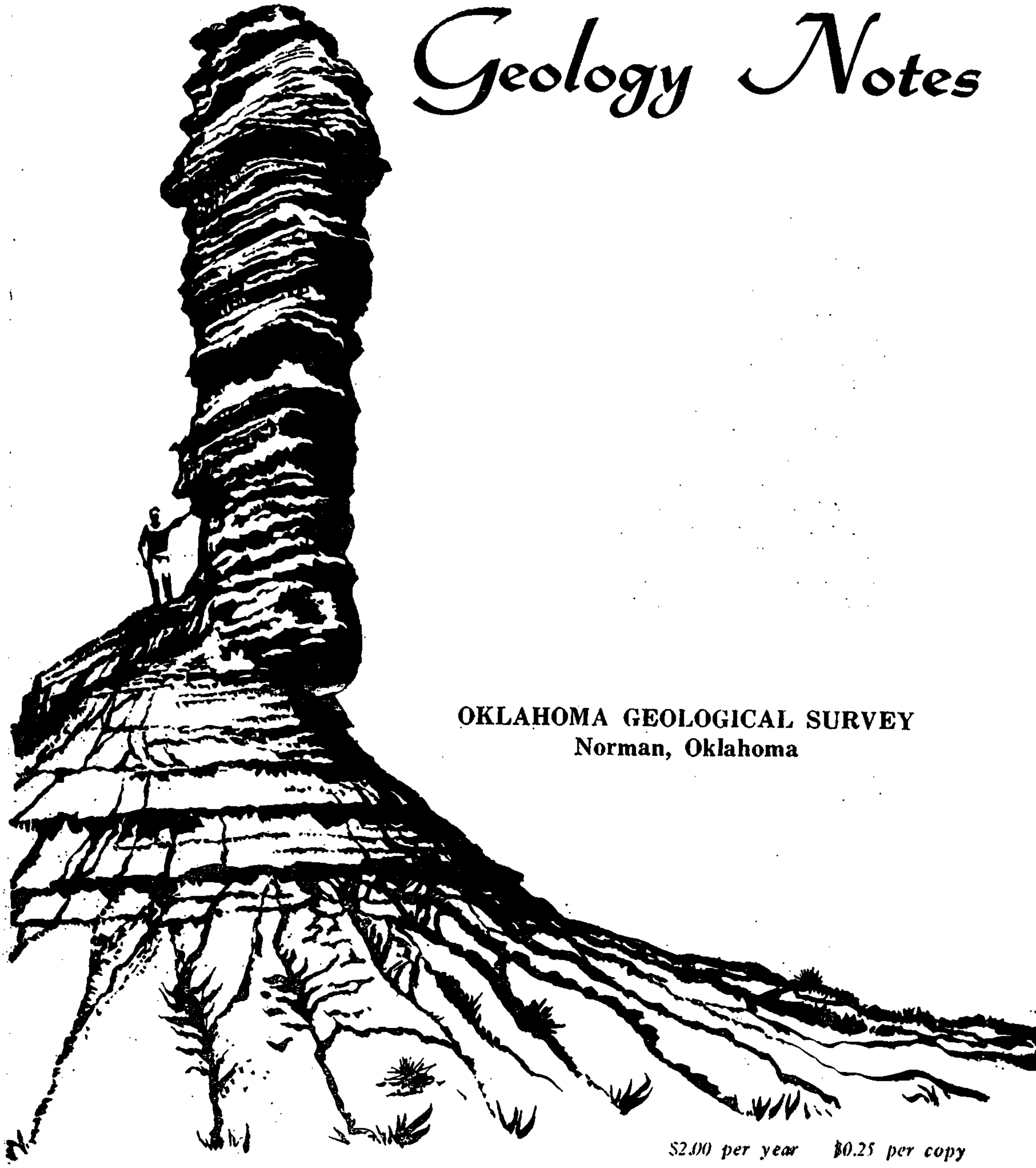
OKLAHOMA

Geology Notes



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LPG Storage in Flowerpot Salt, Beaver County, Oklahoma

LOUISE JORDAN

In 1959, Texaco, Inc. et al. decided to construct an underground liquefied-petroleum-gas storage facility in the Camrick District, an oil and gas area of southwestern Beaver County. The storage well, No. 1 Lehman, located in SW¼ SE¼ sec. 31, T. 1 N., R. 20 ECM, was drilled to 723 feet and then cored by means of a diamond bit taking a 3.5-inch core to a total depth of 1,098 feet. Salt-base mud was used and, of the total section cored, less than 15 feet was not recovered.

The stratigraphic section, described by geologist L. E. Case from the cores and adjusted to the gamma ray log, is illustrated in figure 1. The Blaine formation from 736 to 840 feet consists of seven anhydrite beds, none less than five feet thick. Red-brown shale is present between the upper six anhydrite beds. Gray shale occurs both above the basal anhydrite stratum and in the underlying Flowerpot. A six-inch bed of fine-grained gray sandstone is noted at 780 feet. A similar thickness of siltstone and sandstone is present in the 26 feet of Flowerpot shale which overlies the salt. Relatively pure pink salt occurs from 866 to 888 feet and from 894 to 1,030 feet, but some beds of shale, none more than two inches thick, are present. The lowermost 68 feet of section contains salt with a shale content ranging from 10 to 60 percent.

After the hole was completed in July 1959, a 9⅝-inch casing placed to a depth of 833 feet was cemented to the surface. A 7-inch casing was hung to 916 feet and a 3-inch casing to 1,028 feet. In October, the process of washing out the storage cavity commenced. This was accomplished by forcing fresh water down the 3-inch casing and into the formation where the water dissolved the salt. The brine was brought to the surface through the annulus between the 3-inch and 7-inch casings. Washing out of salt took six months to complete. The storage well, with a capacity of 33.000 barrels, was placed in operation April 1, 1960.

Salt is found in the Flowerpot shale in the subsurface under a large area in northwestern Oklahoma and the Oklahoma panhandle as well as in western Kansas and the Texas panhandle. In the Laverne area of Harper County, the rock unit containing salt ranges from 150 to 250 feet in thickness and occurs 30 to 60 feet below the base of the Blaine formation (Jordan, 1959, p. 26). In the Big Salt Plain of the Cimarron River (T. 29 N., R. 19 W.) where salt was collected in the early days (Gould, cited by Snider, 1913, p. 205), continuous cores currently being taken reveal that pure salt layers in the Flowerpot occur within 95 feet of the surface at some places. In one hole, 55 feet of salt with a few thin shale interbeds was cored below 150 feet, Flowerpot shale underlying river deposits being encountered at a depth of 72 feet.

References Cited

JORDAN, LOUISE, 1959, Permian salt beds in Laverne gas area, Harper County, Oklahoma: Okla. Geol. Survey, Okla. Geology Notes, vol. 20, p. 23-28.

SNIDER, L. C., 1913, The gypsum and salt of Oklahoma: Okla. Geol. Survey, Bull. 11, p. 204-209.

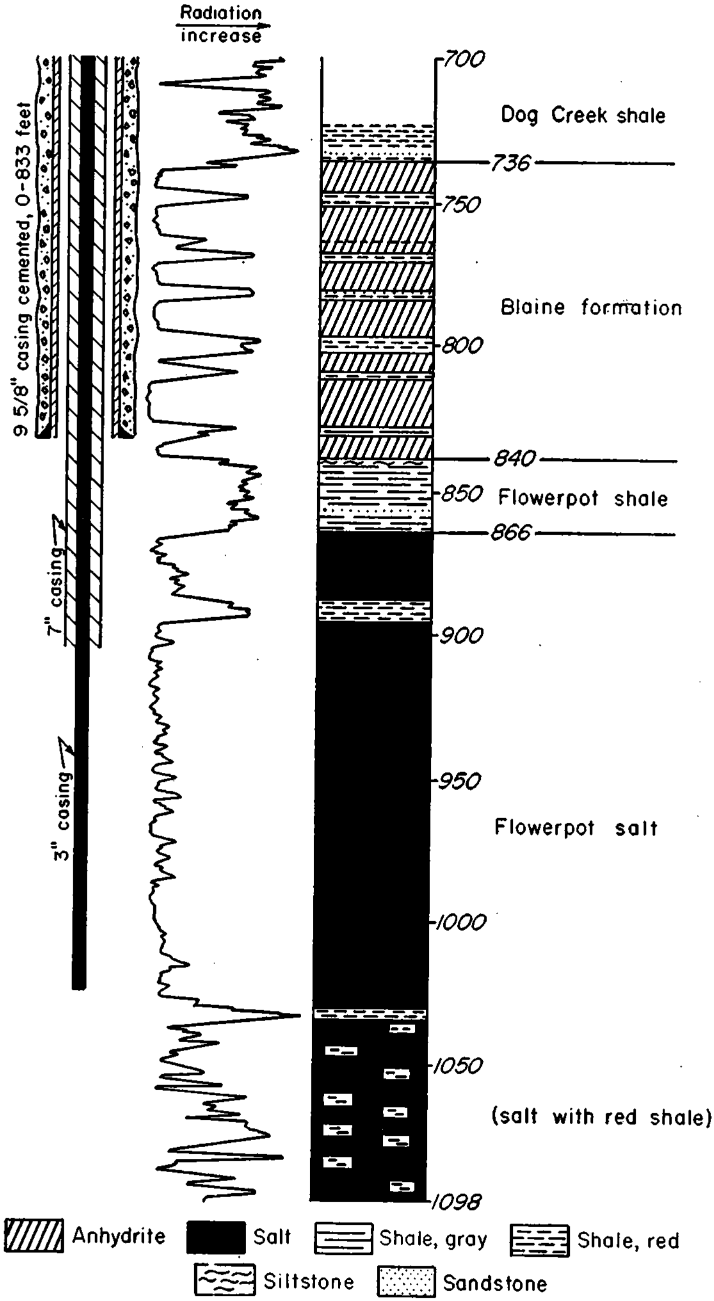

FIGURE 1. *Lithologic and gamma ray log of Texaco, Inc. et al. No. 1 Lehman, LPG-storage well in SW¼ SE¼ sec. 30, T. 1 N., R. 20 ECM, Camrick District, Beaver County. At left, casing program used for washing out of salt in order to create storage cavity.*

Deltoblastus, A NEW PERMIAN BLASTOID GENUS FROM TIMOR

ROBERT O. FAY

The various species of *Schizoblastus* reported from Permian deposits of Timor differ in several aspects from the Mississippian species assigned to the genus and the difference seems to justify the erection of a new genus for the Permian species. The genus *Deltoblastus* is here proposed, with type species *Deltoblastus elongatus* (Wanner) 1924 (p. 61, figs. 16-17; pl. 204 (6), fig. 1). The holotype is from the Permian Amarassi beds, Doeasnain, Timor Island, and is on deposit at the Geologisches Institut der Technisches Hochschule, Delft, The Netherlands. It was originally designated as *Schizoblastus delta* var. *elongata* by Wanner (1924), but is here raised to specific rank and designated *Deltoblastus elongatus*.

DELTOBLASTUS new genus

Calyx subellipsoidal to subrounded, with concave aboral surface; spiracles 10. with anal opening separate from anal spiracles; deltoids long, with broad sinuses, with prominent deltoid septa projected into oral crests, extending to periphery or beyond, and overlapped by radial limbs at a high angle; radials short, strongly concave aborally; ambulacra broad, petaloid, with the sides of the sinuses as wide as the ambulacra; lancet plate widely exposed its entire length; side plates normal, with one pore at the marginal and adoral corner of each secondary side plate; basals 3, normal, within basal concavity; hydrospires two on each side of an ambulacrum; stem round, with small round lumen; range, Permian.

Type species: *Schizoblastus delta* var. *elongata* Wanner 1924, now *Deltoblastus elongatus* (Wanner) 1924, Geologisches Institut der Technisches Hochschule, Delft, The Netherlands.

Deltoblastus is closely related to *Schizoblastus* in that the species of both genera have 10 spiracles, the anal two of which are separate from the anal opening, two hydrospire folds on each side of an ambulacrum, hydrospire plates lacking, and outlines that are ellipsoidal to globular. These two genera differ in several respects, however. In *Schizoblastus* the deltoids overlap the radials, the ambulacra are linear, the lancet plate is exposed along the medial one-third of its length, the ambulacral sinuses are narrow, the basal concavity may be shallow to

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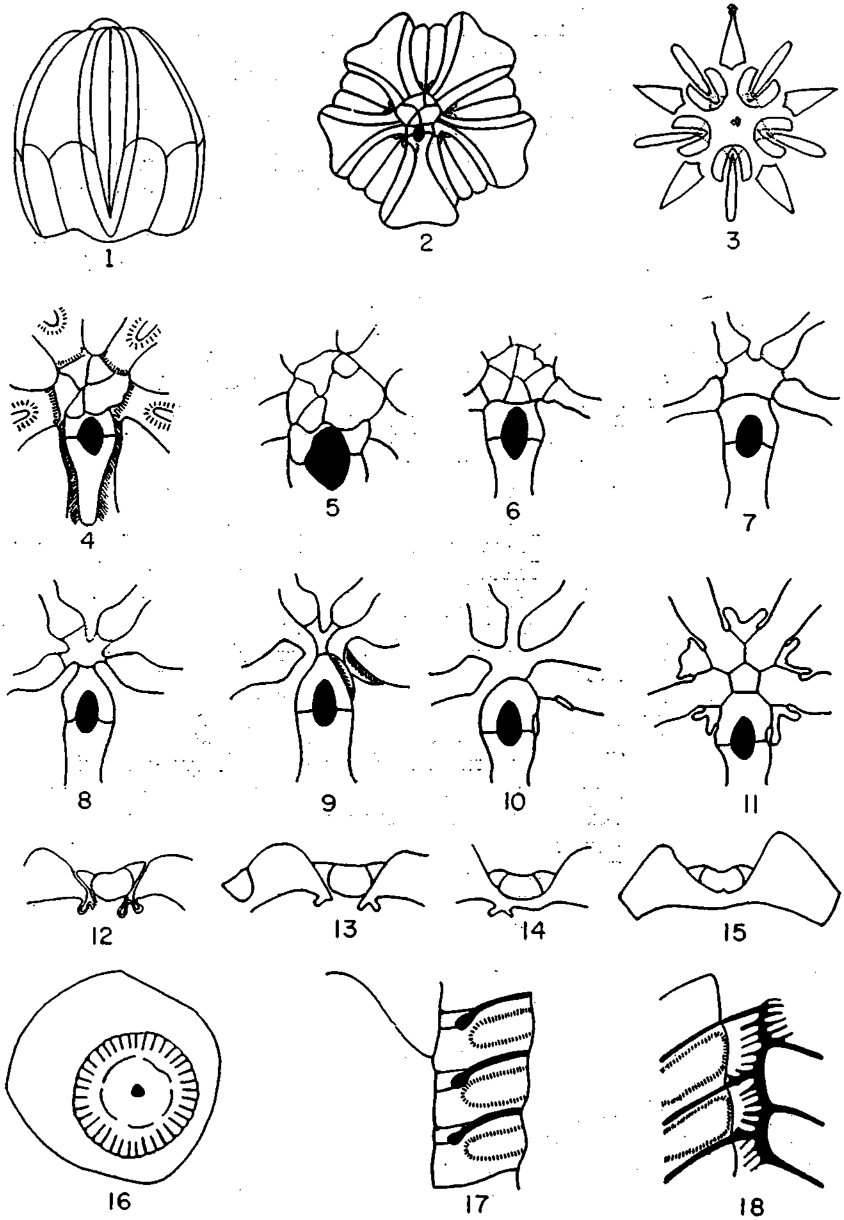
EXPLANATION OF PLATE I

Deltoblastus permicus *(Wanner) 1910. Basleo, Timor, K.U. coll. 7479*

FIGURE 1. *Left posterior ambulacral view, x2.2.*
FIGURE 2. *Oral view, x2.4*
FIGURE 3. *Plate layout, x0.8.*
FIGURE 4. *Detailed oral view, showing oral plates, x4.2.*
FIGURE 5. *Detailed oral view, x5.7.*
FIGURES 6-11. *Serial peel sections from oral area downward, x4.5.*
FIGURES 12-15. *Serial peel sections through tip of an ambulacrum, x3.9.*
FIGURE 16. *Detailed stem view, x31.2.*
FIGURES 17-18. *Detailed ambulacral views, x20.8.*

PLATE I



flat or not concave but convex, the deltoid septa do not extend into oral crests or coronal processes but are flat, and there are about 30 side plates in 10 mm. In *Deltoblastus* the radials overlap the deltoids, the ambulacra are petaloid, the lancet is almost fully exposed, the ambulacral sinuses are broad, the basal concavity is deeply concave, the deltoid septa extend into oral crests, and there are 20 to 26 side plates in 10 mm. There is no other genus comparable to *Deltoblastus* other than *Schizoblastus.*

The following short key, translated from Wanner 1924, gives the essential characters of the various species of *Deltoblastus.* In each case where Wanner recognized a variety I have raised it to the rank of species.

I. Deltoids at radio-deltoid suture more than 3 times wider than an ambulacrum. Ambulacra more or less linear, not indented.
   1. Average size of theca up to 30 mm high ---------- *D. molengraaffi*
   2. Large theca more than 40 mm high ---------------- *D. sebotensis*

II. Deltoids at radio-deltoid suture up to 3 times as wide as an ambulacrum. Ambulacra lancet-shaped.
   1. Ten to twelve side furrows in 5 mm length of an ambulacrum.
      A. Ambulacra not indented or barely indented. Adoral part of deltoids extended into a point or horn.
         a. Theca not ornamented, except with growth striations; average size to large.
            A Deltoids more than twice as long as radial limbs; radio-deltoid suture horizontal.
               1′. Theca ovoid, higher than wide ----- *D. timorensis*
               2′. Theca globose, almost as wide as high -- *D. globosus*
            B Deltoids less than twice the length of the radial limbs; radio-deltoid suture pointed ---------- *D. jonkeri*
         b. Theca ornamented with granules and ridges; small -------------------------------- *D. somoholensis*
      B. Ambulacra more or less deeply indented; adoral part of deltoids extended into a sharp ridge.
         a. Theca not ornamented, except with growth striae; large to very large; periphery mostly deep, below radio-deltoid suture but may be at this suture; sinus edge flat, not bevelled -------------------- *D. verbeeki*
         b. Theca shagreen, without ridges or points; large; periphery as a rule above the radio-deltoid suture, not below.

Explanation of Plate II

Deltoblastus batheri *(Wanner) 1924. Basleo, Timor, K.U. coll. 7479.*

FIGURE 1. *Left posterior ambulacral view, x1.5.*

FIGURE 2. *Oral view, x1.9.*

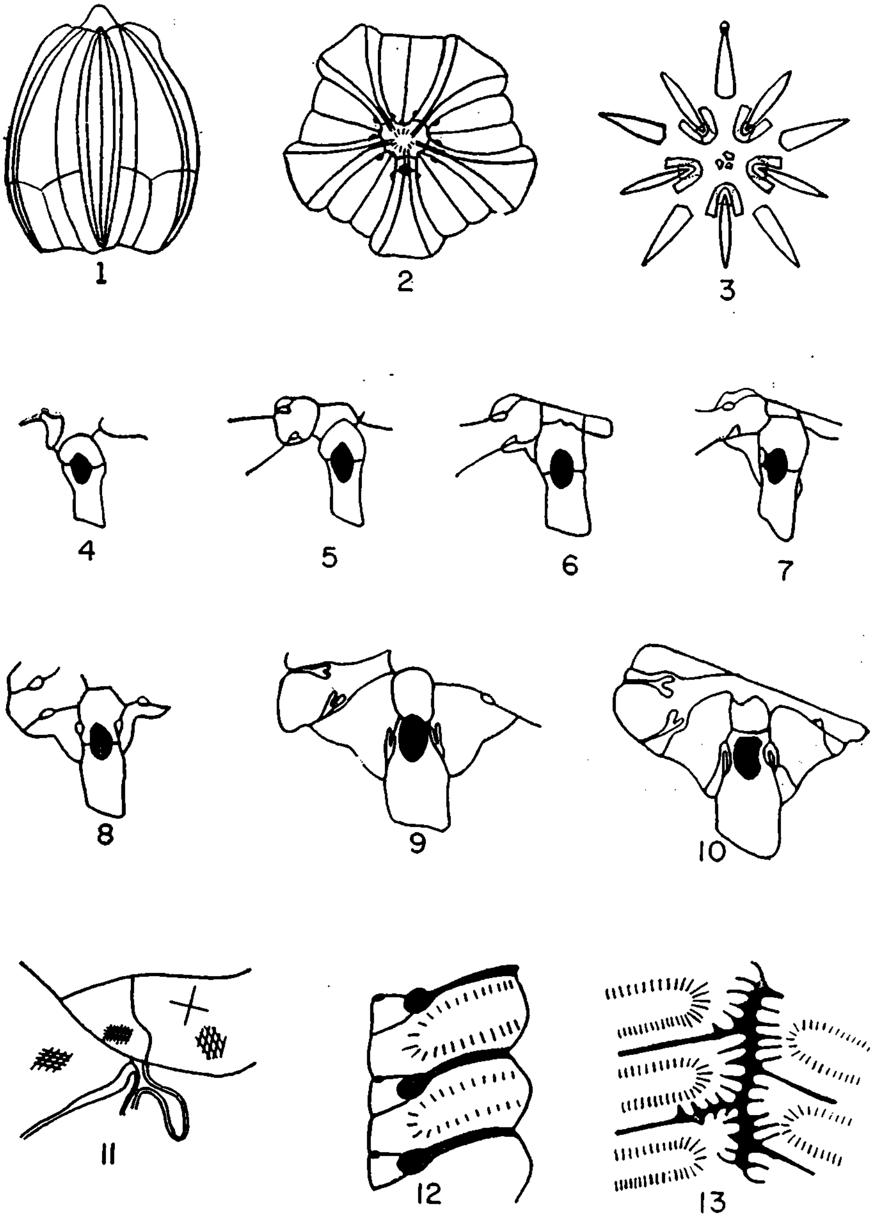
FIGURE 3. *Plate layout, x0.6.*

FIGURES 4-10. *Serial peel sections from oral area downward, x3.5.*

FIGURE 11. *Detailed cross-section of one side of an ambulacrum, showing calcite cleavage, x10.6.*

FIGURES 12-13. *Detailed ambulacral areas, showing side plates and nature of food grooves, x23.5.*

Plate II



A Theca ovoid

1′. Deltoids twice as long as wide---------*D. delta*

2′. Deltoids 3 times as long as wide----*D. elongatus*

B Theca subglobose---------------------*D. subglobosus*

c. Theca shagreen, with cross-ridges in the depression between the radial limbs; moderately large; periphery deep, below the radio-deltoid suture to half the height of the radials----------------*D. magnificus*

d. Theca mostly richly ornamented with granules or ridges (seldom not ornamented)

A Theca average size; periphery mostly below the radio-deltoid suture; deltoids 2 to 2½ times as long as wide-----------------------*D. batheri*

B Theca large; periphery exactly at the height of the radio-deltoid suture; deltoids not quite twice as long as wide--------------*D. pseudodelta*

2. Thirteen or more side furrows in 5 mm length of an ambulacrum.

A. Sides of theca strongly tapering; deltoids 2 to 2½ times as long as wide, extending adorally into a sharp ridge; theca ovoid, expanding rapidly at the stem------*D. permicus*

B. Sides of theca barely tapering as a rule; deltoids 2.4 to 2.8 times as long as wide, extending adorally into a point and not a ridge: theca ellipsoidal or globose, expanding gradually at the stem-----------------*D. ellipticus*

In order to show some features of some species of this genus, the outline drawings of specimens in the collections of the geology department of the University of Kansas are here appended.

References Cited

Wanner, J., 1924, Die Permischen Echinodermen von Timor: Palaontologie von Timor, Teil II, Lieferung XIV, Abh. XXIII, p. 1-81, pls. 199-206, text figs. 1-31, Stuttgart.

Erratum

Oklahoma Geology Notes, January 1961, volume 21, number 1, page 28

Figure 3 of the article, *The Upper Room of Alabaster Cavern, Woodward County*, Oklahoma, by A. J. Myers, is slightly mislabelled. Within the diagram the following emendations should be made:

(fig. 3) should read (fig. 4)
(fig. 4) should read (fig. 5)
(fig. 5) should read (fig. 6)

Fluctuations of Water Levels in Wells

Donald L. Hart, Jr.*

Ground-water levels are not fixed surfaces but rise and fall in response to numerous forces both natural and manmade. Most of these movements result from either the irregularity in the rate at which water is added to or taken from a ground-water reservoir or from changes of pressure on the aquifer. Fluctuations caused by changes in storage are evident in both water-table and artesian aquifers, but pressure effects are greater in artesian aquifers than in water-table aquifers.

Examples of fluctuations caused by some of these influences, particularly those operating in Oklahoma, are illustrated graphically and explained in a series of hydrographs. The fluctuations described are those reflecting changes in storage caused by 1) transpiration, 2) river stage, 3) intense rainfall, 4) pumping, and 5) seasonal trends. Water-level fluctuations reflecting pressure changes are caused by 6) atmospheric pressure, 7) tornadoes, and 8) earthquakes.

Records of water levels in Oklahoma are collected by the U. S. Geological Survey as part of its cooperative programs with the Oklahoma Geological Survey and the Oklahoma Water Resources Board. The observa-

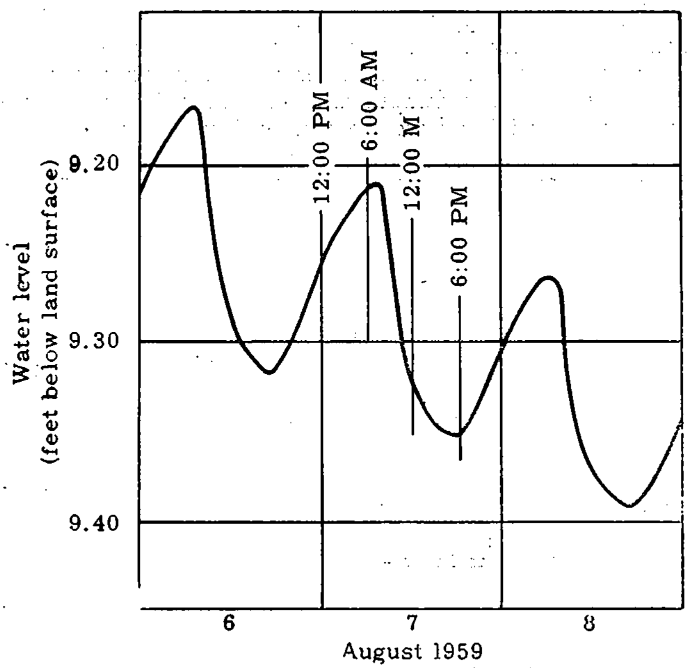


Figure 1. *Water-level fluctuations in a well near Fort Cobb, Oklahoma, due to transpiration.*

*U. S. Geological Survey, Norman, Oklahoma.

tion-well program was started in 1934 in the Stillwater Creek Basin and has been expanded gradually until at the present time about 360 wells in 35 counties are measured periodically. The water-level measurements are published in the continuing series of water-level reports of the U. S. Geological Survey and in the various reports of the cooperating State agencies.

Fluctuations due to transpiration, the process by which plants transport water from the soil to the air, are shown by the hydrograph of a well near Fort Cobb, Oklahoma. Such fluctuations commonly occur in shallow aquifers during the growing season. The amount of water used by a plant varies with the temperature, humidity, and amount of light. Thus, maximum transpiration usually occurs during the hotter sunnier part of the day, and the water table declines, whereas transpiration practically ceases at night and the water table rises. Figure 1 shows that this phenomenon produced a decline in water level of slightly more than 0.1 foot from 7:00 a.m. to 6:00 p.m., and a rise in water level of slightly less than 0.1 foot during the succeeding hours of twilight and darkness. During the cooler part of the day and at night water moving through the aquifer from adjacent areas causes the water level to rise. The net decline of more than 0.1 foot during the period August 6-8 indicates a loss of water from storage in the aquifer.

Changes in river stage are reflected in the hydrograph of a well bottomed in alluvium approximately 1,000 feet from the channel of the Arkansas River (fig. 2). The fluctuations of water level in the well are similar to the fluctuations in river stage but lag about six days behind and are somewhat dampened. A rise in the stage of the river blocks the water draining from the aquifer into the river causing the

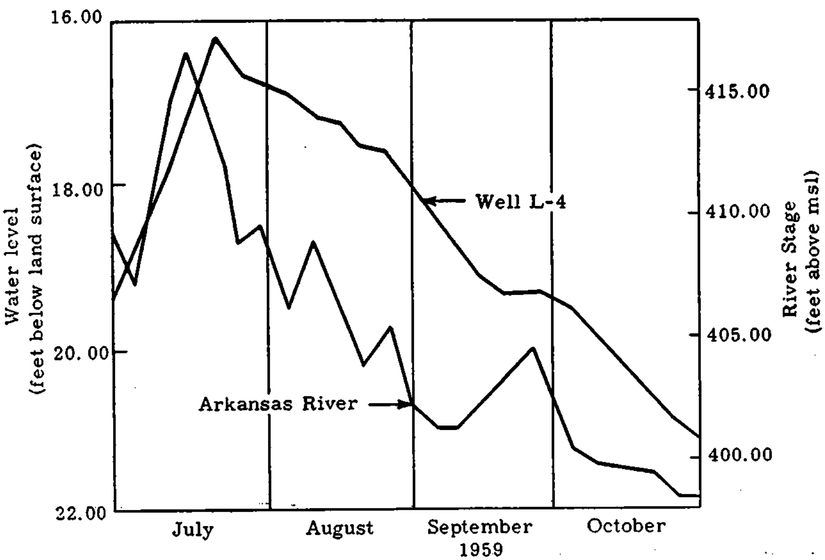


Figure 2. *Water-level fluctuations in a well near Tucker, Oklahoma, due to changes in river stage.*

ground-water level to rise. When the river stage declines the ground water again begins to drain into the river and the water level in the aquifer declines.

Intense rainfall may cause a pronounced rise in water level owing to an increase in the rate of recharge. Figure 3 illustrates the effect of a 1.1-inch rain of short duration on the water level in a shallow well near Fort Cobb, Caddo County. The water level rose 0.36 foot and then declined as the water drained from storage or was distributed to other parts of the aquifer having a lower head.

Pumping may cause a rapid decline in the water level near the pumped well (fig. 4). The rate of decline gradually decreases as the pumping effect spreads through the aquifer. When the pump is shut off the water level rises. If the pumping rate has been constant, the recovery or rising phase of the hydrograph approximates a mirror image of the pumping phase. The hydrograph (fig. 4) is for an observation well 29 feet from a pumped well in Midwest City, Oklahoma.

Figure 5 is a hydrograph of a well near Norman, Oklahoma, that illustrates seasonal trends in water-level fluctuations. The water level in this well rises during the winter and spring and reaches a peak in late spring or early summer. The water level declines during the summer and reaches a low in the period between October and December. During the winter and spring the rate of discharge by pumping is less than in

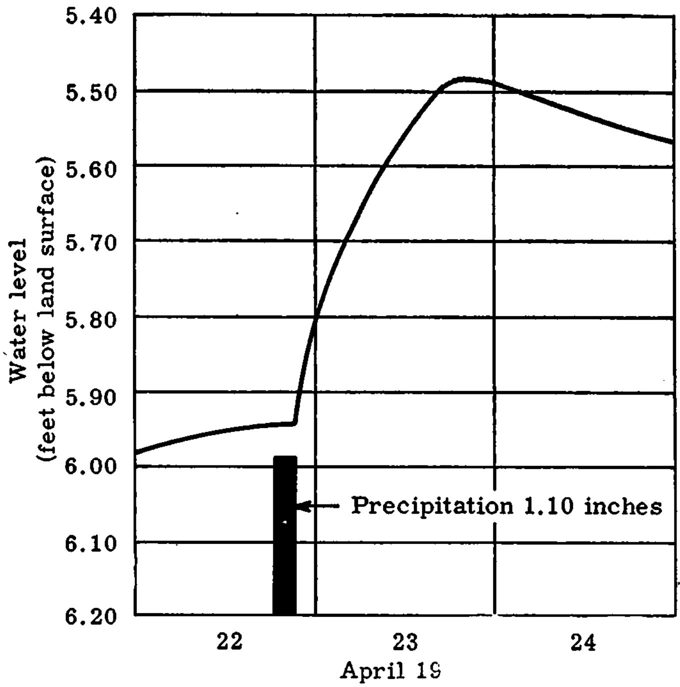


FIGURE 3. *Water-level fluctuations in a well near Fort Cobb, Oklahoma, due to intense rainfall.*

the summer and fall and recharge is greater because of more precipitation and less evaporation in the recharge area. These seasonal trends are typical of many bedrock wells in Oklahoma.

The hydrograph shown in figure 6 illustrates the effect of changes of atmospheric pressure on the water level in a well near Norman, Oklahoma. As the air becomes warmer during the day the atmospheric pressure decreases and the water level rises slightly as it did on July 26 between the hours of 11:00 a.m. and 5:00 p.m. The water level began declining at 5:00 p.m. as the air became cooler and the pressure increased. The daily change in water level in this well due to changes in atmospheric pressure is about 0.1 foot. This effect is limited to confined aquifers or to parts of aquifers where the water is confined because the change in the water level is caused by the difference between the pressure exerted on the surface of the water in the well and the pressure on the surface of the water in the aquifer. In a water-table well the pressure is the same in both places and no fluctuations occur.

Figure 7 shows the reaction of the water level in an artesian well to an extreme change in atmospheric pressure caused by a tornado passing near a well near Binger, Oklahoma. A rapid rise in the water level occurred in response to a sudden drop in atmospheric pressure as the tornado approached the well. After the tornado had passed there was a decline in the water level as the pressure increased again. The change

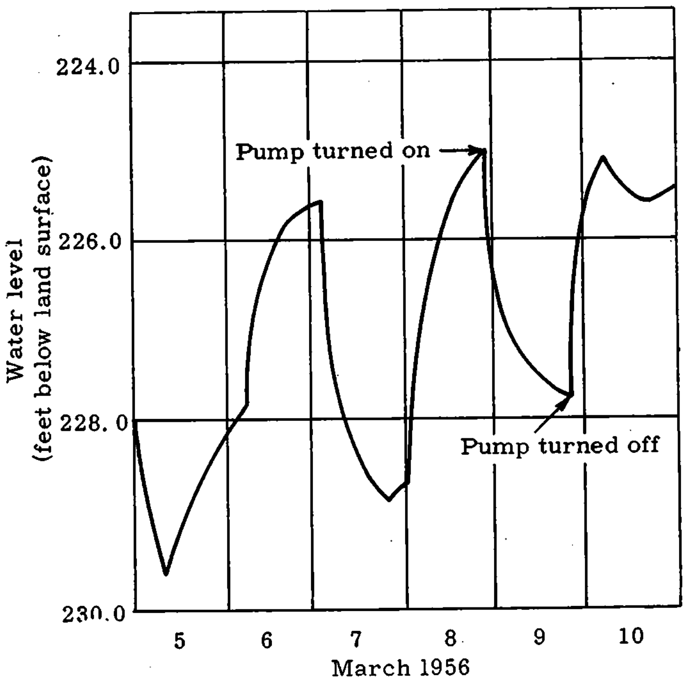


FIGURE 4. *Water-level fluctuations in a well near Midwest City, Oklahoma, due to pumping.*

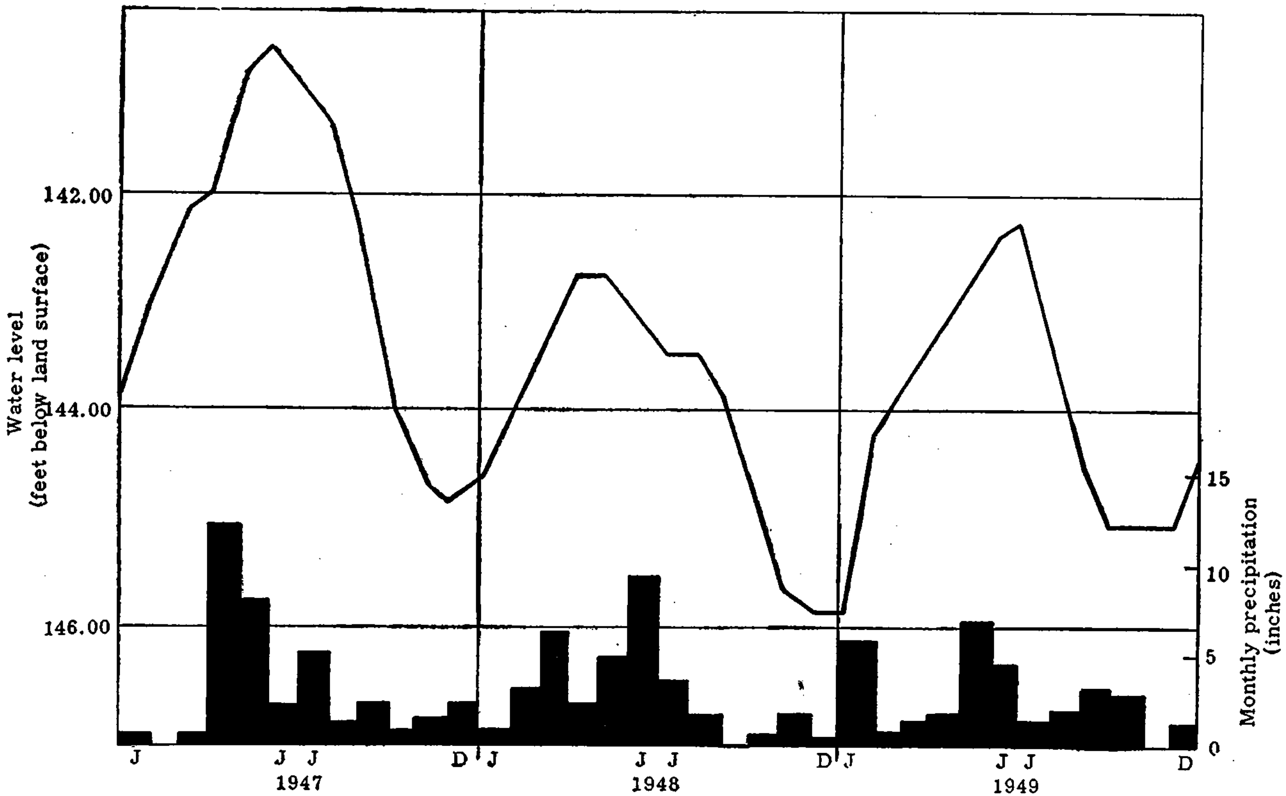


FIGURE 5. *Seasonal trends in water levels in a well near Norman, Oklahoma.*

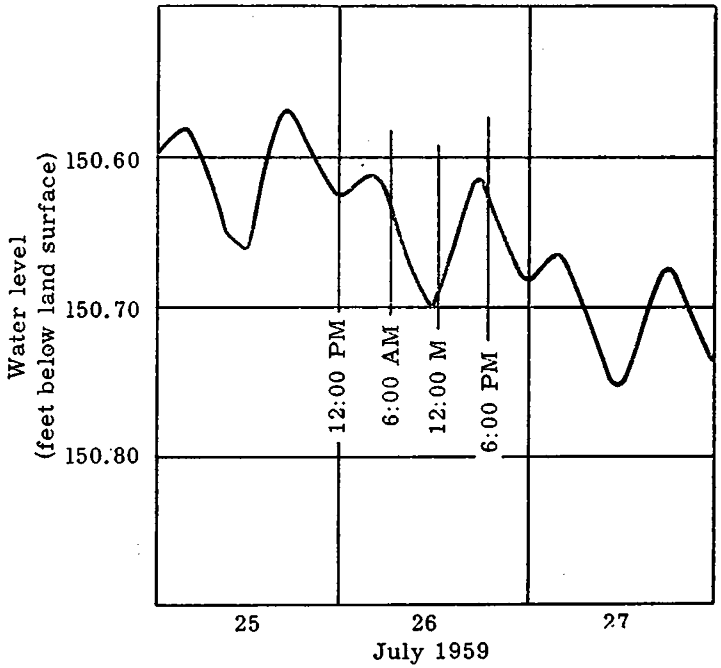


FIGURE 6. *Water-level fluctuations in a well near Norman, Oklahoma, due to daily changes in atmospheric pressure.*

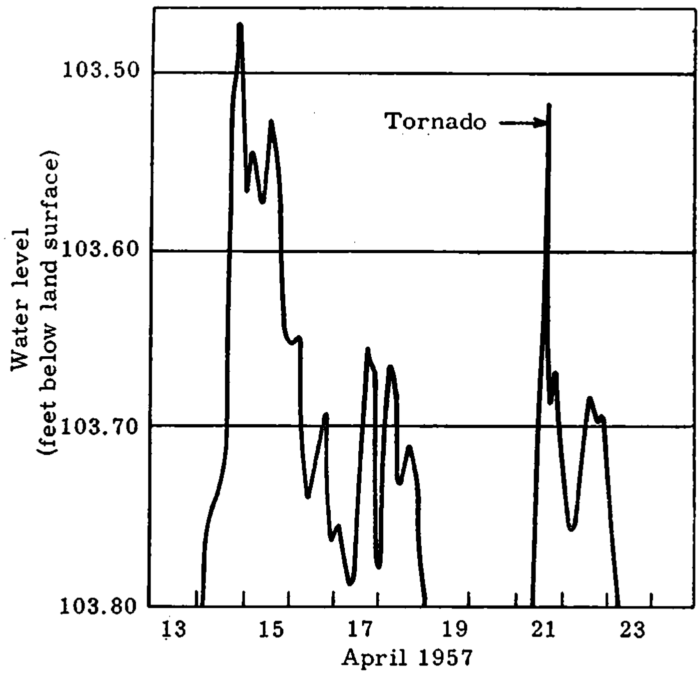


FIGURE 7. *Effect of a tornado on water levels, in a well near Binger, Oklahoma.*

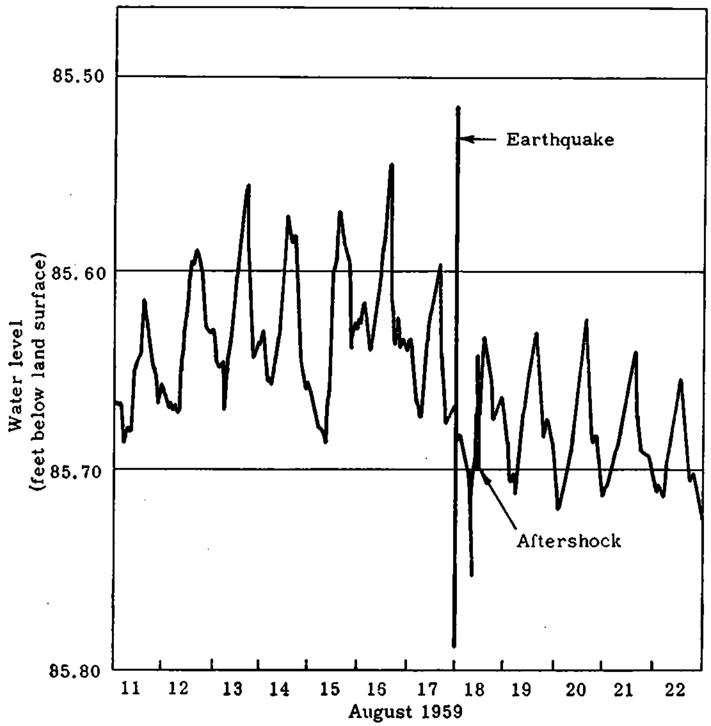


FIGURE 8. *Effect of earthquake on water levels in a well near Rush Springs, Oklahoma.*

in water level caused by this pressure change was 0.14 foot. The other fluctuations shown are caused by a combination of pumping effects and daily changes in atmospheric pressure.

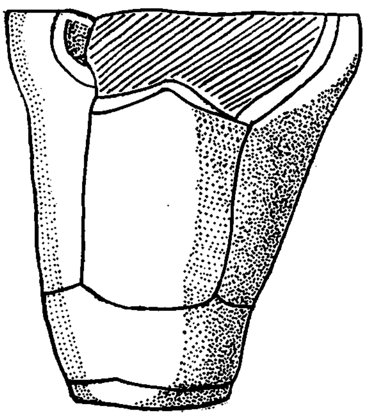
The pressure effect caused by the earthquake near Yellowstone Park was observed in a well near Rush Springs on August 18, 1959 (fig. 8). The hydrograph shows a rapid rise in the water level of 0.16 foot and a decline of 0.13 foot. If the time scale could be expanded, it would show that the water level oscillates up and down in response to the surface waves caused by the earthquake. The water-level recorder acts as a poor seismograph. About 8 hours later an aftershock of lesser magnitude caused the water level to fluctuate in a similar manner. Effects due to changes in atmospheric pressure also are illustrated by the series of daily highs and lows.

On *Synbathocrinus ? antiquus*

Harell L. Strimple and W. T. Watkins

The species *Synbathocrinus ? antiquus* was described by the senior author in 1952, from the Henryhouse formation, Silurian, in sec. 4, T. 2 N., R. 6 E., south of Ada, Pontotoc County, Oklahoma. It was noted at the time, "The unique appearance of *S. antiquus* is not closely approached by any other described species, and no other representative of the genus is recorded from Silurian strata." In addition to the information concerning the species previously recorded, the junior author has discovered the existence of a division of the radial plates in the right posterior, left anterior, and right anterior rays. Fusion has taken place but the sutures are normally distinct when one is aware of their existence, and an upper plate is in some specimens removed by natural pressures, as shown by figure 1. The presence of such a division is not surprising in the order Disparata, but the structure itself is unique. In order to explain the various elements affected we will follow the terminology used by Moore and Laudon (1943, p. 18-19, text-fig. 3) for disparate and some cladoid inadunates. Under this terminology, the plates of the right posterior ray are considered as though they were in effect anal plates; i. e., radianal and inferradianal.

Division between radianal and inferradianal in the right posterior ray (fig. 1) and between the superradial and inferradial of the right and left anterior rays (fig. 2) are not straight lines but have a high apex in mid-section. Each division between radianal and inferradianal



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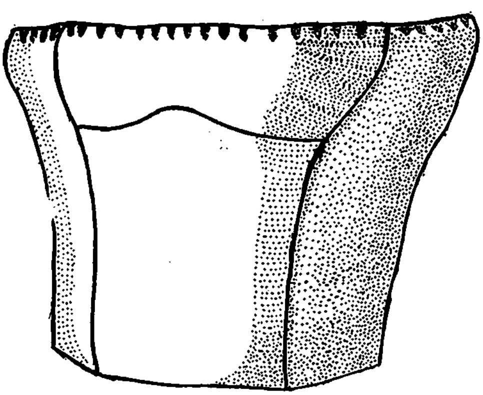

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Synbathocrinus ? antiquus *Strimple*

Figure 1. *Camera lucida drawing of metatype from right posterior with superradianal missing.*

Figure 2. *Camera lucida drawing of radial circlet of a large metatype showing suture between superradial and inferradial in left anterior ray.*

in the right posterior ray (fig. 2) and the superradial and inferradial of the right and left anterior rays (fig. 1) is not a single plane but two planes forming a high angle with the apex in mid-section. It is our thought that, because the cup flares strongly outward in this area, a structural weakness would be incurred if the sutures were straight. This form derived, no doubt, from a form having a narrow straight-sided cup with plates separated by single-planed sutures. It is believed that the angled sutures developed concurrently with the flaring of the top of the calyx.

Some specimens have been observed in which complete anchylosis has taken place in one or more rays, but most show traces of the sutures.

It is of considerable interest that such forms as *Ectenocrinus* and *Haplocrinites* have "double" plates in the same rays, and Moore and Laudon (1943) considered *Ectenocrinus* to be ancestral to *Synbathocrinus*. There is no longer any doubt that *Synbathocrinus* ? *antiquus* is not a bona fide representative of the genus. It represents a stage between *Ectenocrinus* and *Synbathocrinus* and will be assigned to a new genus in another study being made by the senior author covering the Hunton echinoderms.

The two figured specimens are designated as metatypes and are deposited in the Paleontological Collections, University of Oklahoma, number 3911.

References Cited

Moore, R. C., and Laudon, L. R., 1943, Evolution and classification of Paleozoic crinoids: Geol. Soc. America, Special Paper 46.

Strimple, H. L., 1952, Some new species of crinoids from the Henryhouse formation of Oklahoma: Wash. Acad. Sciences, Jour., vol. 42, p. 76, figs. 1-3.

Volcanic Ash Used in Sewer Pipe Glaze

M. P. Bauleke, ceramist on the staff of the Kansas State Geological Survey, reports in the November 1960 issue of the *American Ceramic Society Bulletin* on his research on the use of volcanic ash in compounding glaze for sewer pipe. It should be of interest to Oklahoma industry, as it is difficult to find satisfactory self-glazing shale suitable for sewer pipe within the State, but there is ample volcanic ash in widely scattered areas of the State. The glaze recommended contains, in addition to volcanic ash, proper proportions of siliceous clay, wollastonite, and zinc oxide. It also contains a small amount of Calgon as a dispersant so that a suspension of the mixture may be sprayed onto the fired shale pipe. After coating, the pipe is autoclaved at 300 psi for three hours.

Glazed sewer pipe is not manufactured in Oklahoma at the present time.

—A. L. B.

NOTES ON THE HARTSHORNE SANDSTONE

JEROME M. WESTHEIMER*

In the pre-Pennsylvanian sedimentary rocks the stratigrapher encounters few difficulties in correlating individual members by lithologic characteristics across the State of Oklahoma and in many cases hundreds of miles beyond the borders of this State. However, by the beginning of Pennsylvanian time geologic conditions had undergone abrupt changes which make lithologic correlations from one sedimentary basin to another extremely difficult. Orogenic movements were initiated (at least in some places) in Late Mississippian time and continued intermittently throughout Pennsylvanian time. These conditions restricted deposition and furnished diverse sources of sediments, and, as a consequence, it has been difficult to correlate Pennsylvanian rocks from the north side of the Arbuckle Mountains to the south side.

Nevertheless, there were short periods of quiescence when uniform conditions of deposition were relatively widespread. The earliest of these in Pennsylvanian time was during the deposition in Morrowan time of the Union Valley limestone—Primrose sandstone. These rocks, consisting of slightly arenaceous, spicular, marly limestones with included gray shale varves, are easily recognizable in both surface and subsurface on both sides of the mountains.

Another formation that displays this same uniformity of lithologic character over a large area is the Hartshorne sandstone. The Hartshorne sandstone consists of thinly interbedded laminae of very-fine-grained quartzose sandstones and gray shale; individual laminae may be from less than a millimeter to several centimeters thick. Both the sandstone and shale layers contain a profusion of relatively prominent mica flakes, these flakes having been deposited parallel to the bedding planes. In addition, these laminae practically everywhere contain abundant microscopic carbonacous flecks. These criteria afford an easy lithologic determination of the Hartshorne sandstone both at the surface and in the subsurface in the Franks graben area southeast of Ada, Oklahoma.

However, the surprising fact is the identification of the Hartshorne in a large area south of the Arbuckle Mountains and in the eastern part of the Ardmore basin, east of Ardmore, Oklahoma. Furthermore, this lithologic correlation has been partially confirmed by recent work on fusulinids done by Dwight E. Waddell.

One of the first wells in which the Hartshorne was recognized was the Buffalo Oil Company No. 1 Poland, SE¼ SE¼ NW¼ sec. 14, T. 4 S., R. 3 E., approximately ten miles east of Ardmore. The Hartshorne sandstone is found in this well between 4,080 and 4,185 feet. Its stratigraphic position can be ascertained because the oolitic Lester limestone is present in this well from 3,638 to 3,668 feet. Beneath the Hartshorne in the Buffalo well occurs the Bostwick conglomerate from 4,535 to 4,848 feet. The Primrose formation is also present between 6,335 and 6,955 feet.

A few of the other wells in which the Hartshorne may be recognized are as follows: (1) Tomlinson No. 1 Wilkinson, NW¼ NE¼ NE¼ sec.

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18, T. 4 S., R. 3 E., approximately 4 miles west of the Buffalo well, from 6,260 to 6,330 feet; (2) Shell Oil Company No. 1 Dickerson, SW¼ SW¼ sec. 35, T. 7 S., R. 4 E., 22 miles south-southeast of the Buffalo well, from 2,740 to 2, 796 feet; (3) California Company No. 1 Nelson, SE¼ NW¼ SE¼ sec. 20, T. 6 S., R. 8 E., about 33 miles southeast of the Buffalo well, from 1,140 to 1,190 feet (sample determination only; the sandstone laminae are thin and do not show up on the electric log).

Because the Hartshorne sandstone occurs below the Lester limestone, and the Otterville limestone has been correlated with the Wapanucka limestone, the Atoka formation would correlate with only that portion of the Dornick Hills group from the Hartshorne sandstone to the top of the Otterville limestone—a much more restricted section than had been previously thought. The thickness of the Atoka in the eastern part of the Ardmore basin is relatively constant (about 1,500 to 1,600 feet).

The Hartshorne sandstone has not been reported to have been found in the surface outcrops in the Ardmore basin. It should be identifiable on the surface in the Mannsville area, and possibly farther west.

A New Instrument in Use at the Oklahoma Geological Survey Geochemistry Laboratory

John A. Schleicher

The Oklahoma Geological Survey, cooperatively with the University of Oklahoma Research Institute, recently acquired a new research and analytical instrument, a Zeiss model PMQ II Spectrophotometer. In addition to this basic instrument, attachments for flame analysis and reflectance measurements are also in use.

Although many different types of spectrophotometers have been in use for a number of years, the closely controlled and carefully balanced electronic circuitry and the high-quality optical system of this machine combine to produce one of the more advanced and precise instruments of its type available today. The attachments mentioned above make it one of the more versatile.

The basic purpose of a spectrophotometer is to measure the intensity of light. The light measured may be emitted from a sample under examination or it may be emitted from some other source and absorbed in part by the sample. As light of a particular "color," or wave length, is passed through a solution, some of the light is absorbed by the substance in solution, so that the light emerging from the solution is less intense than that entering it. If the light is of the correct wave length, within narrow limits, the attenuation, or dimming, of the light will be found to be exactly proportional to the amount of the substance in solution. This is readily apparent with colored solutions, but even solutions which appear colorless will absorb "black" or ultra-violet light of some particular wave length. The light source of the Zeiss PMQ II will produce light from the medium-far ultra-violet at 2,000 Angstrom Units to the infra-red at 25,000 Angstrom Units. The precision of the optical system at about 6,000 A can be as close as ±3 A. The range of precision is less than ±0.2 A in the ultra-violet to ±9 A in the dark-red area of the spectrum. The precision then improves slightly into the infra-red.

With the aid of solutions of known concentration, the amount of a compound necessary to absorb a given amount of light can be determined. The absorbance of unknown amounts of compounds in solution can then be measured and their exact concentration obtained. In general, substances which absorb light of other colors or wave lengths do not interfere, and thus time-consuming separations need not be made.

Removal of the solution containers from the instrument and replacement of the constant light source with the flame attachment provides the means for another type of analysis. When atoms of the various elements are excited by heat, they are stimulated to give off light of a particular color, which is solely characteristic of the particular element being excited (Schleicher, 1958, 1959). The amount of light of the characteristic wave length which each element gives off is exactly proportional to the amount of the element present in the sample.

For thermal excitation the Zeiss PMQ II flame attachment uses a small burner, giving off either an oxy-hydrogen or an oxy-acetylene flame. Integral with the burner is a small stainless-steel, hollow needle, through which the upward flow of the gases draws the solution to be analyzed, and atomizes it directly into the hottest part of the flame. The light emitted is beamed into the optical measurement system of the spectrophotometer, where the exact wave length of the light emitted by the particular element to be determined can be selected. The intensity of light of this wave length is measured by the instrument, and the amount of the element present can be determined by use of a graph previously obtained by the use of known amounts of the element in solution. More than sixty of the elements can be determined in this way.

The low temperature of the flame (3,500° C maximum), as compared with that of the emission-spectrograph arc (5,500° C), produces fewer wave lengths from each element, and therefore has the advantage of reducing the possibility of error in identifying the elements. However, the lower temperature excites large atoms only slightly, and this sharply reduces the sensitivity of the analysis of such elements. The element the presence of which can be determined most easily is sodium, which can be detected in concentrations as small as 0.0002 ppm. However, for detection, some elements must be present in amounts of at least 1,000 ppm (or 1 gram per liter of solution). The elements the sensitivities of which allow their determination to reasonably low limits of concentration number about 50.

As with the spectrophotometric and emission-spectrographic methods, flame photometry makes possible the accurate determination of individual elements present in mixtures, without the necessity of resorting to time-consuming separations.

References Cited

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