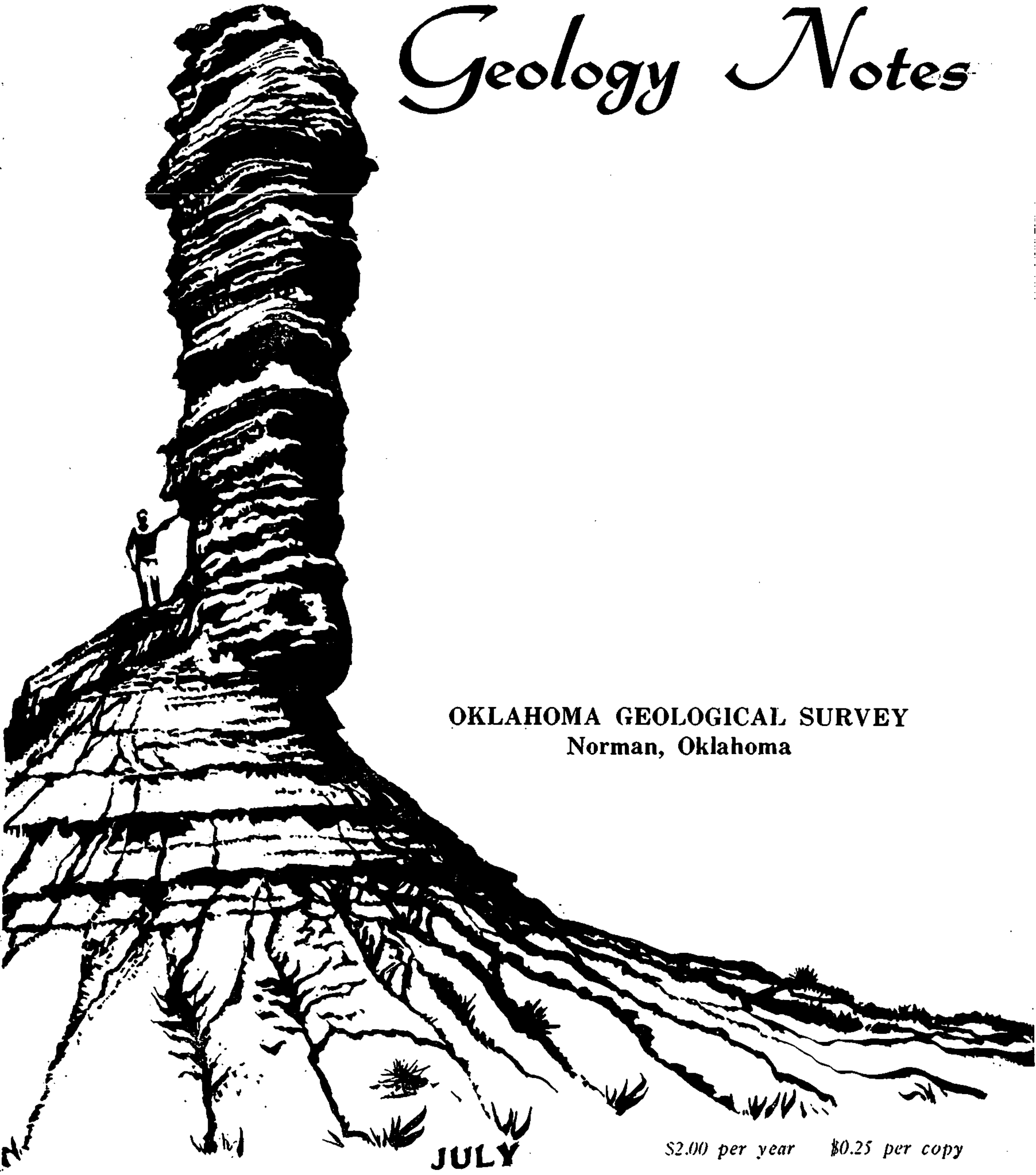
OKLAHOMA

Geology Notes



OKLAHOMA GEOLOGICAL SURVEY
Norman, Oklahoma

$2.00 per year $0.25 per copy

JULY

VOLUME 21 [redacted] 1961 NUMBER 7

Oklahoma Geologic Literature of 1958

The invaluable "Bibliography of North American Geology" is augmented by the 1958 volume, U. S. Geological Survey, Bulletin 1118, priced at $2.00 for the 592-page report. In the listing are 89 articles on or involving Oklahoma geology. Of these, 29 were published by Oklahoma Geological Survey, nine by the Shale Shaker of Oklahoma City Geological Society, five each by the American Association of Petroleum Geologists and Journal of Paleontology, four each by Oklahoma Academy of Science and Panhandle Geological Society, three by Oil and Gas Journal, two each by Geological Society of America, Geophysics, Tulsa Geological Society, World Oil, and Texas Journal of Science. Nine journals published one article apiece, and 11 of the total of 89 articles were abstracts.

The list of "Published papers on Oklahoma Geology in the year 1959," by N. M. Curtis, issued in Oklahoma Geology Notes in March 1959, contained 215 titles. That list contained titles of many articles from trade journals, many reviews, and listed earlier titles republished in Shale Shaker Digest, volume 2. If the 52 reprinted articles and anonymous articles are eliminated, together with review articles and trade-journal short notes, the two lists are closely comparable. The only important article noted as missing from the U. S. Geological Survey list is Herrington and Taylor, "Pliocene and Pleistocene Sphaeriidae (Pelecypoda) from the central United States," and the Oklahoma Geological Survey listing did not include Vaughn's article in the Journal of Geology on an Oklahoma captorhinid.

C. C. B.

Survey Publications in Press

A new list of available publications of the Oklahoma Geological Survey, dated July 1, 1961, is now available on request.

The geologic map of Okmulgee County, by Malcolm C. Oakes, was released on June 13. The map is on a scale of one inch to one mile and is in full color. The price is $1.50. The report on the county will be available early in 1962.

Now in press and scheduled for early release are:

Bulletin 92, Borate minerals in Permian gypsum of west-central Oklahoma.

Bulletin 93, Late Desmoinesian crinoid faunule from Oklahoma.

Circular 57, Geology of northeastern Cherokee County, Oklahoma.

Helium from Keyes Gas Area, Cimarron County, Oklahoma

Louise Jordan

The Bureau of Mines reports that in the fiscal year 1960, the Keyes Helium Plant, 15 miles northeast of Boise City, Cimarron County, produced and shipped 262,672 thousand cubic feet (MCF) of helium, equivalent to an annual rate of 290,000 MCF (Deaton and Haynes, 1961). The plant produced nearly 24 percent of the 624,000 MCF produced by the five Bureau plants. The first tank car of helium was shipped on August 17, 1959, less than nine months after ground was broken to start construction of the plant. Total investment in the Federal Bureau of Mines plant was $11,055,390.

Production is expected to be adequate to meet predicted demands for only the next two to three years. About 90 percent of the total helium shipped by the Bureau is used by Federal agencies or by government contractors in atomic-energy or national-defense activities. New and unique uses were found when Grade-A helium became available in commercial quantities in 1950. These new uses include applications in the fields of atomic energy, missiles, aerology, space exploration, shielded-arc welding, and low-temperature physics. The largest single commercial use is as a protecting gas in shielded-arc welding.

Two-percent helium-bearing natural gas from the Keyes Gas Area is processed at a production cost of $9.11 per MCF of helium. A low-temperature process involving two steps is used: (1) separation of crude-helium product from the natural gas at about —250° F and 225 pounds per square inch gage (psig); (2) purification of the crude helium to high-purity Grade-A helium (99.995 percent helium) at about —320° F and 2,750 psig. Grade-A helium is shipped in specially constructed railway tank cars at pressures ranging from 2,100 to 3,675 psig.

The helium-bearing natural gas, with a calculated low Btu rating of 817, is supplied to the Keyes plant under a gas-sales agreement between the United States and the Colorado Interstate Gas Company. The reservoir is the Keyes sand, a sandstone which Wagner (1955) described as an unconformity deposit present at the base of the Morrow (Early Pennsylvanian), resting upon Mississippian rocks (mostly Chesterian). The Keyes Gas Area (formerly called the Keyes gas field) was discovered in 1943 by Pure Oil Company's No. 1 Cox (SE¼ SW¼ SE¼ sec. 16, T. 5 N., R. 8 ECM), which was completed in the Keyes sand at 4,684 to 4,375 feet after having been drilled into igneous rock to a total depth of 6,280 feet. Wagner believed that deposition of the sand was controlled by Mississippian structure and topography although stratigraphic factors may be responsible locally (Hare, 1956). The thickness of the sandstone ranges from a few feet to a maximum of 126 feet, and as many as four lenses may be present. Normally one or two sand bodies are present and in most wells only the two upper sandstone lenses have been productive of oil or gas (Wagner, 1955, p. 8). Depth to the producing sandstone ranges from 4,100 to 4,800 feet. Pays called Marmaton (Des Moines) and Purdy (Morrow) in the Pennsylvanian, and one of Mississippian age are also gas reservoirs at places, but probably contributed only a minor portion of the cumulative production.

As of January 1, 1956, 102 gas wells, 6 oil wells, and 10 dry holes had been completed. Cumulative production from the Keyes pay alone amounted to 21,000,840 MCF of gas and more than 45,000 barrels of oil (Hare, 1956, p. 131). As of the end of 1960, the *Oil and Gas Journal* reports (1961, p. 104), the Keyes Gas Area is a major gas reserve of at least one trillion cubic feet of which 90 billion has been produced. As a major gas area (ultimate recovery of a trillion cubic feet or more), the area, with 169 productive wells, ranks forty-first in the United States and fifty-first in the world.

References Cited

DEATON, W. M., and HAYNES, R. D., 1961, Helium production at the Bureau of Mines Keyes, Okla., plant: U. S. Bur. Mines, Info. Circ. 8018, 16 p., 9 figs., 4 tables.

HARE, M. G., and GUNN, Y. J., 1956, Cimarron County, Oklahoma, *in* W. R. King (ed.), Pre-Permian handbook of the Hugoton embayment: Liberal (Kansas) Geol. Soc., p. 131-147.

OIL AND GAS JOURNAL, 1961, Natural gas recognizes no barriers: Oil and Gas Jour., vol. 59, no. 17, Apr. 24, p. 104-108.

WAGNER, C. R., 1955, The Keyes gas field, Cimarron County, Oklahoma: Amarillo (Texas) Geol. Soc., Panhandle Geonews, vol. 2, no. 3, p. 4-16, 9 figs.

On *Myeinocystites* Strimple

HARRELL L. STRIMPLE

In 1953, I described a small carpoid as *Myeinocystites natus* Strimple. There was only one specimen which, as a monotype, is the holotype of the genotype species. The illustrations did not reproduce well and I therefore prepared camera lucida drawings which are presented here (fig. 1).

One additional specimen was collected subsequently by Mr. Allen Graffham, Ardmore, Oklahoma, and deposited in the U. S. National Museum. It is somewhat smaller than the holotype.

The specimens are from the bank of Spring Creek, a tributary of Hickory Creek, north of the "Rock Crossing" exposure in the Criner Hills, southwest of Ardmore, Oklahoma; Bromide formation, Ordovician. This is also the type locality of the following echinoderms:

Anthracocrinus primitivus Strimple and Watkins, 1955 (genotype species)

Archaeocrinus subovalis Strimple, 1953b.

Pararchaeocrinus decoratus Strimple and Watkins, 1955 (genotype species)

Cyathocystis oklahomae Strimple and Graffham, 1955.

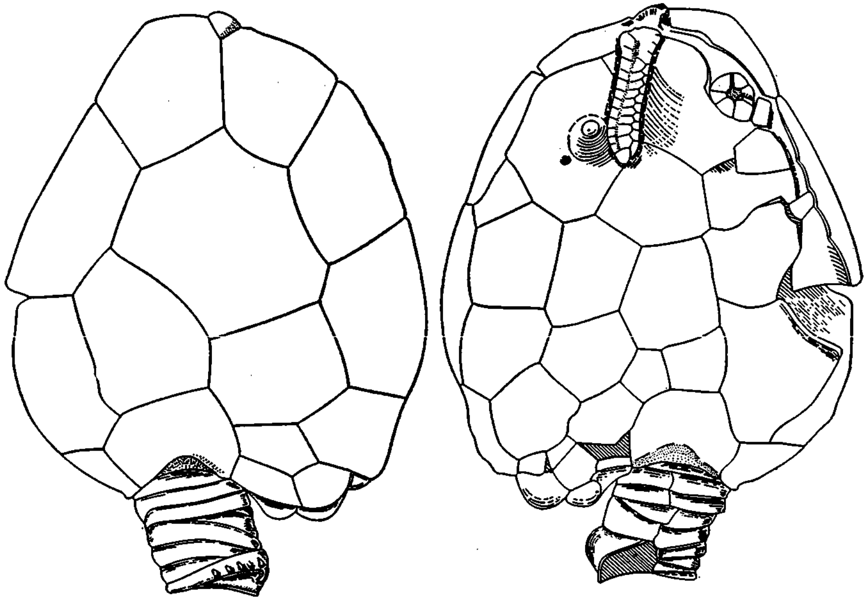


FIGURE 1. *Obverse and reverse views of the holotype of* Myeinocystites natus, *x4. These are camera lucida drawings of the two views published in Strimple (1953a).*

REFERENCES CITED

STRIMPLE, H. L., 1953a, A new carpoid from Oklahoma: Wash. Acad. Sciences, Jour., vol. 43, no. 4, p. 105-6, 2 figs.

__________ 1953b, A new species of *Archaeocrinus* from Oklahoma: Jour. Paleontology, vol. 27, p. 605-606, 7 figs.

STRIMPLE, H. L., GRAFFHAM, ALLEN, and WATKINS, W. T., 1955, New Ordovician echinoderms: Wash. Acad. Sciences, Jour., vol. 45, no. 11, p.348-355, 6 figs.

Stratigraphy of the Frisco and Sallisaw Formations

Bulletin 90 of the Oklahoma Geological Survey, *Stratigraphy of the Frisco and Sallisaw Formations (Devonian) of Oklahoma,* by Thomas W. Amsden, was issued on 13 June, 1961. The book deals with the physical stratigraphy of the Frisco formation in the Arbuckle Mountain region and Sequoyah County and of the Sallisaw formation in Sequoyah County The report is based on a field study complemented by detailed laboratory investigation of the lithologic characteristics by means of thin sections, paralodion peels, insoluble residues, and chemical analyses. The book comprises 121 pages, 26 text-figures, and 13 plates, one of which is a colored geologic map of the Marble City area, Sequoyah County. The price of the book is $4.00, cloth bound, and $3.00, paper bound. The map may be purchased separately for $0.75.

New Species of *Bronaughocrinus* and *Stuartwellercrinus* from the Carboniferous of Oklahoma

Harrell L. Strimple

The species *Bronaughocrinus figuratus* Strimple, is the monotype of the genus and has been reported from only one exposure, that in the Pitkin limestone formation (Chesterian). It is therefore of considerable interest to report a small specimen of the species obtained from a shale sample by Mr. Allen Graffham from what he considers to be lower Pitkin, but I believe is upper Fayetteville shale, exposed in a road cut southeast of Hulbert, Oklahoma. Mr. Graffham also obtained a dorsal cup from the older Hindsville formation, exposed at the base of the same hill, a specimen described herein as *Bronaughocrinus cherokeensis,* new species.

The genus *Stuartwellercrinus* has been essentially a Permian genus so that the discovery of a specimen in the Wapanucka limestone (Morrowan) is of more than passing interest. The form is described herein as *S. praedecta,* new species.

Bronaughocrinus Strimple, 1951

Bronaughocrinus cherokeensis, Strimple, new species

Plate I, figures 1-3

The dorsal cup is broad, low, bowl-shaped, with deep broad basal concavity. There are five infrabasals confined to the bottom of the basal concavity. Five large basal plates form the sides of the concavity, curve into subhorizontal position to form the basal plane and curve upward to form a small portion of the cup walls. There are five large, wide radials that reach the basal plane but do not curve into the basal area. Three anal plates are in normal arrangement (Primitive Type), except for the large radianal, which has lost contact with the right posterior basal plate. The dorsal cup is slightly constricted at the summit. Articular facets are broad, subhorizontal, and not well preserved. The outer ligament ridge is heavily crenulated and the pit is well defined. The transverse ridge is prominent and the oblique furrows are sharply defined. Muscle areas are broad, triangular, and shallow. Columnar scar is round.

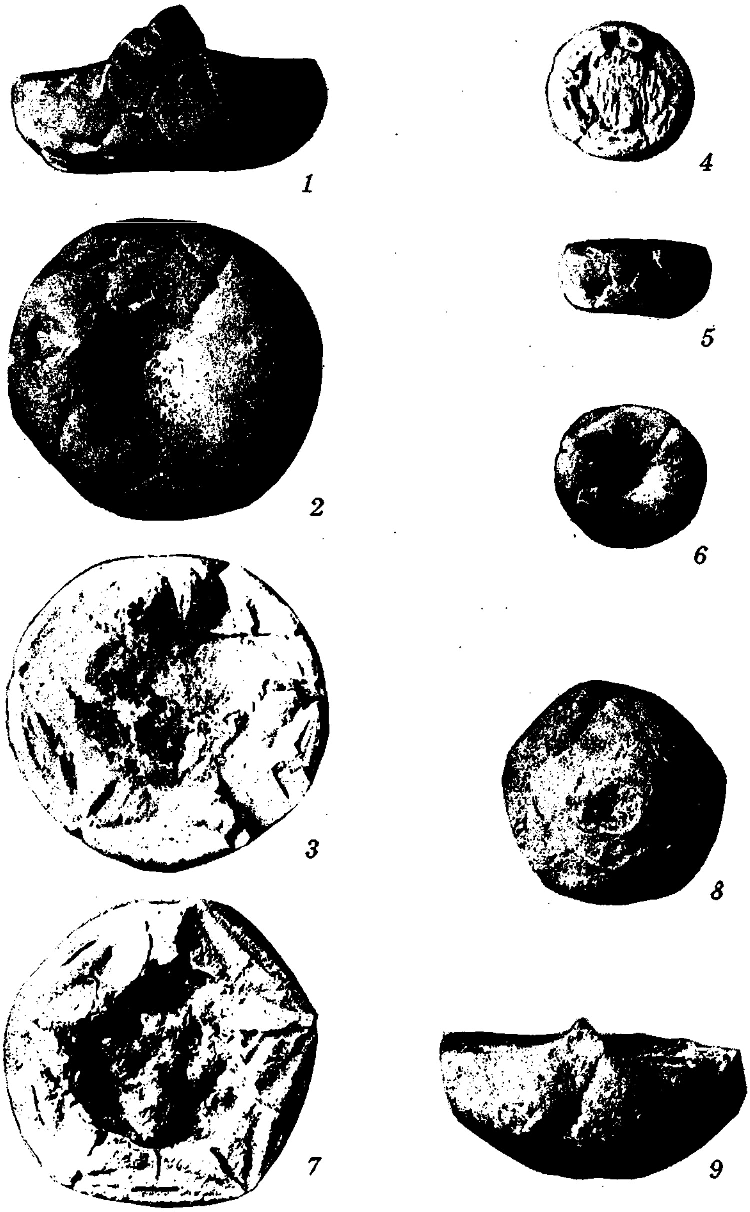
Explanation of Plate I

Figures 1-3. *Bronaughocrinus cherokeensis* Strimple, new species, OU 4329. Holotype viewed from posterior, base, and above, approximately x2.

Figures 4-6. *Bronaughocrinus figuratus* Strimple, 1961, OU 4328. Young specimen viewed from above, posterior, and base, approximately x2.

Figures 7-9. *Stuartwellercrinus praedecta* Strimple, new species, OU 4330. Holotype viewed from above, base, and posterior. Figures 7 and 9 x3, figure 8 approximately x2.

PLATE I



Measurements in millimeters:

	Holotype
Maximum width of dorsal cup	20.2
Height of dorsal cup	6.6
Length of basal (right anterior)	10.7*
Width of basal (right anterior)	7.7*
Length of suture between basals	5.0*
Length of radial (right anterior)	9.2*
Width of radial (right anterior)	12.1*
Length of suture between radials	4.6*
Width of infrabasal circlet	3.5
Width of basal concavity	9.6
Depth of basal concavity	2.4

*Measurement taken along surface curvature.

Remarks.—This species differs from *B. figuratus* in having slightly broader and lower cup, broader basal concavity and a more advanced arrangement to the anal plates. In *B. cherokeensis* the radianal has lost contact with the right posterior basal plate. This is considered to be an advanced stage of development, yet the species is considerably older than *B. figuratus*.

Occurrence.—Hindsville formation, Chesterian, Mississippian, road cut NE¼ sec. 25, T. 17 N., R. 20 E., southeast of Hulbert, Cherokee County, Oklahoma.

Holotype.—Paleontological collections, The University of Oklahoma, number OU 4329.

STUARTWELLERCRINUS Moore and Plummer, 1940

Stuartwellercrinus praedecta Strimple, new species

Plate I, figures 7-9

The dorsal cup is somewhat lower than normal for the genus, but the infrabasals are slightly upflared and the cup is therefore more nearly conical than bowl-shaped. The sutures between the infrabasals are obscured and it is not certain whether there are three or five. Five large basal plates form the remainder of the convex basal area. Most of the cup height is formed by the broad, bulbous radial plates. The articular facets are well preserved and are broad. The outer ligament area is short but well defined, with the pit sharply depressed. Oblique furrows are prominent, especially at their outer extremities. The intermuscular furrow is long, and distinctive. A single, long anal plate within the cup does not quite reach the upper tip of the posterior basal. About half its length extends above the summit of the cup. The upper facet is for the reception of a single tube plate. The column is round.

Measurements in millimeters:

	Holotype
Width of cup (maximum)	14.5
Height of cup	6.5
Width of infrabasal circlet	5.2
Length of basal (right anterior)	2.8*
Width of basal (right anterior)	5.0*
Length of radial (right anterior)	6.0*
Width of radial (right anterior)	8.7*
Width of columnar scar	3.2

*Measurement taken along surface curvature.

Remarks.—This species is readily distinguished from other species assigned to the genus by its low cup height and the relatively large anal plate. Most younger species of the genus have a rudimentary anal plate.

There are only four species of *Stuartwellercrinus* known at this time, and one of them is assigned to the genus with reservation, *S. argentinei* Strimple, from the Wyandotte limestone (Missourian) of Missouri. The other three species are *S. turbinatus* (Weller), *S. symmetricus* (Weller), and *S. texanus* (Weller), all from the Cibolo limestone (Lower Permian) of Texas. *S. turbinatus* is the genotype species and, of all four known species, is the most comparable to *S. praedecta*. The Morrowan species has a better developed anal plate and the radials are more bulbous, but all in all it is remarkably close to the Permian species. *S. symmetricus* appears to be the most advanced species yet it has the most primitive cup shape; that is, it has a high conical dorsal cup. It is evident that regressive evolution has taken place in this phyletic line.

Occurence.—Wapanucka formation, Morrowan, Pennsylvanian; near C sec. 8, T. 1 N., R. 7 E., Pontotoc County, Oklahoma.

Holotype.—Paleontological collection, The University of Oklahoma, number OU 4330.

A Somewhat Different Clay

A. L. Burwell

A sample of the clay described herein was first collected in 1953 by John Warren, at that time a member of the Survey staff. It was taken from a gravel pit in an area from which the gravel had been removed. The location was given as SE¼ NW¼ sec. 34, T. 28 N., R. 23 E., Ottawa County, Oklahoma. The occurrence is described on Field Sheet 0940 and the sample is designated as Lab. No. 10118. The occurrence was visited in the late summer of 1956 and the location corrected to the SE¼ of the NE¼ by N. M. Curtis, Jr., who reported (Field Sheet 01012) that the thickness of the clay is approximately 3 feet and that its areal extent is 30 acres. The gravel and clay are considered as a portion of the Batesville sandstone.

The first work on this sample in the laboratory was to determine the handling and firing properties. The tests involved the following procedure: 500 gm of the "run-of-mine" material was made into a stiff mud with 150 ml of distilled water. The mud was cast in a 1-inch by 14-inch mold. After removal from the mold, the bar was air-dried and then oven dried at 110° C. The amount of drying shrinkage was determined. The bar was carefully sawed into several portions, each approximately 2 inches long. Five portions were placed in a cold heavy-duty electric furnace and the temperature raised at the rate of 200°C per hour. At 1,000°C, portion No. 1 was removed from the furnace. The rate of temperature increase was reduced to 100°C per hour and other portions were removed at 1,100°C, 1,200°C, 1,250°C, and 1,288°C. This last temperature was the maximum allowable for this particular furnace. After cooling, the several portions were examined and tested. The results as shown in table I.

TABLE I.—HANDLING AND FIRING PROPERTIES OF CLAY FROM BATESVILLE SANDSTONE

Portion No.	*Fired at (°C)*	*Color of Product**	*Bulk Density*	*Porosity (% vol)*	*Absorption (% weight)*
1	1,000	11'0 sea shell pink	2.57	44.52	17.35
2	1.100	19'YO-Y cartridge buff	2.61	30.87	11.84
3	1 200	Pale gull buff	2.51	24.00	9.57
4	1,250	Pale gull buff	2.45	20.13	8.08
5	1 288	Pale gull buff	2.61	20.45	7.83

Lineal shrinkage: 5.6%

Firing shrinkage (dry basis): 2.2%

*Ridgway color chart.

Wet-screen tests were made on the "run-of-mine" material and showed some grains coarser than 200 mesh. Approximately 85 percent of the material falls in the size range between 200 and 325 mesh and is made up almost entirely of silica particles. The 15 percent that passed the 325-mesh screen was filtered from suspension, dried, and a portion subjected to chemical analysis. The results are given in table II.

TABLE II.—CHEMICAL COMPOSITION OF FINE FRACTION OF CLAY FROM BATESVILLE SANDSTONE

SiO_2	58.00
Al_2O_3	29.30
Fe_2O_3	1.02
TiO_2	0.02
MgO	1.30
CaO	0.30
H_2O (loss at 110°C)	1.90
Loss on ignition (at 1,000°C)	7.47
	99.31

The crushing strength was determined on the product obtained at 1,200°C, in a Carver laboratory press. It was approximately 3,500 psi.

Conclusions: The material is highly siliceous but contains sufficient clay to bind the silica silt. The products are hard, strong, and light buff in color. The material may serve as a medium refractory such as a sagger clay.

Concentration of Palynological Fossils by Heavy-Liquid Flotation

James B. Urban

A problem of primary concern to the palynologist is the relative sparsity of fossils in certain rock types. Sparsity is due primarily to two factors: (1) fossils may actually be few or (2) they may be masked by associated insolubles that remain after normal digestion techniques have been applied. In either case it is necessary to concentrate the fossils by eliminating undesirable insolubles.

Funkhouser and Evitt (1959) described a flotation technique in which zinc chloride solution was used. This solution gives a satisfactory range of specific gravities but the procedure is more complex than their description indicates. Zinc chloride has been found to have a somewhat corrosive effect on the fossils if they are not processed quickly. This problem led me to search for a chemical with essentially the same specific gravity and solubility range as zinc chloride but with less corrosivity. Experiments with stannic chloride have shown it to be as good or better than zinc chloride. It is readily soluble with a maximum solution specific gravity of 1.97, which compares favorably with zinc chloride's maximum specific gravity of 1.96 (Hodgman, 1949, p. 1657). The cost is only slightly more than that of zinc chloride and the chemical is decidedly less reactive.

Procedure for Heavy-Liquid Flotation.—The fossil-bearing sample is first digested according to one of the methods prescribed for the rock type. After washing thoroughly and centrifuging, the remaining residue is split into several small portions and placed in separate centrifuge tubes. The tubes should be filled to approximately ¾ to ⅝ capacity with stannic chloride solution. Use of the flotation technique has shown that fossils in different rock types separate at different specific gravities. A specific gravity of 1.55 is recommended for the initial separation. At this point

Table I.—Quantities of Stannic Chloride Required for 1,000 Milliliters of Solution of Various Specific Gravities

Specific gravity	*Amount of $SnCl_4$ (gm)*	*Percent $SnCl_4$*
1.23	320.6	26
1.25	351.4	28
1.27	383.4	30
1.33	468.0	35
1.40	561.2	40
1.47	663.8	45
1.55	777.5	50
1.64	904.2	55
1.74	1,045.0	60
1.85	1,203.0	65
1.97	1,380.0	70

TABLE II.—REDUCTION OF SPECIFIC GRAVITY OF 100 MILLILITERS OF STOCK SOLUTION*

To reduce specific gravity to	*Add H_2O to increase volume to (ml)*
1.85	107.7
1.74	116.6
1.64	127.2
1.55	140.0
1.47	157.7
1.40	175.0
1.33	200.0
1.27	233.3
1.25	250.0
1.23	269.2

*70 percent stannic chloride, specific gravity 1.97.

two factors should be kept in mind: (1) the amount of residue used should be determined by the length-diameter ratio of the centrifuge tube; the quantity should be sufficiently small so that the mass-action effect of the settling material will not carry fossil material down and (2) the residue should be thoroughly disaggregated so that the fossils will be freed and given a chance to float. Centrifuge the samples at a constant speed and for a specific time. Best results are obtained with a centrifuge in which the tubes are spun horizontally. The length of centrifuging time and the rpm are as critical as the specific gravity. Only through careful manipulation of these three variables can better separations be accomplished. A run of nine minutes at 2,200 rpm has been found to be a good starting point. It is important that no braking be employed to stop the centrifuge.

After a separation has been effected, the stannic chloride with the light fraction is withdrawn. Both the light and heavy fractions should be checked to see if the separation is complete. If the fossils are found in the heavy fraction, one of the three variables should be changed. The same is true if there is a large amount of undesirable insolubles in the light fraction. Experimentation indicates that the most easily changed variable is the specific gravity of the stannic chloride solution. It is suggested that a stock solution with a specific gravity of 1.97 be prepared in order that a desired specific gravity may be obtained simply by the addition of distilled water. This procedure also eliminates the necessity of waiting for the solution to cool.

Once the desired separation has been obtained, the light fraction is withdrawn with the stannic chloride. The stannic chloride is then removed by dilution and centrifuging. A few drops of hydrochloric acid should be included with each addition of water to prevent precipitation of stannic chloride. It is absolutely necessary to remove as much of the stannic chloride as possible because it has a tendency to cloud many mounting media. The removal of any soluble halide is a fractional process, so numerous washings in small quantities of water are more effective than a few washings in large quantities. The cleaned residue is stored according to personal preference.

Procedure for Making Stock Solution.—Table I is a list of the quantities of stannic chloride, in grams, needed to yield 1,000 ml of solution of various specific gravities, ranging from 1.23 to 1.97. It is, however, more convenient to prepare a stock solution of 70 percent stannic chloride, the specific gravity of which can be changed by the addition of distilled water (table II). The stock solution is prepared in the following manner: (1) place 1,380 gm of stannic chloride in a container large enough to hold 1,000 ml of solution, (2) add enough water to make 800 ml of solution and then add 10 ml of hydrochloric acid, (3) fill to 1,000 ml and stir until the stannic chloride is dissolved, (4) cool solution to room temprature before using.

References Cited

FUNKHOUSER, J. W., and EVITT, W. R., 1959, Preparation techniques for acid insoluble microfossils: Micropaleontology, vol. 5, p. 369-375.

HODGMAN, C.D., (editor), 1949, Handbook of chemistry and physics, 31st ed.: Cleveland, Chemical Rubber Publishing Co.

New Gypsum Plant to Open Soon

Southwestern Gypsum Company has announced plans for opening a quarry in the Cloud Chief gypsum near Weatherford and for producing a 200-mesh product for use in horticultural applications. According to Mr. Travis Chambers, general manager, the plant will be located in Weatherford and will employ an estimated 14 persons. It will be in operation approximately on August 1.

By crushing, fine grinding, and packaging, specialty products will be produced as a source of calcium and sulfur for grass lawns, shrubs, and bedding plants. Ground gypsum also is beneficial in counteracting the alkalinity of soils.

Mr. Chambers and his partner, Mr. Doren E. Shepherd, have gained experience in producing agricultural gypsum the past two years from a deposit in the Cloud Chief gypsum near Colony, in eastern Washita County, where they now have a crushing and spreading operation. When the new plant and quarry are opened at Weatherford, the present quarry will be closed.

This will be the first production of gypsum from the enormous deposits in the Weatherford area, described in Oklahoma Geological Survey Mineral Report 35, by William E. Ham and Neville M. Curtis, Jr. Nearly 1.3 billion tons of gypsum for making wallboard and plaster, for use as a retarder in the making of portland cement, and for general agricultural use, was determined to be present on the basis of a program of coring during the summer of 1956. The Chambers of Commerce at Weatherford and Clinton took an active interest in promoting the possible use of these deposits, and financed the cost of drilling.

W. E. H.

Doryblastus, a New Mississippian Blastoid from Germany

Robert O. Fay

A new blastoid genus, *Doryblastus*, with type species *Mesoblastus melonianus* Schmidt, 1930, is here proposed for forms, from Mississippian rocks of Germany, with the following characteristics: The theca is subglobular to ellipsoidal, with 5 spiracles, anispiracle between an epideltoid and hypodeltoid, presumably 3 hydrospire folds on each side of an ambulacrum, lancet exposed the medial one-third of its width for its entire length, a wide, thick hydrospire plate along radial and deltoid margins, approximately 2 pores per side plate along the same margins, radials overlap deltoids, and deeply concave base.

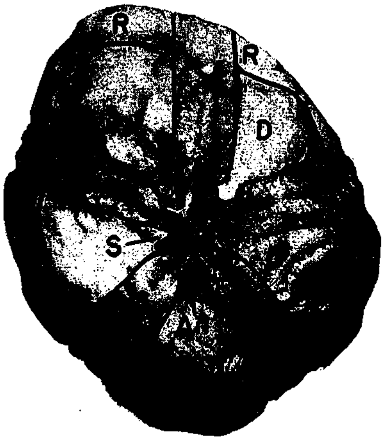
The only genus that has characteristics similar to the above genus is *Ellipticoblastus* Fay (1960), which has longer deltoids, one hydrospire fold on each side of an ambulacrum, 2 unnamed plates beneath the hypodeltoid, and flat base. *Mesoblastus* has 9 openings around the mouth (or 8 spiracles plus anispiracle), with anispiracle between a superdeltoid and hypodeltoid, with 2 unnamed plates beneath the hypodeltoid, 3 hydrospire folds on each side of an ambulacrum, lancet covered by side plates, 5 pores per side plate along radial margins only, hydrospire plate along radial margins only, radials overlap deltoids, and flat to convex base. Thus the above species must belong to some new genus, here named from the Greek *dory*, meaning spear, referring to the relative exposure of the lancet plate, which is one characteristic that distinguishes the genus from *Mesoblastus*.

Doryblastus melonianus (Schmidt) 1930, new combination
Plate I, figures 1-3

Mesoblastus melonianus Schmidt, 1930, p. 69-71, figs. 14 a-c.

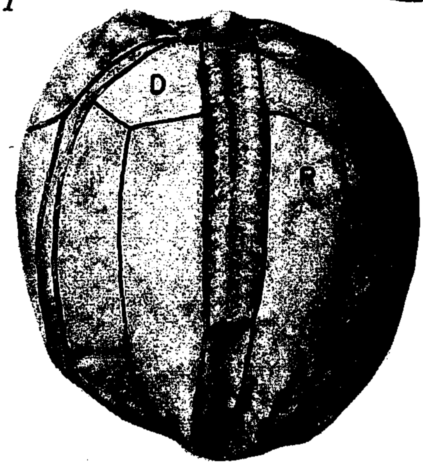
Theca calcitic, subglobular to ellipsoidal, 9.5 mm long by 8-9 mm wide, with deeply concave base and periphery about midheight. Basalia pentagonal, in deep sharply defined concavity, about 2 mm wide, with round stem in center, about 1.5 mm wide. There is a small round central lumen in the top columnal, with approximately 45 crenellae extending half-way radially from the circumference toward the center. Radials 5, elongate, pentagonal, each 8 mm long by 5 mm wide, with long, narrow, deep sinus about 1.5 mm wide by 7.5 mm long, turned aborally into basal concavity.

Deltoids 4, short, each 3 mm long by 3 mm wide, in side view 1.5 mm high, with a large V-shaped spiracle notched in the adoral tip. On the anal side there are at least 2 anal deltoid plates, a small arrow-shaped epideltoid adjacent to the oral opening, and a large hypodeltoid on the aboral side of the large anal opening. Parts of these structures are broken and it is impossible to determine the presence of other anal plates. It is suspected that 2 unnamed anal plates may occur beneath the hypodeltoid, infolded to form the hydrospire plates on the anal side, but only



1

2



3

Plate I

Doryblastus melonianus *(Schmidt), 1930. Lectotype, E.24, Geologisch-Palaontologisches Museum, Berlin, Germany. From uppermost Tournaisian limestone, Mississippian, waterfall near Velbert, Germany. All figures x6.2.*

Figure 1. *Oral view with anal side toward bottom of page.*

Figure 2. *Aboral view with anterior ambulacrum toward bottom of page.*

Figure 3. *Left posterior (D) ambulacral view.*

An—anal opening
B—basal plate
C—columnal
D—deltoid plate
ED—epideltoid plate
HD—hypodeltoid plate
L—lancet
R—radial
S—spiracle
Z—azygous basal plate

the hydrospire plates are preserved. The hydrospire plates are present in all ambulacral areas as thick wide plates along the deltoid and radial margins, with pores between the plates and the margins. There are approximately twice as many pores as side plates, as pointed out by Schmidt (1930). Radials overlap deltoids. In one ambulacral area in which the radial plate is broken there appear to be 3 hydrospire folds on each side of an ambulacrum, but this remains to be confirmed.

Ambulacra 5, linear, recurved below, each 1.5 mm wide by 12.5 mm long, with lancet exposed along the medial one-third of its width for the length of the ambulacrum. The side plates rest upon the thick wide hydrospire plate and the bevelled margin of the lancet plate, with about 30 side plates in 10 mm length of an ambulacrum. The outer side plates are normally disposed, each resting upon the bevelled adoral-abmedial corner of each primary side plate, as shown by Schmidt. There are approximately 6 cover-plate lobes per side plate along the main food groove. The surfaces of the thecal plates are ornamented with fine growth lines subparallel to plate margins.

Remarks.—The concave base, thick hydrospire plate, and exposed lancet plate are advanced characteristics of blastoids, showing that this genus was advanced and specialized. *Doryblastus* probably came from an ellipsoidal blastoid with flat to convex base, 3 or more hydrospire folds, lancet covered by side plates, and no hydrospire plate; in other words from a form similar to an elliptical *Schizotremites*, if such existed.

Occurrence.—Two specimens from the uppermost Tournaisian limestone, waterfall near Velbert, Germany, correlated with the C_1 Avonian (*Syringothyris* zone) of England.

Types.—Lectotype (here designated), $E_4$24, Geologisch-Paläontologisches Museum, Berlin, Germany (figured); and syntype, one specimen, Göttingen collection, figured by Schmidt (1930, p. 70, fig. 14a). I wish to thank Professor Doctor Walter Gross for loan of the type which is on deposit at the Geologisch-Paläontologisches Institut und Museum der Humbolt-Universität zu Berlin.

Refrences Cited

Fay, R. O., 1960, The type species of *Orbitremites* Austin and Austin 1842, and *Ellipticoblastus*, a new Mississippian genus: Okla. Geol. Survey, Okla. Geology Notes, vol. 20, p. 315-317, 1 pl.

Schmidt, W. E., 1930, Die Fauna des deutschen Unterkarbons, 1. Teil, Die Echinodermen: Preussischen Geologischen Landesanstalt, Abhandlungen, new series, vol. 122, p. 1-92, pls. 1-3, text-figs. 1-20.