different phases can be seen plainly at the place mentioned. Inasmuch as the seams in the clay are not wide, the veins of mineral are thin and hence are generally extended in two dimensions, the jointing being distant compared with the thickness of the original vein. If the interstitial clay should be washed away these flat nodules would settle in plates or laminae, according to the position of their centers of gravity, and form layers which if subsequently cemented would show the characteristics of the well known plate rock phosphates.

Those interested in phosphate in Oklahoma, are referred to the following:

Oklahoma Geological Survey Bulletin, No. 3, p. 60.

United States Geological Survey Folio, No. 122.

University of Texas Bulletin, No. 1814, p. 64; which mentions phosphatic material in the Wichita beds of the Permian in the adjacent state of Texas.

The writer is continuing the investigation of these interesting nodules and hopes to be able to present in the near future some data regarding the nodules of the Permian Red Beds.

Summarizing: The present paper calls attention to the fact that phosphate rock exists in Oklahoma, points out a locality where it occurs, presents an analysis of the material, and offers an explanation as to the method of its formation.

XIX. NOTES ON BARITE IN OKLAHOMA WITH CHEMICAL ANALYSES OF SAND BARITE ROSETTES

A. C. Shead

From the Oklahoma Geological Survey.

Notwithstanding the fact that barite and especially the form known as "sand barite rosettes," has long attracted attention as one of the most widely disseminated of Oklahoma minerals, yet little definite progress has been made in working out the extent of its areal distribution, the methods of its genesis, or the geological significance of its presence in the rocks.

Before any of these general questions can be answered a great amount of detailed work, both in the field and in the laboratory, will have to be done and it is the purpose of this paper to present a short summary of the accomplishment recorded up to the present time.

The only statement regarding the areal extent of the deposits is a verbal one, attributed to C. N. Gould in which it was said that the barite occurs in an outcrop of red sandstone about ten mile

Location	Nature of Aggregate	Observer
Cotton County NW. ¼ Sec. 26, T. 4 S., R. 11 W.	Pure thin fibrous vein material	A. C. Shead
Cotton County	Geodes containing pure crystalline barite	A. C. Shead
Near Cache, Okla.	Pure, radiate structure, balls	
Near Snyder, Okla.	Radiate Structure	
Near byers, Okla.		
T. 4 N., 1 W., 1 mi. E. Paoli, Okla.	Sand barite rosettes	C. W. Honess
SW. of SE. ¼ Sec. 18 T. 9 N., R 1 W.	Sand barite rosettes	A. C. Shead
Secs. 18, 22, 30, 31, T. 9 N., R. T E.	Sand barite rosettes	Norman Meland
Secs. 5, 8, 25, T. 8 N., R. 1 W.	Sand barite rosettes	Norman Meland
Sec. 31 T. 12 N., R. 7 E.	Sand barite rosettes	A. C. Shead
Sec. 6 T. 3 S., R. 6 W.	Pure, radiate balls plus vein material	Wallace Thompson
Chandler, Okla., about 2 mi. W. of NE. ¼ sec. 1 T. 14 N., R. 3 8.	Very impure sandy barite	H. E. Lillibridge
Maude, Okla., near.	Very pure crystalline barite	
Watson, Okla., 3½ mi. south of.	Very pure massive	M. C. Oakes
Near White Mound, Okla., in Sylvan shale, Arbuckle Mountains.	Thin flat radiate crystals	C. E. Decker
Center NE. ¼ Sec. 27, T. 3 S., R. 14 W.	Flat disc-like impure sand barite rosettes	H. E. Lillibridge

wide and fifty to seventy-five miles long that passes through several counties, among which were Cleveland, Oklahoma, and Lincoln.

Partly within this area are situated the particular localities noted in the following table.

From what the writer can learn from a somewhat limited field study, the barite of the red beds is of two distinct qualities depending upon whether it was deposited in shales and limestones or in porous sandstones.

Barite does not seem to so readily include argillaceous material as arenaceous impurities consequently barite deposited in shales maintain quite fully its chemical integrity while that deposited in sandstones may be diluted with quartzitic sand to almost any extent. If the proportion is about 50 per cent, $BaSO_4$ will exert its influence upon the outward form of the aggregate. With a greater proportion of SiO_2 this influence gradually becomes less until above 70 per cent sand is included when the presence of barite may only be inferred from the satiny saccharoidal appearance and an increased specific gravity of the sandstone above its usual weight.

Those impure forms developed by deposition of $BaSO_4$ in sandstone, known usually as sand barite rosettes, have been so carefully described by Nichols* that they need no further mention other than the citation of the literature and a tabulation of various analysis available, which are as follows:

Analyses of sand barite rosettes (Expressed in Percent).

SiO_2	35.99	45.13	45.20
Al_2O_3	5.36	0.88	0.86
Fe_2O_3	0.82	0.96	0.93
MgO	0.03	0.00	0.00
CaO	0.51	0.00	0.00
H_2O	0.27	0.31	0.36
P_2O_5	n. d.	faint trace	trace
SO_3	19.20	17.87	18.14
MnO	n. d.	0.02	0.02
BaO	35.76	34.25	34.50
SrO	n. d.	n. d.	0.00
CO_2	n. d.	0.0	0.07
Organic	0.32	n. d.	n. d.
Total	99.26	99.42	100.08
Specific Gravity	3.38	3.36	3.36

*Nichols, Henry Windsor "New Forms of Concretions". Publication Number 111 Geological Series of Field Columbian Museum Vol. III No. 3, 1906, Chicago.

NOTE: Analysis "A," by Nichols on specimen from indefinite location in sand barite area. Analysis "B," by A. C. Shead, on sample from S.W. of S.E.¼ of Sec. 18. T.9N., R.1W., near Norman, Okla. Analysis "C," by J. D. Fairchild of United States Geological Survey, checking "B."

The specific gravity determinations quoted under "B" and "C" are due to Meland.*

Those approximately pure varieties of $BaSO_4$ separating out in shales and as vein material generally, exhibit the following modes of aggregation.

1. Massive white material with porcelain luster.
2. Massive crystalline transparent barite.
3. Thin vein material, fibrous in character, whitish and translucent.
4. Crystalline, reddish, radiate spheroidal balls.
5. Inclusions in geodes.
   a. Radiate in structure, generally reddish.
   b. Massive crystalline material, colorless.
6. Thin flat lens like aggregations with a radial structure and a greenish color.

Little need be said of the first two varieties mentioned above, as they exhibit no especial pecularities. Number 1 comes from a vein at a depth of 105 feet in the old prospect shaft of the Buffalo Mining Co., about 3½ miles south of Watson, McCurtain county, Oklahoma; while Number 2 comes from the vicinity of Maude, Oklahoma.

However, the writer has observed carefully the mode of occurrence of Number 3 mentioned above. This variety was observed in red shale in a large wash in NW.¼ Sec. 26,T.4S., R.11W. in Cotton county, Oklahoma. Small veins, never more than about ¼-inch thick, traverse the clay for a few yards and extend to an unknown depth.

From the fact that the fibers of the mineral extend perpendicular to the sides of the vein and seem to meet in a median line parallel to the sides of the vein it is logical to assume that the barite solutions seeped in from the sides of the small fissure and built out to the center, marked by the median line.

From consideration of the evident method of formation of the vein material just described, the writer advances the theory that the radiate balls of barite were formed by an analogous process to the above on the assumption that a spheroidal cavity was originally

*Meland, Norman "Sand Barites", 1922. A Masters Thesis in Library of University of Oklahoma.

present and that seepage of solution carrying barite took place with concomitant crystal growth perpendicular to the walls of the cavity. These crystals must meet in the center, thus forming the radiate structure observed, inasmuch as by geometry the radii of a sphere are perpendicular to its surface (or tangents to the surface).

This theory is further borne out by the actual existence of a ferruginous hard shell found actually surrounding barite with radiate structure giving rise to the geodes mentioned under 5a. This shell is considered the lining of the cavity, which only needs to be removed by water rolling, or other form of attrition to produce the radiate form from the geode having a radiate internal structure.

The writer has no theory to cover the reason why geodes sometimes have a radiate structure and sometimes have massive crystalline interiors though possibly differences of temperatures, rapidity of formation, or changed conditions, produced the difference observed in the transition from 5a to 5b. It is probably most plausible to assume that the radiate structure is developed when the rate of crystal growth exceeds the rate of seepage of the barite solution into the original cavity and the massive form, when the rate of crystal growth exceeds the rate of seepage of barite solution into the original cavity and the massive form, when the rate of crystal growth is less than the rate of seepage.

The flat lens-shaped radiate forms with the light greenish color are said to occur in the Sylvan shale near White Mound in the Arbuckle mountains. Since the writer has never seen these forms in place he is not in position to advance any theories as to their genesis.

It is an interesting fact worthy of note that many times barite is associated with copper ores and hematite and these in turn have been shown to be connected in some instances with faulting; which often is a very significant phenomenon.

In the foregoing paper an attempt has been made to call attention to an interesting problem in the barite deposits of Oklahoma, to lay a foundation for future work by summarizing the definite accomplishments already achieved along this line and to place on record a few of the writer's observations, theories and analyses, pertaining to these deposits.*

*To those interested further the writer recommends Meland's bibliography in the thesis cited. Vide Supra.