Bulletin of the
Association of Engineering Geologists
Vol. XXX, No. 2, 1993
pp. 139-155

Biography of Charles Butler Hunt, Geologist

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Engineering geologists owe a debt of gratitude to Charles Butler Hunt, mainly because he has already been there and left a trail for most of us. Late in 1990, I resolved to spend New Year's Day doing something truly worthwhile, and after a telephone proposal to Charlie (as he prefers to be addressed), I went to Salt Lake City for the express purpose of trying to capture Charlie on paper.

To get a proper perspective on Charlie, one has to immediately acknowledge that his whole career of 63 years in geology has been one long adventure. Initially he did not have a plan for this odyssey, but only a voracious appetite for encountering geology and making the most of it. Charlie joined the U. S. Geological Survey (USGS) at a time when there were damned few positions and one did not think twice about accepting one as offered. At the time, October 1930, he was an honor graduate of Colgate University (1928), had completed three seasons in Montana, Utah and New Mexico as a Field Assistant with the U. S. Geological Survey and was a doctoral candidate at Yale. Charlie summed up his life's ambitions, married Alice Parker and left Yale's program without so much as a compensating master's degree, in order to take advantage of the last career-conditional position that the Survey filled in the wake of the Great Depression (Figure 1).

THE EARLY YEARS

Charles Butler Hunt, an Army brat, was born on 9 August 1906 at the U. S. Military Academy, West Point, New York, son of Irvin L. and Annie B. Hunt. Captain Hunt, a Californian and an Infantry graduate of the Class of 1899, was pulling a tour of duty as an instructor of history at the Academy. Charlie recalls that the quarters, which never needed locking, were ceremoniously secured with a five-inch-long key. As was the case in the Post-Spanish-American War Army, Captain Hunt was soon assigned to the Philippines and Charlie's young pre-school eyes, ears and mind were treated to a strange world about Camp Keithly, Mindanao. Supplies were mule-trained in from the coastal port of Overton. The camp was an outpost in Igorot country, the home was a stilt house, and the geology was a *maar* (volcanic crater). How could a young and inquisitive mind escape an interest in geology, where there were so many frequent earthquakes such as the young boy could feel and see through the recurrence of earth tremors and swaying of his mother's numerous hanging orchid plants?

As was traditional in the Army in the Far East, Captain Hunt took his family off to China, on leave, when the semi-annual contract steamships rotated troops and resupplied the China garrisons. Charlie recalls the Great Wall, to which he was sent to view in the custody of a native. Charlie's early powers of observation surfaced when he returned to report to mother that he had seen a donkey and a pig, the wall not withstanding.

Stateside duty brought the family back to the Presidio of San Francisco on an Army transport ship, which was followed by the long, geologic-rich train ride to Washington, DC, where Captain Hunt was to be assigned until World War I. Charlie remained in DC for grade school and high school (here as a classmate of later Military Geology Unit colleague Edwin B. Eckel, who was later named first USGS Branch Chief of Engineering Geology in 1945). He recalls being content enough with Army life to suggest that he would follow in Dad's footsteps. The elder Hunt, on hearing this somewhat unimaginative declaration,

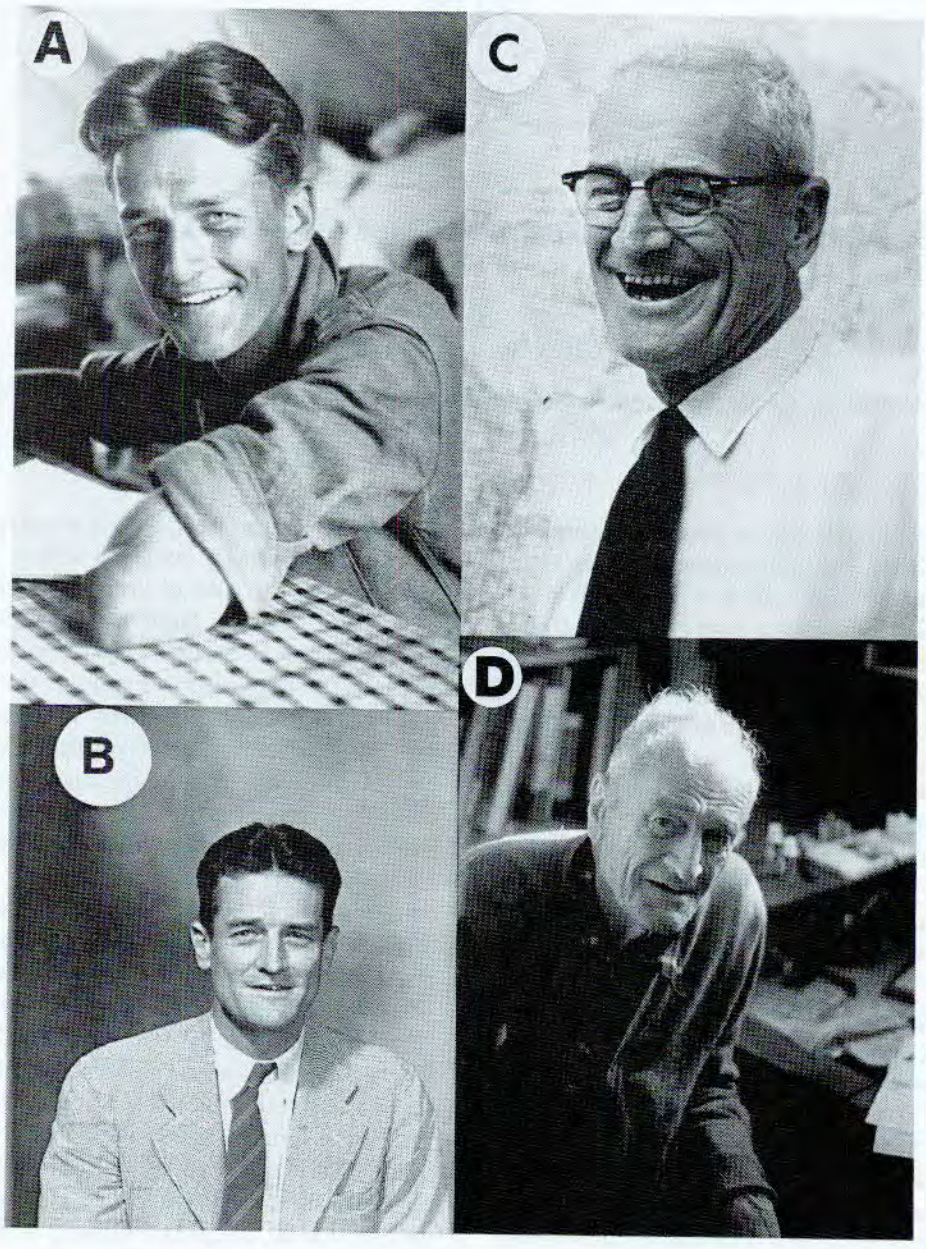

Figure 1. The four stages of Charles Butler Hunt: A) Field Assistant (age 23) to Carle H. Dane, summer of 1929, in the mess tent at the Colorado River, Moab, Utah. B) Assistant Chief, Military Geology Unit (age 36), 1942; a passport photo for the visit to British Military Intelligence, Oxford, United Kingdom. C) Distinguished Visiting Professor of Geology, New Mexico State University (age 70), 1976. D) Racountier of Grand Canyon geology, New Year's Day (age 84), 1991, Salt Lake City, Utah (Photographed by the author).

declared that Charles ought to identify a variety of options for his life's work and stated that his parents would invest in a year at Colgate University for that purpose. If, after that year, Charles still wanted an army career, his father would do what he could to aim him toward an offer of admission at the Academy (influence was important in those days, but is non-existent within the modern Army, and strictly minimal within the Congress, in today's highly-competitive admissions policy).

COLGATE, YALE UNIVERSITY AND THE U. S. GEOLOGICAL SURVEY

Father and son cut a deal, so to speak, to try the alternative to Dad's profession. Colgate gave a lot to Charlie; geology stuck in his heart, and he experienced a social coming-out from pledging Beta Theta Pi fraternity.

Colgate's small geology faculty was dominated by Professor Harold O. Whitnall. Charlie's mentor was upperclassman G. Arthur ("Gus") Cooper who later convinced Charlie to apply to Yale, where Gus and Charlie became graduate school roommates after graduation from Colgate in 1928. Professor Whitnall made the appropriate introductions to the Geological Survey and Charlie hired on for a total of three years of seasonal field assistant duty with the Fuels Branch; two years with Wood Bass in surveying the coal deposits of the Montana plains and a last year with Carle Dane (starting on 22 June 1927) doing baseline geologic mapping of the Colorado River at about the Colorado/Utah border, in the vicinity of Moab. Charlie got a massive dose of Colorado River curiosity that has remained with him right up to the present time (*Geologic History of the Colorado River*, Professional Paper 669).

Caught up with a consuming interest in field geologic mapping, Charlie twice sat for the difficult Geological Survey entrance examination, passed, and was offered and accepted the very last career appointment before the effects of the Great Crash of October 1929 stock market reached the Government. Recommended by Carle Dane, his chief the previous field season, Charlie was sent back to New Mexico to continue work there for the Fuels Branch (Figure 2). At the end of his season in charge of a field party there, Alice and Charlie were married in an old shrine at Seboyeta, New Mexico, near the oldest settlement west of the Rio Grande (Figure 3). After a second year in New Mexico, Charlie went, with Bill Pierce, back to oil, gas and coal work on the plains of Montana.

In 1934, in the depth of the depression, Charlie was sent to eastern Kentucky by the Public Works Administration to map the coal beds there, and to give work to five young unemployed geologists, one of whom, Paul Averitt, later became the principal USGS authority on coal.

Charlie's well-recognized work on the origin and character of small igneous intrusions began in the Henry Mountains of Utah in the late 1930's. This was a time during which field camps were the rule and the geologic maps were prepared by alidade (Figure 4) right along with their topographic bases, for no mapping of any sort had been attempted to date. Mapping this roadless wilderness required logistical support, right down to pack trains and trail building for the mules to cross slippery Moenkopi Formation flagstones.

Before leaving the Kentucky coal mapping project in 1935, Alice and Charles adopted their two children, Anne and Gene, two siblings. His son today lives with his own family in Salt Lake City and is a frequent visitor to the elder Hunts. There are nine grandchildren and 16 great grandchildren.

Charlie's productivity in fuels work had been recognized and he was given the lead to begin his studies of the Henry Mountains of Utah in 1935, spending five years at the task. This was all part of an informal effort to regionally map the Colorado Plateau, with individual teams led by Hunt, Art Baker (Moab, Monument Valley and Green River Desert), E. T. McKnight (Green River to Colorado River plateaus), and C. H. Dane (Salt Wash anticline). By this time, former Hunt compatriot and mentor Jim Gilluly had gone off to teach at UCLA.

In 1940, the Survey began to undertake a massive search for defense-related minerals. By now the Survey management had recognized that Charlie had the scientific basis, people skills, and pride of completion necessary to manage some of this high-paced work. Charlie was placed in charge of the effort to locate manganese. He and Alice moved to Tucson to activate a lower Basin and Range regional search for exploration targets. By this time Charlie's leading "good soldier" characteristic had emerged. He would accept any worthwhile assignment the Survey had in mind for him and he excelled either at managing it or in producing its detail. The particular target was a large-scale, very-low-grade deposit in a bedded sedimentary paleo-environment. The Three-Kids Manganese District, near Boulder, Nevada offered the best possibility for bringing in a find, which it did.

In order to deal with the vast breadths of valley fill lying between the basin's faulted mountains, Hunt began to work with the unconsolidated sedimentary units. This was the start of his later fascination and dedication with physiography and surficial geology. His talents in scientific classification led him to create and test a facies model incorporating an upslope gravel, a high-midslope sand unit (bearing the least soluble calcium carbonate), a low-midslope fine-clastics unit, and a saline central-basin facies,

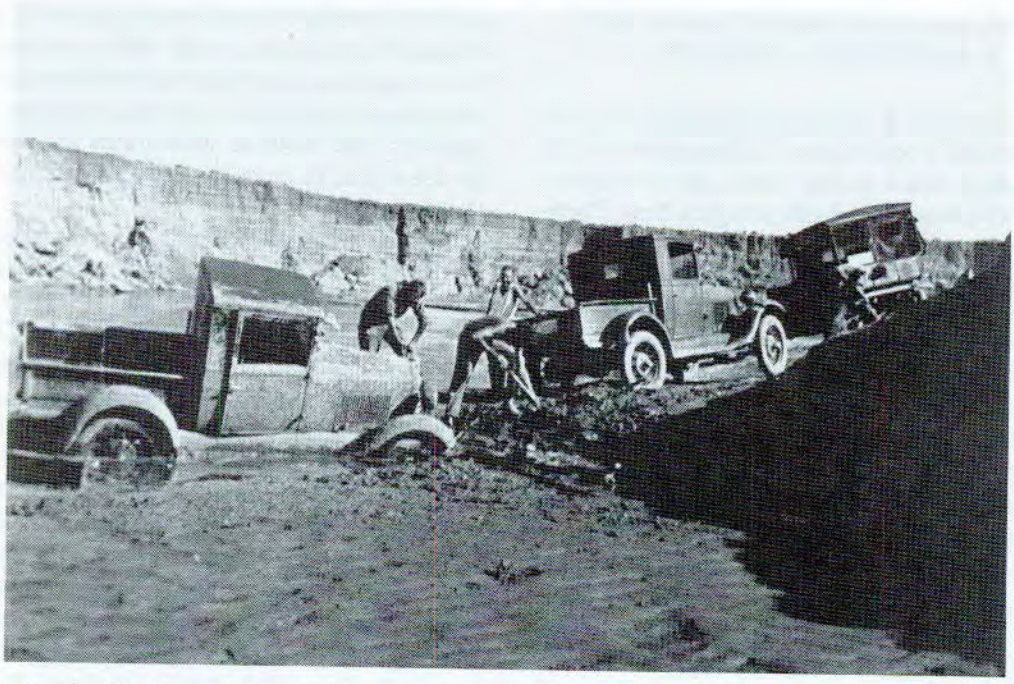

Figure 2. Crossing the Rio Puerco, flanks of Mount Taylor, New Mexico, 1930, with three 1928 Model A Ford pickup trucks, tow chains, shovels, muscle, and lots of willpower. This work was associated with Survey Bulletin 860-B (1936) and Professional Papers 189-B (1938) and 193-F (1941).

Figure 3. Best view of all! Autumn 1930: Newlyweds Alice and Charlie counting coup on the day's collection of Cretaceous ammonites from the shales of the Rio Puerco Valley, New Mexico. The work was in connection with Survey Bulletin 860-B (1936) and Professional Paper 193-F (1941).

Figure 4. The way we used to do it—Charlie in topographically-unmapped terrain making a geologic map (1:31380) from the alidade-up. Mount Taylor, New Mexico, 1931, Survey Professional Paper 189-B (1938).

in which the most soluble salts (NaCl, MnCl and $MnSO_4$) were to be found.

While on the manganese survey, Charlie was stricken with mumps. Seeing that he had nothing better to do, he rectified his long-standing phobia of technical writing. Acquiring a 1931 edition of T. A. Rickard's *Technical Writing*, popular with geologists and mining engineers, Hunt digested Rickard and emerged from bed with an urge and taste for writing, now one of his few most favored activities. Charlie claims that his previous writing was so stilted that he drew constant attention (to help him improve) from Bill Ruby, Bill Bradley, Carle Dane and Jim Gilluly. An accomplished technical writer since 1941, Hunt's productivity is now hampered by deteriorated eyesight, so Charlie often dictates to Alice or to their granddaughter, Valerie, the latter of whom is his partner on the ongoing study of the Grand Canyon (1992, in press).

THE MILITARY GEOLOGY UNIT (MGU)

On the night of the Pearl Harbor attack (7 December 1941), Charlie was working his usual Saturday field routine and drove into Wickenburg, Arizona, for dinner, fully sensing that "something was in the air." Charlie returned to Washington, DC immediately, anticipating that there would be a sharp refocusing of the work of his manganese crew.

In Washington, Charlie was handed a reassignment to the fledgling Military Geology Unit (MGU), just created on a memorandum of agreement between the Survey and the U. S. Army. Already, the Army General Staff was planning the North African invasion (D-Day, 8 Nov 1942) and Wilmot H. (Bill) Bradley was serving as the first MGU chief. Charlie's first comment was that this military geology was out of his field of expertise, followed by a second-breath question "was not surficial geology of importance in military operations?" The answer being a resounding "yes," Charlie was asked to draw up a prospectus on what a geological team could produce, from surficial geology, that would be of use to military commanders. Since he had just returned from southern Arizona, Charlie suggested that there ought to be plenty of terrain analogs in the lower Basin and Range province that would duplicate North Africa. This was indeed a fact already established by Major General George S. Patton, who had flown his own small airplane out from Fort Benning, Georgia, and had returned to the Pentagon, having personally surveyed what would shortly become the Army's vast California-Arizona Maneuver Area (CAMA). CAMA comprised the eastern half of Riverside County and sizeable portions of adjacent San Bernardino County and Colorado River-shore Arizona.

MGU was staffed and in place by June 1942, created to assist the Chief of Engineers, U. S. Army, with terrain evaluations. In this effort, Charlie found such Geological Survey notables as Wilmot Bradley, Chief of the Unit, Philip B. King, Association of Engineering Geologists (AEG) Honorary Member Alice S. Allen, Carle H. Dane, Edwin B. Eckel (Honorary Member, AEG, deceased), Engineering Geologist Charles E. Erdman, Henry G. Ferguson, Esper S. Larsen, III, Levi S. Noble, Vincent E. McKelvey, John Rogers, V. C. Theis, and, from the outside, Fritiof M. Fryxell (Augustana College), John T. Hack

(Hofstra College), Konrad Krauskopf (Stanford University), Allan Nicol (California Department of Highways), Frank C. Whitmore (Rhode Island State College), George Roberts (U. S. Navy; AEG deceased), James S. Gilluly and William C. Putnam (both of UCLA; the latter creator of *Putnam's Geology*, and whom became Charlie's Assistant Unit Chief on Hunt's assumption of leadership from Bradley on 1 January 1944). Aside from producing various quick-response products, the first consolidated MGU product was begun with the Fall 1942 Allied decision to invade Sicily as soon as the Axis was expelled from North Africa. For this invasion, MGU produced the *Sicily Folio*, its pattern not unlike that of the existing and traditional USGS *Folio* series, but with additional maps, drawings and tables interpreting the terrain in terms of water supply, construction materials, airfield sites, and other engineering factors. *Sicily*, as the first folio, was produced with East and West segments, at 1:100,000 on a Geological Survey of Italy topographic base recovered from the Survey's world-extensive Washington library. Charlie fondly recalls that the key to this and subsequent MGU successes-in-a-hurry was the original USGS policy set in the 19th Century by second Director John Wesley Powell, which was a world-wide program of exchange with all the world's geological surveys.

Of the *Sicily Folio* (Figure 5), Colonel Garrison H. Davidson, Seventh Army Engineer at the time of the invasion, said "The Strategic Engineering Studies ... proved to be accurate and complete; were at times indispensable and in many cases possessed more information than the natives themselves." (*Report of Military Geology Unit, 15 December 1943*).

Already fascinated with the ways and means of describing landforms for practical purposes, the Military Geology Unit developed many tools and techniques for making military geologic evaluations useful to strategists and field commanders alike. In order to bring the MGU into early production, Charlie flew to Britain to visit the Royal Army Military Geology Unit at Oxford, and came away with an awe for what the British were already producing and a firm respect for broad-based invasion maps that the Wehrmacht had produced (and which British Intelligence had obtained). The *Regelquerschnitt zu Blatt Hastings* (*Cross Section of the Hastings Sheet*), hand-drafted on the *Umgezeichnete Geologische Karte von England* (*Manuscript Geologic Map of England*) had been developed to portray known British coastal defenses and suspected lines of resistance to the invasion that der Fuehrer had begrudgingly canceled in 1940. Key to this interpreted military geologic map were the importance of interpreted geologic and geomorphic features as they affected both the offense and the defense.

By the time that active planning was underway for the June 1944 Normandy invasion of *Festung Europa*, British Intelligence was assigned the responsibility for military geology for the European theater and MGU refocused its activities to the Pacific Theater of Operations.

After June 1944, Hunt restructured the MGU effort, sought and hired more staff (on the basis of the Sicilian success) and sent military geology teams to the Pacific; Jim Gilluly, Bill Putnam and F. M. Fryxell (to name three team leaders), with Phil Shenon in charge in Hawaii and John T. Hack as liaison in Washington, DC. The work products are amply described in Hunt's 1950 Engineering Geology Division Berkey Volume paper. An outstanding innovation of the Unit was a pantographic sketching device developed by Bill Bradley and Phil King, used to construct terrain diagrams from topographic maps or aerial photographs. These sketches (Figure 5) became the single most important means of portraying geomorphic features of military significance. Bradley had especially recruited Phil King on the basis of King's natural talents (not unlike those of G. K. Gilbert) as a landscape artist (as illustrated in King's delightful *The Evolution of North America*, of 1959 and by King and McKee, 1949).

JAPANESE INCENDIARY BALLOON INVESTIGATION

Perhaps the most unusual of the many successes of MGU was the "sand ballast" study. Early in the war (1942) the Japanese developed and sent aloft balloon-mounted incendiary bombs (Figure 6), designed partly as a terror weapon but mainly as an effort to start fires in America's timber-rich northwest, extending from northern California through British Columbia, Alberta, and as far east as Saskatchewan and north to Alaska. The bombs rose to the jet stream, crossed the Pacific, and descended by timer and barometrically-released ballast sacks. Army intelligence searched for and collected dud bombs and asked MGU to somehow identify the launch sites, to become priority bomb targets as soon as long-range bombers could be placed in action against the Japanese homeland. Kenneth E. Lohman was MGU's point-of-contact for this work and he subdivided the

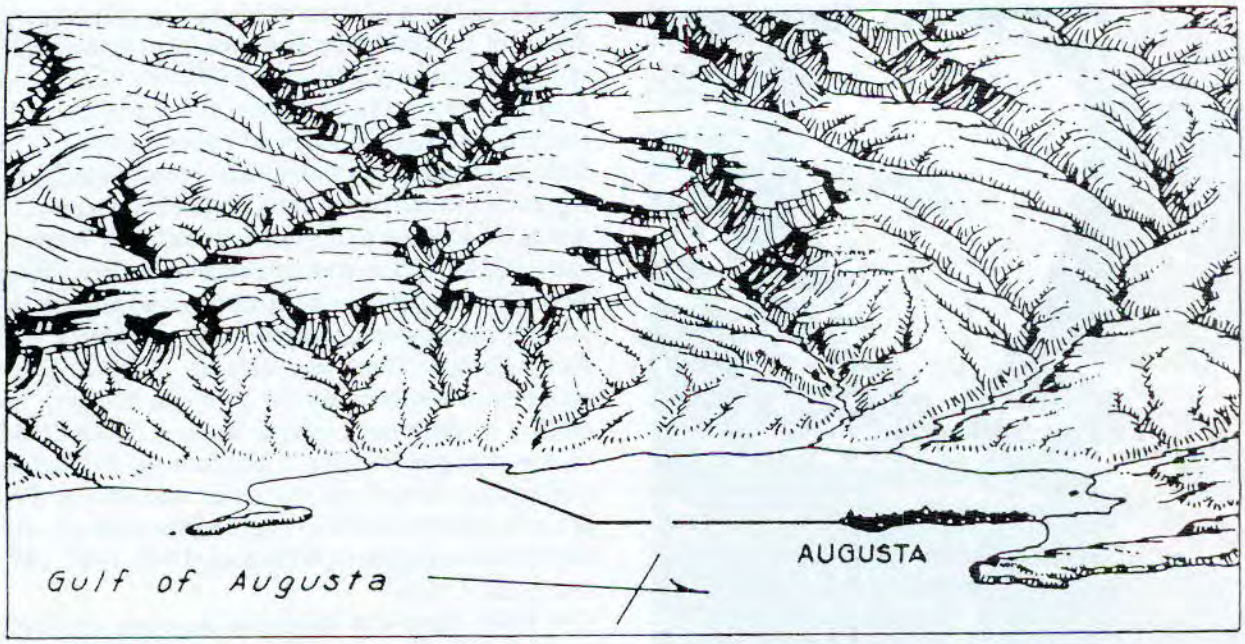

Figure 5. Low-angle physiographic view of the Sicilian coastline drawn in orthographic perspective on a device developed by P. B. King and Esper S. Larsen, Jr., of the Military Geology Unit (from USGS, 1945b, as part of the *Sicily Folio*, produced for the 1943 Allied invasion of that island).

sand from each recovered ballast sack into about a half-cup volume for each of his specialists. Tertiary paleontologist (mollusks) Julia A. Gardner found and identified cold-water marine pelecypod and gastropod shell fragments in the beach-sand ballast. Ken Lohman's wife Kathryn, a micropaleontologist and ex-Texas Company foraminifera specialist, separated out the workable fragments and Ken studied the foram garbage of a chemically disintegrated fraction. Among the residue were diatoms, references to which were found in the Japanese literature. Occurrences of these diatoms were confined to latitudes north of Tokyo, a fact Julia substantiated by the absence of coral fragments. Phase One of the evaluation pointed to a Western Pacific location. Clarence S. Ross determined petrographic lithology of the source rocks, and Henry G. ("Fergie") Ferguson's heavy-mineral assessment of the sand yielded illmenite with a high excess of titanium and a match on its potential igneous source at only three Japanese insular bays, all on the east coast of Honshu and north of Tokyo. The selection was further verified when a Japanese paleontological paper was translated and revealed that Pliocene marine beds near Sendai contained the exact diatom species. Interpretation of Army Air Forces low-level, aerial reconnaissance (P-38 aircraft) photos revealed the sand deposits, and geomorphic keys identified the southern portion of one of the three bays. As a result of a February 1945 MGU report, military photointerpreters located specific launch sites and two of the three hydrogen-generator facilities. These launch sites, which had sent out some 9,000 incendiary balloons, were soon obliterated by B-29 heavy bombers of the 20th Air Force, operating out of Okinawa (U. S. Geological Survey, 1945a; Lohman, 1991).

Typical of the questions fielded by MGU was the query from Army Air Corps Chief of Staff, General H. H. ("Hap") Arnold, who asked Charlie to explain ("Please, in one page") why so many mountains trend north-south, but every so often there's one east-west!

BACK TO CLASSICAL GEOLOGY

With the end of World War II Hunt left MGU, in December 1945, in the able hands of Esper S. Larsen, III (1946), as it became the Military Geology Section, and later, Branch. The War Department made an Appreciation (Figure 7) for Charlie's service, and in the name of the Quartermaster General recognized what his leadership had provided Quartermaster Corps in the war effort. The vast majority of work product however was under the aegis of the Chief of Engineers (Table 1). At the urging of former team

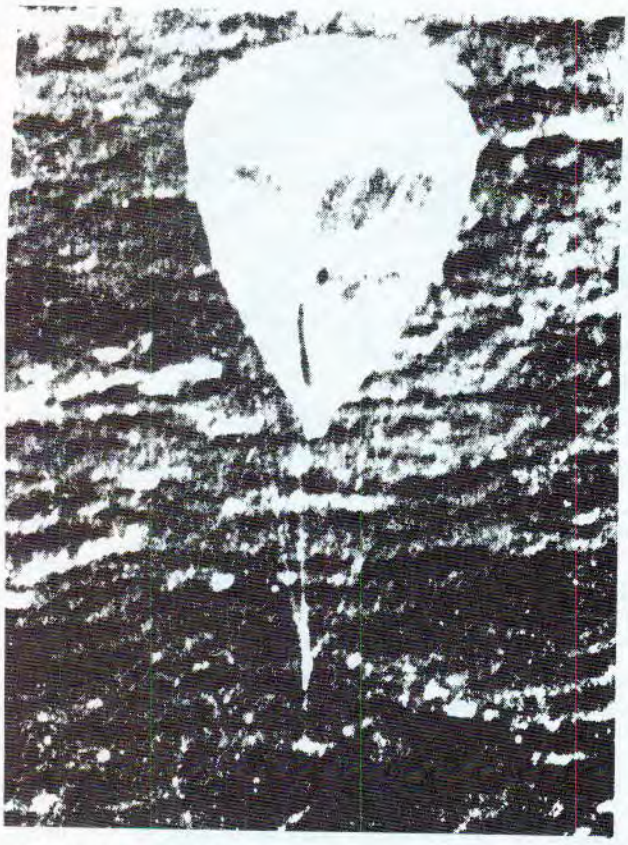

Figure 6. One of the 9,000 incendiary balloon-bombs launched by the Japanese against the west coast of North America in World War II. This terror bombing continued unabated for three years, beginning in early 1942, until Miltary Geology Unit geologists deduced the location of the launching sites from lithologic and micropaleontologic analysis of ballast-sacksands (Photograph by U. S. Army, from *Defense of the Americas*, 1991).

member Fritiof M. Fryxell, Professor of Geology (on leave) from Augustana College, Charlie directed that most of the work product from MGU to be shipped to Rock Island, Illinois, where it resides in the Augustana College library.

Larsen was in turn succeeded, on 1 July, 1946, by Frank C. Whitmore, Jr., as Chief (1946-1959) who managed the significant amount of 1950's work products, dealing largely with the Pacific islands left in military trust to the United States. In later years the Branch was inactivated and its subsequent work declined to its present state of near nonexistence. Surficial geology, in 1946 however, was left foremost on Charlie's mind.

Frank Whitmore was given charge of military geology operation for the purpose of liquidating the Branch and then to transfer himself to paleontology. Winds of the Cold War, however, blew in and Whitmore was to save and rebuild the Branch. The postwar program of the Military Geology Branch (GB), which reached a strength of about 120 people, continued to include preparation of classified terrain intelligence reports for the Office of the Chief of Engineers, U.S. Army. In addition to the main operation in Washington, DC, an office was established in Heidelberg, West Germany, where trafficability and engineering geologic maps were prepared for Headquarters, U. S. Army Europe. There was also an office in Tokyo which was headquarters for geologic mapping (including engineering geologic studies) of the islands of the western Pacific. A program of permafrost studies was carried out in Alaska, and smaller field projects, mostly related to engineering geology, were carried out as required (Whitmore, 1946, 1948, 1950, 1953, and 1960).

In 1946, Hunt was appointed Regional Geologist for Utah. Another call to duty; out of the administrative detail Charlie saved one working day and Saturdays for his field work and began to map (1:62,500) the northern half of Utah Valley (Professional Paper 257-A, 1953) in cooperation with Helen Varnes (a former MGU co-worker) and Harold E. Thomas, Water Resources Division. It was during this assignment that Charlie discovered the yet-today best-kept secret of the intrinsic geologic value of pre-Seventh Approximation (pre-1960) U. S. Soil Conservation Service (SCS) soil survey maps. These were the maps of the early SCS (and its predecessor, U. S. Bureau of Soils, 1895-1922) soil survey maps, mainly at 1:62,500 and authored by Quaternary geologists in the days before soil scientists.

Charlie's ample frustration with the Seventh Approximation was stated in a letter to *GeoTimes* (September 1974, pp. 31-32) in which he notes: *This plea for simple English 'as she is spoke' is not a matter of frustration arising from an inability to create impossible words, for I can boast both* ***cactolith*** *(USGS Professional Paper 228) and* ***preatosol*** *(Geology of Soils). Both were offered in satire; cactolith even made the* ***New Yorker****. But the Seventh Approximation is offered seriously, which makes it funny without being humorous.*

With completion of the Utah Valley work in 1948, Charlie was reassigned to Denver, as Chief of the General Geology Branch. After five years in this position, Charlie hurried along the paperwork and went frequently to the field to oversee and peer-review field geologic studies in the western states

THE

War Department

expresses its appreciation for patriotic service in a position of trust and responsibility

to

CHARLES B. HUNT

Who, as Director of the Military Geology Unit of the U. S. Geological Survey, Department of the Interior, rendered invaluable assistance to the Quartermaster Corps from 1 January 1944 until the present date by furnishing geologic information and personnel from his department to aid in the preparation of War Department pamphlets dealing with the coal industries of the world.

Washington, D. C. 14 December 1945

Lieutenant General
The Quartermaster General

General
Commanding General, Army Service Forces

Secretary of War

Figure 7. War Department Certificate of Appreciation for just a bit of what Charlie's leadership produced at the Military Geology Unit, in World War II.

Table 1. *Sample of military geologic products; military geology unit: 1 June 1942 – 15 December 1943.*

Work Product	Military Client	Subtotal	Total
Terrain Intelligence Folios	Engineer Intelligence	65	
Special Intelligence Reports	Engineer and Air Corps	21	
Commodity Reports	Air Corps Intelligence	8	
Air Objective Reports	Air Corps Intelligence	9	
Total major studies			103
Minor Reports	Army and Naval Intelligence	51	
Minor Reports	Board of Economic Warfare	31	
Total minor reports			82
Maps and Books Handled			75,000
Large-Size Maps Compiled		1,400	
Small Maps and Figures Compiled		500	
Tables Compiled			1,050
Photographs and Figures Mounted		1,250	
Photographic Negatives Made			1,250
Terrain Diagrams Completed		51	

Source: Report of Military Geology Unit, 15 December 1943

(Baker et al., 1952). Of particular merit was his work on the La Sal Mountains laccoliths (published in 1958, and coauthored by Aaron C. Waters), which were seen as intrusion-analogs of those in the Henry Mountains and which had never been mapped. While Charlie served in Denver he also completed Bulletin 996-C (1954), *Pleistocene and Recent Deposits in the Denver Area, Colorado*, still a useful reference source on Denver-area surficial deposits. In the meantime, Alice completed (1952) an MS in archeology at the University of Denver.

For two years (beginning in June 1953) Charlie became the third Executive Director of the fledgling American Geological Institute formed a few years earlier, just another of the "good soldier" assignments handed him by the Survey. During this time he founded the *Geological Newsletter*, then saw that it was quickly transformed to become *GeoTimes* in 1956. After his 1941 association with Rickard and the mumps, Charlie had taken a real liking to technical writing and was now propelling *GeoTimes* forward by doing a lot of the writing himself, including his delightful 1958 piece "Tin cans and bottles for dating mining camps" (Discover why pre-1914 glass turns purple in the sun!).

Alice and Charlie spent five years (1955–1960) at Death Valley field work; Charlie completed his Professional Paper, and Alice completed *Archeology of the Death Valley Salt Pan*. While working with Alice, Charlie collected the materials for his paper dating mining camps with tin cans and bottles.

RETIREMENT, SOILS AND PHYSIOGRAPHY PHASE (1972–PRESENT)

Charles Hunt really never has retired. He "retired" from the Survey on 15 September 1961 to become professor of Geology in the Geography Department of The Johns Hopkins University, as recruited by Ernst Cloos and M. Gordon "Reds" Wolman (Past President, GSA). Charlie was at Johns Hopkins for twelve years (1960–1972), during which time he published *Physiography of The United States* (1967) and *Geology of Soils* (1972). While at Johns Hopkins, he served for seven years (1961–1968) on the Advisory Panels for the National Science Foundation, first for the Earth Sciences Division (Chairman 1962–1963), then for the Physical Sciences Division. As a professor, Charlie applied for and received NSF grants to conduct research on saprolites along the Atlantic seaboard, a string of papers on the Henry Mountains region (36 laccoliths and five bysmaliths), and the east-slope drainage history of the Rocky Mountains. Throughout this period and as late as 1985, Charlie held "When Actually Employed" (WAE) appointments with the Geological Survey, providing

much of the means for his highly-productive retirement-years field work.

The first of what were to be three Hunt textbooks is *Geology of Soils: An Introduction to the Ground Around Us*, published in 1972. Awakened as he was about soil, as a result of his World War II technical support work, Charlie set out to bring together non-geological explanations to these units that have been traditionally underrated in geology. Any of us trained early in classical geology will recall our training to quickly dispatch the "dirt" in geologic mapping as "Qal," subject of the first ink marks on the field map and a dab of yellow. Here Charlie avoids the use of technical terms, thankfully, especially in the realm of the dreaded Seventh Approximation of the Soil Conservation Service, an impossible language of coined terms. The title, *Geology of Soils* belies the fact that little of its primary material is geologic. However the non-geologic material is made understandable to us geologists. The book is by far the most assimilable treatise on soils yet available for use by engineering geologists. Two of Charlie's pencil-sketch messages are illustrated in Figure 8.

In his introduction to *Physiography of The United States* (2nd edition, 1974) Charlie writes that the concept of both the first and second editions was conceived in the mid-1950's, while he was at AGI. His purpose was to produce a broad-audience treatment of geology from the viewpoint of most intelligent non-earth scientists; to relate what one can see in travels to what is important to our natural environment. In two parts, the book first introduces greater landform features and processes, then (part Two) applies both to individual physiographic provinces. Charlie has a sixth sense about how all the pieces fit together, based mainly on his innate feeling for the development of geologic structure. As with his contemporaries, he is not a "plate tectonicist." Not ignoring such, he does dwell mostly on the character and interrelationships of distinctive features of each province. Charlie starts with soil and blades of grass and works into such useful discussions as their effects on water resources, wildlife environments, seismicity, major units of unconsolidated materials, landforms peculiar to the province, and mineral resources. He always considers the basic geologic stratigraphy, but seldom becomes encumbered at the Formation level. Chapter subdivision vary by the province, relying on Charlie's critics-choice of what is most important to know about the province. Charlie's own pencil sketches are everywhere, all in the style of P. B. King and reminiscent of Gilbert and Holmes (Figure 9). For the engineering geologist, *Physiography of the United States* has two main points of value. First, when you are contemplating an assignment in a province other than the familiar one, Hunt's books should be consulted as a wellspring of ideas and the basis for making that first sketch of the possible site geologic conceptual model. Secondly, from time to time, you should read again into your familiar province to stimulate new thinking and to crystallize what it is that you have been observing over and over and which you have not yet come to appreciate. These Hunt books are generic thought stimulators.

After leaving Baltimore, the Hunts moved in 1973 to New Mexico, where Charlie followed in the footsteps of his old mentor, Carle Dane. Charlie served as Distinguished Professor of Geology at New Mexico State University, Las Cruces. During this time he produced the *Surficial Geologic Map of New Mexico* which ranks as the first general surficial geologic map of a state south of the glacial mantle of North America. The work was performed under contract with the New Mexico Bureau of Mines and was completed between 1974 and 1976 at quarter-million scale (published 1977–1978 at 1:500,000). Charlie recalls the effect of the continuing learning process for a retired person. Starting at the SE corner of the State, he worked counter-clockwise and had difficulty in tying his geologic contacts together three quadrants later! His experience illustrates the trauma that usually assaults an open mind!

SALT LAKE CITY YEARS (1976–PRESENT)

Having "blitzed" the surface of New Mexico, Charlie and Alice returned to Salt Lake City in 1976. Charlie served as Visiting Scholar at the University of Utah and for another four succeeding years served as a member of the Geology Work Group formed to represent the State of Utah in oversight of the Department of Energy's efforts to locate a high-level radioactive waste repository site in the Paradox Basin of southeastern Utah. The Paradox Basin selection eventually was deactivated when the Congress chose (1987) the present Yucca Mountain site in Nevada.

Charlie next looked at Grove Karl Gilbert's work on Pleistocene Lake Bonneville, and completed his work as *Pleistocene Lake Bonneville, Ancestral Great Salt Lake, as Described in the Notebooks of G.K. Gilbert, 1875–1880* (1982). Hunt's humility shows in the fact that Charlie has merely "edited" the product.

Figure 8. Two sketches by Charles Hunt illustrating the engineering implications of mudflows (from Hunt, 1972, *Geology of Soils*).

Clearly, Charles B. Hunt is a geologist whose inquisitive interests are torn between the physical processes that create landforms (dynamic geomorphology?) and the ultimate product of those forces, soil. Those engineering geologists who are familiar with Charlie's work recognize both facets. Charlie has never let himself lean wholly into engineering geology, but his work products have a constantly high use potential for us. Take for example, his 1974 *GeoTimes* article, "Soil—a Dirty 4-Letter Word."

In 1986 Van Nostrand Reinhold published Charlie's third major text, *Surficial Deposits of the United States*. Charlie's little green book does the same for the 1985 USGS National Atlas map of the same title, a copy of which is also tucked away in a handy pocket in the book. This book delivers the message about what engineering geologists also call "soils." The manner of presentation is in four parts: *Untransported Deposits, Transitional Deposits* (colluvium and gravity deposits), *Transported Deposits*, and *Miscellaneous Deposits* (basalt, bedrock, clinker and hot-spring deposits. All discussions are related to American conditions and is current enough to have included the Thistle Slide, Utah, of April 1983. No new

Figure 9. Typical Hunt (1974; *Natural Regions of the United States and Canada*) landform sketch, in the style of W. H. Holmes, G. K. Gilbert and P. B. King. This view gives us the character of the east front of the Sierra Nevada at the west border of the Great Basin, in Owens Valley, California.

Charlie-drawings accompany this book, but a new selection of his field photographs add to the value of the book considerably.

CHARLIE, COLORADO RIVER AND THE BASIN AND RANGE PROVINCE

His Colorado River work has consumed much of Charlie's professional career. Charlie really wants to see unraveled the yet-remaining uncertainty about the Canyon; that is, the area of western dip of the lower Paleozoic formations west of the edge of the Kaibab Plateau, at the Grand Wash Cliffs. West of this point there is a band of block-faulted strata lacking the entire Paleozoic section. Charlie has been intrigued by the missing one to one-and-a-half kilometer section of Paleozoic strata (Noonday Dolomite and the Johnnie Formation). These are the strata older than the lower Paleozoic units of the Grand Canyon, which would have normally rested on unmetamorphozed Precambrian marine sedimentary rocks. Could they, Charlie proposes, have been displaced to the west, into what is now the Mojave Desert of eastern California, via low-angle detachment faults? Charlie admits that he has not always been a proponent of low-angle faulting in the region and that he was once a "thruster."

Embedded in Charlie's strong desire to see the Grand Canyon enigma solved is his appreciation of a well-documented chronology of his predecessors and peers in Canyon work, some of whom include:

1. John Wesley Powell, and his theory of base-level control over river erosion;
2. Clarence E. Dutton, who proved that the river cuts through its own elevated rim;
3. Grove Karl Gilbert, who found differentiation between the Basin and Range province and the Colorado Plateau;
4. Charles D. Walcott, and his detection of renewed Tertiary-aged movement of the Great Plateau faults;
5. Oscar E. Meinzer's emphasis upon the importance of ground-water movement in the geologic section surrounding the Canyon, and the presence of a westward facies transition from dissolution-prone limestone to lesser-affected dolomite;
6. Levi F. Noble's discovery of "The Chaos" of Death Valley, the phenomenon of westward-directed detachment faults; and,
7. Peter Huntoon and his idea that regional groundwater circulation occurs through karst features of the Kaibab Plateau.

It is Charlie's still unpopular contention that the above discoveries, coupled with his own western Colorado Plateau work, point to an undeniable removal of the off-Canyon Paleozoic section by a combination of denudation and westward fault displacement of mountain-sized blocks. But if he were not plagued with this question he would have found another of substance to capture his curiosity.

HIS LATEST WORKS

In 1990, Charlie was still searching out G. K. Gilbert's field stations in Utah, as he did when he was compiling GSA Memoir 167, *Geology of the Henry Mountains as Recorded in the Notebooks of G. K.*

Gilbert, Powell Survey, 1875–76" (Ross, 1989). To complete this work, he and Alice tracked Gilbert's trail from photocopies of original field books, lying untouched by everyone else, in the Survey's Denver archives. One of the sympathetic observations that Charlie and Alice made on that trail was to note the deterioration in the quality of Gilbert's precise hand-inscribed notes immediately following his observation of "fresh moccasin tracks."

What's keeping Charlie busy now that his field work is limited? He has a project "Age of Formation of the Grand Canyon, as Told by Grandad" which has had some setbacks but is still in the works. Also he is widely regarded in Utah as an expert from whom the press can seek and receive an unbiased comment on land management issues, and he has been able to help the Bureau of Land Management in their Environmental Impact Statements. He has a number of other ongoing writing projects. His writing is still done on a massive 1920-model black-porcelain-finished Underwood typewriter.

Charlie and Alice live a comfortable life of reduced activity due to his poor eyesight. He towers at six-foot-three inches and weighs the same as the day he joined the Survey, 63 years ago. He is an exciting conversationalist eager to give and trade ideas. Charlie never got around to completion of those graduate studies, yet his published gifts alone equal, in worth and number, the accomplishments of many other prominent geologists, save, of course, the giant Gilbert whose trail Charlie has paced with great zeal for years.

Today, the Hunt's living room in southwest Salt Lake City is well stocked with their libraries and W.H. Holmes' landscape drawings of the Grand Canyon (from Clarence E. Dutton's 1881 USGS Monograph No. 2) dominate the walls. Down a flight of stairs, past framed copies of the Survey's first two national geologic maps (1886 and 1893), is Charlie's office, replete with the technical tools, files, and books of his 63 years' interest in geology, history, archeology, and other fields. A skychart, created by Charlie, with the help of Greek mythology, and which has been on the ceiling of each of their family homes since the mid-forties, graces the ceiling of the library, evidence of Charlie's fondness for the same firmament of stars noted by Grove Karl Gilbert in the clarity of the Utah desert in his notebook sketch of source of *The Pleides*. Charles Butler Hunt is still chasing and working on interesting ideas about geology, and that is the second good reason, following his legacy of surficial geology and terrain evaluation, that engineering geologists should have in making use of the results of his life work.

HONORS

Charlie's life contains a string of honors: Honorary Memberships bestowed by Phi Beta Kappa, The Society of the Sigma Xi, Baylor Geological Society, Utah Geological Society (of which he is a founder), Distinguished Lecturer of the American Association of Petroleum Geologists, professorships at Johns Hopkins University and New Mexico State University, adjunct professor at Brigham Young University, membership on the Geological Survey's Powell Centennial Committee, and an Interior Department Gold Medal for Distinguished Service (6 August 1962).

An Interior Department citation of 6 August 1962, on the advent of his retirement, is a worthy summation of Charlie's professional career and character. The following are two appropriate excerpts:

> "Mr. Hunt is one of the country's leading general geologists, and a world leader in several geologic specialties—the geology of small intrusions, desert geomorphology and stratigraphy of continental deposits. He has made outstanding contributions on the disciplines of botany, archeology, pedology, and geography... In 1942 he was assigned to administrative work where he served with distinction for eleven years. He brought into his work the highest degree of moral earnestness, vigor, imagination and capacity for organization. This invariably resulted in adoption of new ways and new ideas, and in molding of an enthusiastic, productive and loyal staff."

In Charlie's words:

> "My Dad always pooh-poohed such citations as false gods. Like other senior officers he did have a chest full of campaign ribbons but he never spoke about them. I never knew about the citation he received for his DSM (Distinguished Service Medal) following WWI until my grandson, a VMI (Virginia Military Institute) graduate, discovered the citation in the military archives at Fort Leavenworth! So the military citations rather illustrate my Dad's low opinion of them. Included with the QMC (Quartermaster Corps) citation is the citation received by me when I was presented the Interior Department's

gold medal, its DSM. So again, beware of the false gods!"

ACKNOWLEDGMENTS

First of all, my thanks go to Alice P. and Charles B. Hunt; for providing me the best New Year's Day I've had—and it had nothing to do with bowl games or parades! That was 1991 and my excuses for not having earlier completed my self-imposed assignment are not worth hearing. I sought out Charlie because of his overall reputation and on the value of his works to engineering geologists. I was excited to have learned a great deal from and about Charlie, as well as some new historical and technical perspectives about our profession. Between Alice, and Charlie, Frank Whitmore, Jr., and Ken Lohman, sole survivor of the MGU incendiary balloon investigation of nearly fifty years ago, what we were able to put together was a lode of clear and precise information, and all of that as Charlie nears his ninth decade. Mr. Dennis Vetock, of The Center for Military History, U.S. Army, Carlisle Barracks, Pennsylvania, provided some of the historical names and dates from World War II.

My only regret has been singular—on New Year's Day Alice deftly slipped away from me that really attractive photo of her, riding pants leg-up on the running board of the Government 1928 Model A Ford pickup truck at the Rio Puerco. But how can one even think of embarrassing such a gracious lady as Alice, for exercising self determination and humility?

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