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William Aubrey "Bill" Cobban (1916-2015)

Memories and personal reminiscences

"That's some cephalopod, son"

Shortly after the August 26-27, 2006 symposium in Golden, Colorado, honoring Bill's lifetime achievements, my wife and I took a mini-vacation to the Ghost Ranch area of north-central New Mexico. The area was made famous by the landscape paintings of American artist Georgia O'Keefe (1887-1986), who was a long-time resident of the village of Abiquiu, 85 km northwest of Santa Fe (Text-fig. 1). We stopped in Abiquiu for lunch at Bode's General Store, an iconic building that has served "… travelers, hunters, pilgrims, stray artists, and bandits since 1893." Their website encourages everyone to stop because you "… never know what or who you'll find here!" What I found on a large rack of tourist postcards was a quirky image that made me laugh out loud and think of Bill Cobban.

Text-fig. 1. Map of New Mexico

The postcard (Text-fig. 2) depicts a man and a boy who are sitting on a train. The man in a business suit is obviously the boy's father; the boy is casually dressed and about 8 years old, judging by the missing tooth. The boy has just opened a box on his lap; three large, sucker-clad arms of an octopus have emerged from the box; one is draped over the boy's shoulder. The size of the octopus's arms suggests that the animal is much larger than the box. The boy's expression shows that he is very pleased with his new pet. The father points at the octopus and says "That's some cephalopod, son." I was struck by the absurdity of the image and impressed by the use of the more scientific word "cephalopod" in the caption.

I immediately thought that I should send this card to Bill with a note asking if this was how he began his life-long fascination with ammonites. My wife did not share my enthusiasm. She thought the card was

Text-fig. 2. Scan of the postcard "That's some cephalopod, son," copyright 2000 by Ken Brown Cards, 12 Harrison Street, NY, NY 10013. Used by permission

weird and unrealistic. After all, an octopus could not live for long out of water.

When we returned to Socorro a few days later, I mailed the card to Bill with an unsigned note saying "The poster for the new movie *Bill Cobban: the early years*." After the tremendous response to the symposium, surely a movie or two about Bill's life was in order.

I was sure that Bill would recognize my printing, which is nothing like his almost microscopic, but very precise script. However, after a couple of weeks during which he said nothing to me about the card, I called him to ask about it. Yes, he had received it, but did not know who sent it, although he had suspect or two in mind. I was not on the suspect list, because the postcard was postmarked Albuquerque, not Socorro. What Bill did not know is that Socorro is so small that all of its outgoing mail is sent to Albuquerque, 120 km to the north, where it is postmarked. After finding out that I had sent the postcard, Bill thought it was a little funnier. I don't know if he kept the card, but I am fairly sure he did not discuss it with anyone else. Everyone I have shared the card with since then has enjoyed seeing it and hearing the story. Some have even looked forward to seeing the movie.

Unrealistic, pet land-octopi are not unknown in recent popular literature, e.g., 2013's *Walking Your Octopus: A Guidebook to the Domesticated Cephalopod* by Brian Kesinger. Books like this one belong to a subgenre of science fiction known as steampunk and are often well written and profusely illustrated. Steampunk incorporates technology inspired by 19th-century industrial steam-powered machinery (hence the "steam" in steampunk, apparently a play on the word cyberpunk). Many of the steampunk stories take place in Victorian settings.

Although the postcard (Text-fig. 2) appears to be more mid-twentieth century than Victorian, the train setting suggests a steam engine and the land-octopus and use of the word "cephalopod" are similar to the cited book. Perhaps the author of the book got his inspiration from the postcard.

In my request to Ken Brown Cards to reproduce this copyrighted image, I asked the artist about his inspiration. Ken Brown, who created the image in 2000, replied that the "origination of that cartoon was really based on a longstanding love of absurdity and when playing with collage material that one bubbled up one day and just needed a good caption" (personal communication, May 26, 2016).

During our discussion of the land-living octopus depicted on the postcard, Bill and I recalled an ongoing, tongue-in-cheek conversation we had had since 1977 about depicting the ammonites from the Colorado Formation in the Cookes Range as land-living creatures, happily swinging from trees. The basal 11 m-thick flag member of the Colorado Formation in the Cookes Range contains a late Cenomanian *Calycoceras canitaurinum* assemblage zone fauna and is interbedded with 31 flint clays ranging in thickness from a few mm to 10 cm (Text-fig. 3). These flint clays are hard, dense, yellow or orange claystones that break with a conchoidal fracture. Compositionally, they are almost entirely kaolinite. Conventional wisdom has it that flint clays form only in acidic (i.e., nonmarine) environments; they are especially common as underclays for coal deposits. Hence, the hypothetical paleoenvironment in which the ammonites swing through the trees.

Text-fig. 3. Outcrop photograph of the upper portion of the flag member of the Colorado Formation, Cookes Range, New Mexico, looking north. The orange-weathering, 10 cm-thick flint clay in the center background is one of 31 flint clays interbedded with thin limestones in the flag member. Marine fossils collected from the flag member are from the late Cenomanian *Calycoceras canitaurinum* assemblage zone fauna

Flint clays are common in the lower, flaggy part of the Colorado Formation and Mancos Shale in a band extending westward to the Arizona border from Truth or Consequences on the north to the Cookes Range on the south (see Text-fig. 1). Our interpretation of the flint clays is that they are altered volcanic ash beds deposited in the Late Cretaceous Seaway. Flint clays extend downward to the middle Cenomanian *Acanthoceras amphibolum* Zone and upward to the base of the late Cenomanian *Euomphaloceras septemseriatum* Zone in the lower part of the Bridge Creek Limestone Member. Above that level, the ash beds in southwest New Mexico are soft, white bentonites.

The postcard and subsequent discussions rekindled our interest in the ammonite faunas of southwest New Mexico, published in 1989 as New Mexico Bureau of Mines Memoir 45. Southwest New Mexico, including the Cookes Range, contains one of the richest late Cenomanian ammonite faunas in the world. A few years ago, Bill and I began updating the ammonite faunas of southwest New Mexico on a collection-by-collection basis and revising the biostratigraphy. That work is nearing completion and will shortly be submitted as a paper with an online, digital database. This database considerably enhances the biostratigraphic utility of the ammonite faunas recorded from 168 USGS Mesozoic invertebrate localities. The localities can be sorted on 16 attributes, including genus, species, zone, stratigraphic position, measured section, quadrangle, and provenance. Digital location information allows selected attributes to be plotted directly to maps or images.

Acknowledgements

I thank Ken Brown Cards for permission to use its 2000 copyrighted image. Mr. Brown emailed me with permission on May 18, 2016 saying "It's always been fascinating to hear of the various connections people have made with my cards over the years." I also thank Dave Love for acquainting me with steampunk and "Walking your octopus." Little Hawk Studios, Magdalena, New Mexico, drafted, scanned, or enhanced the text-figures.

Stephen C. Hook,
Socorro,
New Mexico, USA

Dr. Cobban's legacy – Outreach in Cañon City Students Discover the Western Interior Seaway

Dr. William Cobban's pioneering work on fossil assemblages and deposition in the Greenhorn Limestone (GHLS) of the Western Interior Seaway (WIS) provided the basis for a year-long collaborative effort between the 7th grade Earth Science class at Cañon Exploratory School (CES) in Cañon City, CO, and the community on a project studying the geology and paleontology of the WIS in Fremont County, CO.

The GHLS forms one of the smaller hogbacks on the west side of Cañon City just behind the school and between the scenic Skyline Drive-Dakota Sandstone hogback and the Ft. Hayes Limestone hogback. Ideally located just east of the GHLS outcrop, CES and teacher Kelly Albrecht incorporate the geology and landscape of the students' backyard with discovery and learning, extending the classroom into the outdoors.

With assistance from members of Fremont County Stones 'n Bone (SnB), Western Interior Paleontological Society (WIPS), and the Royal Gorge field office of the Bureau of Land Management (BLM), students were able to add meaning to the 'rocks' adjacent to their school.

The project began with a $1,500 grant from the National Environmental Education Foundation (provided through the cooperation of the BLM) and presentations by members of SnB and WIPS, acquainting students with the creatures that inhabited their neck of the woods from 110-85 million years ago, as well as the geology of the deposition.

Working in teams, students researched the WIS, rock formations, geologic time, marine creatures in general and ammonites in particular, and then presented an educational package to younger classes at CES.

These presentations included information about the fossils found in the Bridge Creek Member of the GHLS (this from many who had never seen an ammonite before), as well as the rock layers and importance of the WIS. Their efforts culminated in the development of two interpretive signs along the Greenhorn Trail explaining the geology and paleontology of the Greenhorn Limestone, one describing the creatures that inhabited the waters 94.5 million years ago and the fossils left behind as evidence of their existence, and the other describing the deposition and formations.

The Greenhorn Trail parallels the Dakota Ridge and Graneros Trails in the Hogbacks Open Space Park. All trail names were determined by the students.

Local artist Ken McGowan donated his expertise to weave students' suggestions on content and design into the interpretive signs. Field trips to two GHLS outcrops in the area and to the Denver Museum of Nature and Science enhanced students' understanding of how the WIS fits into geologic history. Following one field trip, a 15-year-old commented that she now understands sandstone, shale, and limestone, and when her family hikes the hogback, she will now see the rocks, understand what they mean, and be able to explain the formations to her family.

This project built on Dr. Cobban's research, as well as his ammonite and Inoceramus clam collection housed at the US Geological Survey (USGS) in Denver. The primary sources used to study the GHLS fossils were "Stratigraphy and Ammonite Fauna of the Graneros Shale and Greenhorn Limestone Near Pueblo, Colorado"; A USGS Zonal Table for the Upper Cretaceous Middle Cenomanian-Maastrichtian of the Western Interior of the United States Based on Ammonites, Inoceramids, and Radiometric Ages; and "The Global Boundary Stratotype Section and Point for the base of the Turonian Stage of the Cretaceous: Pueblo, Colorado".

Thanks to the generosity of Kevin McKinney at the USGS, ten representative ammonite casts were selected from Dr. Cobban's collection; casts were then made using impression foam, preventing any risk of damage to the original cast specimens. Using these casts, students studied ammonite anatomy and noted the effects of the extinction event. The class received a set of the ten ammonite casts and a copy of Dr. Cobban's "Stratigraphy and Ammonite Fauna of the Graneros Shale and Greenhorn Limestone Near Pueblo, Colorado".

As a result of this project, students now grasp geologic time, the exposure of the GHLS due to the uplift of the Rocky Mountains, the record fossils leave behind as evidence of previous life, deposition, extinction, the process involved in development of interpretive signs, and the need for preservation and stewardship.

COMMENTS FROM TWO STUDENTS

"Before we hiked the Skyline Trail, Dan Grenard and Steve Miller came in and talked a bit about the Western Interior Seaway and its creatures. I didn't quite understand it, and then after they finished talking to us, we started hiking and then I understood it." – Clara

"Lately our class has been going on geology and fossil hikes with actual geologists. Learning in this particular way has been a definite privilege. It is more hands on and experiential learning which has helped me to understand things better. Such as how things move or what kinds of creatures were here just by looking at rocks! I am so thankful for these things." – Allison

Today and for generations to come, as we walk over the traces of the Western Interior Seaway, we are indebted to those countless field and desk hours Dr. Cobban spent unraveling the palimpsest, allowing us to appreciate the geology and paleontology record left behind and beneath our feet here in Cañon City.

This project was successful due to the contributions of many members of the paleontology community, both in Cañon City and metro Denver. Providing extensive support for this project were Dan Grenard, Monica and Ken McGowan, Steve Miller, Tom Nolan, Melissa Smeins, Cindy Smith, Christina and Harold Taylor, Loretta Bailey, Mary Chamberlain, Millie Wintz, and Kevin McKinney.

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Cindy Smith;
Cañon City,
Colorado, USA

Working with Bill

I first encountered Bill Cobban in the summer of 1973. Erle Kauffman of the Smithsonian had organised a field trip for Annie Dhondt, Jake Hancock, Thor Hansen, Heinz Kollmann, Jiri Kriz, and his family, to drive west from Washington D.C. and tour throughout the Cretaceous rocks of the U.S. Western Interior. I joined them in New Mexico, and, in due course, we visited Bill, and I saw for the first time, the extraordinary collections he had brought together in Denver. Bill himself was a great collector, working with, amongst others, Jim Gill, Steve Hook, Al Merewether, Glen Scott, and John Obradovich. He also had the task of producing reports on the fossil collections made by the many field geologists and map makers working on the vast expanse of the Cretaceous from the Canadian border to the Mexican border. Come the autumn, the collections would arrive, be unpacked and broken up, and the fossils prepared by his then assistant, Bob Burkholder. The specimens were meticulously tagged with little rectangular green paper labels bearing the appropriate USGS locality number. The best, most interesting, and potentially publishable material was coated with ammonium chloride and photographed, on sheet film, by Bob. The coating process was, to me, positively alarming, involving a bottle of concentrated Hydrochloric Acid and one of 880 Ammonia, bound together with tape, and a complex system of glass tubes that one blew down to produce the vapour. I never used it, rather bringing my own glass drying tube and solid ammonia to volatilze and blow onto specimens – all this of course before the present fixation with health and safety. Once photographed, the sheet negatives were meticulously painted with an opaque medium, so that when printed, the background was pure white. This part of the project occupied Bill's winter evenings. Bob then prepared prints on several grades of paper, and these were was placed in the card tray with the specimen. There were thousands of them, and the most time consuming part of our future collaboration was already done.

I returned to Denver to work with Bill, at the request of Erle Kauffman and Joe Hazel, on a chapter on the role of ammonites in biostratigraphy for the book they were to edit: *Concepts and Methods of Biostratigraphy* (Dowden, Hutchinson and Ross, 1977). Bill wrote (as he did to the end) in pencil, which, with my illegible scrawl was converted in to typescript by the devoted branch secretary. The manuscript was submitted in due course, and deemed unacceptable because of length. A butchered version was finally published in 1977, with 13 pages only. It has vanished from the field, and quite right too. However, we persevered with the original, and it rapidly developed into a much broader project on ammonites, finishing up as the seventeenth *Special paper in Palaeontology* of the Palaeontological Association, entitled *Aspects of Ammonite Biology, Biogeography, and Biostratigraphy*, with 94 pages, 10 plates, and 24 text-figures. Published in 1976, and long out of print, it still gets quoted, fourty years on (vanity, vanity! I checked volume 43 of *Topics in Geobiology: Ammonoid Paleobiology*, *from anatomy to ecology* (Springer2015*)*; there are 21 chapters,, and it appears in the bibliography of a third of these).

I visited Denver every few years (depending on the research grant position), usually for two or three weeks, the last research visit in 2002. Research, initially on my own interest in faunas from Texas, slowly evolved into a project to complete the description of the Upper Cretaceous ammonites of the US Western Interior, and then the ammonites from the Gulf Coast and Atlantic Seaboard, sifted from the collections in Washington plus material collected by Bill, L. W. Stevenson and Norm Sohl of the USGS, together with the amateurs to whom Bill provided constant help and advice. Chief of these was Jim Conlin, working in Texas, but others include Harold Meyndrick, and Ralph Johnson of the Monmouth Amateur Paleontologist's Socity, all of them outstanding collectors with meticulous records of their finds. Bill and I have our names on 97 papers together, with a host of collaborators, the last in 2013, with our most prolific collaborator, Neil Lanman, on Bill's beloved scaphites, and in this volume is his unfinished manuscript on *Placenticeras* that I finally found in early 2015, when thinking about this contribution.

So, we worked a lot together. Bill's extraordinary knowledge and experience I was able to complement with the wherewithall to get things finished, as USGS funding, resources and publications dried up. He was a diminutive figure, brought up to be an early riser, tough in the field, and enormously patient with me. There were four basic responses 'uh hu', when I had not got it right, 'well', when there was room for improvement, and 'nope' (no translation required). There was also silence. I best recall the last, when in Denver with Jake Hancock, who was, as ever in his later years, fixated on sea level changes. He was picking Bill's brains on mid-Cretaceous shoreline

positions. Silence was followed by Bill's disappearance, only to return shortly thereafter with a roll of maps of the western margin of the US Western Interior Seaway, with shorelines plotted zone by zone, unpublished at that time, objective, and like all of Bill's work totally free of b*** s***.

It was an extraordinary and unlikely partnership that we developed, and I never knew quite how it came about that we two very different people collaborated so closely for more than 30 years. There was a job to be done, and I guess we did most of it so far as the ammonites went, although there are still a few scaphites for Neil to do…..

William James Kennedy,
Oxford, UK

Old gate to Red Bird section

U.S. Geological Survey Professional Paper 393-A on the Red Bird section of the Pierre Shale in Wyoming, USA, is justifiably considered one of the finest papers of Bill Cobban's long career. Published in 1966, it is as relevant and modern in its approaches to paleontology, biostratigraphy, and paleogeography as it was when published fifty years ago. Utilizing 158 megafossil collections from 118 levels, Bill and lead author James Gill (1922-1972) divided and mapped the 3,100 foot-thick Pierre Shale into 18 ammonite range-zones, 30 to 525 ft-thick. Using the half dozen or so published potassium-argon dates available for the Campanian/Maastrichtian, they estimated that each zone lasted approximately 1/2 million years.

Utilizing the locations of hundreds of fossil collections and scores of measured sections, Bill generated a map of the entire state of Wyoming showing the probable positions of the western shoreline of the Late Cretaceous Seaway during the time represented by nine of the 18 range zones present in the Red Bird section. The shorelines range from 60 to 200 miles west of Red Bird. This diagram (Gill and Cobban 1966, fig. 16) of shifting shorelines, i.e., alternating transgressions and regressions, was the first of what was to become a signature contribution of Bill's. The list of the important contributions in PP 393-A could continue for another page or two. The important point is that this paper marked a seminal contribution to our understanding of the Upper Cretaceous of the Western Interior and provided a manual on how to study it.

Knowing the importance of this paper, I was surprised on March 1, 2013 to find a photograph of a barbed-wire gate taped to the inside front cover of Bill's dog-eared copy of PP 393-A. At the time I was working in the Denver USGS collections, researching echinoid occurrences in the Western Interior Upper Cretaceous (Hook and Cobban, 2017, this volume).

Text-fig. 1. Scan of the black and white photograph of the barbed-wire gate leading to the Red Bird section, Wyoming. This photograph is taped to the inside front cover of Bill Cobban's work copy of USGS Professional Paper 363-A. The exact location of the gate is unknown, although Joshua Slattery, University of Wyoming, suspects that it was on the main dirt road to the west of US Highway 85, a couple of miles north of Red Bird, Wyoming (personal communication, April 4, 2016). He states further that many of the old barbed-wire gates have been replaced by cattle guards, and that he has first-hand experience with rattlesnakes that hang around the existing barbed-wire gates

I was looking for information on the echinoid *Eurysalenia minima* Kier described in PP 393-A when I discovered the photograph of the "Old gate to Red Bird section" (Text-fig. 1).

I am not sure what extraneous information I expected Bill would find important enough to preserve in his personal copy of PP 393-A: perhaps a chart of newer or more refined K-Ar dates, or an updated Campanian-Maastrichtian ammonite zonation, or a refined shorelines map? After I returned to Socorro, I telephoned Bill to ask about the gate. Any one who tried to contact Bill by telephone while he was in assisted living knows how difficult and frustrating it was. During most of the day, Bill was in the common room at Emeritus, where he was involved in whatever activities were scheduled and where he could be among the first to be seated for meals. Unlike most of

the residents, Bill really enjoyed the "grub" at Emeritus. Having eaten several meals there with Bill, I have to agree with him—the grub was terrific.

I finally reached Bill in his apartment on June 19, 2013. We chatted about the Red Bird paper and especially about the gate. He told me that he had "fond" memories of that gate because it was always his job to open and close it when going to and from the section. Jim Gill drove and Bill rode shotgun (in the front passenger seat), regardless of how many people were in the field party. I thought riding shotgun was a reward for being the senior geologist, but Bill said it was because the log at the bottom of the gate was extremely heavy and no else wanted to move it. In addition, there was usually a rattlesnake curled up by the gate, trying to avoid being seen by the hawks in that wide-open country. Bill's job was to "kick" the rattlesnake out the way, then open and close the gate quickly before the snake came back.

Apparently, rattlesnakes were not necessarily the worst aspects of gate duty. On more than one occasion, Jim and Bill were chased off the outcrop by thunderstorms. During one of these storms, Bill had to dodge both lightning bolts and a snake to open the gate and get back to civilization. Being the tallest object for several square miles, Bill thought he was a "goner"! The air surrounding the gate that day felt charged, his hair stood on end, and his rock hammer "hummed." Fortunately, for us and the profession, Bill did not become a human lightning-rod that day. Years later, he could laugh while telling the story.*

Casey McKinney (USGS), Dave Sawyer (USGS retired), Bill's son Robert, and I had lunch with Bill on March 4, 2015 during my last visit to Denver. At that time, Bill was in the extended-care portion Emeritus, but still liked the grub and activities. The staff prepared a separate dining room for us, probably so that we would not disturb the other residents with talk of siphuncles, umbilical ratios, and sexual dimorphism. I brought Bill's copy of the Red Bird paper, which he delighted in discussing, especially the story of that old gate. As was typical of Bill, he emphasized Jim Gill's contribution to that monumental paper. Jim, he told us, was a superb fossil collector who made more than a thousand megafossil collections, all tied precisely to geographic locality and stratigraphic position.

The Emeritus staff served us a three-course meal that day and went out of their way to make our meal pleasant and memorable. Several of his caregivers noted the festive atmosphere in our dining room and came in to talk to Bill and to meet his friends. A few gave him hugs. The staff at Emeritus treated Bill not only professionally, but also affectionately because he was a kind, gentle, humble, appreciative, and unassuming man. Not one of them knew that he was one of the greatest paleontologists in the world, nor would it have made any difference in their feelings toward him.**

REFERENCE AND FOOTNOTES

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* Details of this electrifying event were discussed again at our March 4, 2015 lunch and verified by K.C. McKinney (oral communication, April 6, 2016).

** The Red Bird Gate incident was not the only time Bill dodged a bullet, or more literally, escaped a lightning strike with his life. Retired USGS geologist Dave Sawyer recently recounted another near miss (oral communication, August 8, 2016). In mid-July 1998, Dave, Bill, and Jim Cole (USGS) were driving south on Interstate Highway 25 from Denver, Colorado, to Albuquerque, New Mexico. Bill was again riding shotgun. About 3:00 PM they were a few miles north of Wagon Mound, northeast New Mexico, when their Ford Expedition was actually struck by lightning. The front-mounted radio antenna turned incandescent and assumed the shape of a bishop's crook. The engine died, but started a few minutes later. The stunned passengers were glad to be alive, possibly because the windows had been rolled up, they wore rubber-soled shoes, and/or they were not in contact with the metal frame of the vehicle. The lightning bolt exited the vehicle through the right-front tire, which had to be repaired the next day. As the junior member of the field party, Dave was accused of being the geologist who almost killed Bill Cobban. Bill, though, was the one who led a charmed life!

Stephen C. Hook,
Socorro,
New Mexico, USA

"You will just have to collect a smaller one" – a remembrance of Bill Cobban (1916-2015)

I did not know Bill Cobban when I started my first professional job as a geologist.

However, I introduced myself to Dr. Cobban on March 24, 1976, shortly after joining the New Mexico Bureau of Mines and Mineral Resources as a post-doctoral fellow in paleontology. The introduction was in the form of a letter asking for his help on my first major project, a study of paleontology of the Upper Cretaceous Carthage coal field, about 35 km southeast of Socorro. I followed this letter with several others. My recently completed dissertation was on Ordovician nautiloids. I realized that I needed some help if I were going to be able to understand the isolated exposures of Upper Cretaceous in the southern part of New Mexico. The Bureau was involved in numerous mapping projects and coal studies with the US Geological Survey and an understanding of Cretaceous stratigraphy was essential.

Bill, not Dr. Cobban, was gracious and humble. He patiently answered all my letters and sent me numerous reprints. We met for the first time in August 1976 when he, his son Robert, and I visited isolated Upper Cretaceous outcrops in southern New Mexico. From then until July 1981, when I moved to Houston to work for an oil company, Bill and I spent several weeks a year in the field together. Most of the rest of my time was spent in the field as well, although I usually spent at least a week every year in Denver with him studying our collections and working on papers. Those five years were the most exciting and fulfilling years of my professional career. Here I was, a young kid, working with the one of the greatest paleontologists in the world, solving all manner of biostratigraphic, taxonomic, and paleogeographic problems, all the while being treated as his equal.

One of my fondest memories of working with Bill occurred while researching the stratigraphy of the ammonite Family Coilopoceratidae (Cobban and Hook 1980). In the Western Interior region (excluding Texas), representatives of this Tethyan family are almost exclusively confined to New Mexico, where the Boreal faunas of the north intermingled with the warmer-water Tethyan faunas of the south. Hyatt (1903, pp. 91-100) named the family and described three species from New Mexico. Two of those species came from Carthage including the type species for the genus, *Coilopoceras colleti*. Hyatt's (1903) definition was based mainly on the suture. Wright (1957, p. L424) characterized the family as large ammonites that were moderately to very involute, compressed forms that were either flat-sided with a flat venter that becomes rounded in the adult or cordate with a sharp venter; at some stage broad, low, rounded ribs spring in pairs from umbilical tubercles. Most species in the family are dimorphic with stout, well-ribbed individuals (females?) and slender, smoother individuals (males?).

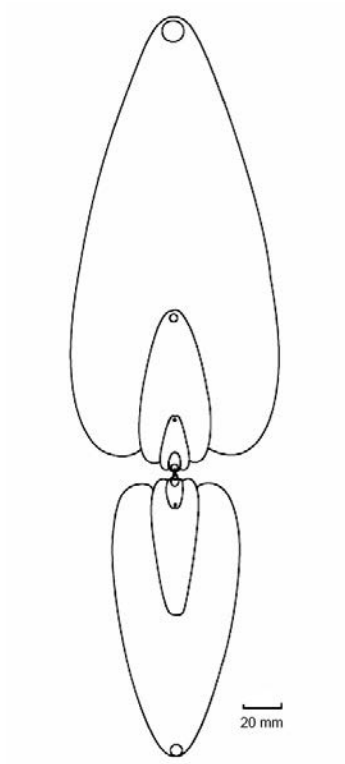
Our collecting indicated that the Coilopoceratidae in New Mexico ranged from the latest early Turonian to the earliest late Turonian, occurring throughout the entire middle Turonian. However, most species of the family were known only from local areas, complicating their age relationships. The early forms were species of *Hoplitoides*; the later forms, species of *Coilopoceras*. The major difference between *Hoplitoides* and *Coilopoceras* is that at some growth stage *Hoplitoides* has a flat to truncate venter, whereas the venter on *Coilopoceras* is sharp or rounded at all stages. *Coilopoceras* was derived from *Hoplitoides* by progressive reduction in the extent of venter truncation and finally its disappearance. For practical purposes, the shape of the venter on juvenile whorls is the best way to distinguish the two genera; this determination generally requires that a cross section be cut through an adult shell. The early species of *Hoplitoides* in New Mexico are known from only a handful of specimens, whereas the younger species of both genera often occur in large numbers. In addition, adults of both genera are virtually indistinguishable from each other.

On October 1, 1980 while doing reconnaissance geologic work on the Mancos Shale east of D-Cross Mountain (Text-fig 1), I collected a large, well-preserved, involute ammonite that was either *Hoplitoides* or *Coilopoceras*. The specimen had a diameter estimated to be 620 mm (Cobban and Hook 1981). By stratigraphic position at or just below the base of the middle Turonian, it should have been *Hoplitoides*. At the time the specimen was collected, our paper on the Coilopoceratidae (Cobban and Hook 1980) was in press, if not published. Thinking that this specimen would be a good test of our biostratigraphy, I sent it to Bill. After its arrival in Denver, I asked Bill if it were *Hoplitoides* or *Coilopoceras*. He told me that the specimen was so large that he could not tell. I suggested that he cut a cross section,

as though he could not have thought of that himself. He told me that it was too nice a specimen to mutilate and that I would "just have to collect a smaller one." I objected that I had spent two days in that part of the section and all I had to show for it was that large ammonite and a poorly preserved internal mold of *Morrowites depressus* (Powell, 1963). He replied that "where there is one, there is another one." Therefore, a week or so later I went back to that rugged, remote area in northwest Socorro County. Bill was correct, I did find another one. The only problem was that it was as large, if not larger, than the first one. After looking in vain for more specimens, I decided there was only one way to determine the ammonite's genus—I applied my rock hammer to its outer whorls and made it into a smaller specimen. I justified this extreme course of action by telling myself that the outer whorls were poorly preserved anyway and by making it smaller it would be easier to get it back to the vehicle. However, before surgically removing its outer whorls, I looked around to make sure Bill was not watching me!

Bill did section this smaller specimen (Cobban and Hook 1981, fig. 9), but only after I assured him there were no more specimens in the area. The venter of this specimen (Text-fig. 2) is rounded to a diameter of 4.0 mm; at 5.8 mm it is slightly flattened and at 9.2 mm it is well flattened. At diameters of 14.8 and 24.5 mm, the venter is sulcate. The venter is flat at 41.0 mm and narrowly rounded at 69.5 mm. The specimen is, indeed, a *Hoplitoides* and was referred to *H. wohltmanni* (von Koenen, 1898). Our biostratigraphy had survived it first test.

Text-fig. 1. D-Cross Mountain, elevation 2589 m, a Tertiary volcanic neck that stands approximately 91 m above Upper Cretaceous strata in northwest Socorro County, New Mexico, 90 km northwest of Socorro. The neck is elliptical in map view and approximately 460 m across. The "D" and "X" visible on top of the mountain formed naturally in cooling, basaltic lava. View is to the northwest. Modified by Little Hawk Studios, Magdalena, New Mexico, from Robinson (1981, pl. 22)



Text-fig. 2. Cross-section of the inner whorls of the "smaller" specimen of *Hoplitoides wohltmanni* (von Koenen) from USGS Mesozoic locality D11318 in the Rio Salado Tongue of the Mancos Shale east of D-Cross Mountain, Socorro County, New Mexico. Figured specimen USNM 307656. Scale bar is 20 mm. Redrawn by Little Hawk Studios, Magdalena, New Mexico, from Cobban and Hook (1981, fig. 9)

I did not tell Bill for many years how I was able to acquire a smaller specimen that he might be willing to sacrifice. However, 26 years later, I unburdened my conscience and confessed. On the night of August 26, 2006 at the banquet in his honor (Larson and Landman 2006), I followed Neil Landman (American Museum of Natural History) in reminiscing about working with Bill. While Neil was a graduate student at Yale, Bill called him to discuss his research. Neil said he felt as though he had received a telephone call from god. My story about an omnipresent Bill Cobban in the field and Neil's story about a telephone call from god reflected the awe and admiration that Neil and I had for Bill, not only as a scientist, but also as a person. I know that I am a much better geologist for having known and worked with Bill. I often sense Bill's presence when I do field work at the outcrops we studied together, especially those at Carthage, Darton's Hill in the Cookes Range, and D-Cross Mountain.

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Interpretation of the Cenomanian-Turonian boundary – Building on Dr. William A. Cobban's Research

Fossil enthusiasts in Cañon City worked on a year-long educational program in 2014 to acquaint a group of 7th grade students at Cañon Exploratory School in Cañon City, Colorado, with the Western Interior Seaway and the Greenhorn Limestone. This project led to a second project currently underway which is the development of an interpretive exhibit focusing on the Bridge Creek Member of the Greenhorn Limestone Formation and the Cenomanian-Turonian Boundary (CTB) in the recently developed Hogbacks Open Space Park. As we began to explore this well-researched subject and looked at the vast array of information, we discovered that Dr. William Cobban was there at every turn; it became clear that Dr. Cobban's dedication and research provided the very foundation we were seeking.

Locally our research of the Bridge Creek Member of the Greenhorn Limestone Formation in which the CTB lies led us to the 1972 Professional Paper 645 entitled "Stratigraphy and Ammonite Fauna of the Graneros Shale and Greenhorn Limestone near Pueblo, Colorado", where we found detailed references to the ammonites and bivalves of that period, as well as this marvelous sentence, ". . . plaster casts of most are in the Federal Center in Denver, Colo".

Kevin McKinney, Paleontology Collection Curator with the USGS repository in Denver, kindly allowed us access to explore the fossil collection housed at the USGS and was willing to loan casts of representative Greenhorn Limestone fossils.

Fellow Western Interior Paleontological Society (WIPS) members Thomas Nolan, Robert Atkinson, and Steve Miller lent their expertise to our project, as they have expanded and built upon Dr. Cobban's work by measuring the stratigraphy of the Bridge Creek Member in Comanche National Grasslands and Cañon City, CO. With Steve Miller's help, we made our own casts of the USGS fossils which we used with our school educational project. At that time we were not thinking about these fossils in relation to the CTB.

A related event that later became instrumental in our CTB project was a Geologic Society of America dedication ceremony on October 25, 2013, at Lake Pueblo State Park, where the local connection of the CTB to the Bridge Creek Member of the Greenhorn Limestone was introduced in a way that a CTB educational project was starting to formulate for us. This dedication ceremony resulted from research by W.J.Kennedy, I. Walaszczyk, and W.A. Cobban in a 2000 summary paper entitled "The Global Boundary Stratotype Section and Point (GSSP) for the base of the Turonian Stage of the Cretaceous: Pueblo, Colorado, U.S.A". A review of this paper once again brings to life the richness of the work on the CTB by Dr. Cobban and the appreciation of paleontologists around the globe for the work that he has done to enable the GSSP location to be established at Lake Pueblo State Park.

One of the key individuals behind the dedication event was Dr. Ireneusz Walaszczyk, colleague of Dr.

Cobban and Professor of Earth Sciences at the University of Warsaw; Dr. Walaszczyk has spent recent years at the USGS researching the biostratigraphy of the Late Cretaceous inoceramid bivalves. Thanks to an introduction by Kevin McKinney, we had the honor of meeting with Dr. Walaszczyk to learn more about the CT extinction and the existing supporting fossil evidence; we were joined by other Greenhorn Formation enthusiasts Steve Miller, Tom Nolan, Millie Wintz, and staff from the Royal Gorge Regional Museum in Cañon City, We walked away from that meeting in awe of what we were presented, and we gained an even deeper appreciation for the work that Dr. Cobban did over his lifetime to make this meeting possible.

In the spirit of Dr. Cobban, Dr. Walaszczyk provided a foundation for understanding the world as it existed those 94 million years ago. Using a selection of Dr. Cobban's ammonites and clams collected in the field and housed in the Denver USGS collections, Dr. Walaszczyk compiled a chart upon which he placed Dr. Cobban's ammonites and Inoceramus clams, helping us visualize fauna zones and changes following the extinction event. He explained the environment during the Western Interior Seaway, extinction events in general and the CTB extinction event in particular, the likely causes of the extinction and the cycle of limestone/shale layers found globally.

We looked at biostratigraphic zonations, both the taxon range zone and the interval range zone. Clam and ammonite species dominate these zones, but aren't restricted to these zones. We learned that the clams are used as the primary index fossil to best identify the extinction event; ammonites aid in the process.

Dr. Walaszczyk shared that at the time of the CTB, the globe was considerably warmer than today; the polar and equatorial regions didn't exhibit the extremes of temperatures we're accustomed to. We learned about what a mass extinction is and how it is measured. It would be easy to assume that a wet and warm planet would be conducive to a proliferation of life but life in the seas became stressed and over a half million year time period some taxa ceased to exist. Dr. Walaszczyk helped clarify how changes in ocean temperature and other factors can lead to extinction through oxygen level changes in the water column.

Dr. Walaszczyk introduced us to the ammonite *Neocardioceras juddii* and the *Inoceraumus pictus* from the upper Cenomanian, and ammonites such as *Mammites nodosoides*, *Watinoceras coloradoense*, and *Watinoceras devonense* and inoceramids such as *Mytiloides puebloensis* from the Turonian. It was largely the genius of Dr. Cobban and his ability to recognize fossils that made this discussion possible. Neil Larson said it well in his dedication to Dr. Cobban:

"Bill has authored and co-authored more than 300 papers on the invertebrates, biostratigraphy and geology of the North American Late Cretaceous; published nearly 300 new genera, subgenera, species, and varieties of invertebrates; named and defined most of the 71 Upper Cretaceous ammonite zones of the Western Interior; measured, described and published most of the Late Cretaceous marine stratigraphy of the Western Interior; co-authored numerous geological and stratigraphical maps; and, along with John Obradovich, dated most of the Upper Cretaceous bentonite layers."

We wish to expose a section of the Bridge Creek Member of the Greenhorn Limestone in the Hogbacks Open Space Park adjacent to Cañon City. We will introduce many features of the Bridge Creek, including the rhythmic cycling of the limestones and shales, the bentonite layers, and the fossils. We plan to utilize these and other evidence to introduce the CTB and demonstrate how we know what we know. Visitors will be able to touch the layers and experience the earth as it was here some 94 million years ago.

A few years ago we all looked at the various formations within our Hogbacks Open Space Park as something representative of the Western Interior Seaway and were aware of many of the fossils within. Today we look at it with a much deeper appreciation and perspective. We are able to do this in large part because of the foundation Dr. William Cobban and Dr. Irek Walaszczyk have provided.

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