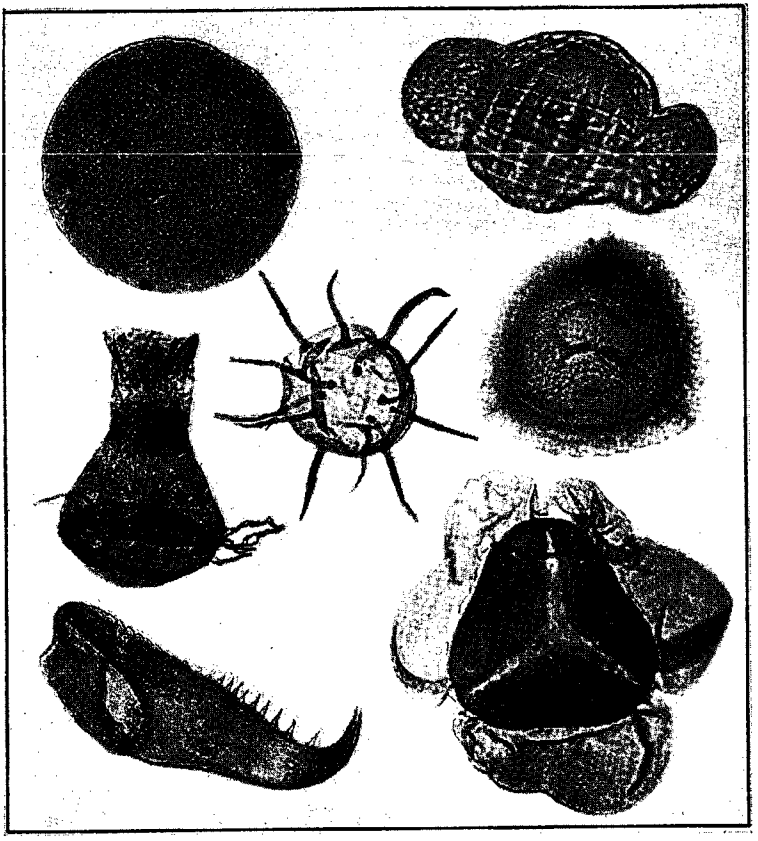
OKLAHOMA GEOLOGY NOTES



OKLAHOMA GEOLOGICAL SURVEY

NORMAN, OKLAHOMA

VOLUME 20 NUMBER 7

JULY, 1960

SINGLE NUMBER $0.25

SUBSCRIPTION $2.00

Paleobotanical Field Trip

The Paleobotanical Section of the American Botanical Society will meet at Stillwater, Oklahoma, August 29-30, 1960. Preceding the meetings will be a paleobotanical field trip, on August 26 and 27. The group will consist of approximately 30 members. The first day's trip will be from Stillwater to Lake Texoma where the party will spend the night at the University of Oklahoma Biological Station. The second day's trip will be from Lake Texoma to Stillwater via Tulsa.

Stops will be made en route at Norman to visit the Oklahoma Geological Survey; in the Arbuckle Mountains to observe the fossil algae of the Arbuckle group and the travertine at Turner Falls; near Baum to collect fossil charophytes; at Ada to visit the *Callixylon* monument for Dr. David White. Collecting Pennsylvanian plant compressions will be done near Porter and a visit will be made to the Palynology Laboratory of Jersey Production Research Company in Tulsa. The field trip is being led by Dr. L. R. Wilson of the University of Oklahoma and the Oklahoma Geological Survey.

Kansas Geological Society Field Conference

The Twenty-Fifth Annual Field Conference of the Kansas Geological Society will be held in northeastern Oklahoma September 16-17, 1960.

The field trip will be primarily concerned with studying the Atokan and Morrowan series on the southwest flank of the Ozark uplift; several excellent exposures of each will be visited including one outcrop showing Atoka channel sands. Stops will also be made at Mississippian and pre-Mississippian outcrops.

Dr. Jack Blythe, University of Wichita, will lead the field trip, assisted by Dr. C. C. Branson of the Oklahoma Geological Survey and Dr. G. G. Huffman of the University of Oklahoma.

Museum of the Great Plains

The new museum of the Comanche County Historical Society, located in Elmer Thomas Park, Lawton, has been officially named the Museum of the Great Plains. The Museum, under the directorship of Marvin E. Tong, Jr., historian and anthropologist formerly with the Missouri Archaeological Society, will collect and exhibit historical, archaeological, biological, and geological material of the Comanche County area. It is Mr. Tong's intention to set up an exhibit showing the geology of the Wichita Mountains and surrounding area.

NOEL SHALE IN NORTHEASTERN OKLAHOMA

GEORGE G. HUFFMAN AND JOHN M. STARKE, JR.

INTRODUCTION AND HISTORICAL RESUME—The term "Chattanooga" was first applied by Hayes (1891, p. 143) to the well-known "Black Shales" of Tennessee exposed near Chattanooga. Safford and Killebrew (1900, p. 104) proposed the name "Hardin" for the basal sandstone member of the Chattanooga formation.

In northern Arkansas, stratigraphically similar shales were called "Eureka" (name preoccupied) by Branner (1891, p. 26) and in southwestern Missouri they were named "Noel" by Adams (Adams et al., 1904, p. 24) from exposures near Noel, McDonald County, Missouri.

The Sylamore sandstone was named by Branner (Penrose, 1891, p. 113, 114) for exposures of yellow, brown, or gray earthy sandstone and interbedded green and black shale along Sylamore Creek, Stone County, Arkansas. The term "Chattanooga" was first extended into northwestern Arkansas by Adams and Ulrich (1905, p. 3) and applied to a Late Devonian sandstone and shale in the Fayetteville area. They defined the Sylamore sandstone as the basal member of the Chattanooga formation and stated that the upper black shale is the same as that exposed at Noel, Missouri.

Taff (1905, p. 3) applied the term "Chattanooga" to Upper Devonian black shales in the Tahlequah area of northeastern Oklahoma and described a local or lenticular deposit of conglomerate or sandstone, the Sylamore sandstone member, at its base.

Subsequent workers in the Ozark region of Arkansas, Oklahoma, and Missouri (Purdue and Miser, 1916; Ireland, 1930; Cram, 1930; Clark and Beveridge, 1952; and Huffman, 1958) have continued the usage of the term Chattanooga formation subdivided into a basal Sylamore member and an overlying unnamed black shale member.

PROPOSED TERMINOLOGY FOR NORTHEASTERN OKLAHOMA—It is proposed that the term Chattanooga be retained for Late Devonian-Early Mississippian shale and sandstone lying immediately below the St. Joe group and that the Chattanooga formation be divided into two members, the lower, or Sylamore, sandstone member and the upper, or Noel, black shale member.

Sylamore sandstone member: The Sylamore sandstone, although variable in thickness and erratic in distribution, crops out in several localities in northeastern Oklahoma. It has been identified from near Marble City in northern Sequoyah County (T. 13 N.) to the vicinity of Spavinaw, Mayes County (T. 22 N.). It occurs in the Marble City area on the eastern side of Quarry Mountain, in Payne Hollow, and along the side of Walkingstick Hollow. It crops out near Bunch in sec. 29, T. 14 N., R. 24 E., and at the bottom of a canyon in sec. 2, T. 16 N., R. 23 E., and in Prichards Hollow, sec. 9, T. 16 N., R. 23 E. In the Cookson area, it is present in Walkingstick Hollow in sec. 35, T. 14 N., R. 23 E.; in Natural Bridge Hollow, sec. 36, T. 14 N., R. 23 E.; in Hastings Hollow, sec. 36, T. 14 N., R. 23 E.; and east of Dry Creek in secs. 1 and 2, T. 14 N., R. 23 E. It is poorly developed in the Qualls area in sec. 35, T. 15 N., R. 21 E., and in secs. 14 and 15, T. 15 N., R. 20 E. In the Yonkers area it is present in secs. 30 and 31, T. 18 N., R. 20

E., and in sec. 36, T. 18 N., R. 19 E. In southern Mayes County, it occurs along Spring Creek in secs. 1 and 12, T. 19 N., R. 20 E. It crops out along Barren Fork in secs. 22 and 27, T. 17 N., R. 23 E., at Camp Egan in secs. 11 and 12, T. 17 N., R. 23 E.; along the Illinois River in sec. 9, T. 17 N., R. 23 E.; along Spring Creek in sec. 20, T. 19 N., R. 21 E.; and in Bryant Hollow, a tributary of Spring Creek in sec. 18, T. 19 N., R. 21 E. It is present locally in the Spavinaw Lake area.

The Sylamore sandstone is composed of well-rounded grains of sandstone and angular to well-rounded phosphatic pebbles. The basal portion is composed of dark gray to black sandy shale and blue-gray phosphatic calcareous sandstone. The color ranges from white to yellow to pink and black. The sand grains are of medium size, pitted, and have well-developed crystal faces. Fresh exposures of the sandstone exhibit a typical "salt and pepper" appearance. Normally the Sylamore is friable, but locally it is extremely hard and quartzitic.

Thickness is variable, reaching a maximum of 18 feet in sec. 29, T. 14 N., R. 24 E.

The Sylamore sandstone member of the Chattanooga formation unconformably overlies the St. Clair, Frisco and Sallisaw formations in the southern part of the area near Marble City. It rests upon the Fernvale, Fite, Tyner and Burgen along the Illinois River northeast of Tahlequah, on the Tyner near Murphy (T. 19 N.), the Burgen and Cotter along Spavinaw Creek (T. 22 N.). It is succeeded conformably by the Noel black shale member of the Chattanooga formation.

Faunal and floral remains include numerous small phosphatic brachiopods of the genus *Lingula*, fragments of "spirifers," traces of fossil wood, and molds of *Cordaites* (Huffman and Starke, 1960).

The Sylamore sandstone is correlated with the Misener sandstone of the subsurface of the Mid-Continent area and with the Hardin sandstone of Tennessee.

Noel shale member: The Noel black shale member of the Chattanooga formation is widely distributed throughout the Ozark uplift in northeastern Oklahoma (fig. 1). Near Marble City it is present around the sides of Jackson and Quarry Mountains and in intervening Payne Hollow, in Walkingstick Hollow, and in McEachin Hollow. Near Bunch, it is exposed along the Lyons fault in secs. 29 and 31, T. 14 N., R. 24 E. It is exposed in several deep stream cuts on the upthrown side of the Qualls-Welling fault in secs. 2, 9, 10, 16, 17, 18, 19, and 20, T. 16 N., R. 23 E.; along the Illinois River in secs. 25 and 36, T. 16 N., R. 22 E., and secs. 19, 30, and 31, T. 16 N., R. 23 E.; along the North Cookson fault in sec. 2, T. 15 N., R. 23 E.; on Blackgum Mountain, secs. 32 and 33, T. 14 N., R. 22 E.; in the Tenkiller Lake area in secs. 11, 20, and 21, T. 13 N., R. 21 E.; at Qualls Dome in sec. 35, T. 15 N., R. 21 E. and in secs. 1 and 2, T. 14 N., R. 21 E.; along the eroded crest of an anticlinal uplift near Fort Gibson (secs. 14 and 15, T. 15 N., R. 20 E.); along Clear Creek in secs. 20, 29, 30 and 31, T. 18 N., R. 20 E. and in sec. 36, T. 18 N., R. 19 E.; along Spring Creek in secs. 1 and 12, T. 19 N., R. 20 E.; and along Spavinaw Creek in and near Spavinaw. It crops out along Barren Fork, T. 17 N., R. 24 E., and along Illinois River east of Tahlequah in secs. 24, 26, and 35, T. 17 N., R. 22 E. It is exposed almost continuously along the Illinois River valley from sec. 8, T. 17 N., R. 23 E., northeast of Tahlequah to the vicinity of Flint in T. 20 N., R. 25 E. It is exposed

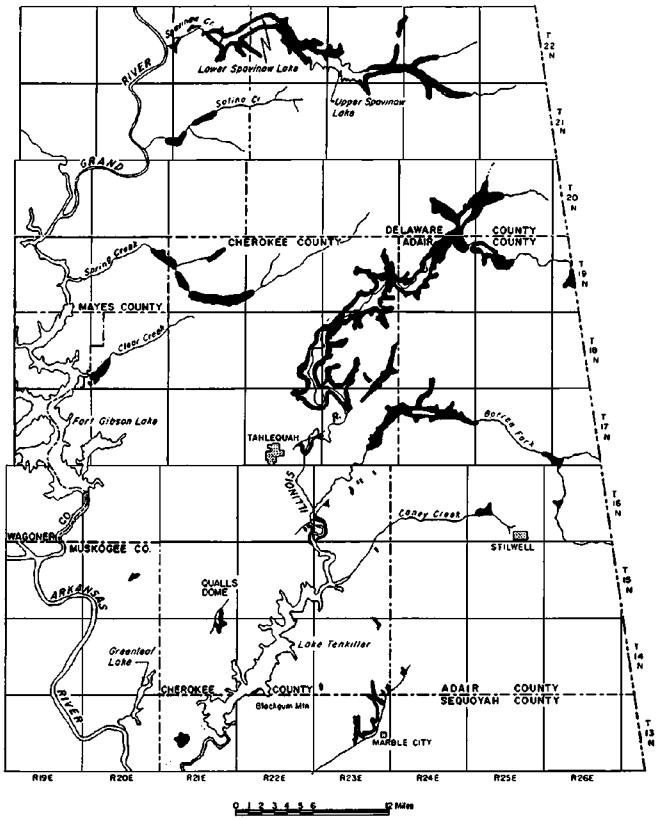


FIGURE 1. Map showing location of principal exposures of the Chattanooga formation in northeastern Oklahoma.

along Spring Creek and Bryant Hollow in T. 19 N., R. 21 E., and along Salina Creek in T. 21 N., Rs. 20 and 21 E. It crops out near Watts, T. 19 N., R. 26 E., and near Baron in T. 17 N., Rs. 25 and 26 E. It is exposed along Big Cabin Creek, secs. 23 and 26, T. 24 N., R. 20 E., Craig County (not shown on map).

The Noel shale is a fissile carbonaceous pyritic bituminous black shale. It is well jointed and breaks into quadrilateral blocks. Joint surfaces and

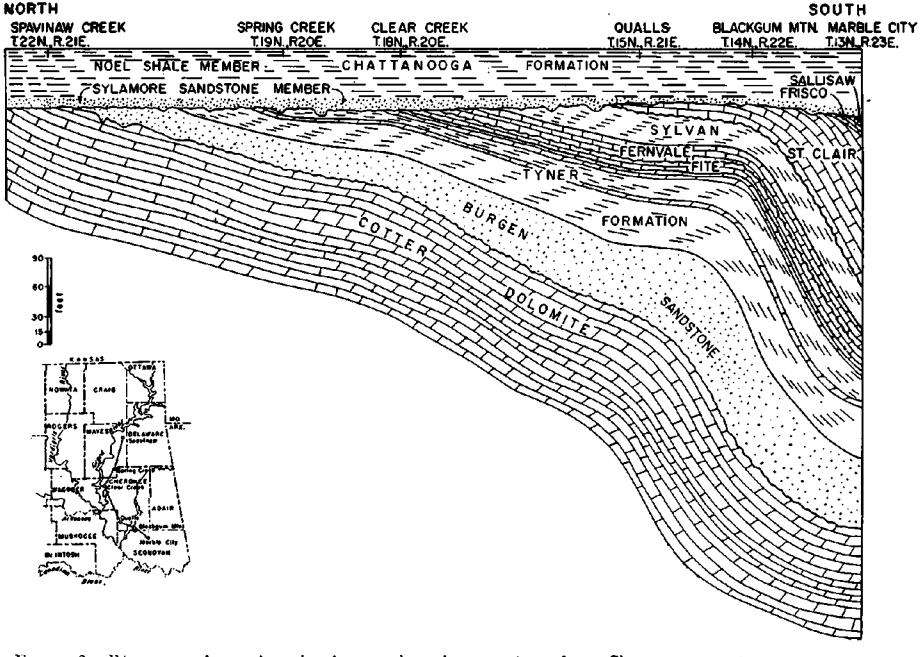


FIGURE 2. Diagrammatic section showing northward truncation of pre-Chattanooga units.

bedding planes are covered witht a yellow-red to brown film of iron oxide. Cone-in-cone structure is common in basal portions. A thin bed of phosphatic sandstone is present a few feet above the base in some sections.

The Noel shale lies conformably upon the Sylamore sandstone where that member is developed. Where the Sylamore is absent because of nondeposition, the Noel black shale lies with unconformity upon beds ranging in age from Early Ordovician Cotter, as near Spavinaw, to the Sallisaw formation of Devonian age near Marble City (fig. 2). The Chattanooga is succeeded unconformably by the limestones of the St. Joe group and the Reeds Spring formation.

The thickness ranges from a few inches near Bunch to more than 65 feet near Spaviaw.

The Noel shale is relatively unfossiliferous. It contains small linguloid brachiopods, conodonts, remains of *Dinichthys*, and a unicellular plant, *Tasmanites huronensis*.

The Noel shale is equivalent to the black shale member of the Chattanooga of Tennessee, the New Albany of Indiana and Kentucky, the Woodford of Oklahoma, the Ohio black shale, and the Antrim of Michigan. On the basis of conodonts it appears to be Late Devonian and Early Mississippian in age.

References Cited

Adams, G. I., Purdue, A. H., and Ulrich, E. O., 1904, Zinc and lead deposits of northern Arkansas: U. S. Geol. Survey, Prof. Paper 24.

Adams, G. I., and Ulrich, E. O., 1905, Description of the Fayetteville quadrangle [Arkansas—Missouri]: U. S. Geol. Survey, Geol. Atlas, Folio 119.

Branner, J. C., and Simonds, F. W., 1891, The geology of Washington County, Arkansas: Ark. Geol. Survey, Annual Report for 1888, vol. 4.

Clark, E. L., Beveridge, T. R., et al., 1952, Sixteenth regional field conference guidebook: Kansas Geol. Society, 93 p.

Cram, I. H., 1930, Cherokee and Adair Counties, *in* Oil and gas in Oklahoma: Okla. Geol. Survey, Bull. 40-QQ.

Hayes, C. W., 1891, The overthrust faults of the southern Appalachians: Geol. Soc. America, Bull., vol. 2, 141-154.

Huffman, G. G., 1958, Geology of the flanks of the Ozark uplift: Okla. Geol. Survey, Bull. 77, 281 p.

Huffman, G. G., and Starke, J. M., Jr., 1960, A new fossil plant locality in the Sylamore sandstone member, Chattanooga formation, northeastern Cherokee County, Oklahoma: Okla. Geol. Notes, vol. 20, p. 89-91.

Ireland, H. A., 1930, Mayes, Ottawa, and Delaware Counties, *in* Oil and gas in Oklahoma: Okla. Geol. Survey, Bull. 40-NN.

Penrose, R. A. F., Jr., 1891, The Batesville region of Arkansas: Ark. Geol. Survey, Annual Report for 1890, vol. 1.

Purdue, A. H., and Miser, H. D., 1916, Description of the Eureka Springs and Harrison quadrangles [Arkansas—Missouri]: U. S. Geol. Survey, Geol. Atlas, Folio 202.

Safford, J. M., and Killebrew, J. B., 1900, Elements of geology of Tennessee, 264 p.

Taff, J. A., 1905, Description of the Tahlequah quadrangle [Indian Territory—Arkansas]: U. S. Geol. Survey, Geol. Atlas, Folio 122.

Summer Schedule of Geological Survey

An unusually large number of projects are scheduled for the summer of 1960 by permanent and temporary members of the staff. Dr. Ham and Dr. Mankin plan to complete their study of borates in Permian evaporites. Dr. Unklesbay will study Pennsylvanian cephalopods during two summer months. Dr. Jordan and Mr. Vosburg will complete their work on subsurface evaporites of western Oklahoma. Dr. Kitts, assisted during July by Charles Rowett, will complete his mapping of Ellis County. Dr. Merritt, Dr. Ham, and Mr. Denison will complete their studies of pyroclastics and of subsurface basement rocks in the Wichita Mountain region.

Dr. Hunter will continue his work on the basic rocks of the central Wichita Mountain area and will direct master's theses in the area by W. L. Hiss, M. Charles Gilbert, A. B. Spencer, W. Karns, P. M. Rotan, and H. Johnson. Dr. Myers will complete his mapping of Woodward County and will direct Alton Riley on a study of the Doe Creek member. Also he will direct Frank Sorrell in Woodward County, Gene Jeary in Major County, Frank Lovett in Roger Mills and Ellis Counties, John Bowers in Roger Mills County, and Joe Meinert in Roger Mills and Beckham Counties. Richard Hedlund will assist him in July. Dr. Pitt will work on unmapped areas of Pushmataha County, and is directing Connie Krivanek, George Ray, and Larry Platt in their mapping, as well as preparing a guidebook to Beaver's Bend State Park. Don Seely will complete his field work of the Rich Mountain area, along the frontal belt of the Ouachita Mountains. Herman Burrough and Harry Todd have completed their reports on the Jumbo and Moyers quadrangles.

Dr. Huffman will prepare a report on Craig County and will finish a guidebook to the state parks of northeastern Oklahoma. Mr. Fay will be on leave to write a section of the *Treatise on Invertebrate Paleontology*. Mr. Curtis will complete his report on Bryan County. Mr. Oakes has reached retirement age and will be on a part-time basis to complete his report on Okmulgee County. Dr. Amsden will complete his report on the Frisco formation. Dr. Wilson will complete his work on the Flowerpot shale microflora, will finish his report with Richard Hedlund on the Sylvan shale Chitinozoa and hystrichosphaerids, will finish his report with James Urban on the Woodford shale spores, hystrichosphaerids, and *Tasmanites*, and will, with Maurice Higgins, complete a section of the study of an early Cabaniss coal. Dr. Branson will work with Dr. Huffman on the Craig County report and will complete, with Dr. Elias, a report on the Atoka series.

Dr. Ham and Dr. Jordan will attend the International Geological Congress meeting in Copenhagen, and Dr. Ham will read a paper there and will travel to study evaporites in Europe. Mr. Nicholson, our geologist-editor, will begin a geologic project in addition to his heavy editorial load. Mr. Schleicher will continue his spectrographic analysis of borates, of clays, and of other specimens which have long needed such analysis.

DARCY

CARL C. BRANSON

The unit of permeability is called a darcy. The permeability of a rock or other material is one darcy if one cubic centimeter of fluid of one centipoise viscosity will flow through a section one centimeter thick and of one square-centimeter cross section in one second at a pressure difference of one atmosphere. The unit is named for Henri Philibert Gaspard Darcy, a French engineer whose best known work is *Les fontaines publiques du ville de Dijon* (1856). Darcy is not mentioned in dictionaries nor in the *Encyclopaedia Britannica*, although the latter work perpetuates the name of Henry Garnet (alias Henry Darcy, and nine other aliases) who was an obscure conspirator in the Gunpowder Plot and was executed on May 3, 1606. The Britannica also immortalizes such trivial persons as Amelia D'Arcy, Lord Byron's half-sister's mother; Conyers D'Arcy, an obscure henchman of Charles I; Robert D'Arcy, even less notable; George Frederick D'Arcy (1828-1879), noted only for the fact that he held the title, Earl of Durham; Thomas Darcy Darcy, a stubborn and opinionated baron and soldier, beheaded by Henry VIII on June 20, 1537; and William Knox D'Arcy, an entrepreneur who obtained the oil concession for Anglo-Persian Oil Company, Ltd., from the government of Persia.

My dictionary (Funk & Wagnalls, *New Standard Dictionary*, 1935, p. 653) mentions Mr. Darcy, a character in Jane Austen's "Pride and Prejudice," and Count Patrick D'Arcy, an Irish military officer and mathematician.

The familiar measurement of permeability, the millidarcy, is embodied in each core analysis, and the obscurity of the man for whom the darcy unit was named is puzzling.

Levorsen (1954, p. 686) refers to the unit as a millidarcie, an obvious error, for on p. 101-102 he correctly gives the name, and he refers to Darcy's law (p. 101, 107). The *Glossary of Geology and Related Sciences* (Amer. Geol. Institute, 1957) refers to the unit as a darcy, but to the law as D'Arcy's law.

The many variations in spelling are typified by:

H. D'Arcy—Lalicker, *Principles of Petroleum Geology*, 1949, p. 109, also "Les Fountains Publiques."

H. D'Arcy—Tiratsoo, 1951, *Petroleum Geology*, p. 68, D'Arcy's law, p. 64, D'Arcy's Coefficient of Permeability, p. 64. Darcies, centidarcies, millidarcies, p. 65.

Henry Darcy—British Museum, *Catalogue of Printed Books, 1881-1900*, 1946.

Henry-Philibert-Gaspard Darcy—*Catalogue Général de Livres Imprimés de la Bibliothèque Nationale*, 1908.

Henry Philibert Gaspard Darcy—British Museum, *General Catalog of Printed Books*, vol. 48, 1952.

Henri Philibert Gaspard Darcy—Library of Congress, *Catalog of Printed Cards*, 1949.

Henry Darcy—*Catalogue Général de la Librairie Française Pendent 25 Ans* (1840-1865), vol. 10, p. 13.

H.-P.-G. Darcy—La Librairie Française, *Catalogue Général des Ouvrages en Vente au 1er janvier*, 1930, 1931, p. 613.

Henri Dárcy—McCray and Cole, 1959, *Oil Well Drilling Technology*, p. 17-18. The law is stated and is labeled Dárcy's Law. The unit is spelled Dárcy (p. 20).

Henri Philibert Gaspard Darcy—Poggendorf, *Biographisch-Literarisches Handwörterbuch*, vol. 3, p. 327, 1898.

The unit "darcy" as a measure of permeability was named by Wykoff, Botset, Muskat, and Reed in 1934 (p. 161, 167), but even they spelled the name H. D'Arcy (p. 163) and referred to D'Arcy's Law (p. 164, 165). They gave the plural as darcys, and we should follow that precedent. The millidarcy is a convenient unit equal to 1/1000 darcy.

Darcy's Law, according to Schlichter (1898), states that the velocity of the flow of a liquid in a given direction is proportional to the difference in pressure at the ends of the column and inversely proportional to the length of the column.

The rarity of copies of Darcy's book is probably the cause of the various misspellings, not only of his name, but of the title of the book. It is clear that the name is Henri (not Henry) Philibert Gaspard Darcy (not D'Arcy, Dárcy). No English language biography of Darcy was found, and a man of his attainments and services deserves to be memorialized in English, as well as in the three rather obscure French references located. It is possible that his name appears as Henry Darcy on his 1856 book, but no copy has been located here.

The following bibliographic record is modified from Muteau and Garnier (1860).

Henri Philibert Gaspard Darcy was born in Dijon on June 10, 1803, and died in Paris on January 2, 1858 (two authors say January 3). He was left fatherless at the age of fourteen years, and Darcy and his younger brother, Hugues Darcy, were raised by their mother, who guided them in the early steps of the brilliant career of each. The H. Darcy who was president of the Comité Central de Houillicre de France may have been Hugues. As a student in the Royal College of Dijon, Darcy, after having followed the course with distinction, entered in 1821 the Ecole Polytechnique, and was since 1820 in the Ecole des Ponts et Chausées, from which he departed in 1826 to be engineer in the department of Jura. He stayed only one year, and was asked to return to Dijon at the express request of the prefect and the deputation of the Côte-d'Or. As engineer in charge of the southern district, he built numerous roads, and constructed, among others, the bridges of Saint-Jean-de-Losne at Le Seurre, over the Saône. The work of drilling an artesian well undertaken in 1829 in Saint-Michel Place of Dijon, under the direction of the engineers of bridges and highways, became for Darcy the occasion of the beginning of his long and laborious researches into the behavior of water.

For no other reason than to give public service, he sought to procure for his natal city the pure and abundant water which it had needed for almost four centuries. His choice had been determined by the well of Rosoir, situated in the valley of Sujon, 12 kilometers from Dijon. Darcy presented, on December 25, 1833, to the municipal council, a report which

produced a strong reaction, and which that assembly, in its sitting of March 5, 1834, voted unanimously to have printed. This same project, complete with means and details of execution, was made ready for the examination of the Council on Bridges and Highways and of the Council of the State, and proved acceptable. A royal ordinance of December 31, 1837, had declared these works of public benefit; they were authorized on July 19, 1838, and begun on March 21, 1839. On September 6, 1840, the water entered the reservoir at the Guillaume Gate, with applause from a crowd which had not dared hope. May 7 of the same year, Darcy had been given the rank of engineer at the head of the department and on August 21, 1842, the government awarded him the Cross of Chevalier of the Legion of Honor. As recompense he was given all expenses and travel costs, as well as an honorarium which amounted to more than 50,000 francs. Darcy would not accept from his fellow citizens a gold commemorative medal (session of May 4, 1846) which the mayor, aided by a deputation of the city council, offered him publicly, as well as to his mother and his brother, whom Darcy had made known were associated in this work. The Academy of Sciences, Arts, and Belle-Lettres of Dijon had, on January, 1845, given him the title of resident member. Darcy belonged to the Commission on Antiquities of the department in the year 1834.

The public wells had not yet been finished when Darcy, in his desire to serve his country, occupied himself, with the devoted activity that he showed in all things, in finding a way to ensure to Dijon the route of the railroad line from Paris to Lyon. The route through the valley of the Seine, which best served the interests of Dijon, was abandoned; the two routes remaining, of which one was by the valley of the Serain and the other by the African hill, each left Dijon to one side. Darcy solved the problem: he studied with care the valleys of the Oze and of the Brenne and at the crossing of the tunnel of Blaisy found a route connecting the valley of the Yonne with that of the Seine. Thanks to these many surveys, and to discussions that he had before the Council General of Bridges and Highways, and before the commissions of the Chambers, this last route was adopted, and Darcy had at the same time the honor of being selected to supervise the work. The deputation then made the offer to Darcy, who had the rare courage to refuse a position so coveted at the time.

Darcy now seemed able to follow his own desires in his work when the February revolution of 1848 destroyed his plans. He had been too closely associated with men of high rank on the now discredited side not to be suspect to the new leaders. These men ousted him, and in spite of strong protests, Darcy was, in a sense, banished. He was named chief engineer of Cher, and there attacked the problem of the purification of the Sologne, vainly attempted since 1780.

He was so highly thought of by the Council General of Bridges and Highways that he had not completed this work when, on June 16, 1848, he was called to Paris as engineer and chief director of the Services of Water and Streets. This new position enabled him to resume his experiments, begun at Dijon, on the flow of water in pipes. He was made officer of the Legion of Honor, and in April 1850 was sent to London to examine the causeways, highways, and macadam roads of that city. On April 30 he was promoted to the grade of divisional inspector. Some years later, the administration of the city of Brussels, wishing to establish public wells, could think of nothing bet-

ter than to consult the creator of those of Dijon. Darcy, authorized by the Minister of Public Works, went to Brussels, and there received the decoration of the Order of Leopold. At the same time, Darcy submitted to the Academy of Sciences his memoir on the movement of water in tubes. This memoir, reviewed by a special commission, received the approval of the Academy, which, on June 26, 1854, ordered its insertion in the *Recueil des Savants Etrangers*.

He could not further ignore a longstanding weakness in health and asked relief from travel. He wrote on his researches on the movement of water in covered canals, for which the administration had made him responsible at the request of the Academy of Sciences. These experiences, enterprises of large scale, undertaken to design the canal from Bourgogne to Dijon, produced remarkable results. Unhappily, death unexpectedly came to Darcy and did not permit the completion of these interesting studies. Darcy's body was brought back to Dijon and was received by an immense gathering of the people, sorrowfully affected by the loss. Interpreting the general sentiment, the mayor of Dijon gave the name of Place Darcy to the plot in front of Guillaume Gate (January 5), and the Municipal Council voted on January 8 the erection of a bronze bust of the illustrious dead man, upon one of the faces of the monument which crowned his most beautiful creation, the artesian well.

Darcy had published:

1. Rapport à M. le maire et au conseil municipal de Dijon sur les moyens de fournir l'eau necessaire à cette ville: Dijon, 1834. quarto.
2. Rapport à M. le ministre des travaux publics sur le pavage et le macadamisage des chausées de Londres et de Paris: Annales des ponts et chaussées, Paris, 1850. Octavo. 262 p. and plate.
3. Les fontaines publiques de la ville de Dijon. Exposition et application des principles à suivre et des formules à employer dans les questions de distribution d'eau. Ouvrage terminé par un appendice relatif aux fournitures d'eau de plusiers villes, au filtrage des eaux et à la fabrication des tuyaux de fonte, de tâle et de bitume. Paris, Victor Dalmont. 1851, quarto, VII-647 p. and atlas of 28 plates.
4. Recherches expérimentales relatives au mouvement (de l'eau?) des eaux dans les tuyaux: Académie des sciences, Recueil des mémoires des savants étrangers.

Darcy had thus contributed notably to perfection of the gauging tube of Pitot.

5. Bazin, H., 1865, Recherches hydrauliques enterprises par m. H. Darcy, continuées par m. H. Bazin. Recherches expérimentales sur l'écoulement de l'eau dans les canaux découverts. Paris, National Press. Mem. Inst. Impérial de France.

This search for data on Darcy has been greatly aided by Dr. Duane Roller and by Mr. Alex. Nicholson.

Biographical Sources

Muteau, Ch., and Garnier, Joseph, 1860, Darcy (Henri-Philibert-Gaspard): Galerie Bourguignonne, vol. 3, p. 340-347. J. Picard, Dijon; Lamarche, Dijon; A. Durand, Paris; Dumoulin, Paris.

Dumay, M. 1845. Rapport a l'Académie des sciences de Dijon pour l'admission de M. Darcy au nombre de ses members residents: Frontin, Dijon, brochure in octavo. (not seen)

Charié-Marsaine, M., 1858. Notice nécrologique sur M. Darcy, inspecteur général des ponts et chaussées: Annales des ponts et chaussées, Paris (not seen)

Candemberg, Girard de, 18—, Notice sur M. Henri Darcy: Académic de Dijon, Mémoires, second series, vol. 6, p. 109. (not seen)

Tarbé de Saint-Hardouin, Pierre H., 1884, Notices biographiques surs les ingénieurs des ponts et chaussées. Encyclopedie des travaux publiques, p. 224-226, Paris.

References Cited

Levorsen, A. I., 1954, Geology of Petroleum: W. H. Freeman and Co., 703 p.

Schlichter, C. S. 1899, Theoretical investigation of the motion of ground waters: U. S. Geol. Survey, 19th Ann. Report, part 2, p. 295-384.

Wykoff, R. D., and others, 1934, Measurement of permeability of porous media: Amer. Assoc. Petroleum Geologists, Bull., vol. 18, p. 161-190.

Petroleum Facts and Figures

A Review

The Centennial Edition of *Petroleum Facts and Figures*, published by the American Petroleum Institute, brings together as much data about the petroleum industry as it is possible to fit between the covers of an eight-by-twelve-inch volume. The book contains 472 pages of figures and facts, listed by years and by states, concerning production, refining, transportation, marketing and utilization, prices and taxation, finance, labor, fire and safety, and world data. Conversion tables, a glossary, and a bibliography are also included for convenience.

In addition to the conventional statistics, one may find many interesting items. For example: The Osage Indians received $14,178,096 in royalty, bonus, and rental payments from 1901 through 1957. It took 41 years to produce the first billion barrels of oil in the U. S. (1859-1900), whereas we now produce one billion barrels in about five months. Refiners can now wring more than four times as much gasoline from a barrel of crude as they could fifty years ago. Three out of eight barrels of U. S. crude oil production in 1958 were provided by smaller companies and independent operators. In most cases each of these independents produced fewer than 10,000 barrels daily.

The amount and use of collected taxes is always interesting to the taxpayer. The State of Oklahoma collected gasoline, motor vehicle, and motor carrier taxes in the amounts of $90,234,000 in 1957 and $89,358,000 in 1958. In 1957, $9,057,000 was diverted to non-highway purposes. Although the tax receipts in 1955 and 1956 were less than those of 1957, more than $17 million was diverted in 1955 and $15 million in 1956. In the 24-year period, 1934-1957, $136,299,000 has been used for non-highway purposes. Of this amount, $82,314,000, or more than 60 percent, was diverted in the last seven years (1951-1957).

If you need statistical petroleum data about any of the states, the nation, or the world for the last hundred years, you will find them in *Petroleum Facts and Figures*.

—L.J.

A PERMIAN HYSTRICHOSPHAERID FROM OKLAHOMA

L. R. WILSON

Hystrichosphaerids are abundant microfossils in many marine sediments from Late Precambrian to Recent, but they have not been previously reported in literature from the Permian or the Triassic rocks. In the Flowerpot formation of the Guadalupean series ("middle" Permian) of Oklahoma several specimens of one hystrichosphaerid species have been found associated with an abundant spore and pollen flora. Also in this assemblage a single scolecodont, or worm jaw, was observed. The hystrichosphaerid is a new species of the genus *Hystrichosphaeridium* but until more specimens have been found and studied it will not be given a name. Two views of one specimen are illustrated in figure 1. The photomicrograph on the left represents a view at a high-level focal plane and the one on the right is at a focal plane one-half micron lower. The photographs were taken with a Carl Zeiss Photomicroscope using a 100 mm objective, an Optivar setting of two, and a medium green filter. The film used was Adox KV14.

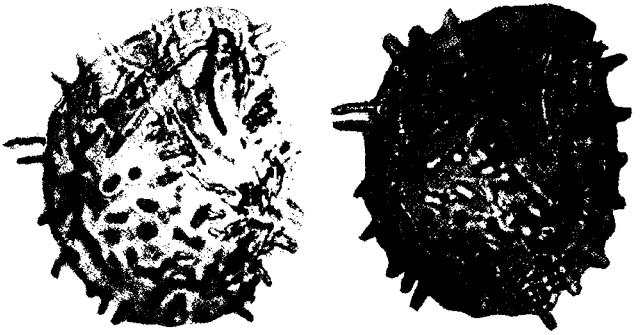


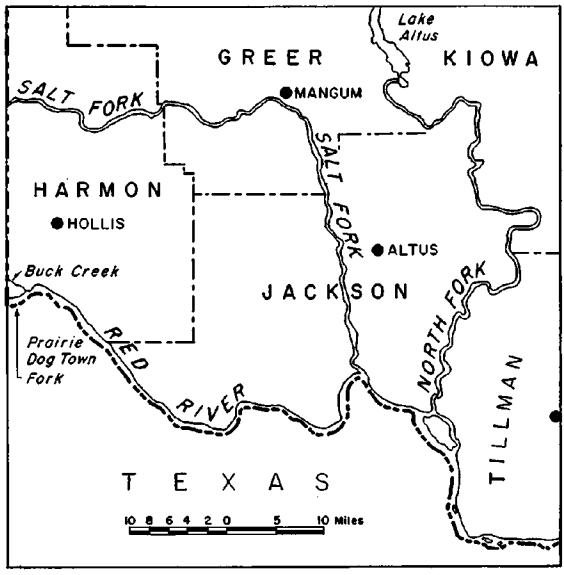
FIGURE 1. Two views of *Hystrichosphaeridium* sp. from the Flowerpot shale of Oklahoma. The photomicrograph on the left represents a view at a high-level focal plane and the one on the right is a view one-half micron lower.

The specimen is slightly compressed and shows some concentric folding. Its original shape probably was spherical or subspherical. The dimensions of the specimen are 34 by 43.5 microns. The wall is yellowish but transparent and little more than one micron thick. It is covered with solid cylindrical spines the tips of which are blunt or rounded. The spines range in length from three to ten microns and in diameter from one to two microns. The distribution of the spines is quite uniform and they are spaced three to four microns apart. The specimen is cataloged in the palynological collection of the Oklahoma Geological Survey as OPC 1-2-12. The Flowerpot shale sample containing the *Hystrichosphaeridium* was collected by W. E. Ham and L. R. Wilson along the Salt Fork of the Red River in NE¼ SE¼ SE¼ sec. 2, T. 4 N., R. 23 W., Greer County, Oklahoma.

*Preliminary report of one study being conducted b yNational eSience Foundation Grant No. G6589.

Red River Tributaries Named

The most recent list of decisions (No. 5903) of the United States Board on Geographic Names at last officially names and defines the tributaries of the Red River in southwestern Oklahoma. The tributaries recognized by the Board are: North Fork, Salt Fork, and Prairie Dog Town Fork. The identification of these tributaries and of the Red River itself figured largely in the long controversy over the boundary between Oklahoma and Texas.



The accompanying figure shows the Red River and its tributaries as named by the Board. These names have been long established by usage and the decisions of the Board serve merely to reaffirm them. There is, however, a change in the definition of the Red River. Current custom is to define the head of the Red River as its juncture with the North Fork on the western side of Tillman County. It is so designated on most maps (e. g., Geologic Map of Texas, 1937, and Geologic Map of Oklahoma, 1954) and in Webster's Geographical Dictionary (G. & C. Merriam Co., 1949, p. 936). Westward from this point the stream is called Prairie Dog Town Fork. The decision of the Board extends the Red River westward at the expense of the Prairie Dog Town Fork to the mouth of Buck Creek about 2 miles east of the 100th meridian.

AN UNUSUAL CRINOID FROM THE PENNSYLVANIAN OF OKLAHOMA

EDWARD A. FREDERICKSON AND DWIGHT E. WADDELL

The University of Oklahoma recently acquired an unusually well-preserved crown of a new crinoid. Scattered crinoid plates and dorsal cup circlets are relatively common in Pennsylvanian sediments in southern Oklahoma, but complete crowns are considered prize specimens by amateur and professional paleontologists alike.

The crown was purchased from Mr. Allen Graffham of Ardmore, Oklahoma, who found it in the old quarry in the Pumpkin Creek limestone in NE¼ NE¼ sec. 15, T. 6 S., R. 2 E., approximately 11 miles southeast of Ardmore, Oklahoma. The specimen is in the paleontological collection of the University of Oklahoma (OU No. 3615).

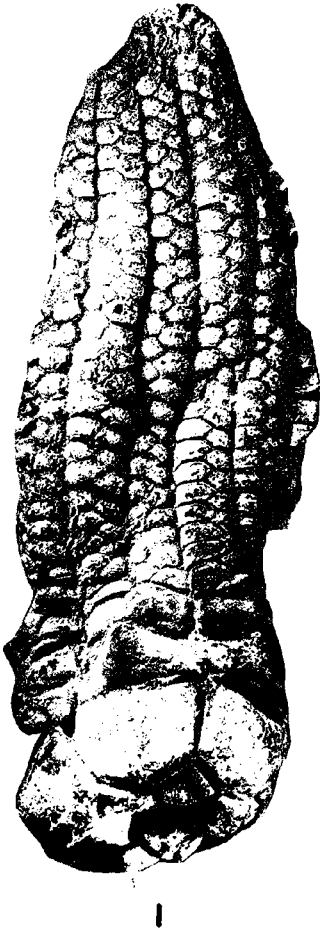
The crown is extremely well preserved, although slightly crushed. However, all plates of the dorsal cup are readily visible and the arms are nearly complete. The dorsal cup has been flattened by crushing, and the infrabasals and stem impression have been forced inward from the basals giving the appearance of a basal concavity. Careful inspection of the dorsal cup indicates that the base is essentially flat, if not slightly convex, and that the apparent basal concavity is the result of the distortion of the specimen.

The cup is composed of three circlets, each containing five plates. The infrabasal circlet is star-shaped, and contains five flat to gently convex pentagonal plates. The basal circlet has the shape of a symmetrical, five-pointed star. Individual basals are hexagonal, rather bluntly pointed proximally, sharply pointed distally, essentially flat, and slightly wider than high. The five radial plates are pentagonal, wider than high, and curved in both dimensions.

The arm structure is simple. The first primibrach is also the primaxil from which branch two isotomous, biserial arms. The arms are gently tapering and bear no pinnules. The anal plate is not included in the dorsal cup, and was not observed in the crown, because of obscuring superjacent primibrachs.

We consider the specimen to be a new species of the genus *Paradelocrinus*. The genus *Paradelocrinus* was erected by Moore and Plummer (1938, p. 294) for forms similar to *Delocrinus* which do not have an anal plate incorporated into the dorsal cup. In the original description they also added: "*Paradelocrinus* is distinguished from *Erisocrinus* by the presence of a funnel-like basal concavity in the former, and almost invariably, also, by well marked differences in contour of the dorsal cup as seen in side view." However, one year later, Moore and Plummer (1939, p. 317-318) modified that part of the description concerning the basal concavity to: "In typical species the base of the cup is marked by a strong concavity of funnel-like form, but in a few forms where this is lacking, the subcircular outline of the cup in dorsal or ventral view and the nearly regular strong curvature of the sides in profile view distinguish representatives of this genus from *Erisocrinus*."

All of the species described by Moore and Plummer (1938, 1939) are characterized by a basal concavity, and the lack of such a feature in the University of Oklahoma specimen eliminates it from consideration of inclusion in any of these species. Strimple (1949, p. 6-8) described three



2

PLATE I

Paradelocrinus sp. x2 (OU No. 3615)

FIGURE 1. Profile view showing preservation of the arms, slight crushing of the dorsal cup, and what appears to be a basal concavity.

FIGURE 2. Dorsal view showing apparent basal concavity caused by crushing. Infrabasal circlet is partially hidden by basals, but appears to be gently convex.

(Photograph by Dwight E. Waddell)

species of *Paradelocrinus*, two of which were collected from the Pumpkin Creek limestone member. These forms also lacked a well-defined basal concavity. However, detailed comparison of the various measurements and ratios used by crinoid workers precludes the possibility of the crown's being included in any of Strimple's species.

REFERENCES CITED

Moore, R. C., and Plummer, F. B., 1938, Upper Carboniferous crinoids from the Morrow subseries of Arkansas, Oklahoma, and Texas: Denison Univ., Jour. Sci. Laboratories, vol. 32, p. 209-314, 5 plates.

Moore, R. C., and Plummer, F. B., 1939, Crinoids from the Upper Carboniferous and Permian strata in Texas: Texas, Univ., Publication 3945, p. 1-468.

Strimple, H. L., 1949, A group of Pennsylvanian crinoids from the Ardmore basin: Palaeontographica Americana, vol. 3, no. 23, p. 6-8.

SPWLA, First Annual Meeting

The Society of Professional Well Log Analysts held its first annual meeting in Tulsa, May 15-17, 1960. After several years of discussion, the Society was organized in December 1958, with 19 charter members. The purpose of the Society as stated in the Constitution is to advance the science of formation evaluation through electrical, nuclear, lithological and other well logging techniques; to promote the proper application of these techniques to exploration for an exploitation of gas, oil and other naturally occurring substances; to maintain high ethical standards; and to further the interests of persons engaged in these endeavors. It is a non-profit, scientific organization.

Membership in the organization is divided into four categories on the basis of experience and degree of participation: members, associates, junior and honorary members. Only members shall vote and hold office. Their primary occupation must be the study and analysis of well logs and related well data. They must have a minimum of nine years professional experience in the field; however, each year of study of science at a university satisfactory to the Executive Committee, up to a maximum of four years, may be counted as professional experience.

As of May 5, 1960, the Society had 46 members, 16 juniors and three associates of whom 31 are from Oklahoma, 14 from Texas, four from Colorado, three from Wyoming; two each from Kansas, Montana, and France, and one each from California, Nebraska, New Mexico, Canada, Spain and Venezuela.

More than 150 persons attended the four sessions at which technical papers were presented during a two-day period. The Society has not considered publication of the papers, but several will be printed by the trade journals. Preprints were available at time of registration and are available in limited number from the Society, P. O. Box 4713, Tulsa 24, Oklahoma.

The following technical papers were presented:

A review of fundamental nuclear physics applied to well logging, by Joe D. Owen, Phillips Petroleum Company.

Exploration for petroleum traps using Rocky Mountain electrical log evaluation, by Bob Jones, consultant.

Use of flowing well logs in solving production problems, by Harvey L. Bryant, Jersey Production Research Company.

Accuracy of porosity determination, by Ralph E. Jenkins, Core Laboratories, Inc.

Applications of the proximity log, by Robert G. Hamilton, consultant.

A method of off-location quantitative mud analysis for hydrocarbons, by Wendell H. Russell, Baroid Division, National Lead Company.

A method for determining formation permeability from well logs, by Jarl P. Johnson, Kewanee Oil Company.

Resistivity-velocity log evaluation of the Morrow sand in western Oklahoma, by F. S. Millard, Humble Oil & Refining Company.

Field results with nuclear magnetism logging, by Paul W. Hull, Standard Oil Co. of Texas, and John E Coolidge, Byron Jackson Division of Borg Warner Corporation,

Interpretation of dipmeter surveys in Mississippi, by James A. Gilreath, Schlumberger Well Survey Corporation.

—L. J.

A New Use for Pumicite

Oklahoma possesses numerous deposits of pumicite located in widely scattered areas extending from Beaver, Harper and Woodward Counties in the northwestern part of the State to Kiowa and Tillman Counties in the southwestern part, and from Custer and Kingfisher Counties in the west-central part on eastward through Pontotoc and Hughes Counties to Wagoner and Haskell Counties in the east-central part. Several deposits have been utilized but production has been spasmodic and in relatively minor amounts. Oklahoma pumicite has served as a cleaner and cleanser, as an oil absorbent, and as a pozzolan to control difficulties in portland-cement concrete due to reactive ingredients in the aggregate material. It has been added to oil-field drilling mud to scour the tools. Back in 1949, research in the laboratory of the Oklahoma Geological Survey demonstrated that cellular products can be produced from Oklahoma pumicite to serve as lightweight insulation. One of these products closely resembles the expanded perlite so widely used in lightweight compositions.

An item in the May issue of *Rock Products* reported that a large deposit of pumicite near Ohio, Colorado, will furnish raw material to be ground and cast in molds to yield conical room-deodorizers.

Whereas there may be a question about the tonnage of pumicite that will be consumed in this venture, there is no question about the originality of the proprietors in creating a new industry based upon a mineral material locally available.

—A. L. B.

REVIEW OF SYSTEMATICS AND RECENT RESEARCH OF PRIMITIOPSID OSTRACODA

REGINALD W. HARRIS

During the past few years Dr. Anders Martinsson, University of Uppsala, has investigated primitiopsid ostracodes from type localities and has published several articles regarding his research. His latest publication, *Primitiopsid ostracodes from Ordovician of Oklahoma and systematics of the family Primitiopsidae*, introduced four new subfamilies and three new genera, as well as a systematic outline of the family.

The following is a brief review and chronological resumé of primitiopsid research, with emphasis on the work of Martinsson:

Genus *PRIMITIOPSIS* Jones, 1887

The genus *Primitiopsis* Jones, 1887 (p. 5), with genotype *P. planifrons* Jones, 1887 (p. 5, 3 figs.); (a synonymous form is *P. planifrons* variety *ventrosa* Jones, 1887 (p. 6; also 1888, pl. 22, fig. 19a-c), from Silurian of Fröjel, Gotland, Sweden, was established for rather closely appressed straight-hinged, subquadrate, reticulate forms with adductorial pit and closed terminal pouch (dolon). Jones considered the closed pouch (dolon) of *P. planifrons* an "anterior chamber," not recognizing it as the posterior pouch of a dimorphic form. Apparently he considered this "anterior chamber" more significantly analogous to the anterior chamber of the Recent ostracode *Chlamydotheca* Saussure than to similar (velate) posterior structures that he illustrated and described as "posterior. . .sharp crests" in contemporary Silurian species *Primitia cristata* Jones, 1865 (p. 240, pl. 13, fig. 1a) and *Primitia reticristata* Jones, 1887 (p. 5; also 1888, pl. 22, fig. 15a).

As Martinsson recounted (1955, p. 2), it was Ulrich and Bassler (1923, p. 300, fig. 15, nos. 7-9) who first recognized the dimorphic status of *Primitiopsis planifrons*, and illustrated from type material both the pouchless male and the closed-pouch female carapaces. It was Henningsmoen (1954, p. 59), however, who discovered that the contemporary pouchless male dimorph had already been described as *Primitia valida* Jones and Holl (Jones, 1887, p. 4; also 1888, p. 405).

Family PRIMITIOPSIDAE Swartz, 1936

Ulrich and Bassler (1923, p. 300) described *Primitiopsis* and assigned it to the new Family Primitiidae Ulrich and Bassler, 1923 (p. 297).

Swartz (1936, p. 555) established the Family Primitiopsidae, and assigned to it the reticulate genus *Primitiopsis* Jones (with nine species). One of the nine species, nonreticulate *P. oblonga* of authors (not Jones and Holl), Swartz recognized as a member of some unestablished new genus (later named *Amygdalella* Martinsson, 1956).

Genus *SULCICUNEUS* Kesling, 1951

The monotypic Devonian genus *Sulcicuneus* Kesling, 1951 (p. 222) was erected as the second primitiopsid genus. Genotype *S. porrectinatium* Kesling, 1951 (p. 223, pls. 1-3, 69 figs.) has a granulose surface (rather than reticulate), and bears peripheral denticles along the posterior closed pouch (dolon). In such exaggerated development of surficial granules and peripheral spines this genus apparently attained early extinction. Martinsson (1954, p. 148) suggested that the genus represents such an end-member of the

Family Primitiopsidae by assigning it to a new Subfamily Sulcicuneinae in 1959.

Genus *CLAVOFABELLA* Martinsson, 1955

In 1954 Henningsmoen (p. 59) reported from type Fröjel Silurian material not only the original closed-pouch female, *Primitiopsis planifrons* Jones, and the synonymous dimorphic pouchless male, *Primitiopsis* (*Primitia*) *valida* (Jones and Holl) Henningsmoen, but also a "trimorphic" posteriorly frilled (open-pouched or velate) "young female ?" form previously described as *Primitia reticristata* Jones, 1887 (p. 5; also 1888, pl. 22, figs. 15a-c).

Confronted with such evidence of trimorphism, and admitting trimorphism as a possible natural phenomenon, Martinsson, nevertheless, also recognized some impractical possibilities of limiting and confusing species should trimorphism be accepted, established, and exploited in differentiating fossil ostracodes. This immediate problem was solved when further investigation by Martinsson proved that the posteriorly frilled (open-pouched or velate) *Primitia reticristata* types possess additional features justifying assignment to a new genus. Accordingly the genus *Clavofabella* Martinsson, 1955 (p. 3, 23) (with three species) was erected as the third primitiopsid genus.

Clavofabella resembles *Primitiopsis* in subquadrate lateral profile, reticulate surface, adductorial pit, and overlap; it differs in its wider hingement, umbonate dorsal ridge, and open-pouched or velate posterior end.

Genus *LIMBINARIA* Swartz and Whitmore, 1956

From Silurian strata of New York and New Jersey the genus *Limbinaria* Swartz and Whitmore, 1956 (p. 1054-1056) was erected to include straight-hinged forms with elevated, reticulated median platform, adductorial pit, thickened umbonate dorsal ridge continuing to peripheral margins, and open-pouched or velate posterior end (in female). Three new species and three established Silurian octonarian species were assigned to this fourth genus of Primitiopsidae. Of the six limbinarian species, dimorphism has been observed in but two (p. 1055).

Subfamily PRIMITIOPSINAE Martinsson, 1956

The Subfamily Primitiopsinae was erected by Martinsson (1956, p. 1, 10, 26), though he courteously ascribed the subfamily to the credit of Swartz. Martinsson included in the new subfamily the genera *Primitiopsis* Jones and *Clavofabella* Martinsson. The genus *Limbinaria* Swartz and Whitmore was added to the subfamily in his classification of 1959 (p. 139, 148).

Genus *LEIOCYAMUS* Martinsson, 1956

The monotypic Silurian genus *Leiocyamus* Martinsson, 1956 (p. 29-30) was described as the fifth primitiopsid genus. Genotype *L. apicatus* Martinsson, 1956 (p. 30, pls. IV, V, figs. 38-42) is smoothly convex (not reticulate), with sharply rounded umbo, overlapping right valve, and without adductorial pit and preadductorial external node. The female dimorph exhibits slightly gaping (velate) posterior dolon extended forward as a narrow ventral flange.

Genus *AMYGDALELLA* Martinsson, 1956

The genus *Amygdalella** Martinsson, 1956 (p. 31-32) was erected

*The spelling **Amygalella** (p. 31) occurs in the original heading of the generic description. This is an unfortunate typographical error, because on four previous pages, and in all subsequent spelling, the word is **Amygdalella** "diminutive of Latin, **amygdala**, almond." Another typographical error may be observed on the same page (31) in the twelfth of sixteen synonymous references, "Swartz, 1936, p. 555, pl. 88, fig. C [**not B**], 3a-f."

as the sixth primitiopsid genus. In establishing the genus, Martinsson properly acknowledged that both Swartz in 1936 and Hessland in 1949 had recommended such procedure to receive the smooth, closed-pouch *Primitiopsis oblonga* of authors (not Jones and Holl, 1865) (p. 423, pl. 13, figs. 14a-c).

Monotypic Silurian *Amygdalella* differs essentially from *Leiocyamus* in possessing a closed pouch (dolon) limited to the posterior end (rather than an open or velate pouch extending forward along the ventral margin).

The genotype, *Primitiopsis oblonga* of authors (not Jones and Holl), was named *Amygdalella subclusa* Martinsson, 1956 (p. 31) in order to reduce taxonomic confusion in synonymous references involving the trivial name *oblonga*.

Genus *ANISOCYAMUS* Martinsson, 1959

In his latest publication regarding primitiopsids from Oklahoma, Martinsson erected three new subfamilies and the last three of the nine recorded genera.

In 1931 and 1957 Harris described several species of *Primitiopsis* from Ordovician Mohawkian strata of Oklahoma. These Ordovician primitiopsids resemble the Silurian genotype *P. planifrons* in: 1) subquadrate lateral outline; 2) reticulate surface; 3) narrowly compressed straight hingement; 4) overlap of right valve; furthermore, both types possess a posterior brood pouch and near-median muscle pattern. Direct comparison of Oklahoma primitiopsids with several specimens (male and female) of Silurian *P. planifrons* in the writer's collections, however, reveals obvious differences. *P. planifrons* is strongly inflated ventrally (wedge-shaped in end view), is more coarsely reticulate, and is twice as large as the more flatly convex, subparallel-sided Tulip Creek *Anisocyamus* (*Primitiopsis*) *elegans* and Bromide *A. (P.) basslери*. The Silurian genotype differs further in its distinct adductorial pit (rather than essentially flush muscle spot), closed dolon (rather than open velum), and smooth, nonreticulate areas involving anterior cardinal angle and dolon (rather than three margins and right valve). These and less obvious differences involving degree of overlap and nature of peripheral contact induced Martinsson in 1959 (p. 140, 142, 148-150) to establish *Anisocyamus* to receive the Simpson primitiopsids.

These Simpson primitiopsids are the open-pouched (velate female), essentially reticulate, subquadrate types resembling Henningsmoen's (1954) "young female ? trimorphic" *Clavofabella (Primitia) reticristata* (Jones) Martinsson, from the Silurian of Gotland. Ordovician *Anisocyamus* differs from Silurian *Clavofabella* in possessing: 1) smooth, near-median, essentially flush adductorial spot (in some forms visible when moistened), instead of distinct adductorial pit; 2) more closely appressed hingement (narrowly channeled, though widest posteriorly), without bordering thickened, umbonate dorsal rim; 3) more extensive areas of smooth, nonreticulate surface.

The writer has type Fröjel specimens of *Clavofabella multidentata* Martinsson and of the more coarsely punctate *C. reticristata* (Jones), Martinsson, both with non-reticulate, smooth surfaces limited to the widened, depressed hingement area, and extending from anterior shoulders through dorsal umbonal ridge, through dolonal flanges, and peripheral rim (particularly the outer part). The coarsely punctate *C. reticristata* (14 to 15 pores along median latitude) has proportionately more extensive smooth areas than the more finely punctate *C. multidentata* (18 to 20 pores). Signifi-

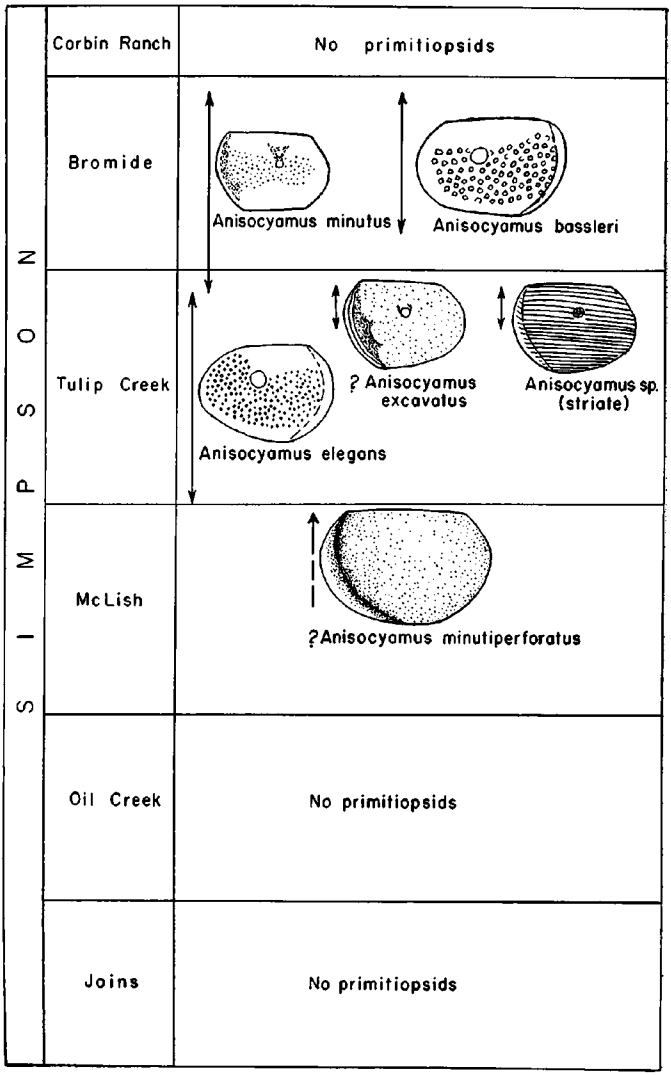


FIGURE 1. Stratigraphic range of Simpson primitiopsids.

cantly, the left valve of the more coarsely perforate Bromide *Anisocyamus bassleri* displays more extensive smooth areas than that of the more finely reticulate Tulip Creek *A. elegans*.

The genotype, *A. elegans*, is either finely reticulate in toto (except peripheral band) or is reticulate at least in some anterior portion (Martinsson, 1959, text fig. 1; pls. 1 and 2).

Bromide *A. bassleri* possesses a reticulate left valve (except peripheral rim) and a smooth right valve, illustrated by Harris (1957, pl. 6, figs. 17a, b). Martinsson (1959, pl. 3, figs. 1-10) also published excellent illustrations of the differential reticulation of the species, though making a typographical error in describing the smooth valve (1959, p. 146, line 31 should read "right [*not left*] valve").

When *A. bassleri* was described by Harris in 1931, he considered the differential reticulation a fortuitous superficiality, saying, "the right valve will be found weathered smooth, while the left valve will show less wear" (p. 92). On plate 11, figure 2b and plate 11, figure 2a, lateral views of the reticulate left valve of the holotype female specimen (Harvard University MCZ No. 4593A); and on plate 11, figure 2d, lateral views of paratype male specimen (Harvard University MCZ No. 4594A) were shown. The smooth right valve of neither type was illustrated, although artistic oversight in the drawings of the end view (pl. 14, fig. 2a) and of the dorsal view (pl. 11, fig. 2b) of the holotype suggests that the right, as well as the left valve, is reticulate.

In 1950 Levinson (p. 67-68, text figs. 4a, b) described and illustrated the hingement of two female valves of *A. bassleri* (Washington University No. 700001). The "left valve" (right valve) has median groove and terminal tooth at either end; the "right valve" (left valve), median bar and terminal sockets. Upon the basis of differential teeth and sockets, Levinson used an incorrect orientation. The elements of median bar and terminal sockets of left valve versus median groove and terminal teeth of right valve are essentially correct as inked in Levinson's two text drawings. Martinsson (1959, p. 141) noted Levinson's incorrect orientation and emphasis upon terminal dentition.

The Tulip Creek-Bromide *A. minutus*, though with smooth peripheral band about dorsal, ventral, and anterior margins, possesses fine reticulations on both valves (essentially twice as densely perforate as the third instar of corresponding size in contemporary *A. bassleri*. The small subsulcate, densely porate *A. minutus* was originally considered an instar of *A. elegans*; but further investigation revealed that the latter is limited to the Tulip Creek, and that the smaller descendant (without larger molts) extends from the Tulip Creek into the Bromide. Martinsson (1959, p. 143) originally expressed doubt regarding the primitiopsid affinity of small, pouchless *A. minutus*; but after examining the type specimen, he diagnosed it as a primitiopsid with ". . .very inconsiderably developed dolonal flanges" (1959, p. 153). It is entirely probable that this small species did not develop posterior velate flanges—no flanges were observed on third instars of corresponding size in *A. bassleri* and *A. elegans*. Furthermore, only two of six species of the primitiopsid genus *Limbinaria* have revealed dimorphic carapaces. Paratype male specimen of *A. minutus* is now added to Harvard type collections (MCZ No. 4598A).

Martinsson also questioned the primitiopsid status of *A. minutiperforatus* before examining types from Harvard University. Examination of types

proved the species to be a primitiopsid in which ". . .the anterior end of the dolon is bent towards the free margin and not continued forward by a velar bend clearly set off from the free margin" (1959, p. 153).

Several other distinctive features of this oldest known (McLish) primitiopsid, in contrast with Tulip Creek-Bromide anisocyamids, are being investigated for possible justification for assignment of the form to a new primitiopsid genus. These are: 1) both valves appear finely porate (without smooth marginal band and differential reticulation; 2) larger size (approximately one and one-half the size of *A. elegans*); 3) all specimens velate (no pouchless male dimorph observed); 4) apparently more closely appressed hingement; 5) district channeling between inflated carapace body and slightly flaring velate flanges.

Primitiopsis excavata Harris, the fifth primitiopsid described in 1957, is also being investigated further. The form apears to be a species of *Anisocyamus* in: 1) retral swing in lateral profile, with produced anterior nose and maximum height in posterior half; 2) appressed hingement, without clavofabelline dorsal ridge; 3) right valve projecting ventrally and posteriorly slightly beyond left valve (corresponding edges of left valve slightly beveled for reception); 4) differential ornamentation, the right valve (not left, as in *Anisocyamus*) displaying more distinct posterior channeling, node, and pores. Only pouchless male specimens have been discovered to date.

Associated with *P. excavata* is apparently a new species of *Anisocyamus*. The form is of the size and shape of *P. excavata*, but differs in dimorphic status and in its finely striate surface (striae are comparable to the several fine striae observable along the mid-venter of some specimens of *Clavofabella multidentata*).

Subfamily ANISOCYAMINAE Martinsson, 1959

Martinsson (1959, p. 139, 143, 149, 150) erected the Subfamily Anisocyaminae to receive the Ordovician genus *Anisocyamus*, characterized by subequal, reticulate (pores of right valve reduced or absent), dorsally compressed, velate (female) valves without adductorial pit or preadductorial external node. Martinsson (1959, p. 149, 151) included in the subfamily four of the five Oklahoma primitiopsids described by Harris, *A. elegans*, *A. bassleri*, *A. minutiperforatus*, and *A. minutus*.

Subfamily SULCICUNEINAE Martinsson, 1959

Martinsson (1959, p. 139, 149, 150) established the Subfamily Sulcicuneinae to receive Devonian *Sulcicuneus* Kesling, characterized by granulose, velate (male and female) valves with sulcoid adductorial pit and preadductorial node.

Subfamily POLENOVULINAE Martinsson, 1959

In 1959 Martinsson (p. 139, 149, 150) erected the Subfamily Polenovulinae for two new smooth Devonian genera, *Polenovula* Martinsson and *Viazovicila* Martinsson.

Genus *POLENOVULA* Martinsson, 1959

The genus *Polenovula* Martinsson, 1959 (p. 139, 149, 151), was erected to receive smooth, nonsulcate, subovate forms with near-median muscle spot and closed dolon limited to posterior end. Genotype *Leperditellina? crassa* Polenova, 1955 was described from Devonian strata of the southwestern Ural. Tentatively assigned to the new genus was a second species in the Devonian, *Primitiopsis eifliensis* Kummerow, 1953. The new genus was assigned to the Subfamily Polenovulinae.

Genus VIAZOVIELLA Martinsson, 1959

The ninth primitiopsid genus, monotypic Devonian *Viazovicella* Martinsson, 1959 (p. 139, 149, 151, 152), was erected to include faintly sulcate, smooth ostracodes with posterior closed dolon extended forward in a sharp bend through post-ventral margin. The genotype, *Leperditellina miranda* Polenova, 1955, was described from Devonian strata of the southwestern Ural. The genus differs from *Polenovula* in its subsulcate (not flush) carapace, with dolon extended forward ventrally (not limited to posterior end). This genus was assigned also to the Subfamily Polenovulinae.

REFERENCES CITED

Harris, R. W., 1931, Descriptions of ostracodes and conodonts, *in* Decker and Merritt, The stratigraphy and physical characteristics of the Simpson group; Okla. Geol. Survey, Bull. 55.

....., 1957, Ostracoda of the Simpson group: Okla. Geol. Survey, Bull. 75.

Henningsmoen, G., 1954, Silurian ostracods from the Oslo Region, Norway, 1. Beyrichiacea, with a revision of the Beyrichiidae: Norsk. Geol. Tidsskrift, vol. 34, no. 1.

Jones, T. R., 1887, Notes on some Silurian Ostracoda from Gothland: Stockholm.

....., 1888, Notes on the Paleozoic bivalved Entomostraca. No. 25. On some Silurian Ostracoda from Gothland: Annals Magazine Nat. History, ser. 6, vol. 1, p. 395-411.

....., and Holl, H. B., 1865, Notes on the Paleozoic bivalved Entomostraca. No. 6. Some Silurian species (*Primitia*): Annals Magazine Nat. History, ser. 4, vol. 16, p. 414-425.

Kesling, R. V., 1957, A new genus and species of primitiopsid ostracode from the Devonian Traverse group of Michigan: Univ. Michigan Contrib. Museum Paleontology, vol. 8, no. 9.

Levinson, S. A., 1950, The hingement of Paleozoic Ostracoda and its bearing on orientation: Jour. Paleontology, vol. 24, p. 63-75.

Martinsson, A., 1955, Studies on the ostracode family Primitiopsidae: Uppsala Univ. Geol. Institutions, Bull., vol. 36, p. 1-33, 2 pl. (*also* Palaeont. Inst. Univ. Uppsala, Publ. no. 4).

....., 1956, Ontogeny and development of dimorphism in some Silurian ostracodes. A study of the Mulde marl fauna of Gotland: Uppsala Univ. Geol. Institutions, Bull., vol. 37, p. 1-42, 5 pl. (*also* Palaeont. Inst. Univ. Uppsala, Publ. no. 14).

....., 1959, The primitiopsid ostracodes from the Ordovician of Oklahoma and the systematics of the family Primitiopsidae: Uppsala Univ. Geol. Institutions, Bull., vol. 38, p. 139-154, 3 pl., 3 figs. (*also* Palaeont. Inst. Univ. Uppsala, Publ. no. 24).

Swartz, F. M., 1936, Revision of the Primitiidae and Beyrichiidae, with new Ostracoda from the Lower Devonian of Pennsylvania: Jour. Paleontology, vol. 10, p. 541-586.

....., and Whitmore, F. C., Jr., 1956, Ostracoda of the Silurian Decker and Manlius limestones in New Jersey and eastern New York: Jour. Paleontology, vol. 30, p. 1029-1091.

Ulrich, E. O., and Bassler, R. S., 1923, Morphology and classification of Paleozoic Ostracoda: Maryland Geol. Survey, Silurian Volume.

U.S.G.S. Publishes Cross Section Through Central Oklahoma

A Review

A structural cross section of subsurface rocks from Barber County, Kansas, through Alfalfa, Major, Blaine, Kingfisher and Canadian Counties to the southern part of Caddo County (T. 6 N., R. 13 W.) has been issued by the U. S. Geological Survey as *Subsurface cross section of Paleozoic rocks from Barber County, Kansas, to Caddo County, Oklahoma,* by W. L. Adkison, Oil and Gas Investigations, Chart OC 61, two sheets. Dr. Adkison has made an excellent study which will be of great interest to geologists in Oklahoma.

Detailed lithologic logs of 19 wells and electric logs for 11 of these wells are illustrated. The northern wells (nos. 1-11), well 15 (T. 10 N., R. 9 W.) and well 19 (T. 6 N., R. 13 W.) penetrate Ordovician rocks. The Superior Oil Company No. 51-11 Weller is well 17. Because this hole is 17,823 feet deep and the vertical scale is one inch equals 200 feet, it is readily understood why two sheets, each 51 inches high, are needed. The horizontal scale is one inch equals six miles. The second sheet shows the lower parts of the logs of wells 8 through 18. Datum is sea level. The accompanying text discusses the lithology, facies changes, structure, and correlation of the rocks. A table of oil and gas fields and districts lying partly or entirely within 6 miles of the cross section as of November 1956 is given. Presumably the choice of wells and study of samples were made prior to this date.

No subsurface names are used. Nomenclature of most units from the surface to the base of the Virgil series is carried southward from Kansas. The top of the Pennsylvanian in Oklahoma is placed lower in the section than it is normally placed by many geologists in Oklahoma. Virgilian fusulinids are found several hundred feet above the top as placed in well 17. The basal Douglas group of the Virgil series is questionably correlated as far south as Superior's Weller well 17 (sec. 11, T. 8 N., R. 12 W.). Although the Oread member of the Vamoosa foramtion includes the radioactive Heebner shale in well 3 (sec. 9. T. 28 N., R. 10 W.), the Heebner shale is 100 feet above the top of the Oread in well 4 (sec. 12, T. 24 N., R. 11 W), and 700 feet above the base of the Vamoosa in well 14 (sec. 18, T. 11 N., R. 8 W). In Oklahoma, the terms Ochelata and Skiatook groups (Missouri series) are used, and the Tonkawa pay is placed in the uppermost Skiatook, equivalent to the Lansing group of Kansas. Thus Dr. Adkison does not consider the Tonkawa as an equivalent of the Tonganoxie sandstone of the Kansas surface. The Des Moines series is divided into Marmaton, and Cabaniss and Krebs group undifferentiated even in the northern part of Oklahoma where the Krebs is undoubtedly absent. C. C. Branson is of the opinion that the term Cherokee group or formation should be used in western Oklahoma inasmuch as the division into the two groups named at the surface in eastern Oklahoma has not been made and the Krebs group does not appear to extend over the Central Oklahoma arch into the Anadarko basin. The term Deese formation is applied to the rocks of the Des Moines series in southern Oklahoma.

The Atoka series includes the upper part of the Dornick Hills formation (Lake Murray); the Morrow series of the Pennsylvanian system contains the lower part of the Dornick Hills formation (Golf Course) and the Springer formation. Correlation of pre-Pennsylvanian rocks is made, but because the correlating lines are nearly vertical, and pass from the lower part of sheet 1 to the bottom of sheet 2, this portion is difficult to examine.

It is my opinion that the lithologic detail could have been sacrificed in order to print the cross section on one sheet of paper. In fact, geologists in the area doubt that such detail can be so accurately placed. A considerable amount of distraction could have been eliminated and the legibility improved, if the horizontal lines denoting top and bottom of beds, where the lines are not part of the lithologic symbol, had been omitted. The deletion of these lines would have allowed printing at a smaller vertical scale and yet would have preserved much of the detail now shown. Most petroleum geologists believe that electrical or radioactive characteristics of rocks are as important for correlation purposes as the lithologic descriptions, and, if available, should not be omitted.

Copies of Oil and Gas Investigations Chart OC 61 can be purchased at 75 cents per set from the Geological Survey, Washington 25, D. C., and from the Distribution Section, Geological Survey, Denver Federal Center, Denver, Colorado. It is also available for over-the-counter sale (but not by mail) at Geological Survey offices at 468 New Customhouse, Denver, Colo., and 602 Thomas Bldg., Dallas, Texas.

—L. J.

Malcolm C. Oakes Retires

Malcolm Christie Oakes was born on June 25, 1890, a date which made his age 70 before the end of the fiscal year, and he retired from the Oklahoma Geological Survey on June 30. Malcolm was born near Hugo and raised in the McGee Valley and near Ashland in the Choctaw Nation. His father, although he had no Indian blood, was made a member of the Choctaw tribe, and Malcolm is also officially a Choctaw. He graduated from Waurika High School and came to the University of Oklahoma where he received the Bachelor of Science degree (Electrical Engineering) in 1916, the Bachelor of Arts (physics) in 1919, and the Master of Science (geology) in 1922. In the meantime he had served from September 1917 to February 1919 in the armed forces in which he was commissioned 2d Lt. in the Signal Corps.

Mr. Oakes is the oldest member of the Survey in terms of service. He was first appointed in 1921, went with Shell Petroleum Corporation from 1923 to 1931, was a consultant from 1931 to 1937, then joined the Survey again in 1937. In his 25 years with the Survey he has published 19 scientific papers, of which the more noteworthy are his reports on Washington County (Bulletin 62, 1940), on Haskell County (Bulletin 67, 1948), on Tulsa County (Bulletin 69, 1952), and on Creek County (Bulletin 81, 1959). He has directed remapping of and has done field work in Okmulgee, McIntosh, and Muskogee Counties, and is now preparing the Okmulgee County report for the press.

Malcolm Oakes is a devoted family man. He and Lyra Bahrenburg were married in 1926. The couple have two girls, Peggy Joyce (Pettybone) and Anne Catherine (Cramer), and have one grandchild.

—C.C.B.