

**Circular 63**

**Geologic Notes on the Delaware Basin**

**by Leon Haigler**

United States Geological Survey

**NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY**

**E. J. Workman, President**

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PLATE

1. East-west cross section through the Delaware basin  
of New Mexico . . . . . in pocket

## ***Abstract***

The Delaware basin of New Mexico lies in Eddy and Lea counties, New Mexico, and contains about the northern one fourth of the total area of the Delaware basin. It is a structural depression bordered on the east by the Central Basin Platform and on the west by the Guadalupe Mountains and has its inception in either Late Pennsylvanian or Early Permian time. For the purpose of this report the limits of the Bone Spring Limestone are considered to be the limits of the Delaware Basin.

Formations ranging in age from Ordovician up to the Ochoa Series of the Permian are of marine origin, while deposits ranging in age from the Ochoa Series of the Permian through the Quaternary are evaporites or red beds of continental origin. The maximum thickness of formations of Permian age is approximately 12,000 feet. None of the wells examined penetrated formations that are Precambrian in age, and the problem of locating the contact between formations of Permian and Pennsylvanian ages is still unsolved. Examination of well cuttings and electric and radioactivity logs indicated that the following geologic horizons could be correlated for considerable distances across the Delaware basin:

The El Paso Limestone where the Simpson Group equivalent is present, the Simpson Group equivalent, the formations of Silurian(?) and Devonian(?) ages, the Woodford Shale equivalent, the limestone of Mississippian age, the shale of Mississippian age, the Strawn Group of Pennsylvanian age, the Hueco Limestone where the third Bone Spring sand of local usage is present, the Bone Spring Limestone, top of the Delaware Mountain Group, and the Rustler Formation. Other correlations within the Delaware basin could be made, but they should be considered less reliable or made only over shorter distances.

## ***Introduction***

The Permian basin of New Mexico and west Texas includes two smaller basins known as the Midland and the Delaware which are separated almost entirely by the Central Basin Platform. The Delaware basin extends for approximately 100 miles east-west and 160 miles north-south. This report deals primarily with that part of the Delaware basin within New Mexico; its limits are considered to be the limits of the Bone Spring Limestone.

A few wells have been drilled to the Precambrian in the Delaware basin, mostly located around the margin of the basin. Therefore, accurate information on the total thickness of sedimentary deposits in the Delaware basin of New Mexico is lacking. It is estimated that the depth to Precambrian rocks is 10,000 feet in the vicinity of well 7, as shown on the cross section (pl. 1), and approximately 12,000 feet of these deposits are of Permian age. The basin is probably much deeper in Texas south and east of well 7.

Well cuttings were examined microscopically and correlated with available electric and radioactive logs as a basis for the east-west cross section of the Delaware basin. The lithology shown on the cross section is taken from percentage sample logs and corrected in most instances to agree with electric logs. One well, well 3, was drilled with a cable-tool rig and no electric nor radioactivity log is available.

Cores are available from well 7 and some additional wells drilled by Richardson and Bass within the Delaware basin. Acknowledgment is made to personnel of the New Mexico Bureau of Mines, Branch of Oil and Gas Operations of the United States Geological Survey, and several major oil companies who cooperated and aided in the compilation of this report. Acknowledgment is also made to Ward Motts and B. R. Alto of the United States Geological Survey for their assistance in locating surface exposures in the Carlsbad area.

### ERRATA

Line 5 of the second paragraph on page 2 should read

"is 19,000 feet in the vicinity..."

## ***Structural Features***

The major structural features shown by the cross section (pl. 1) are the Central Basin Platform; Delaware basin, and a structural high west of the Huapache structure which may possibly be interpreted as the eastern margin of a horst underlying the Guadalupe Mountains. The Huapache structure, which is a monoclinial structure on the surface and a fault or fault zone at depth, has an indicated displacement of 5400 feet between wells 1 and 2. In the Humble Oil and Refining Company No. 1 Huapache, located in the SW1/4NW1/4 sec. 35, T. 23 S., R. 22 E., N. M. P. M., the stratigraphic section from formations of Mississippian age into the El Paso Limestone of Early Ordovician age was repeated, which indicated a fault with a displacement of 4000 feet. The Huapache structure as well as the fault zone bordering the west side of the Central Basin Platform (pl. 1), which has a similar magnitude of displacement, have their inceptions either in Late Pennsylvanian or Early Permian time and contributed to the structural development of the Delaware basin.

The Bone Spring flexure was reported by King (1948) in the southern Guadalupe Mountains as being produced by pre-Delaware Mountain uplift. The flexure, as indicated by the relations between well 4 and 5, is believed to be a northeastern extension of the Bone Spring flexure, a structural feature that possibly governed the location of the reefs of Guadalupe age on the northwest side of the Delaware basin. A north-south cross section published by the Roswell Geological Society (1958) indicates a flexure is present in T. 18 S., R. 32 E., and it also holds the same relative position with the reefs of Guadalupe age as the Bone Spring flexure,

A structure that has been interpreted as being a fault with a displacement of about 1000 feet has been located between wells 8 and 9. However, other geologic interpretations are possible. Probably other similar structural conditions exist within the Delaware basin, but the spacing between available wells and the scale of the cross section is not adequate for them to be located and depicted.

The most recent tectonic movements in southeastern New Mexico took place during the Cenozoic Era when the entire Delaware basin and the area to the north and west was tilted eastward. It is probable that some of the older structures within the basin were reactivated at that time. It is significant that some geologists do not recognize faulting as occurring any later than Pennsylvanian time. They interpret the displacements within the Permian indicated between wells 1 and 2 and 8 and 9 as folds rather than faults.

No evidence of igneous activity in the Delaware basin was discovered in the preparation of the cross section. Three dikes have been mapped by Hayes (1957) and classified as being of Tertiary(?) age in sec. 11, 14, and 15, T. 26 S., R. 24 E. It has been reported that igneous dikes or sills have been penetrated by wells drilled in T. 20 S. R. 32 E., and sec. 9, T. 22 S., R. 29 E. Also, black igneous rock was reported in the Salado Formation of



Permian age in workings of the International Minerals and Chemical Corporation mine in the NE1/4 sec. 1, T. 22 S., R. 29 E. Several wells on the Central Basin Platform in southeastern New Mexico have indicated occurrences of igneous dikes or sills. There may be other occurrences as yet unnoticed.

## STRATIGRAPHY

None of the wells in the section penetrated the Bliss Sandstone, granite wash, or Precambrian rocks. However, it is believed that the Bliss Sandstone of Late Cambrian and Ordovician age underlies the El Paso Limestone in the western edge of the section. The El Paso Limestone and the Ellenburger Group overlie Precambrian rocks or granite wash for the remainder of the section.

## ORDOVICIAN SYSTEM

### El Paso Limestone and Ellenburger Group

The El Paso Limestone of Early Ordovician age crops out on the west face of the Sacramento Mountain escarpment. This is the nearest surface exposure that may be correlated with the El Paso Limestone or Ellenburger Group of Early Ordovician age in the Delaware basin. Formations of the Ellenburger Group or the El Paso Limestone were penetrated in wells 1, 2, 5, 6, and 15 of the cross section, but only in wells 1 and 5 were the formations penetrated to any extent. The formations in the subsurface in the Delaware basin of New Mexico are almost entirely a light-gray to gray dolomite. However, in well 1 much chert was found in the top of the formation and small amounts of sandstone were noted at several intervals. About 729 feet of the El Paso Limestone was penetrated in well 1 and it is assumed that the well was very near the base of the El Paso Limestone at its total depth.

In wells 1 and 2 the El Paso Limestone is overlain by the Montoya Dolomite, but in well 5 and the area to the east of well 5 the El Paso Limestone is overlain by formations equivalent to the Simpson Group. Wherever the Simpson Group equivalent was present, selecting the top of the El Paso Limestone or Ellenburger Group presents no great problem. However, the lithology of the Montoya Dolomite, El Paso Limestone, and Ellenburger Group is quite similar and selecting the contact between them is difficult.

### Simpson Group Equivalent

Formations equivalent to the Simpson Group were penetrated in wells 5,

6, and 15 of the cross section. Between wells 6 and 15 the Simpson Group equivalent is believed to exist and to increase in thickness; however, it is beyond the depth of wells in that area. The Simpson Group equivalent is 1025 feet thick in well 15, 315 feet thick in well 6, 160 feet thick in well 5, and is absent in wells 1 and 2 which penetrated the El Paso Limestone of Early Ordovician age. Somewhere between wells 2 and 5 is the western limit of the Simpson Group equivalent. Also, no surface exposures of the Simpson Group equivalent have been identified in New Mexico or west Texas.

The age of the Simpson Group equivalent is Middle Ordovician, and it has been described and subdivided from surface exposures in southern Oklahoma. However, due to the rapid westward thinning of the Simpson Group equivalent and the limited amount of data available, no attempt was made at subdividing the Simpson equivalent in the Delaware basin.

The upper and lower limits of the group can be clearly defined either by the examination of well cuttings or by use of electric or radioactivity logs. The Simpson Group equivalent consists of limestone; green, brown, and black shale; black shale with rounded quartz grain inclusions; and sandstone as determined by well cuttings from wells 5, 6, and 15. This stratigraphic section is in considerable contrast to the dolomite section of the overlying Montoya and the underlying El Paso Limestone or Ellenburger Group.

#### Montoya Dolomite

The Montoya Dolomite is present in wells 1, 2, 5, 6, and 15 and is overlain by formations of Silurian(?) and Devonian(?) age. In the Delaware basin the Montoya consists of medium- to dark-gray dolomite with minor amounts of dark-gray limestone and chert. The contact between the Montoya and rocks of Silurian(?) and Devonian(?) age is difficult to determine with accuracy. However, on the cross section (pl. 1) this contact is based on a change in color from the light-gray dolomites of Silurian(?) and Devonian(?) age to the darker gray dolomites of the Montoya. This contact became increasingly vague in well 1 where the Montoya section was unusually light in color. The electric and radioactivity logs were also studied, but they offered no solution to the problem.

The Montoya Dolomite of the Delaware basin is correlative with the Montoya as it occurs in Alamo Canyon east of Alamogordo. Here the thickness of the Montoya is from 140 to 250 feet. In the Delaware basin the thickness was found to range from 280 to 440 feet as determined from the examination of well cuttings.

#### SILURIAN( ? ) AND DEVONIAN( ? ) SYSTEMS

Rocks of Silurian(?) and Devonian(?) age were penetrated in wells 1, 2, 4 through 9, and 15. Wells 1, 2, 5, 6, and 15 penetrated the entire section

with thicknesses ranging from about 600 to 1170 feet. Also, well 9 penetrated 836 feet of Silurian(?) and Devonian(?) rocks and at its total depth was possibly very close to the top of the Montoya Dolomite of Ordovician age.

The cross section shows that the Silurian(?) and Devonian(?) Systems consist largely of light-gray dolomite in the western portion. However, in well 6 a light—gray limestone appears within the upper portion of the Silurian(?) and Devonian(?) section. The color of this limestone changes from gray to tan in well 7. In well 15 on the Central Basin Platform the Silurian(?) and Devonian(?) rocks from 8210 to 8990 feet in depth are largely gray limestone, and the dolomite section below 8990 feet is considered to be the Silurian Fusselman Dolomite. Some of this Silurian(?) and Devonian(?) section in well 15 may be Devonian in age and exist only in the subsurface in New Mexico. It was not found within the Silurian(?) and Devonian(?) section in wells 1, 2, and 5. It has been reported that fossil evidence (Lloyd, 1949) from a well in Ward County, Texas, indicates most of this upper section, as illustrated in well 15, is Middle Silurian in age.

All of the Silurian(?) and Devonian(?) section in wells 1, 2, 4, and 5 and at least the lower portions of this section in wells 6, 7, 8, 9, and 15 probably are correlative with the Fusselman of Silurian age as exposed east of Alamogordo and described by Darton (1928). Pray (1953) reclassified the Fusselman and named the lower unit the Valmont Dolomite of Late Ordovician age and left only the upper unit described by Darton as the Fusselman Limestone of Silurian age.

## DEVONIAN AND MISSISSIPPIAN SYSTEMS

### Woodford Shale equivalent

The Woodford Shale equivalent is shown on the cross section in wells 1, 2, 4 through 9, and 15. It is a black shale, and its limits are easily determined by the gamma ray and sample logs. It is highly radioactive as compared on the gamma ray log with the overlying Mississippian limestones and the underlying dolomites of Silurian(?) or Devonian(?) age, and its thickness gradually increases from 20 feet in well 1 to 450 feet in well 15.

Available information indicates that the Woodford Shale is probably of Devonian and Mississippian age; however, this is open to question and there are some geologists who claim that it is Mississippian. The formation obtains its name by correlation with the Woodford Chert of Devonian and Mississippian age which has its type locality near Woodford, Carter County, Oklahoma. However, formations apparently equivalent to the Woodford also crop out on the west face of the Sacramento Mountains near Alamogordo as the Percha Shale of Late Devonian age. The Percha at this locality is a black shale about 15 feet thick.

## MISSISSIPPIAN SYSTEM

The Mississippian System within the Delaware basin consists, basically, of two stratigraphic units. The upper unit within the Delaware basin has been referred to as the Barnett Shale, Chester, Chester and Meramec, or simply the shale of Mississippian age. It consists mainly of a black argillaceous shale with approximately the lower 100 feet of the section being a dark-gray to black calcareous shale or shaly limestone. This statement is true for the central portion of the Delaware basin. However, as shown in the north-south cross section of the Delaware basin—Northwest shelf (Roswell Geological Society, 1958), limestone beds begin to occur at the top of the shale section of Mississippian age with some interspersed thin sandstone beds near the north and west edges of the Delaware basin. This condition is shown on the east-west cross section (pl. 1) between wells 2 and 5.

Apparently there are no positive criteria for locating the top of the shale of Mississippian age in the Delaware basin. At least there is considerable disagreement among geologists for locating the top of the shale of Mississippian age in well 7. In this well the section has been reported to be from 295 to 810 feet thick. The dotted line depicting the top of the shale of Mississippian age on the cross section represents an anomaly on the radioactivity and resistivity logs, which is the point that Richardson and Bass geologists selected and reported as the top of the shale of Mississippian age in well 7. This may or may not be the true top of the shale of Mississippian age, but it can be correlated with the other wells on the section. Upon this basis, the shale of Mississippian age is between 250 and 320 feet thick in the Delaware basin. Fossil evidence obtained in the core taken from well 7 is further indication that the shale section is of Mississippian age.

Conversely, the limits of the limestone of Mississippian age are easily defined when both sample logs and electric and radioactivity logs are used. The section consists of a light- to dark-gray cherty limestone and varies from 220 to 320 feet thick. It is represented on the electric and radioactivity logs by a very high resistivity and a very, low radioactivity compared to overlying and underlying beds.

The Mississippian System of the Delaware basin is possibly equivalent to the Mississippian formations exposed on the west face of the Sacramento Mountains. However, detailed correlation of the subsurface data with the Sacramento Mountain exposures is unreliable. Therefore, no attempt is made to correlate the Mississippian in the Delaware basin with specific portions of the exposed Mississippian section.

## PENNSYLVANIAN SYSTEM

In the New Mexico portion of the Delaware basin, the Cisco, Canyon, Strawn, and Bend groups, and rocks probably equivalent to the Morrow Series

of the Pennsylvanian System have been reported by geologists. These units are equivalent to the Virgil, Missouri, Des Moines, Atoka, and Morrow, respectively, as recognized and reported (Thompson, 1942) from exposures on the west face of the Sacramento Mountains. Until recently Pennsylvanian formations younger than the Strawn Group were not believed to exist within the Delaware basin, and there is still no fossil evidence to indicate otherwise. However, there is an unfossiliferous black shale, with minor amounts of dark-gray limestone, overlying the Strawn Group from somewhere between wells 5 and 6 eastward to the Central Basin Platform that is now believed to be Cisco(?) and Canyon(?). These rocks have not been included within the Pennsylvanian System as illustrated between wells 6 and 10, but the black shaly section of possible Pennsylvanian age immediately overlies the dash-and-query line and was determined to be about 750 feet thick in well 7. In wells 2, 4, and 5 it is believed that all the Pennsylvanian System is probably within the limits shown.

The Pennsylvanian System from the top of the Strawn Group to the indicated top of the Mississippian System consists of dark- to light-gray limestone and includes some oolitic limestone and dark-gray to black shale in its upper portion. The lithology changes to a dark-gray to black shale with lesser amounts of gray sandstone in the lower portion. Some thin beds of coal were detected in a well core and well cuttings from Pennsylvanian formations below 12,885 feet in the Richardson and Bass No. 1 Cobb well located in sec. 23, T. 20 S. , R. 31 E., N. M.P.M.

There is considerable disagreement over the determination of the limits of the Pennsylvanian. However, with careful study of well cuttings and electric and radioactivity logs, dependable long-range correlations can be made using the top of what has been reported to be the Strawn Group between wells 6 and 10. Other Pennsylvanian age formation correlations should be made over shorter distances or regarded as less dependable. Because of questionable correlations, subdivision of the Pennsylvanian System was not attempted.

## PERMIAN SYSTEM

### Hueco Limestone

The Hueco Limestone in the Delaware basin consists of dark-gray limestone, dark-gray to black shale, sandstone, and some conglomerate as shown by cores from well 7. In well 2 some reddish and greenish shales were penetrated. The top of this formation may be recognized in well samples by appearance of dark-gray limestone and black shale beneath the third Bone Spring sand of local usage. This contact with the Bone Spring Limestone may be traced throughout the Delaware basin of New Mexico and generally may be located by an increase in resistivity on the electric logs. Wherever the Hueco Limestone is overlain by dolomites or limestones of the Abo Formation, the upper limits of the Hueco become more difficult to determine. It should also

be noted here that some geologists believe that the top of the Hueco Limestone properly belongs at the top of the third Bone Spring sand of local usage.

The Hueco Limestone is considered to belong to the Wolfcamp Series of Permian age and is therefore referred to by many geologists simply as the Wolfcamp. The Hueco Limestone in the Delaware basin may be correlated with surface exposures in the Hueco Mountains, Texas, which is the type locality.

### Bone Spring Limestone

The Bone Spring Limestone of the Delaware basin has been placed in the Leonard Series of Permian age with the exception of a basal sand member which may belong to the Wolfcamp Series of Permian age. The Bone Spring consists of dark-gray limestone; gray, very fine-grained sandstone concentrated into three separate zones; and black shale. This formation contained considerable chert in wells 10, 11, and 13. The top of the Bone Spring Limestone is selected at the top of a black shale with dark-gray limestone; and wherever it is overlain by a sandstone of the Delaware Mountain Group, it is easily discernible. This formation top shows as an increase in radioactivity on the gamma ray curve of electric logs, and as an increase in resistivity on the resistivity curve.

The Bone Spring Limestone was named from its occurrences at Bone Spring one mile west of Guadalupe Peak. Two miles north of this point, 1700 feet of Bone Spring have been measured but its base was not exposed. The thickness of the formation ranges from 4135 feet in well 4 to 2880 feet in well 9.

### Delaware Mountain Group

The Delaware Mountain Group consists of light-gray, very fine-grained sandstone (possibly a siltstone), gray shale, light-gray to gray limestone, and dolomite. A persistent gray limestone bed, known locally as the Delaware lime, the Lamar Limestone Member of the Bell Canyon Formation, marks the top of the Delaware Mountain Group on the basinward side of the Capitan Limestone. Available information indicates that the group probably grades into the Goat Seep and Capitan limestones, and in these gradational areas, the Delaware Mountain Group is recognized by the presence of its characteristic gray, very fine-grained sandstone. The maximum thickness is near well 7 where 3800 feet of Delaware Mountain Group rocks were penetrated.

The Delaware Mountain Group is named for its exposures in the Delaware Mountains, Texas, and P. B. King (1948) did considerable work in subdividing it. Because of the long distances between surface exposures and wells as shown on Plate 1, subsurface correlations of these subdivisions are doubtful and, therefore, have not been indicated. The Delaware Mountain

Group belongs in the Guadalupe Series of Permian age.

#### Permian back-reef or shelf formations

The Yeso, San Andres, Grayburg, Queen, Seven Rivers, Yates, and Tansill are all back-reef formations and are not present within the Delaware basin. Detailed correlations of these formations through the reefs and shore-line deposits into the Delaware basin have not been determined to the satisfaction of all geologists familiar with the area. However, the correlations as illustrated on Plate 1 are generally accepted.

#### Permian reefs

The Permian reefs as illustrated (pl. 1) have been referred to in geologic literature as the Capitan Limestone and Goat Seep Limestone of the Guadalupe Series. Reefs were especially well developed in late Guadalupe time and almost encircled the Delaware basin. Available evidence indicates that the formations deposited as Yeso and Bone Spring equivalents are shore-line deposits of the Leonard Series, and possibly represent the Victorio Peak Gray Member of the Bone Spring Limestone. The publications of King (1948) and Newell and others (1953) are the result of considerable work on the Permian reefs.

In well 3 the Yeso and Bone Spring equivalents were topped at 2280 feet and bottomed at 4840 feet. However, two black limestone sections, appearing very much like typical Bone Spring, were penetrated from 3340 to 3360 feet and 4540 to 4600 feet. In general, the section was composed of light-gray to gray limestone, sandstone, and dolomite.

On the west side of the Delaware basin the Capitan and probably Goat Seep limestones were penetrated by wells 4 and 5, including about 1700 feet of the Capitan Limestone by well 5. The Capitan Limestone and the underlying reef facies are very similar in appearance, both being largely white to light-gray dolomite with lesser amounts of white limestone. The top of a clean, white limestone bed has been chosen as the top of the Capitan Limestone.

The Goat Seep Limestone crops out in the southern end of the Guadalupe Mountains and was mapped in detail by King (1948). It is also probably present in the subsurface around a considerable portion of the western and northern portion of the Delaware basin of New Mexico. The Capitan Limestone is a prominent surface feature from the southern end of the Guadalupe Mountains until it plunges underground about 10 miles southwest of Carlsbad, New Mexico. It is also present in the subsurface around the northern and eastern margins of the New Mexico portion of the Delaware basin. On Plate 1, between well 3 and the surface exposure of the Capitan Limestone, the combined width of the reef facies and the Capitan Limestone is about 14 miles. It is doubtful that the width of the reefs is less than this anywhere in the

Delaware basin of New Mexico, except for that part that lies on the eastern edge of the Delaware basin near the Central Basin Platform. This narrow condition is illustrated between wells 11 and 14, where the reef facies of the Guadalupe Series, underlying the Capitan Limestone, and the shoreline facies of the Leonard Series, probably exist in a very narrow band.

#### Salado and Castile formations, undifferentiated

These formations are classified in the Ochoa Series of Late Permian age. The Salado Formation consists mainly of salt and anhydrite with minor amounts of red shale, silt, and sandstone. Potash minerals of economic value occur within its limits. The Castile Formation consists of anhydrite, salt, and banded dolomite and anhydrite. The combined thickness of the two formations as measured on the cross section range from 0 at their western limits to about 3560 feet in well 10.

#### Rustler Formation

The top of the Rustler Formation is placed at the top of the first persistent anhydrite bed penetrated by oil and gas tests in southeastern New Mexico. It is overlain by the Dewey Lake Redbeds and underlain by the Salado Formation, both of Permian age. The Rustler was penetrated in wells 6 through 15 and consists of anhydrite, dolomite, shale, salt, and sandstone.

The Rustler Formation is exposed over a large area of the Delaware basin and is named from outcrops in the Rustler Hills, Culberson County, Texas. It is about 530 feet thick in wells 7, 8, 9, and 15; but in well 10, 780 feet of probable Rustler was noted.

#### Post-Rustler formations

On the cross section, these formations are Quaternary, Tertiary, Triassic, and Late Permian in age, and range in thickness from 0 at their western limits to nearly 2000 feet in the vicinity of well 13. They consist of red sandstone and shale, caliche, limestone, and small amounts of anhydrite and gypsum. Formations of Quaternary, Tertiary, and Triassic age are valuable sources of fresh water in Eddy and Lea counties, New Mexico.



## ***Oil and Gas***

In the New Mexico portion of the Delaware basin, oil or gas production has been obtained from the Castile Formation, Delaware Mountain -Group, Bone Spring Limestone, and Hueco Limestone of Permian age, and from formations of Pennsylvanian, Silurian(?), and Devonian(?) ages. One well in the South Vacuum field is producing gas from the Simpson Group equivalent of Middle Ordovician age.

All formations in the Delaware basin from the top of the Delaware Mountain Group to the top of the Precambrian are considered prospectively valuable for oil or gas. The Rustler, Salado, and Castile formations are largely composed of evaporite or nonmarine deposits and are not normally considered prospectively valuable for oil or gas. However, a thin dolomite bed near the Rustler—Castile contact did produce a total of about 1700 barrels of oil before the well was abandoned. This well was located in sec. 29, T. 26 S., R. 27 E., N.M.P.M.

Until the spring of 1960, most of the oil and gas exploration and development was within the Delaware Mountain Group. The three largest fields obtaining oil or gas production from the Delaware Mountain Group are the North Mason, El Mar, and Malaga fields. The most notable development of oil and gas from pre-Delaware Mountain rocks was in the Reeves and South Vacuum fields in T. 18 S. , R. 35 E. Here, 18 wells productive of oil or gas were completed in the Bone Spring Limestone of Early Permian age, formations of Pennsylvanian, Silurian(?) and Devonian(?) ages, or the Simpson Group equivalent of Middle Ordovician age. The Bell Lake field also obtains oil or gas production from the Bone Spring Limestone, formations of Pennsylvanian age, and formations of Silurian(?) and Devonian(?) ages. The Bell Lake field is represented by wells 8 and 9 on Plate 1.

Considerably more exploration for oil and gas deposits within pre-Delaware Mountain rocks has been undertaken in the Delaware basin of New Mexico during 1958 and 1959. Prior to March 1, 1960, a total of about 125 wells penetrating the Bone Spring Limestone had been drilled in New Mexico, and of these about 63 have been drilled since January 1, 1958. This has resulted in many small fields scattered over the basin, with a total of 49 wells that are producing or have produced oil or gas from pre-Delaware Mountain rocks. This total includes six wells reporting oil or gas production from the reef of Abo age.

Several wells productive of gas from formations of Pennsylvanian age have been completed in the vicinity of well 6 on the cross section. Also, a well located in the SW1/4SE1/4 sec. 13, T. 23 S., R. 23 E. discovered gas deposits within formations of Pennsylvanian age in October 1959. This discovery well is about six miles south of well 3.

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