Proposed legend and correlation of map units for revised state geologic map

Orin J. Anderson and Glen E. Jones

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Proposed legend and correlation of map units for revised state geologic map

by *Orin J. Anderson* and *Glen E. Jones*, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM 87801

This correlation and description of geologic units is proposed for the next edition of the state geologic map. Digitizing of geologic maps, both detailed (large-scale) and regional (small-scale), published since 1965 is underway at the New Mexico Bureau of Mines and Mineral Resources. If you wish to comment on any aspect of the map project, including the units and descriptions shown here, please write to:

State Geologic Map Committee
New Mexico Bureau of Mines and Mineral Resources
Campus Station
Socorro, NM 87801

Qa Alluvium; upper and middle Quaternary

Ql Landslide deposits and colluvium; Quaternary

Qe Eolian deposits; Quaternary

Qeg Gypsiferous eolian deposits; Quaternary

Qd Glacial deposits; till and outwash; upper and middle Pleistocene

Qx Lacustrine, playa-lake, eolian and alluvial deposits of major lake basins; upper Quaternary

Qp Piedmont alluvial deposits; upper and middle Quaternary; includes alluvial fan deposits bordering major stream valleys

Qb Basalt and andesite flows and vent deposits; Quaternary

Qr Silicic volcanics; Quaternary

Qv Basaltic volcanics; tuff rings, cinders, and lavas; Quaternary

Qbo Basalts of North Plains area; lower and middle Pleistocene

QTb Basaltic and andesitic volcanics interbedded with Pliocene and Pleistocene sedimentary units

QTa Older alluvial deposits; of upland plains areas, mid-Pleistocene to mid-Pliocene

QTr Silicic flows and domes interbedded with Pliocene and Pleistocene sedimentary units

QTe Older eolian cover sediments and calcic soils of the High Plains region; primarily Blackwater Draw Formation; includes scattered playa-lake, alluvial, and recent dune-sands deposits (e.g. Tahoka, Double Lakes, Tule, and Blanco Formations of the Southern High Plains area); upper Pliocene and Pleistocene

QTg Gila Group. Includes Mimbres Formation (Plio–Pleistocene) and several unnamed units in southwestern intermontane basins; Miocene to middle Pleistocene (base probably uppermost Oligocene)

QTgu Upper Gila Group; uppermost Miocene to Pleistocene

QTsf Santa Fe Group, undivided. Intermontane basin fill of Rio Grande rift region; uppermost Oligocene to middle Pleistocene

QTs Upper Santa Fe Group. Includes Camp Rice, Fort Hancock, Palomas, Sierra Ladrones, Ancha, Puye, and Alamosa Formations; uppermost Miocene to middle Pleistocene

Tg Lower part of Gila Group; uppermost Oligocene, Miocene, and lower Pliocene

Tsf Lower and middle Santa Fe Group. Includes Hayner Ranch, Rincon Valley, Popotosa, Cochiti, Tesuque, Chamita, Abiquiu, and Los Pinos Formations; uppermost Oligocene and Miocene

Tus Upper Tertiary sedimentary units of Colorado Plateau region, undivided; may locally include Fence Lake and Bidahochi Formations of the Little Colorado Basin, and Gila Group in the northern Mogollon–Datil volcanic field

Tbi Bidahochi Formation; alluvial, lacustrine, eolian, and spring deposits of southern Colorado Plateau region; middle(?) Miocene to lower Pliocene

Tfl Fence Lake Formation; coarse alluvial deposits with minor eolian facies and pedogenic carbonates, of the southern Colorado Plateau region; mainly Miocene, (base probably uppermost Oligocene)

To Ogallala Formation, alluvial and eolian deposits, and petrocalcic soils of Great Plains province; middle Miocene to lower Pliocene (locally includes unit QTe)

Tlp Los Pinos Formation (lower Santa Fe Group); includes Carson Conglomerate (Dane and Bachman, 1965) in Tusas Mountains–San Luis Basin area

Tos Mostly Oligocene and upper Eocene sedimentary units, dominantly volcaniclastic with local intermediate volcanics; includes Espinaso, Spears, Monument Park Sandstone, and Palm Park Formations

Tnb Basalt and andesite flows; Neogene. Includes flows interbedded with Santa Fe and Gila Groups

Tnr Silicic volcanic rocks; Neogene

Tc Chuska Sandstone; limited to Chuska Mountains, in northwest

Tv Middle Tertiary volcanic rocks, undifferentiated

Tuv Upper Oligocene volcanic rocks, undifferentiated; younger than 31–32 Ma

Tlv Lower Oligocene and Eocene volcanic rocks, undifferentiated (dominantly silicic); rocks 32 Ma and older

Tuau Uppermost Oligocene and lower Miocene andesitic rocks (26–18 Ma). Includes Bear Wallow Mountain Formation

Tual Upper Oligocene andesitic rocks (31–26 Ma); includes Uvas Basalt and Poverty Creek basaltic andesite

Turp Upper Oligocene rhyolitic pyroclastic rocks (ash-flow tuffs); includes South Crosby Peak Formation, La Jencia, Vick's Peak, Lemitar, La Jara Peak, South Canyon Tuff, Bloodgood Canyon Tuff, Shelley Peak, Turkey Springs, Tuff of Little Mineral Creek, and others. Some contain volcaniclastic and reworked volcaniclastic rocks.

Tlrp Lower Oligocene rhyolitic pyroclastic rocks (ash-flow tuffs); includes Hell's Mesa, Kneeling Nun, parts of the Bell Top Formation, Caballo Blanco, Datil Well, Rock House Canyon and Blue Canyon Tuffs, and other volcanic and interbedded volcaniclastic units (e.g. Spears Formation) formerly referred to as Datil Group

Tla Lower Tertiary, (Eocene and lower Oligocene) andesite and basaltic andesite flows, and associated volcaniclastic units. Includes Rubio Peak Formation

Turf Upper Oligocene rhyolitic flows and masses

Tlrf Lower Oligocene rhyolitic flows and masses

Ti Tertiary intrusive rocks; undifferentiated

Tui Miocene to Oligocene rhyolitic to intermediate dikes, masses, plugs, and diatremes

Tuim Middle Tertiary mafic intrusive rocks

Tli Quartz monzonites (Eocene) in the Silver City area and Los Pinos Range, intermediate intrusives of the Cooke's Range (Oligocene), and other intermediate to felsic dikes and plugs of Eocene and Oligocene age

Tps Paleogene sedimentary units; includes Baca, Galisteo, Love Ranch, and Lobo Formations. (Equivalent to Eagar Formation in east-central Arizona)

Tsj San Jose Formation; Eocene, San Juan Basin

Tn Nacimiento Formation; Paleocene, San Juan Basin

Tpc Poison Canyon Formation; Paleocene, in Raton Basin

TKm McRae Formation, Cutter Sag—Engle Basin area

TKoa Ojo Alamo Formation, in San Juan Basin

TKa Animas Formation, in northeast San Juan Basin

TKr Raton Formation, in Raton Basin

TKav Andesitic volcanics

TKi Late Cretaceous and Paleogene intrusive rocks

K Cretaceous rocks, undivided; in extreme southwestern area includes Ringbone Formation, which may extend into lower Tertiary

Ksv Sedimentary and volcaniclastic sedimentary rocks; restricted to southwestern area

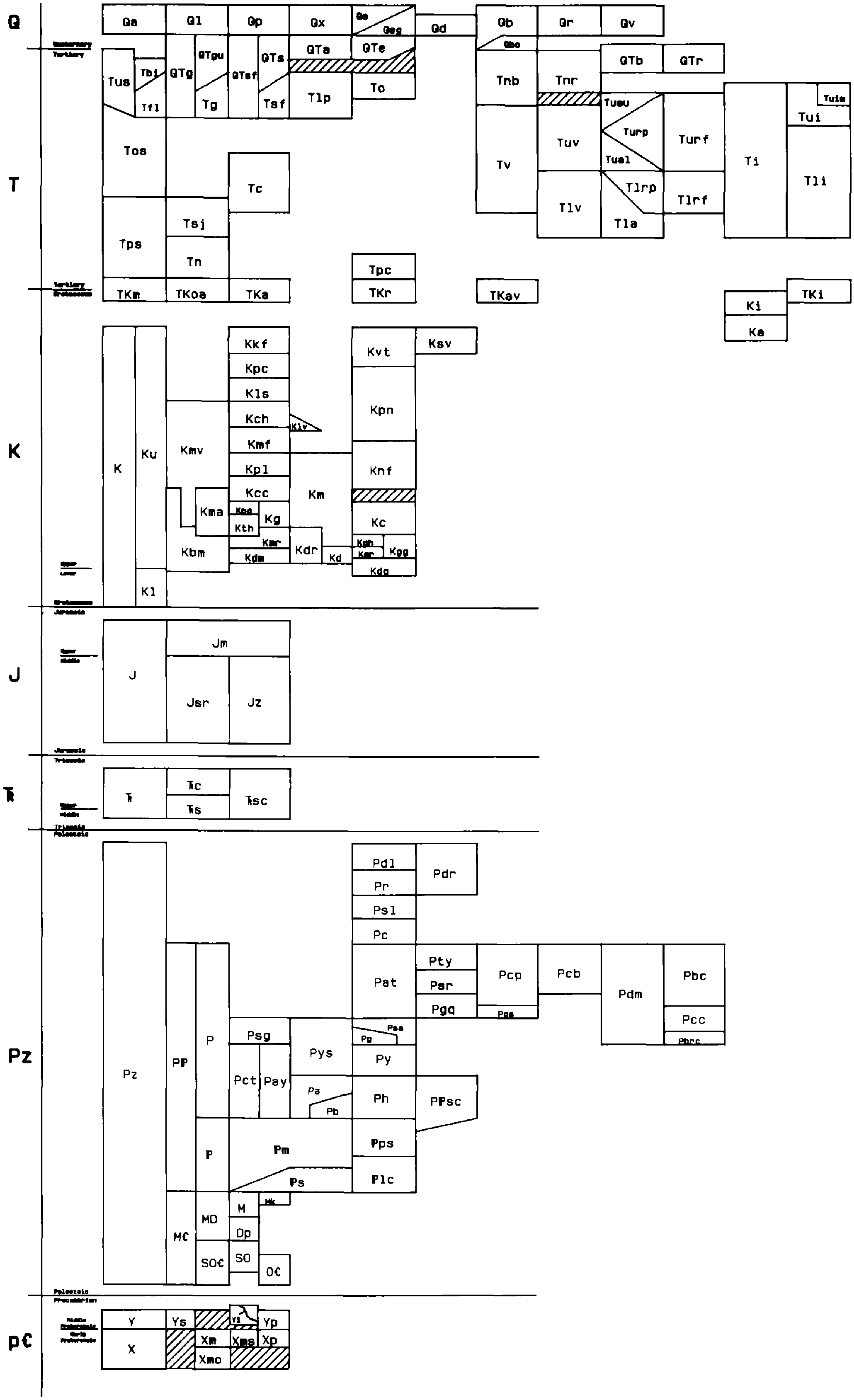
Ki Latest Cretaceous intrusive rocks; restricted to Copper Flats area in Sierra County

Ka Latest Cretaceous andesite flows; restricted to southwestern area

Ku Upper Cretaceous (Gulfian Series); undivided. Includes Virden Formation (Elston, 1960) in Virden area

Kvt Vermejo Formation and Trinidad Sandstone

Kkf Kirtland and Fruitland Formations; coal-bearing



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Kpc Pictured Cliffs Sandstone; prominent cliff-forming marine sandstone

Kls Lewis Shale

Kpn Pierre Shale and Niobrara Formation

Knf Fort Hays Limestone Member of Niobrara Formation

Kmv Mesaverde Group includes the Gallup Sandstone, Crevasse Canyon Formation, Point Lookout Sandstone, Menefee Formation, and Cliff House Sandstone

Kch Cliff House Sandstone

Klv La Ventana Tongue of the Cliff House Sandstone

Kmf Menefee Formation; coal-bearing

Kpl Point Lookout Sandstone; prominent cliff-forming marine sandstone. In McKinley and Sandoval Counties. The lower Point Lookout, the Hosta Tongue, is separated from the main body by the Satan Tongue of the Mancos Shale.

Kcc Crevasse Canyon Formation; coal-bearing

Kg Gallup Sandstone; prominent cliff-forming marine sandstone; locally includes the overlying D-Cross Tongue of the Mancos Shale

Kmr Rio Salado Tongue of the Mancos Shale. Overlies Twowells Tongue of Dakota Sandstone; mapped only where Tres Hermanos Formation is present; included with Dakota Sandstone as Kdr in Socorro County area

Kpg Pescado Tongue of the Mancos Shale and Gallup Sandstone; in Zuni Basin only. Pescado is mostly of Juana Lopez age.

Kth Tres Hermanos Formation; (formerly designated as lower Gallup Sandstone in the Zuni Basin)

Kma Moreno Hill Formation and Atarque Sandstone, in Salt Lake coal field and extreme southern Zuni basin

Km Mancos Shale

Kdr Dakota Sandstone (inclusive of Twowells Tongue) and Rio Salado Tongue of the Mancos Shale

Kdm Intertongued Dakota Mancos sequence of west central New Mexico; includes the Whitewater Arroyo Tongue of Mancos Shale and the Twowells Tongue of the Dakota

Kd Dakota Sandstone includes the main body—Oak Canyon, Cubero, and Paquate Tongues

Kc Carlile Shale; limited to northeastern area

Kgg Graneros Shale and Greenhorn Formation; limited to northeastern area

Kgh Greenhorn Formation; limited to northeastern area. The upper member (Bridge Creek Ls.) can be traced into western area.

Kgr Graneros Shale; limited to northeastern area

Kdg Dakota Group of east-central and northeastern New Mexico; includes both Lower and Upper Cretaceous rocks

Kbm Mancos Formation and Beartooth Quartzite; Mancos includes what was formerly referred to as Colorado Shale, which in turn may include equivalents of Tres Hermanos Formation

Kl Lower Cretaceous (Commanchean Series), undivided

J Jurassic rocks, undivided

Jm Morrison Formation; upper Jurassic rocks in northern third of state

Jz Zuni Sandstone; undivided equivalent of the Entrada and Cow Springs Sandstones; restricted to Zuni Basin. Homotaxial equivalent to the Entrada Sandstone as used in northeastern Arizona

Jsr San Rafael Group; includes middle Jurassic sequence of Entrada Formation and the Todilto, Beclabito, and Horse Mesa Members of the Wanakah Formation

TR Triassic rocks, undivided

TRsc Santa Rosa and Chinle Formations

TRc Chinle Formation; locally includes Moenkopi Formation at base

TRs Santa Rosa Formation

Pz Paleozoic rocks, undivided

P Permian rocks, undivided

Pdr Dewey Lake and Rustler Formations

Pdl Dewey Lake Formation; Ochoan-age red sandstone and siltstone

Pr Rustler Formation; Ochoan-age siltstone, gypsum, sandstone, and dolomite

Psl Salado Formation; Ochoan-age evaporite sequence

Pc Castile Formation; Ochoan-age dominantly anhydrite sequence

Pat Artesia Group; Guadalupian-age shelf facies forming broad S–SE trending outcrop from Glorieta to Artesia area; includes Grayburg, Queen, Seven Rivers, Yatés, and Tansill Formations

Pty Yates and Tansill Formations. Sandstone, siltstone, limestone, dolomite, and anhydrite

Psr Seven Rivers Formation. Gypsum, anhydrite, salt, dolomite, and siltstone

Pgq Grayburg and Queen Formations. Sandstone, gypsum, anhydrite, dolomite, and red mudstone

Pcp Capitan Formation; upper Guadalupian-age limestone (reef facies)

Pcb Carlsbad Limestone; equivalent to Seven Rivers, Yates, and Tansill Formations

Pdm Delaware Mountain Group; includes Brushy Canyon, Cherry Canyon and Bell Canyon Formations

Pbc Bell Canyon Formation; basin facies-sandstone, limestone, and shale

Pcc Cherry Canyon Formation; basin facies-sandstone, limestone, and shale

Pbrc Brushy Canyon Formation; basin facies-sandstone, limestone, and shale

Pgs Goat Seep Formation; Guadalupian-age limestone and dolomite (reef facies)

Psa San Andres Formation; limestone and dolomite with minor shale

Pg Glorieta Sandstone; mature quartz sandstone

Psg San Andres and Glorieta Formations

Pco Cutoff Shale; in Brokeoff Mountains only

Pvp Victorio Peak Limestone; in Brokeoff Mountains only

Py Yeso Formation; sandstones, siltstones, anhydrite, gypsum, halite, and dolomite

Pa Abo Formation; red beds

Pys Yeso Formation and San Andres Formation undivided

Pay Abo and Yeso Formations undivided

Pct Cutler Formation; used in Nacimiento Mountains and Chama embayment only

Ph Hueco Formation; limestone unit restricted to south central area

Pb Bursum Formation

PIP Undivided Permian and Pennsylvanian rocks

PIPsc Sangre de Cristo Formation

IP Pennsylvanian rocks, undivided

IPm Madera Formation; in Sangre de Cristo Mountains includes Porvenir and Alamitos Formations of Baltz and Myers (1984)

IPps Panther Seep Formation

IPs Sandia Formation; predominately clastic unit (commonly arkosic) with minor black shales, and carbonate

IPlc Lead Camp Formation

MЄ Cambrian through Mississippian rocks, undivided; includes Bliss Sandstone (Cambrian and Ordovician), El Paso Formation and Montoya Group (Ordovician); locally rocks of Devonian age, and the Lake Valley Limestone (Mississippian)

MD Mississippian and Devonian rocks, undivided; includes the Lake Valley Limestone of Mississippian age, and the Oñate, Sly Gap, Contadero, and Canutillo Formations in the northern Franklin Mountains

M Mississippian rocks, undivided

Mk Kelly Limestone; of Socorro and Sierra Counties

Dp Percha Shale; Caballo Mountains area

SOЄ Cambrian through Silurian rocks, undivided

SO Silurian and Ordovician rocks, undivided

OЄ Ordovician and Cambrian rocks, undivided; includes Bliss Sandstone, El Paso Formation, and Montoya Group

Yi Precambrian mafic dikes; diabase, metadiabase, metadiorite mainly of Burro Mountains; age not well constrained

Ys Precambrian sedimentary rocks of the Sacramento Mountains

Yp Precambrian plutonic rocks younger than 1600 Ma

Xm Precambrian metamorphic rocks, dominantly felsic, age 1650–1700 Ma

Xms Precambrian metasedimentary rocks, age 1650–1700 Ma, basically equivalent to Hondo Group which includes up to 2000 m of quartzite and pelitic schist

Xp Precambrian plutonic rocks generally older than 1600 Ma

Xmo Precambrian metamorphic rocks, dominantly mafic, age 1720–1760 Ma

Y Middle Proterozoic rocks, undifferentiated

X Early Proterozoic rocks, undifferentiated □

Alvin J. Thompson (1903–1990)

Alvin J. (Lefty) Thompson was the Director of the New Mexico Bureau of Mines and Mineral Resources from 1957 to 1968. During his years of leadership, he developed the metallurgical and chemical laboratories at NMBMMR and was an active mineral-industry leader, professor, and metallurgical researcher. In the 1962–1964 Annual Report of NMBMMR, he wrote "... New Mexico must actively contribute to the promotion of its mineral resources and take the lead in research and development work if it is to attract proper and prudent growth. At the same time the State has a primary obligation to see that mineral development and utilization proceed with due regard to the best conservation practices . . . " Lefty was a metallurgist, but he strongly supported a broad mineral-resources and geologic program for New Mexico.

Mr. Thompson was born July 7, 1903 in Lake City, Iowa, and passed away April 5, 1990. He is survived by his wife, Betty S. Thompson, and son, Richard B. Thompson, as well as grandson, Prescott Alvin Thompson.

Lefty received his B.S. in 1927 and M.S. in 1933 from the University of Arizona and was honored by the University with an Award of Merit in 1960. He had honorary memberships in Phi Kappa Phi (scholastic), Delta Phi Sigma (mathematics), and Sigma Delta Psi (athletic).

He worked for United Verde Mining Company, Phelps Dodge Copper Company, Davis Dunkirk Mines, and Hillside Mining Company in Arizona. During World War II, he did research work at the Batelle Memorial Institute in Columbus, Ohio, which included service on the War Metallurgy Committee of the National Academy of Sciences and development of new methods of extracting metals from many types of ores. He taught for five years at the University of Arizona and for eleven years at the New Mexico Institute of Mining and Technology, serving as chairman of the Mining and Metallurgy Department. From 1957 to 1968 he was Director of the New Mexico Bureau of Mines and Mineral Resources, retiring in 1968.

Mr. Thompson was a registered professional engineer in New Mexico and Arizona and had been a member of the American Chemical Society, Society of Professional Engineers, American Institute of Mining and Metallurgical Engineers, and the Association of American State Geologists. He was a longtime member of the New Mexico Mining Association, serving as president and for many years on the Board of Directors, being Emeritus Director after his retirement. He helped establish and was past chairman of the Central New Mexico Section of AIME and chairman of the New Mexico Mining Safety Advisory Committee.

Lefty was an avid mineral collector and his specimens include some magnificent pieces of smithsonite from the world-famous Kelly mine in the Magdalena mining district, central New Mexico. He oversaw the transfer of New Mexico Tech's Mineral Museum from the basement of Brown Hall, the administration building, to four large bays in the new (in 1958) wing of Workman Center, where it became the responsibility of NMBMMR. With his encouragement, the Mineral Museum assembled one of the more significant collections in the Southwest. As Director of NMBMMR, he was fiscally conservative, as required by the times, but he encouraged and supported new ideas and new projects that helped development of the State's mineral resources. In addition to overseeing projects, he personally wrote some 17 published reports including three on silver, lead, and zinc deposits of New Mexico.

As evidenced by his membership in Sigma Delta Psi, Lefty was an active athlete. During the middle 60's he was the most skilled member of a doubles handball team that twice won the New Mexico Tech campus championship, playing against tall vigorous juniors and seniors. After his retirement in 1968, he had considerably more time to play tennis, which he did almost every morning, often with his wife Betty. Some of his last active moments were on the tennis court. An Alvin J. Thompson Scholarship Fund has been established at New Mexico Tech in his honor.

Eugene Callaghan (1904–1990)

Eugene Callaghan was the eighth Director of the New Mexico Bureau of Mines and Mineral Resources division of New Mexico Institute of Mining and Technology, serving from September 1949 through January 1957. He expanded the Bureau from a staff of ten to thirty-one employees and began many of the geology and mineral-resource programs in place today, with heavy emphasis on field geologic mapping. Dr. Callaghan was active in the Association of American State Geologists (AASG), serving as Statistician and hosting AASG in Socorro in 1954. He was elected Honorary Member of AASG as well as of the New Mexico Geological Society (NMGS) and the Utah Geological Association. Eugene strongly supported the annual spring meetings and fall field conferences of NMGS, beginning the close cooperation between NMBMMR and NMGS.

Dr. Callaghan was born in Snohomish, Washington, and raised in Newport, Oregon. He married Edna Curtis Spenker of San Francisco; they raised two sons, Curtis John Callaghan, now in Petropolis, Brazil, and Dr. William S. Callaghan, Salt Lake City.

Dr. Callaghan received his B.A. and M.A. in geology from the University of Oregon and his Ph.D. in geology from Columbia University in 1931. He worked for the U.S. Geological Survey until 1946, doing projects in Utah, Nevada, Massachusetts, Puerto Rico, and South America. In 1946, he was appointed Professor of Economic Geology at Indiana University, and from there came to New Mexico and NMBMMR. In early 1957, he served as international consultant to Haile Mines Corporation, DeLiew, Cather and Company, and other firms doing geologic work in Cuba, Mexico, Canada, Turkey, and Iran. From 1958 through 1965 he was Chief Geologist for the Cyprus Mines Corporation working in Cyprus, Greece, Israel, Arabia, Spain, Portugal, and Morocco.

In 1965, Dr. Callaghan joined the Utah Geological and Mineral Survey as Associate Director, and in 1968 he became a professor and the first chairman of the newly organized Geology and Geophysics Department of the University of Utah. He retired from public service in 1972.

After retirement, Dr. Callaghan continued geologic consulting and attending professional conferences in such diverse areas as China, Australia, Antarctica, Ireland, Scotland, and Kenya. He frequently attended the annual meetings of the Association of American State Geologists at various sites throughout the nation.

Dr. Callaghan was a Fellow of AIME, Geological Society of America, and the Society of Economic Geologists. He published about 60 scientific reports but also had many proprietary studies and maps that were not published. The published reports are mainly on areas in Utah, Nevada, and New Mexico, but his experience and knowledge spanned seven continents.

A moderately tall, lanky man, Eugene set a fast pace in the field and had penetrating questions concerning interpretation of outcrops. He was a living example of the axiom that the best geologists are those who see the most rocks. He directed by leading and working closely with his staff. He was always a perfect gentleman and was sympathetic but firm. With obvious reference to the Irish background of the name Callaghan, many of his friends called him Pat, but that referred to the good qualities of the Irish. In meeting deadlines he tended to work thirty-six hours straight. Thus, after such a period, it was safest to insist on doing the driving, so he could catch up on his sleep as a passenger and not as the driver. Overall, he had encompassing appreciation for the many beneficial aspects of geologic studies, ranging from developing mineral resources to helping laypersons enjoy the scenery that has resulted from geologic forces. A premier, practical economic geologist, he enthralled his students at Indiana and Utah universities with hands-on descriptions of Utah's Marysvale alunite, Nevada's Gabbs magnesite, Indiana's Gardner Ridge kaolin–halloysite, New Mexico's Santa Rita copper, Mexico's Santa Eulalia silver–lead, Cyprus' Skouriotissa copper, and Brazil's Minas Geraes diamonds and hematite deposits.

He left us January 8, 1990, two days before his 86th birthday.

—Frank E. Kottlowski