum 1.5 m), lenticular, maroon siltstone and sandstone beds in a dominantly eolian, lighter-colored sandstone section that overlies the Bluff-Summerville interval. The siltstones represent interdunal deposits and locally make up 6–8% of the total section. Where present to that extent, the siltstones bleed down over the lighter-colored sands, and their thickness thus is exaggerated. The appearance of this section is apparently sedentary similar to what is called the Recapture Member of the Morrison Formation, because Condon and his colleagues have included these eolian sandstones in their Recapture. The problem is that the type Recapture is a fluvial sandstone that is coarser-grained and sedimentologically different from the unit that Condon calls Recapture in the San Juan Basin. We do not deny the possibility that the two are chronostratigraphic equivalents, but they are not the same lithostratigraphic or lithogentic units. Therefore, we assign the eolianites to the Zuni Sandstone.

Another example of eolian sandstones in this stratigraphic interval was discussed by Szigiets and Fox (1981). In the Black Hills of South Dakota the Unkopa Sandstone was recognized by Dorton (1989) as a separate formation between the Sundance and Morrison Formations. The Unkopa is as much as 81.4 m thick and consists chiefly of massive, fine- to very fine-grained sandstones. Its status as a formation separate from the Morrison Formation has long been upheld, particularly by mappers of the U.S. Geological Survey (e.g., Bell and Post, 1971). Indeed, Szigiets and Fox (1981) did not include the Unkopa eolianites in the Morrison Formation, although Condon, in his reply, cites them when he states that "eolian rocks in the Morrison have also been described in . . . South Dakota." Szigiets and Fox (1981) provided no such description, but instead argued that the Unkopa and Morrison Formations interfinger in the southern Black Hills, although they noted that "this is partially obscured by landslide deposits" (Szigiets and Fox, 1981, p. 333).

Conclusion

Condon's reply to our article presents no new data to support his interpretations of Middle and Upper Jurassic stratigraphy and sedimentation on the Colorado Plateau. Instead he rehashes correlations we refuted and presents nomenclatural arguments (Wanakah of Grabau not a valid unit; Todilto a unit of member rank: Horse Mesa a distinct unit) that reveal his lack of understanding of basic stratigraphic principles and practice. His reply/discussion, in which he explains how he and his colleagues arrived at their conclusions, only reinforces our original evaluation and conclusions. To wit, the work of Condon, Peterson and O'Sullivan on this Middle and Upper Jurassic strata of the Colorado Plateau has confused and obscured a rather straightforward stratigraphy that was quite well understood by the early 1950s.

References

Miller, K. B., 1991, High-resolution correlation within a storm-dominated muddy epeiric sea: Taphofacies of the Middle Devonian Wanakah Member, western New Mexico Geology August 1993
Always encouraged writing of and distribution of geology (and mineral-resources) information for everyone—publications such as the Scenic Trips to the Geologic Past, informal road logs to mineral- and fossil-collecting localities, and the popular Geologic Highway Map by the New Mexico Geological Society. Lois often handled the NMBM&MR and NMGS publication booth at meetings of NMGS, GSA, AAPG, and other organizations. Probably more of our "customers" benefited from Lois' advice and service than from most of the scientific-engineering staff.

Born in Webster, South Dakota (1922), Lois Sandvig attended the University of South Dakota. During World War II she was secretary to the commander of the Sioux Falls Army Air Force Base. (He later became president of Oklahoma University.) There she met and married (1944) Edward J. Devlin; after the war they moved to Wellsville, New York, where their two children were born.

When they moved to Socorro, Lois joined our staff (1962) as a typist, then secretary, office manager, Director of Publications and Business Office, and Business Services Coordinator. Our NMBM&MR was, thankfully, a major part of Lois' life, and to us she was as indispensable as one person can be. Working with Judy Vaiza, Norma Meeks, and coworkers she helped to form the experienced core of our business and administration crew, including the distribution of our publications and those of NMGS, USGS, and USBM. Her help with managing the millions of dollars of state and federal funds was a real service to all of us. Thoughtfully, she unobtrusively corrected our errors, thanked us for routine duties, was genuinely sympathetic for problems, and joyful for accomplishments. A valued coworker and to many of the Bureau staff an older sister, Lois had almost a passion for everyone to enjoy our state's geology, scenery, and people.

South Dakota with its rolling Great Plains, grain fields stretching to the horizon, hot humid summers, and frigid winters contrasted with Socorro's green Rio Grande valley, semiarid bordering slopes, and towering skyline mountains. She enjoyed it, raising lovely Linda Devlin Dixon and expert forester David Devlin. In recent years, she joined her brothers and friends, once or twice a year, to visit the globe, often flying Pan Am while Linda was a flight attendant for the airline. Contrast South Dakota and Socorro with Hong Kong, London, Williamsburg, Frankfurt, Juneau, and San Francisco, all of which she enjoyed. As did she enjoy her many friends in Socorro, work with P.E.O., Women's Golf Association, many bridge clubs, luncheons; always gregarious, cheerful, joyful.

A dear, warm friend, an advocate for practical geology, an efficient worker for New Mexico, we appreciate all she has meant to us and our state. She left us 15 July as the sun reached its zenith.

—Frank E. Kottlowski