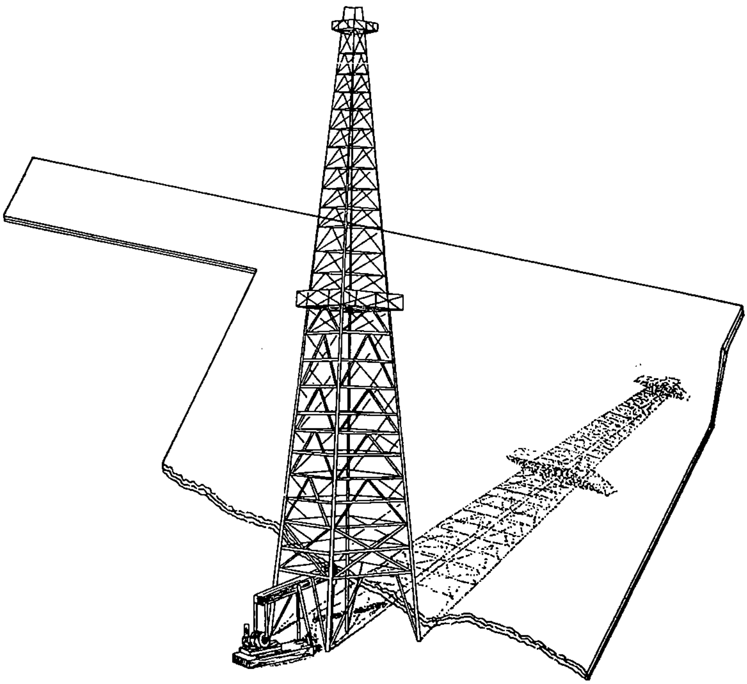
Oklahoma Geology Notes



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Correction to Vol. 16, No. 8.

Have you seen the sign in print shops "Before you louse it up, THIMK!"? We should have had the sign here. In OKLAHOMA GEOLOGY NOTES, Vol 16, No. 8, p. 80, the caption under Figure 1 is that of Figure 3; on p. 81, the caption under Figure 2 is that of Figure 1, and on p. 84, the caption under the figure is that of Figure 2. A reward of a year's subscription to the NOTES is offered to anyone who can honestly state that he detected the errors.

Basic Magnesium Carbonate from Dolomite

By A. L. Burwell

The preparation of basic magnesium carbonate from dolomite is principally by the Pattison process, the operation of which has basically unchanged over a number of years. The process has been outlined by B. L. Miller in Limestones of Pennsylvania, Bulletin M-20 (1934), Topographical and Geological Survey of Pennsylvania.

In brief, the process consists in crushing and calcination of the dolomite to yield a caustic calcine, under conditions whereby the carbon dioxide from both the stone and the fuel is recovered. In practice, the calcine is slaked with water and then ground in a pebble mill. More water is added and the slurry is carbonated under pressure, using the collected flue gas as the source of carbon dioxide. The carbonization converts the calcium hydroxide into insoluble calcium carbonate whereas the magnesium hydroxide, through use of excess carbon dioxide, is converted into magnesium bicarbonate, which is soluble. Separation of the insoluble material from the solution is brought about by sedimentation and filtration.

The solution, carrying slightly more than 2 percent magnesium bicarbonate, is run to an upright boiler and subjected to heat whereby a portion of the carbon dioxide is driven off, causing precipitation of an insoluble basic magnesium carbonate. The released carbon dioxide is returned to the carbonization system and the precipitate collected on a gravity filter. Some wet cake is dried and marketed as magnesia alba for the drug and cosmetic trade, or calcined to yield a high-purity magnesia. However, the major portion is mixed with asbestos fibre before drying and cast into forms, then dried. The product is the "85% magnesia" used extensively as insulation, especially for pipe covering. In prewar years most of the basic magnesium carbonate was produced by plants at Port Kennedy and Ambler, Pennsylvania, and Manville, New Jersey. During the war the process was used at other places, including Austin, Texas.

Reactions involved:

$$CaCO_3.MgCO_3 — CaO — MgO — 2CO_2 \quad CaO — MgO — 4H_2O —Ca(OH)_2—Mg(OH)_2$$

$$Ca(OH)_2—Mg(OH)_2—3CO_2—CaCO_3—MgH_2(CO_3)_2—H_2O$$

$$4MgH_2(CO_3)_2—3MgCO_3Mg(OH)_2.3H_2O—5CO_2$$

There are dolomites in Oklahoma that meet the specifications of raw material for the Pattison process. Reference is to the Royer dolomite of the Arbuckle Mountain area and the dolomites of the McKenzie Hill formation in Comanche County. Possibly there are others on which information is not available.

For the purpose of illustration only, the assumption is made that 50 tons per day is the input into the kilns, and the rock has acceptable composition. It is calculated that the calcine will weigh approximately 26 1/3 tons of which 10 2/3 tons will be magnesia (MgO). The calcine, as such, may be marketed as builder's lime but is not acceptable for water treating.

Calcination removes approximately 23 2/3 tons of carbon dioxide from the dolomite. It is in the flue gases together with carbon dioxide resulting from the combustion of the fuel. The amount derived from fuel will depend upon several factors including the kind of fuel and the type of kiln. According to Taggert (Handbook of Mineral Dressing), the production of a ton of lime uses as little as 2,400,000 BTU of heat to as much as 9,300,000 BTU, and he states that a long rotary kiln efficiently operated may require about 4,500,000 BTU per ton of lime. On this latter basis, the fuel, if natural gas, would furnish about 7 tons of carbon dioxide or slightly more than 30 tons of carbon dioxide from the 50 tons of dolomite and the fuel. However, according to Miller, in Pennsylvania the calcination is carried out in closed kilns, using 1 pound of coke to 100 pounds of dolomite, from which it is calculated that 50 tons of dolomite and the fuel would yield about 43 tons of carbon dioxide. Since a minimum of 35.5 tons of carbon dioxide is required to carbonate the slurry from 50 tons of dolomite, it may be necessary to augment the carbon dioxide supply if natural gas is used as fuel.

The calcined product is slaked, ball mill ground, diluted, and carbonated under pressure using the flue gas. The water necessary for processing may be calculated from the fact that the concentration of magnesium bicarbonate is slightly more than 2 percent. Accordingly, 460,000 gallons of water will be required for every 50 tons of dolomite processed. Probably the water consumption may be reduced by recovery and re-use of the water.

The theoretical yield of basic magnesium carbonate from 50 tons of dolomite is computed at over 19 tons, but the actual yield will depend upon the efficiency of all operations.

Basic magnesium carbonate was produced by 7 plants in 1953, according to information taken from Mineral Facts and Problems (U. S. Bureau of Mines Bull. 556). The production totalled 41,034 tons, but producers consumed all but 5,010 tons, which brought $745,423, or about $148.00 per ton. This information indicates that much of the production is captive and that the product is further processed by the manufacturer, presumably in the making of "85% magnesia" insulation, and other products.

Revised General Geologic Column Available

R. H. Dott prepared for The Oil Scout's and Landmen's Association a general geologic column in Oklahoma oil-producing areas. This was published in the Yearbook in 1944 as a two-page spread. A revision was prepared by Dott in 1948 and it appeared in that yearbook and subsequent volumes. The Survey has distributed the chart separately. The Association had a large supply for use in future years, but a leaky radiator destroyed the stock. Mr. Dott felt that he could not prepare a revision and Carl C. Branson did so instead. The Oil Scout's and Landmen's Association supplied the Survey with a stock of the new chart. This revised chart is now available from the Survey for a mailing charge of ten cents. It will also appear in the Yearbook in the next few weeks.

Hartshorne Formation, Early Desmoinesian, Oklahoma

Carl C. Branson

A widely distributed sandstone lying in the basal part of the Des Moines series was named Hartshorne sandstone by Taff (1899, p. 436). The unit was named for the village of Hartshorne, Pittsburg County, near which it crops out as the rim of a synclinal basin. No type section was designated. The original description states that the sandstone lies below the Hartshorne coal, and the important seam in the area is the Lower Hartshorne coal. It is quite evident that Taff meant the name Hartshorne to apply to the massive sandstone overlying the Atoka formation and underlying the Lower Hartshorne coal.

The next year, Taff and Adams (1900, p. 274) used the name Hartshorne sandstone for a series of sandstone beds separated by coal-bearing shales. The total thickness of the sandstone interval in the area (Eastern Choctaw coal field) is 100 to less than 200 feet. The Upper Hartshorne coal was considered to be above the Hartshorne and to lie in and at the base of the McAlester shale. The Lower Hartshorne coal was said to lie within the Hartshorne sandstone. The Hartshorne sandstone of Taff 1899 is the basal bed of the sequence.

Hendricks and Parks (1937, p. 198) stated that Arkansas usage conformed to the original usage of Taff and that the Hartshorne sandstone is the sheet sandstone below the lower Hartshorne coal.

Newell (1937, p. 35) states that in T. 12 N., the Upper Hartshorne coal lies immediately upon 3 to 25 feet of sandstone, which he identified as Hartshorne sandstone. A coal occurs in the shale under the sandstone in Tps. 13 and 14 N., R. 19 E. This coal Newell placed in the uppermost shale unit of the Atoka, but called it lower Hartshorne coal. On Newell's interpretation, the lower sandstone of the Des Moines section is missing in the Muskogee-Porum district, and the sandstone between the coals is the Hartshorne sandstone.

Oakes and Knechtel (1948, pp. 22-26) and Knechtel (1949, p. 16) employed a special usage because they found that the Lower Hartshorne and Upper Hartshorne coals merge in eastern Haskell County and in LeFlore County. The top of the coal is considered the top of the Hartshorne sandstone. The base of the sandstone lies with apparent conformity upon Atoka shale. The writer is not convinced that the Upper and Lower Hartshorne coals merge, and suggests that the Upper Hartshorne divides locally.

The name Hartshorne sandstone was, then, applied originally to the sandstone below the Lower Hartshorne coal; and in Arkansas, that usage has been and is employed. Taff, himself, in a second paper, and most subsequent authors have used the name Hartshorne sandstone for the sequence of sandstone above and below the Lower Hartshorne coal; Oakes and Knechtel used this latter interpretation and included the Upper Hartshorne coal (Fig. 1).

<table>
<tr><th>Chance, 1890</th><th>Taff, 1899</th><th colspan="2">Taff and Adams 1900</th><th>Hendricks and Parks 1937</th><th>Newell, 1937</th><th colspan="2">Oakes and Knechtel 1948</th><th colspan="2">This Report</th></tr>
<tr><td>U. Grady coal</td><td></td><td colspan="2">U. Hartshorne coal</td><td>U. Hartshorne coal</td><td>U. Hartshorne coal</td><td colspan="2">U. Hartshorne coal</td><td colspan="2">U. Hartshorne coal</td></tr>
<tr><td>shale or ss.</td><td></td><td colspan="2">shale</td><td rowspan="2">shale with ss. lenses</td><td>shale</td><td rowspan="3">Hartshorne ss.</td><td rowspan="2">ss.</td><td rowspan="3">Hartshorne ss.</td><td>shale</td></tr>
<tr><td>Middle Grady coal shale or sandstone</td><td></td><td rowspan="2">Hartshorne ss.</td><td>ss.
sh. & coal
sandstone</td><td>Hartshorne ss.</td><td>local coal
sandstone
shale</td></tr>
<tr><td>Grady coal</td><td>Hartshorne coal</td><td>L. Hartshorne coal</td><td>L. Hartshorne coal</td><td>Atoka sh. coal</td><td>L. Hartshorne coal</td><td>L. Hartshorne coal</td></tr>
<tr><td>Tobucksy ss.</td><td>Hartshorne ss.</td><td colspan="2">sandstone</td><td>Hartshorne ss.</td><td></td><td colspan="2">sandstone</td><td colspan="2">Tobucksy ss.</td></tr>
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Figure 1. Various Stratigraphic Classifications of Hartshorne Units.

The present conception of the Hartshorne formation is that shown in the table below.

TABLE I. UNITS OF THE HARTSHORNE FORMATION

	Haskell and N. LeFlore Cos.	Rest of McAlester Basin	Platform
Part of McAlester fm.	Warner ss. McCurtain sh.	Warner ss. McCurtain	Warner ss.
Hartshorne fm.	Hartshorne coal Tobucksy sandstone	Upper Hartshorne coal shale and sandstone tongue or tongues Lower Hartshorne coal Tobucksy sandstone	Riverton coal shale, coal bed Taonurus siltstone L. Hartshorne (?) coal Tobucksy sandstone
	Unconformity		
	Atoka formation	Atoka formation	Chester, Keokuk

The lowest sandstone, that under the Lower Hartshorne coal, is continuous in the basin. It is the basal unit of the Des Moines series, and as such is an important marker. In the Lehigh district it is conglomeratic (Knechtel, 1937, p. 103), and near Fort Smith it is channeled into the Atoka (Hendricks and Parks, 1950, pp. 73-74). It is clearly desirable that this sandstone have a distinctive name, and one is available. In 1890, Chance (pp. 658, 659) described, mapped, and named the unit. His name is Tobucksy sandstone, and it is here proposed that that name be restored as the stratigraphic name of the sandstone in question. Chance clearly shows that the sandstone is the rim-forming sandstone around the Grady Basin (now Hartshorne Basin), and his type area is the same as that of Taff's Hartshorne sandstone of 1899. Chance demonstrated that the Tobucksy sandstone is below the Grady coal (Lower Hartshorne coal).

The name Tobucksy appears to come from the Choctaw word tobaksi, meaning coal pit. [1] The geographic unit for which the sandstone was named is Tobucksy County, Mosholatubbee District Choctaw Indian Nation. [2] The county seat of Tobucksy County was the town of McAlester, and the sandstone crops out in the county. The name has a clear geographic source, the identity of the sandstone so named is unmistakable, and the name has priority. It is difficult to understand why Taff did not use the name. The section exposed in the cut on the county road near the E¼ corner of sec. 7, T. 5 N., R. 17 E., is here designated the type section. At this locality the unit is 143 feet thick (Hendricks, 1937, p. 12).

The sequence of beds consisting of sandstone with intervening coal-bearing shales and including the Upper Hartshorne coal above requires a name. In effect Oakes and Knechtel did apply the name Hartshorne to the unit in Haskell and LeFlore Counties, but they retained the lithologic designation, Hartshorne sandstone.

It is here proposed that the beds from the base of the Des Moines series (top of Atoka formation where present) to the top of the Upper Hartshorne coal be referred to as the Hartshorne formation. The Tobucksy sandstone member is its lowermost member throughout the basin. Above the Tobucksy in Pittsburg and Latimer Counties and in Arkansas is the Lower Hartshorne coal, a sandstone tongue or tongues, and the upper Hartshorne coal. In Haskell and Northern LeFlore Counties only the Hartshorne coal and associated underclay are above the Tobucksy in the Hartshorne formation (Fig. 2).

On the platform, the section is thinner and the members are quite different. Newell measured several sections (1937, pp. 36, 166, 167, 170, 178, 179, 184) in which he identified the Hartshorne sandstone. In most of these, his Hartshorne sandstone is the upper sandstone bed, and Lower Hartshorne coal is placed in the Atoka. Newell placed strong emphasis on **Taonurus** as an index fossil of the Atoka. The genus is a facies fossil developed in fine-grained

[1] Sears, A. B., Department of History, University of Oklahoma. Personal communication, April 7, 1954.

[2] Rickey, Don, Jr., Librarian, Phillips Collection, University of Oklahoma. Personal communication, April 1954.

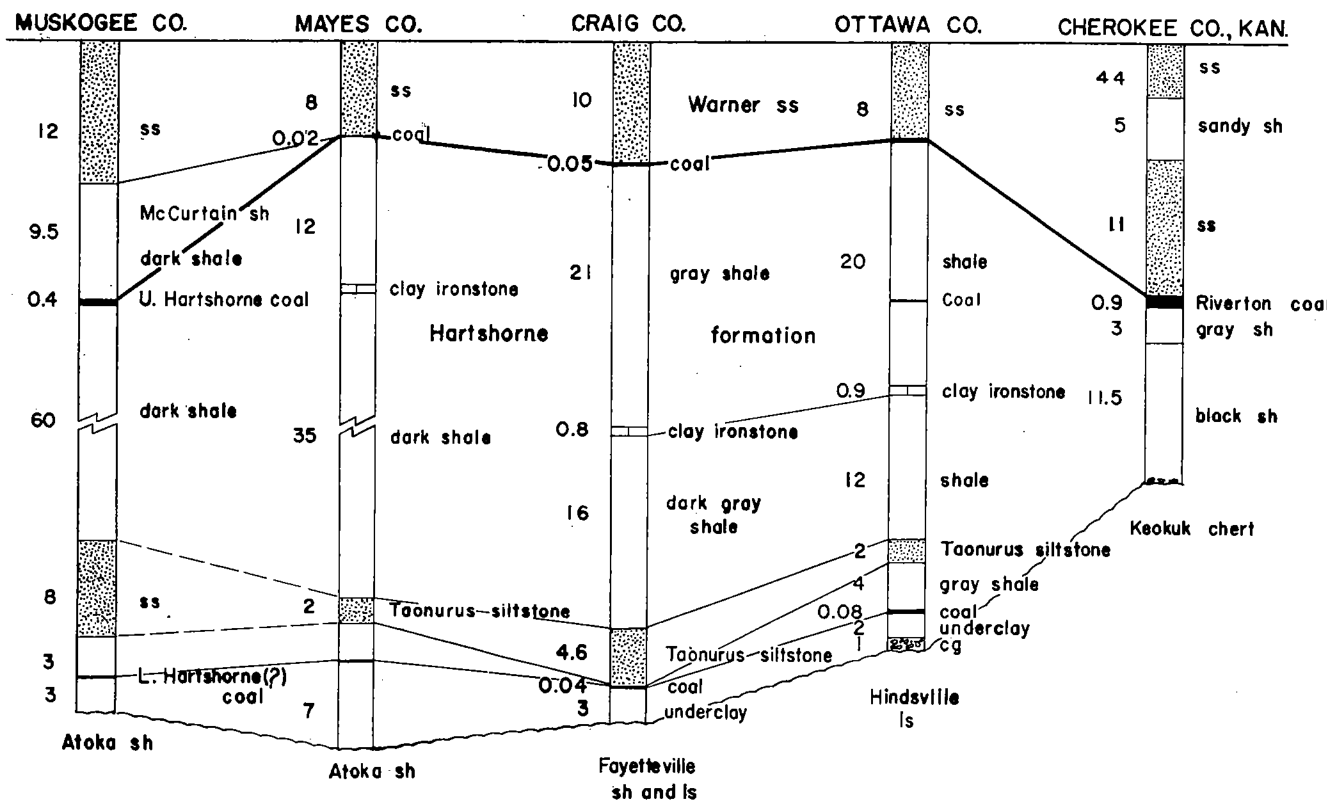

Figure 3. South to north interpretive cross-section of Hartshorne formation.

carbonaceous sandstone and siltstones of former tide flats. It is abundant in the sandstone at the top of the Spaniard limestone member of the Savanna formation in Mayes County, and it occurs in a fine siltstone underlying the Warner sandstone in Ottawa County (Branson, 1954, p. 12). The Atoka contains much material of this lithologic facies, and is thus more likely to bear **Taonurus** than is any other formation of the area. It is here believed that the **Taonurus** siltstone and the underlying coal and underclay belong to the Hartshorne formation.

The Hartshorne formation of Craig and Ottawa Counties consists of a basal conglomerate, an underclay and local coal, a **Taonurus-bearing** siltstone, a dark shale with a thin coal, and an underclay and coal (Riverton). The Warner sandstone rests a few inches above the upper coal. The base of the Hartshorne lies with disconformity upon the Keokuk, Hindsville, Fayetteville, and Atoka within the counties.

The **Taonurus-bearing** siltstone has been identified at places across Mayes County. Newell called it "Blackjack (?) sandstone member" of the Atoka where he saw it east of Vinita (Newell, 1937, p. 184). The siltstone is considered here to be the sandstone tongue between the Lower and Upper Hartshorne coals.

In Wagoner, Mayes, Craig, and Ottawa Counties, and in Cherokee County, Kansas, the top of the Hartshorne formation is essentially the base of the Warner sandstone member of the McAlester formation. The base of the Hartshorne is exposed at few places, but is mappable as the top of the underlying formation is recognized.

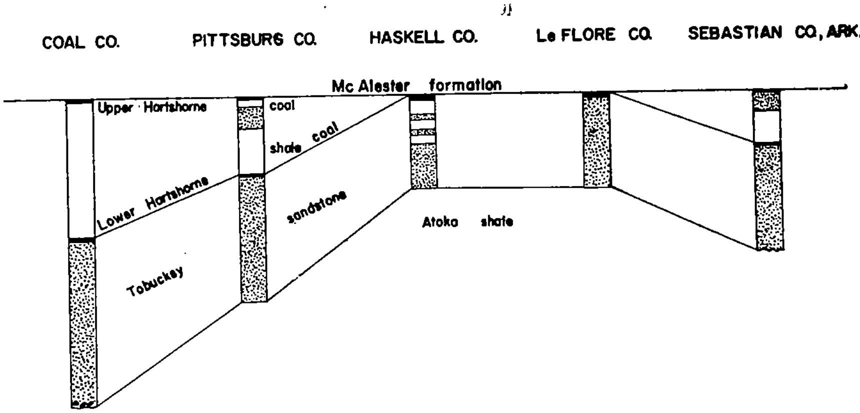

Figure 2. Southwest-Northeast cross-section of Hartshorne formation.

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Fossils of the Hunton Group Cataloged

Dr. Thomas W. Amsden of the Oklahoma Geological Survey has just completed an annotated listing of fossils described from the Hunton group. For each species the original reference, the stratigraphic data, the repository of types, and for species described originally from other states the information on Oklahoma specimens is given. Dr. Amsden found 229 species described or figured. The incompleteness of knowledge of the fauna is shown by the facts that only Foraminifera are described from the Chimneyhill formation, no species have been described from either the Bois d'Arc or Frisco formations, and only 3 corals are known from the whole group. No cystoid has been recorded and no vertebrate is known.

The catalog will be of great use in scheduled studies of Hunton fossils. Dr. Amsden is accumulating collections from accurately measured stratigraphic sections and will describe the faunas of the well-known group with its prolific but little-known fossils.

The report is Circular 38, "Catalog of Fossils from the Hunton group, Oklahoma." It is obtainable from the Survey office for \$0.75, or for \$1.25 bound in blue cloth.

Report on Manning Zone Fossils Issued

Circular 39 of the Oklahoma Geological Survey is entitled "Chester Foraminifera and Ostracoda from the Ringwood Pool of Oklahoma." The report is by R. W. Harris and Thomas C. Jobe and consists of 41 pages and four collotype plates of fossils. The authors describe eleven new species and three new subspecies of Ostracoda. They conclude that the Manning strata are Mississippian (Chesterian) in age. The circular is available from the Survey office for $1.00 postpaid, or for $1.50 bound in blue cloth.

Regarding Some Natural Inorganic Fertilizers

"No one can be certain that his ideas are in fact Truth. The nearest approach to certainty is an idea that we believe right."

It is common knowledge that many soils respond to treatment with pulverized limestone as shown by increased yield of crops following such application. The explanation which has been accepted generally is that the limestone acted to neutralize the soil acidity. As a matter of fact, the application of limestone was recommended only on soils that showed an acid reaction on testing. The acidity was attributed to organic acids resulting from natural decomposition of vegetation or to residual portions of inorganic fertilizer materials remaining after the basic portion had been absorbed by growing plants. Chemically, the reason for the lack of plant growth was attributed to excessive amounts of the hydrogen ion. Apparently, no one questioned this line of reasoning.

Now, we are told that the application of limestone to almost any soil is good practice, and especially to acid soils. However, the reason that limestone exerts such a beneficial action is not due to the "killing" of the acid as had been supposed but is due principally to the availability of calcium and magnesium and the essential need of plants for these elements. In other words, the limestone contains fertilizer values in its content of calcium, magnesium, manganese, phosphorus, zinc, nickel, copper and other metals. An impure limestone possibly holds an advantage over high-purity limestone for application to soils.

This change in ideas came about when the colloid chemist recognized that soils offer him a wonderful opportunity for research in his chosen field. Soils are, generally speaking, a mixture of clay and sand in varying proportions. The sand may be particles of quartz (silica) or of unaltered rock minerals, varying in size from very finely divided silt to course gravel. The clay portion is made up of the so-called clay minerals and alteration products similar in composition to the clay minerals. These minerals are all more or less complex silicates whose particles are so small as to be colloidal and they carry many negative electrical charges. This colloidal material offers a tremendous surface for absorbing and exchanging positively charged ions such as hydrogen, calcium, magnesium, potassium, manganese, and zinc among others. However, all clay minerals do not have the same exchange capacity. Kaolinite has, probably, the least exchange capacity among the clay minerals. Some of the positive ions (cations) may be classed as plant nutrients. Others, notably hydrogen, may not be so classed. Hydrogen is called a non-nutrient. Nevertheless, the presence of the hydrogen ion is beneficial in many cases, but as a general rule, plant growth is accelerated by the replacement of the hydrogen ion by ions of metals that are plant nutrients. Thus, the practice of applying pulverized limestone is simply an application of the new concept of reducing the number of hydrogen ions together with the addition of an adequate supply of needed and essential calcium and magnesium which replace the hydrogen ion on the surface and in the molecular structure of the clay minerals where these nutrient elements are available to the plants. It has been shown, also, that application of limestone is beneficial even on soils free from hydrogen ions.

In addition to limestone and dolomite, which have been used as soil additives for a number of years, certain other natural rocks are now being recommended as fertilizer materials due to their potassium content. This subject was treated from the standpoint of Oklahoma raw materials in an acticle in the February 1956 issue of Oklahoma Geology Notes. It is suggested that articles by W. D. Keller and William A. Albrecht of the University of Missouri in the May 1956 issue of Pit & Quarry would be well worth reading.

A. L. B.

A second producer of metallic magnesium is in prospect. The report in Chemical Week(July 21 issue) indicates the ferrosilicon process will be used, since it yields a higher purity product although at a higher cost. We are prompted to recall that Oklahoma's Royer dolomite meets the rigid specifications demanded of raw material for the Pidgeon Process (ferrosilicon process).

A. L. B.

Oklahoma Fossil Locality and a New Snail

Securely buried in a long paper on Permian snails is the identification of a species from the Red Eagle limestone of Osage County. The Burbank Rock Co. quarry on both sides of U. S. Highway 60 east of Burbank has an abandoned area at the southeast end of the workings (NW¼ SE¼ sec. 25, T. 26 N., R. 6 E.). The limestone grades into shaly beds there and the rock is of poorer grade. The shaly portions are fine fossil collecting ground. The snail identified from the locality is **Omphalotrochus wolfcampensis** new species. The type specimens are from the Wolfcamp formation of the Glass Mountains in Texas. The snail is a large, low-spired marine form, member of a genus almost entirely confined to early Permian rocks.

The Burbank quarry locality also yields well-preserved productids, colonies of **Teguliferina,** chonetids, **Wellerella,** goniatites, a large nautiloid, fusulinids, and rare crinoid crowns, clams, and snails.

The fine paper which records the occurrence is "Permian Gastropoda of the Southwestern United States, Part I", by Ellis L. Yochelson, American Museum of Natural History, Bulletin, vol. 110, article 3, 1956.

Oklahoma Tektite Recorded

Tektites are glassy, rounded, black to dark green objects from pin-head size up to several ounces weight. Scientists disagree as to their origin, even as to whether they are of terrestrial origin or of meteoritic origin. A recent article pictures a small specimen from near Delhi, Beckham County, Oklahoma. This is the first Oklahoma record. The reference is "Tektites and the Lost Planet," by Ralph Stair, The Scientific Monthly, vol. 83, pp. 3-12, 1956.

New Stratigraphic Names for Oklahoma Rock Units

By Carl C. Branson

Mountain Lake member of the Bromide formation (Mohawkian, Ordovician)

Named for Mountain Lake E½ sec. 22, T. 2 S., R. 1 W., Murray County, near Woodford. Type section along Spring Creek on both sides of the line between sections 8 and 17, T. 2 S., R. 1 W. Consists of 194 feet of shales with thin limestone beds, lies above the basal sandstone unit of the Bromide. Named by G. A. Cooper, Smithsonian Miscellaneous Collections, vol. 127, part 1, p. 120, 1956.

Pooleville member of the Bromide formation (Mohawkian, Ordovician)

Named for the village of Pooleville, Carter County. Type section on Spring Creek above the Mountain Lake member about on the line between sections 8 and 17, T. 2 S., R. 1 W., Murray County. Consists of light-gray limestone, about 250 feet thick. Seems to be equal to the Criner formation of Ulrich. Named by G. A. Cooper, Smithsonian Miscellaneous Collections, vol. 127, part 1, p. 121, 1956.

Ahloso member of the Caney shale formation (Meramecian, Mississippian)

Named by Elias (as Ahlosa) for the village in sec. 14, T. 3 N., R. 6 E. Type section in NE¼ sec. 14, T. 2 S., R. 7 E. Consists of 25 to 190 feet of dark gray calcareous shale. Equal to the "Ada Mayes" of subsurface. Named by Elias, Petroleum Geology of Southern Oklahoma, p. 60, 1956. Rests on Welden limestone, overlain by Delaware Creek member.

Delaware Creek member of the Caney shale (Meramecian, Mississippian)

Named for Delaware Creek. Type area on the creek in the northeast part of T. 2 S., R. 7 E. Consists of 150 to 270 feet of gray shale with concretions. Rests on the Ahloso member, overlain by the Sand Branch member. Named by Elias, Petroleum Geology of Southern Oklahoma, p. 62, 1956.

Sand Branch member of the Caney shale (Chesterian, Mississippian)

Named for Sand Branch of Clear Boggy Creek. Type section NW¼ sec. 8, T. 2 N., R. 7 E. Consists of dark-gray shale with large limestone concretions. Rests upon Delaware Creek member, overlain by Springer. Named by Elias, Petroleum Geology of Southern Oklahoma, p. 65, 1956.

Redoak Hollow sandstone member of the Goddard shale

Named for Redoak Hollow, S½ sec. 19, T. 2 S., R. 1 W. Consists of calcareous sandstone. Named by Elias, Petroleum Geology of Southern Oklahoma, p. 83, 1956. Contains 185 identified species of fossils.

Rhoda Creek formation (Springeran, Pennsylvanian?)

Named for Rhoda Creek in SW part of T. 3 N., R. 7 E. Best section in SE¼ NW¼ NW¼ sec. 8, T. 2 N., R. 7 E. Consists of 140 feet of gray shale. Rests unconformably upon Caney shale, overlain by upper shales of the Springeran. Named by Elias, Petroleum Geology of Southern Oklahoma, p. 91, 1956.

Gene Autry shale member of the Golf Course formation (Morrowan, Pennsylvanian)

Named for town of Gene Autry. Consists of 700 feet of gray shale. Rests upon Primrose sandstone, overlain by Jolliff formation. Named by Elias, Petroleum Geology of Southern Oklahoma, p. 99, 1956.

Lake Murray formation (Atokan, Pennsylvanian)

Named for Lake Murray. Consists of Bostwick member, Lester limestone, and Frensley limestone. Thickness 3,300 feet. Rests upon Golf Course formation, overlain by Big Branch formation. Named by Harlton, Petroleum Geology of Southern Oklahoma, p. 139, 1956.

Golf Course formation (Morrowan, Pennsylvanian)

Named for the Dornick Hills Country Club golf course. The type section is on the creek in SW¼ SW¼ sec. 7, T. 4 S., R. 2 E. Consists of 1,400 to 1,500 feet of section with Primrose sandstone as basal member, Otterville limestone as top member. Named by Harlton, Petroleum Geology of Southern Oklahoma, p. 138, 1956.

New Oklahoma Fusulines

A paper by M. L. Thompson, G. J. Verville, and D. H. Lokke entitled "Fusulinids of the Desmoinesian-Missourian Contact" appeared in the July number of Journal of Paleontology (vol. 30, pp. 793-810). In this paper two new species are described from Oklahoma.

Oketaella lenensis is a new species which occurs in the Perry Form shale member of the Lenapah limestone on the west side of U. S. Highway 69 at the type locality of the limestone, the old quarry north of the village of Lenapah. This small, unusual type of fusulinid is ordinarily overlooked among immature specimens of larger types, and is, as here, found where no other fusulinid occurs.

Wedekindellina ardmorensis is described from the Confederate limestone at two localities near Ardmore. The species is prolific, but is the only fusulinid in the limestone. This species has been variously placed in **Fusulinella, Fusulina, Triticites** and **Wede-**

kindellina by earlier workers. Since **Triticites** indicates Missourian age and **Fusulina** Desmoinesian age, the Confederate has been shifted back and forth from Hoxbar to Deese. **Wedekindellina ardmorensis** is similar to **W. ultimata,** the only species of the genus known from rocks younger than Desmoinesian. The evidence would appear to place the Confederate in the Hoxbar group (Missourian). C.C.B.

Uranium in Oklahoma Phosphatic Black Shales

A report on uranium content of some samples of phosphatic black shales has just been issued by the U. S. Geological Survey (TEI-590, pp. 253-257). The authors, H. J. Hyden and Walter Danilchik, sampled the black shales of the Pennsylvanian rocks of northeastern Oklahoma and tested these for uranium content. They obtained samples of the shale with phosphatic nodules which overlies the Checkerboard limestone, samples of the Little Osage shale, of the Excello shale, of the black shale below the Verdigris limestone, of the black shale below the Tiawah limestone, and of three shales identified as "capped by Taft ss.", "capped by ss.", and "capped by Little Cabin ss.". The latter three are probably the black shale above the upper Inola limestone unit, the black shale below the Bluejacket sandstone at places, and the black shale some distance below the Warner sandstone.

The authors found values to 0.01% uranium for the shales and 0.05% uranium for the nodules. They conclude that shales capped by limestone are slightly more uraniferous and the uranium is closer to equilibrium. C.C.B.