SHALLOW OIL AND GAS POSSIBILITIES
IN EAST AND SOUTH-CENTRAL UTAH

by Edgar B. Heylmun,* Petroleum Consultant
Utah Geological and Mineralogical Survey

A modern rotary drilling operation. (Courtesy Utah Petroleum Council.)

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INTRODUCTION</strong></td>
<td>7</td>
</tr>
<tr>
<td><strong>STRATIGRAPHY</strong></td>
<td>7</td>
</tr>
<tr>
<td><strong>OIL IN THE WHITE RIM - COCONINO SANDSTONE</strong></td>
<td>11</td>
</tr>
<tr>
<td>Distribution - General Features - Oil Seeps</td>
<td>11</td>
</tr>
<tr>
<td>Significant Wells</td>
<td>13</td>
</tr>
<tr>
<td>Standard of California No. 1 Moonshine Wash</td>
<td>13</td>
</tr>
<tr>
<td>Stanolind No. 1 Caineville</td>
<td>13</td>
</tr>
<tr>
<td>Tennessee Gas No. 1-A Sorrel Butte</td>
<td>13</td>
</tr>
<tr>
<td>Tennessee Gas No. 1-A Poison Springs</td>
<td>13</td>
</tr>
<tr>
<td>California Company No. 1 Muley Creek</td>
<td>15</td>
</tr>
<tr>
<td>North and South Last Chance Test Wells</td>
<td>15</td>
</tr>
<tr>
<td><strong>OIL IN THE KAIBAB LIMESTONE</strong></td>
<td>15</td>
</tr>
<tr>
<td>Distribution - General Features</td>
<td>15</td>
</tr>
<tr>
<td>Significant Wells</td>
<td>15</td>
</tr>
<tr>
<td>Upper Valley Wells</td>
<td>15</td>
</tr>
<tr>
<td><strong>OIL AND GAS IN THE MOENKOPI FORMATION</strong></td>
<td>17</td>
</tr>
<tr>
<td>Distribution - General Features - Oil Seeps</td>
<td>17</td>
</tr>
<tr>
<td>Significant Wells and Areas</td>
<td>19</td>
</tr>
<tr>
<td>South Last Chance Field</td>
<td>19</td>
</tr>
<tr>
<td>Grassy Trail Creek Field</td>
<td>19</td>
</tr>
<tr>
<td>Equity No. 3 Mounds</td>
<td>21</td>
</tr>
<tr>
<td>Reserve No. 1 Cedar Siding</td>
<td>21</td>
</tr>
<tr>
<td>R. H. Reed No. 1 Suckle-Gov’t</td>
<td>21</td>
</tr>
<tr>
<td>Wells at Iron Wash</td>
<td>21</td>
</tr>
<tr>
<td>Wells on Nequoia Arch</td>
<td>23</td>
</tr>
<tr>
<td>Amerada No. 1 Dirty Devil</td>
<td>23</td>
</tr>
<tr>
<td>Tennessee Gas No. 1-A Poison Springs</td>
<td>24</td>
</tr>
<tr>
<td>Virgin Oil Field</td>
<td>24</td>
</tr>
<tr>
<td>Stratigraphic Traps</td>
<td>24</td>
</tr>
<tr>
<td><strong>OIL IN THE MOSS BACK MEMBER OF THE CHINLE FORMATION</strong></td>
<td>25</td>
</tr>
<tr>
<td>Distribution - General Features - Oil Seeps</td>
<td>25</td>
</tr>
<tr>
<td>Significant Wells</td>
<td>25</td>
</tr>
<tr>
<td>Texaco No. 1 Temple Springs</td>
<td>25</td>
</tr>
<tr>
<td>Tennessee Gas No. 1-A Poison Springs</td>
<td>25</td>
</tr>
<tr>
<td><strong>POSSIBILITIES FOR OIL IN JURASSIC AND LOWER CRETACEOUS FORMATIONS</strong></td>
<td>27</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS (continued)

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OIL AND GAS IN THE FERRON SANDSTONE</strong></td>
<td>27</td>
</tr>
<tr>
<td>Distribution and General Features</td>
<td>27</td>
</tr>
<tr>
<td>Significant Wells and Areas</td>
<td>29</td>
</tr>
<tr>
<td>Ferron Field</td>
<td>29</td>
</tr>
<tr>
<td>Shell No. 1 Miller Creek</td>
<td>29</td>
</tr>
<tr>
<td>Cil Securities No. 1 Marakis</td>
<td>29</td>
</tr>
<tr>
<td>Duke No. 1 Federal</td>
<td>31</td>
</tr>
<tr>
<td>Baldwin No. 1 Worthen</td>
<td>31</td>
</tr>
<tr>
<td>Minton No. 1 Snow</td>
<td>31</td>
</tr>
<tr>
<td>Cleveland Area</td>
<td>31</td>
</tr>
<tr>
<td>Wells Southeast of Green River, Utah</td>
<td>31</td>
</tr>
<tr>
<td><strong>CONCLUSIONS</strong></td>
<td>33</td>
</tr>
<tr>
<td><strong>SELECTED REFERENCES</strong></td>
<td>34</td>
</tr>
<tr>
<td><strong>APPENDIX</strong></td>
<td>35</td>
</tr>
<tr>
<td>List of Samples Available from Test Wells in East-Central Utah</td>
<td>37</td>
</tr>
</tbody>
</table>
# LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>East-Central Utah Index Map</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Regional Map Showing Location of Producing Wells and Dry Holes</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Generalized Geologic Column of Formations Pertinent to the Shallow Oil Potential of Part of East-Central Utah...</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>Structure Map of the San Rafael Swell and the Nequoia Arch Areas</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Generalized Map of the Permian White Rim - Coconino Formations</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>Generalized Map of the Permian Kaibab Limestone</td>
<td>14</td>
</tr>
<tr>
<td>7</td>
<td>Generalized Map of the Triassic Moenkopi Formation</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>Structure Map of the Last Chance Anticline</td>
<td>18</td>
</tr>
<tr>
<td>9</td>
<td>Farnham-Mounds-Grassy Trail Area</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>Structure Map of the Henry Mountains Area</td>
<td>22</td>
</tr>
<tr>
<td>11</td>
<td>Generalized Map of the Cretaceous Ferron Sandstone</td>
<td>26</td>
</tr>
<tr>
<td>12</td>
<td>Structure Map of the Ferron Anticline</td>
<td>28</td>
</tr>
<tr>
<td>13</td>
<td>Well Digging Before 1900</td>
<td>30</td>
</tr>
<tr>
<td>14</td>
<td>Early Cable Tool Drilling</td>
<td>30</td>
</tr>
<tr>
<td>15</td>
<td>Early Cable Tool Drilling</td>
<td>32</td>
</tr>
<tr>
<td>16</td>
<td>Modern Cable Tool Drilling</td>
<td>32</td>
</tr>
</tbody>
</table>
SHALLOW OIL AND GAS POSSIBILITIES IN EAST AND SOUTH-CENTRAL UTAH

by Edgar B. Heylmun

INTRODUCTION

This report is a discussion of the relatively shallow oil and gas possibilities of portions of Late Paleozoic and Mesozoic strata in parts of Emery, Carbon, Sevier, Grand, Wayne, and Garfield Counties, Utah (Figure 1). The main area of interest extends southward from the Book Cliffs and eastward from the High Plateaus of central and southern Utah. Other areas with shallow oil and gas possibilities, such as eastern Grand County and parts of Washington County with the exception of the Virgin field, are not included in this report. Over two hundred wells have been drilled for oil and gas in the aforementioned areas (Figure 2). Good oil and gas shows, and some commercial production, have been encountered at shallow or moderate depths from beds of Permian, Triassic, Jurassic, and Cretaceous age. The region also includes the Salt Wash and Big Flat oil fields, but their production is from deeper zones in rocks of Mississippian age; and they are not within the scope of this report. "Shallow" as used in this report, refers to tests or objectives lying from a few hundred feet to as deep as 3,000 feet beneath the surface. "Moderate" refers to depths in excess of 3,000 feet, but not more than 5,000 feet.

Good possibilities for additional oil and gas production from Mesozoic and uppermost Paleozoic beds exist. To date, the Grassy Trail Creek oil field (Figures 2 and 9), which produces from the Triassic Moenkopi Formation, is the only commercial field producing from these relatively shallow units. The Ferron and South Last Chance gas fields (Figures 2, 8, and 12), which are potentially commercial, contain shut-in gas reserves in the Ferron and Moenkopi Formations, respectively. Commercial production from these fields may be attained once pipeline connections are made. Wells in the Farnham-Mounds area east of Wellington, Utah (Figures 2 and 9), produce carbon dioxide gas which is manufactured into dry ice. A discouraging factor in the development of the region has been the relatively low formation pressures which have been found in many of the wells.

STRATIGRAPHY

The generalized stratigraphic section for the area is shown in Figure 3. Whereas oil or gas shows, or both, have been noted in several Mesozoic and upper Paleozoic formations, current data indicate the best chances for commercial oil or gas production occur in four formations -- the White Rim, or
Figure 2. Regional Map Showing Location of Producing Wells and Dry Holes.
**Figure 3: Generalized Geologic Column of Formations Pertinent to the**

- **Cretaceous**
  - Mancos Fm.
  - Dakota (?), Sandstone
  - Cedar Mountain Fm.
  - Morrison Fm.
  - Summerville Fm.
  - Curtis Fm.
  - Entrada Fm.
  - Carmel Fm.
  - Navajo Sandstone
  - Kayenta Fm.
  - Wingate Sandstone
  - Chinle Fm.
    - With Mossback conglomerate member
  - Kaibab Limestone
    - Mossback Cgl., is oil saturated at certain outcrops, oil shows in some wells.

- **Jurassic**
  - Dakota (?), Sandstone
  - Cedar Mountain Fm.
  - Morrison Fm.
  - Summerville Fm.
  - Curtis Fm.
  - Entrada Fm.
  - Carmel Fm.
  - Navajo Sandstone
  - Kayenta Fm.
  - Wingate Sandstone
  - Chinle Fm.
  - Kaibab Limestone
    - Oil production at Grassy Trail Field from zone above Sinbad Ls. Gas at south last chance from lower unit. Numerous good oil shows in lower marine beds.
    - Prominent oil seeps in Elaterite Basin

- **Triassic**
  - Moenkopi Fm.
  - Sinbad limestone mem.
  - KAIBAB LIMESTONE
    - Gas production at Ferron Field gas shows in several other wells.

- **Permian**
  - "Coconino" Sandstone (White Rim)
    - Good oil shows in several wells.
    - Petroliferous unit. Not present in eastern part of region.

- **Scattered minor oil & gas shows.**
- **Sub-commercial oil production at Crescent Junction.**
- **Minor oil shows in a few wells.**
- **Carbon dioxide gas production at Farnham-Mounds Field.**
- **Mossback Cgl., is oil saturated at certain outcrops. Oil shows in some wells.**
- **Oil production at Grassy Trail Field from zone above Sinbad Ls. Gas at south last chance from lower unit. Numerous good oil shows in lower marine beds.**
- **Petroliferous unit. Not present in eastern part of region.**
- **Good oil shows in several wells. Prominent oil seeps in Elaterite Basin.**
Figure 4. Structure Map of the San Rafael Swell and the Nequoia Arch Areas.
"Coconino," Sandstone and the Kaibab Limestone (both of Permian age); the Moenkopi Formation, including the Sinbad Limestone Member (of Triassic age); and the Ferron Sandstone (of Cretaceous time). Other potentially productive units are the conglomeratic Moss Back Member of the Chinle Formation (incorrectly termed "Shinarump") of Triassic age; The Navajo, Entrada, Curtis, and Morrison Formations of Jurassic age; and the Cedar Mountain and Dakota Formations of Cretaceous age. Some wells have encountered good oil and gas shows in Pennsylvanian and Mississippian rocks, but these are beyond the scope of this report.

OIL IN THE WHITE RIM — "COCONINO" SANDSTONE

Distribution — General Features — Oil Seeps

The name "Coconino," applied to a thick sandstone of Permian age that includes both the White Rim and Cedar Mesa Sandstones of the Cutler Group, has been grossly misused in Utah. Only a small portion of this thick unit correlates with the Coconino Sandstone as known at its type locality in the Grand Canyon of the Colorado River in Arizona. However, since the name Coconino is firmly entrenched in literature and in well records pertaining to east and south-central Utah, the usage is provisionally accepted. South and east of the San Rafael Swell, the White Rim Sandstone, as such, is identified in many wells, and the term "Coconino" is not used.

The sandstone, regardless of what it is called, is mainly a massive, white to buff, cross-bedded unit that probably correlates, at least in part, with the Weber and Tensleep Sandstones, prolific oil-producing formations in Colorado and Wyoming. Consisting of fine to medium, rounded, well-sorted quartz grains, the unit is up to 700 feet thick and locally possesses excellent porosity and permeability. The White Rim - "Coconino" is exposed at places on the San Rafael Swell and along the Green River and its tributaries; but elsewhere it is sufficiently buried to offer a good objective for drilling. A number of oil seeps are associated with it on the east side of the San Rafael Swell, in Elaterite Basin (T. 20 S., R. 17 E.), and elsewhere along many of the tributaries of the Green River (Figure 2). In the Elaterite Basin region of southeastern Wayne County, it is estimated that an oil field which contained several million barrels of oil has been breached by erosion and lost.

In the White Rim, or "Coconino," Sandstone, the best opportunities for oil production from shallow to moderate depths are most likely to be in the area east and south of the San Rafael Swell and in the region surrounding the Henry Mountains. Good oil shows have been encountered in several wells on the Nequoia Arch (Figure 4) in an area where the White Rim Sandstone is directly overlain by the basal marine facies of the Triassic Moenkopi Formation and where the intervening Permian Kaibab Limestone is missing or is poorly developed. The same situation exists south of Hanksville where
Figure 5. Generalized Map of the Permian White Rim—Coconino Formations.
Indicating Where Strata are Buried Less than 3,000 Feet.
good oil shows have been found in wells which penetrated the White Rim, or "Coconino," Sandstone, north, east, and south of the Henry Mountains. Figure 5 shows parts of Utah where the White Rim - "Coconino," or its equivalents, would be adequately buried, yet less than 3,000 feet in depth.

**Significant Wells**

The following wells contain important showings of oil from the White Rim - "Coconino" strata:

**Standard of California No. 1 Moonshine Wash:** Sec. 32, T. 25 S., R. 15 E., Emery County (Figure 4). Cores of the interval from 2,294 to 2,336 feet were either oil-saturated or were stained with a heavy black oil. A drill-stem test from 2,290 to 2,315 feet recovered 273 feet of drilling fluid diluted with sulfurous water and containing globules of black oil. No attempt was made to test the zone, and the well was plugged and abandoned.

**Stanolind No. 1 Caineville:** Sec. 29, T. 28 S., R. 8 E., Wayne County (Figure 4). Live oil (oil containing volatile fractions) was observed in samples from 3,649 to 3,669 feet. A drill-stem test of the zone recovered 1,200 feet of water containing specks of oil. This drill-stem test indicates that either the petroliferous zone or closely associated strata or both were heavily saturated with water and that a more favorable location in regard to structure would be necessary in order to attain commercial oil production.

**Tennessee Gas No. 1-A Sorrel Butte:** Sec. 33, T. 29 S., R. 12 E., Wayne County (Figure 10). A serious attempt was made to complete this well as an oil producer in the White Rim, or "Coconino," Sandstone. More than 40 feet of beds in the upper part of the sandstone unit were saturated with black oil. Five and one-half inch casing was cemented at 2,162 feet; and the intervals from 2,162 to 2,164 and 2,169 to 2,176 feet were perforated, acidized, hydraulically fractured, and swabbed. After 48 hours of swabbing, 36 barrels of load oil and 146 barrels of salt water were recovered; but only traces of new formation oil were detected. The well was subsequently plugged and abandoned, and, as of this date, no other wells have been drilled in the vicinity. It is interesting that the nearest well, the Amerada No. 1 Dirty Devil, Sec. 2, T. 29 S., R. 11 E., six miles to the northwest of the Sorrel Butte well, had significant oil shows in the overlying marine Moenkopi beds.

**Tennessee Gas No. 1-A Poison Springs:** Sec. 4, T. 31 S., R. 12 E., Garfield County (Figure 10). Cores in the upper part of the White Rim, or "Coconino", Sandstone were saturated with heavy oil, but the zones were not tested. Excellent oil shows in the overlying Triassic formations were tested and are described later. An attempt to complete the well as an oil producer in Hermosa strata of Pennsylvanian age, occurring at moderate depths, was not successful.
Figure 6. Generalized Map of the Permian Kaibab Limestone.  
Indicating Where Strata are Buried Less than 3,000 Feet.
California Company No. 1 Muley Creek: Sec. 18, T. 36 S., R. 10 E., Garfield County (Figure 10). Fair to good saturation of 33 degree gravity oil was encountered between 3,930 and 4,000 feet at the top of the White Rim Sandstone. Two drill-stem tests of the zone recovered only sulfur water. No further tests were made and no other wells have been drilled within fourteen miles of the Muley Creek well.

North and South Last Chance Test Wells: T. 25-26 S., R. 5-7 E., Sevier and Emery Counties (Figures 2, 4, and 8). Heavy oil was encountered in the top of the "Coconino" Sandstone from three test wells located on the North and South Last Chance structures. Six other wells drilled on the structures did not penetrate the "Coconino" zone. Depths to the oil horizon range between 3,500 and 4,300 feet. The oil appeared to be "dead," contained no visible volatile fractions, and probably could not be made productive.

OIL IN THE KAIBAB LIMESTONE

Distribution — General Features

Shown in Figure 6 is the portion of the region where the Kaibab Limestone is adequately buried, yet less than 3,000 feet in depth. The Kaibab is Permian in age and conformably overlies the White Rim Sandstone in the western part of the region. It is not present in the eastern part due to non-deposition or post-Permian erosion. The Kaibab Limestone consists of limestone and dolomite, locally contains considerable chert, and commonly possesses vuggy and intercrystalline porosity. No wells under consideration have had important oil or gas shows in the Kaibab, although many outcrops are petrolierous in character. Since the Kaibab thins or is truncated toward the east, possibilities for stratigraphic traps are good. The area of stratigraphic possibilities for oil occurrence is in the western and northwestern parts of the region, and very few wells have tested the Kaibab Limestone in those areas.

Significant Wells

The Kaibab Limestone, though penetrated, has not been a specific target for oil and gas production within the region. The best oil shows in Kaibab strata are in the Upper Valley area, some forty miles west of the area.

Upper Valley Wells: Sec. 12 and 13, T. 36 S., R. 1 E., Garfield County. The California Company drilled the first well on the Upper Valley anticline during the period 1947-1951. The well penetrated to a depth of 10,120 feet and tested sub-commercial quantities of oil in the Mississippian and in the Kaibab-basal Moenkopi sequence. The Mississippian oil was 17° gravity, whereas the Kaibab-Moenkopi oil was 27° gravity with a pour-point of 14°F. In 1963 Tenneco (Tennessee Gas Transmission) drilled another well on the structure about one mile to the south of the California Company test.
Figure 7. Generalized Map of the Triassic Moenkopi Formation.
Indicating were the strata are buried less than 3,000 feet.
At the time of this writing, the well is reported to be a commercial oil discovery in the Kaibab Limestone in the intervals between 6,565-6,655 and 6,670-6,716 feet; locations have been made and additional tests are planned.

OIL AND GAS IN THE MOENKOPI FORMATION

Distribution — General Features — Oil Seeps

The Moenkopi Formation (Triassic in age) is found over the entire region. It ranges in thickness from 250 feet in the southeastern part to 1,200 feet in wells in the northwestern part. Figure 7 indicates parts of the region where the Moenkopi is adequately buried, yet less than 3,000 feet in depth. The lower part of the Moenkopi is generally considered to be marine in origin; whereas the upper part of the formation appears to have originated in a mixed environment involving both continental and marine types.

The Moenkopi Formation contains petroliferous strata of marine origin both at surface exposures and in wells. The most prominent marine member is the Sinbad Limestone (Figure 3), which is 100 to 150 feet thick over most of the northwestern and central parts of the region. The Sinbad has good vuggy porosity and is noted for its oil and gas shows in numerous wells of east-central Utah. It normally occupies a position in the lower half of the Moenkopi Formation and contains characteristic Lower Triassic fossils.

The stratigraphic position of the Sinbad Member is progressively lower to the south and southwest of the San Rafael Swell. In the Henry Mountains region it is a thin unit near the base of the Moenkopi Formation; whereas to the southwest it is probably equivalent to the Timpoweap Limestone, the productive basal member of the Moenkopi at the Virgin oil field in Washington County. The Timpoweap Limestone lies directly on the eroded surface of the Kaibab Limestone. The Sinbad Limestone is not present in the southeastern part of the region.

The petroliferous marine green-gray shales and marine yellowish-gray sandstones and siltstones lying below the Sinbad Limestone of the Moenkopi Formation are of doubtful age. These beds unconformably overlie the Permian Kaibab Limestone in the areas where the Kaibab is present, and unconformably overlie the White Rim Sandstone where the Kaibab is absent. The unit is poorly developed or absent in the southeastern and southern parts of the region, but is well developed in the east-central, northern, and northwestern segments. In the area east of the San Rafael Swell, a number of sandstone beds, mostly argillaceous and lacking porosity and permeability, occur in the "Marine Moenkopi" section. They contain oil shows in a number of wells. West of the San Rafael Swell, the sandstones are not as well developed; but there are more limestone beds within the unit, and some have vuggy or intercrystalline porosity.
Figure 8. Structure Map of the Last Chance Anticline.

Contours on a horizon 250 feet above top of the Carmel Formation
In addition to the Sinbad Limestone, the croppings of the "Marine Moenkopi" contain oil-saturated sandstone at several places along the east side of the San Rafael Swell and in tributary canyons of the Green and Colorado Rivers in eastern Wayne and Garfield Counties. Sandstone beds of the Moenkopi are oil saturated on the east side of the Circle Cliffs upwarp in Garfield County. Bennett's oil seep, on the Colorado River in T. 40 S., R. 10 E., apparently issues from Moenkopi beds. The following oil and gas fields produce from the Moenkopi Formation.

**Significant Wells and Areas**

**South Last Chance:** (Gas field, shut-in, possibly commercial.) There are four shut-in gas wells at the South Last Chance field in T. 26 S., R. 7 E., Emery County (Figures 4 and 8). The discovery well, the Ramsey No. 1-X, Section 17 (revised location), T. 26 S., R. 7 E., drilled in 1934, blew out at an estimated rate of 21,000,000 cubic feet of 840 BTU gas per day from a 65-foot sandstone interval between 2,690 and 2,755 feet in the lower Moenkopi Formation. The well was shut-in, pending a market. The three other "shut-in" gas wells, though not as prolific as the Ramsey No. 1-X well, also produce from lower Moenkopi sandstones. There have been five other wells drilled in the field, but they did not penetrate commercial quantities of gas. The American Liberty No. 1 North Last Chance, Section 13, T. 25 S., R. 5 E., Sevier County (Figure 8), drilled in 1948, had gas shows in the Moenkopi, but was plugged and abandoned.

The Last Chance, or Starvation Creek (U.S. Geological Survey designation), anticline has three closures. The north dome, known as North Last Chance, has over 50 feet of closure. The middle dome, known as South Last Chance, has approximately 700 feet of closure; whereas the south dome, named Caineville, has roughly 300 feet of closure. The anticline is one of the few major structural features in the region possessing one or more closures.

**Grassy Trail Creek:** (Oil field, producing.) There are currently five producing oil wells and one abandoned well at the Grassy Trail Creek field in T. 15-16 S., R. 12 E., Carbon and Emery Counties (Figure 9). The field was discovered in 1961, and has produced 56,303 barrels of 40° gravity oil through October 1963. Though drilling is incomplete, about one square mile has proved productive. This production is from sandstones lying above the Sinbad Limestone Member in the Moenkopi Formation.

In the discovery well, drilled in 1952-53 and reworked in 1961 by Cities Service Oil Company, designated the No. 1 Grassy Trail, Section 1, T. 12 S., R. 12 E., Emery County, production is from the interval between 3,872 and 3,906 feet. In this well the top of the Sinbad Limestone is at 4,017 feet.

Figure 9 illustrates the wells that have been drilled in the Grassy Trail-Mounds-Farnham area. At the Grassy Trail Creek field there is no evidence of
Figure 9. Farnham — Mounds — Grassy Trail Area.
structural closure, either at the surface or by interpretation of subsurface data. It is postulated that the oil has accumulated in an up-dip stratigraphic trap. The discovery well resulted by reworking a well drilled in 1952-1953 by Cities Service Oil Company; it was abandoned, even though the producing zone was drill-stem tested and 1,620 feet of oil and gas-cut mud were recovered. This drill-stem test was no more encouraging than a number of tests at other regional wells have been. When the well was reworked in 1961, new techniques were employed — the zone was hydraulically fractured — and the well subsequently produced 85 barrels of oil per day with very little water. New techniques applied to some of the older test wells throughout the shallow oil province in Utah may prove that commercial production is present.

In addition to the two described oil and gas fields, the following wells had important showings of oil or gas, or both, in the Moenkopi Formation.

**Equity No. 3 Mounds:** Sec. 18, T. 15 S., R. 12 E., Carbon County (Figure 9). This well produces carbon dioxide gas from the Jurassic Navajo Sandstone. Good shows of flammable gas and light green oil were encountered in the marine Moenkopi section between 4,413 and 4,763 feet, but no attempt was made to complete the well as an oil or gas producer in the Moenkopi Formation. The well is near the crest of the Farnham-Mounds anticline, a subsurface feature which has over 300 feet of closure. The Farnham anticline, as expressed in surface outcroppings, lies about one mile west of the subsurface crest of the anticline.

**Reserve No. 1 Cedar Siding:** Sec. 21, T. 16 S., R. 13 E., Emery County (Figure 9). This well, four miles southeast of the Grassy Trail Creek oil field, penetrated the Sinbad Limestone at a depth of 3,516 feet. Significant shows of oil and non-flammable gas were encountered in the Sinbad; but drill stem tests were discouraging, and no attempt was made to complete the well as either an oil or gas producer. A well drilled by Carter (Humble) in Sec. 27, T. 16 S., R. 12 E., five miles to the west of the Cedar Siding well, also tested a substantial quantity of non-flammable gas in the Sinbad Limestone.

**R. H. Reed No. 1 Suckle-Gov't:** Sec. 1, T. 17 S., R. 12 E., Emery County (Figure 9). Located four miles southwest of the Reserve well and two miles southeast of the aforementioned Carter Well, this well penetrated to a depth of 3,313 feet, bottoming in the Lower Moenkopi. Drilled in 1963, the well encountered excellent oil saturation in several zones in the Moenkopi, particularly between 3,119-3,121, 3,124-3,137, and 3,267-3,274 feet. The lower zone was in the Sinbad Limestone Member; it was acidized, hydraulically fractured, and swabbed, but production could not be established.

**Wells at Iron Wash:** Two wells have been drilled on a small east-west anticlinal structure associated with faulting which trends through T. 24 S., R. 13
WA MOENKOPI FORMATION EXPOSED AT THE SURFACE

ABANDONED WELL-OIL SHOWS IN MOENKOPI AND/OR WHITE RIM

ABANDONED WELL - NO SIGNIFICANT SHOWS IN MOENKOPI OR WHITE RIM. WELLS IN DIRTY DEVIL AND POISON SPRINGS AREAS HAD NEAR-COMMERCIAL QUANTITIES OF OIL IN PENNSYLVANIAN ROCKS.

Figure 10. Structure Map of the Henry Mountains Area.
and 14 E., Emery County (Figure 4). There is probably a small amount of closure against a fault in the vicinity of the wells.

The A. K. Wilson No. 1 Iron Wash, drilled in 1950, in Sec. 2, T. 24 S., R. 13 E., encountered oil in the Moss Back Member of the Chinle Formation and in several beds in the Moenkopi Formation. A sandy limestone between 1,967 and 1,969 feet was saturated with 23° gravity oil. As much as seven barrels of oil per day were bailed from the hole before operations were suspended. In 1958 Superior Oil drilled their No. 23-2 Iron Wash well, also in Section 2. A drill-stem test of the interval from 1,807 to 1,865 feet in the Moenkopi Formation above the Sinbad Limestone yielded 175 feet of free oil and 188 feet of heavily oil-cut mud. This excellent show of oil appeared to be from fractured shale. No attempt was made to complete the well as an oil producer, and no other drilling has been done in the area.

Wells on Nequoia Arch: A number of wells in southeastern Emery County and northern Wayne County, in the general Nequoia Arch region (Figure 4), have had fair to excellent shows of low gravity oil from the Moenkopi Formation. Oil saturation is in beds in the lower part of the formation, mostly marine sandstones and siltstones with poor porosity and permeability. There are several anticlinal structures on Nequoia Arch, some of which possess small amounts of closure. Most of the anticlines have been drilled -- the first drilling activity having taken place in 1913. The wells and anticlinal trends are shown on Figure 4. Some wells with good Moenkopi oil shows include the following:

- Texaco No. 1 Temple Springs, Sec. 14, T. 25 S., R. 13 E., Emery County.
- Standard of Cal. No. 1 Moonshine Wash, Sec. 22, T. 25 S., R. 15 E., Emery County.
- Carter (Humble) No. 3 Nequoia Arch, Sec. 26, T. 26 S., R. 14 E., Emery County.
- Continental No. 1 State, Sec. 36, T. 27 S., R. 13 E., Wayne County.

A serious attempt was made to complete the Carter No. 3 Nequoia Arch well as an oil producer in the Moenkopi Formation. Zones above the Sinbad Member between 2,488 and 2,513 feet, and zones in the Sinbad between 2,576 and 2,601 feet, were perforated and hydraulically fractured. A little heavy oil and paraffin was swabbed before the well was abandoned.

Wells in the Nequoia Arch region have also encountered good oil and gas shows in sandstones and dolomites of the Pennsylvanian Hermosa Formation at moderate depths. Attempts to establish oil and gas production in the Pennsylvanian have been unsuccessful.

Amerada No. 1 Dirty Devil, Sec. 2, T. 29 S., R. 11 E., Wayne County (Figure 10) is one of several in the Henry Mountain region that had
significant oil shows from the Moenkopi Formation. Several drill-stem tests were made of intervals between 2,647 and 2,783 feet; but only sulfur water with specks and globules of heavy black oil was recovered, and the tests did not indicate the presence of commercial oil production. No other wells have been drilled in the vicinity.

**Tennessee Gas No. 1-A Poison Springs:** Sec. 4, T. 31 S., R. 12 E., Garfield County (Figure 10). Located ten miles east of Mt. Ellen in the Henry Mountains, this well penetrated heavy oil saturation in the Moss Back ("Shinarump") Member of the Chinle, throughout a sizeable interval in the Moenkopi, in the underlying White Rim and in the deeper Pennsylvanian formations. Drill-stem tests of the saturated Moss Back and Moenkopi beds between 1,802 and 2,258 feet were discouraging because of lack of pressure and fluid recovery. No attempt was made to complete the well as an oil producer. Three other wells drilled in sections 4 and 5 of the same township also encountered good oil shows from shallow zones, but also were abandoned. Attempts to complete this well as an oil producer in the deeper Pennsylvanian beds failed, although small amounts of free oil were swabbed.

**Virgin Oil Field:** Sec. 12 and 13, T. 41 S., R. 12 W., Washington County. Outside the region considered here, but important in consideration of the Moenkopi Formation as a shallow oil producer, is the Virgin oil field in southwestern Utah. Approximately 140 shallow wells have been drilled in the narrow valley of North Creek, one to three miles northeast of the village of Virgin, Utah. About thirty wells have produced oil from the Timpoweap Limestone at the base of the Moenkopi Formation, and from the Rock Canyon Limestone at the top of the Permian Kaibab Formation. Two types of oil have been produced -- one, a 23° gravity sour crude; the other, a 31-32° gravity sweet crude. Producing depths range from 475 to 800 feet, depending on well location. Approximately 195,000 barrels of oil have been produced since the field was discovered in 1907, but operations are currently shut down.

**Stratigraphic Traps**

The nature of the Moenkopi sandstone and limestone units is conducive to the development of stratigraphic traps. Structural closures are not necessary for the accumulation of commercial oil and gas, and most of the previously mentioned oil and gas occurrences in the Moenkopi Formation are in part or wholly the result of such stratigraphic entrapments, possibly aided in some instances by fracturing. Portions of Utah where the marine Moenkopi units are shallower than 3,000 feet in depth are shown on Figure 7. It is important to realize that the potential reservoir beds in the Moenkopi are not highly porous and permeable and that hydraulic fracturing, acidizing, and other techniques would be necessary in most instances to establish oil or gas production. In many wells having good shows in the Moenkopi, modern methods had not been developed or employed at the time the wells were
drilled and production was not achieved. As previously mentioned, commercial oil production at the Grassy Trail Creek field was not indicated in the first testing of the zone in 1952-53. Only after re-entering the well and hydraulically fracturing the zone was production established in 1961.

It appears that the best areas for oil accumulation in the Moenkopi Formation are where the sandy marine facies are best developed and where these sandstones interfinger with the marine limestones. The areas surrounding the San Rafael Swell, extending south into the region of the Henry Mountains, are most promising.

OIL IN THE MOSS BACK MEMBER OF THE CHINLE FORMATION

Distribution — General Features — Oil Seeps

The Moss Back Member of the Chinle Formation, Triassic in age, consists of conglomerate, conglomeratic sandstone, and sandstone, and is found under most of the region. Older reports refer to this unit as the "Shinarump", but recent work has demonstrated that the unit does not correlate with the true Shinarump and the name "Moss Back" has been applied. Overlain and underlain by "red beds", the Moss Back occupies a stratigraphic position near the base of the Chinle Formation. At several localities in the San Rafael Swell and Circle Cliffs areas, its outcrops are oil saturated.

The Moss Back Sandstone locally contains good porosity and permeability and could be a good reservoir for oil and gas. The lenticular nature of the Moss Back makes it an intriguing unit from the standpoint of forming stratigraphic traps for oil and gas.

Significant Wells

Several wells have penetrated good oil shows in the Moss Back, the best of which are as follows:

Texaco No. 1 Temple Springs: Sec. 14, T. 25 S., R. 13 E., Emery County (Figure 4). Oil saturation in the Moss Back was cored and tested, but a drill-stem test between 1,540 and 1,592 feet recovered only mud-cut water and sulfur water with globules of oil. The well is on a structural nose north of the Flat Top area, on the Nequoia Arch, and no other wells have been drilled within five miles of the Temple Springs test.

Tennessee Gas No. 1-A Poison Springs: Sec. 4, T. 31 S., R. 12 E., Wayne County (Figure 10). Approximately 21 feet of heavy oil saturation was found in coarse sandstone of the Moss Back strata in this well. A drill-stem test of the interval 1,802 to 1,830 recovered 375 feet of fresh water with a scum of oil. Formation pressures were low, thus contributing to the failure of the test.
Figure 11. Generalized Map of the Cretaceous Ferron Sandstone.
Indicating where the strata are buried less than 3,000 feet.
POSSIBILITIES FOR OIL IN JURASSIC AND LOWER CRETACEOUS FORMATIONS

Oil and gas shows have been encountered in a few wells in the region from Jurassic rocks, namely the Navajo Sandstone, Entrada Sandstone, Curtis Formation, and Morrison Formation; and from the Cretaceous Cedar Mountain Formation. The most important is the occurrence of carbon dioxide gas in the Farnham-Mounds area (Figure 9). This gas, found at a depth of approximately 2,800 feet, has accumulated on a structural closure known as the Farnham anticline. The Navajo Sandstone has excellent oil and gas reservoir characteristics, but would most likely require structural closure for the accumulation of oil or gas. The widespread, clean character of the sands enhances the porosity and permeability of the formation. The uniform high permeability is detrimental to the accumulation of oil and gas in stratigraphic traps.

The Morrison and overlying Cedar Mountain Formations contain shallow oil shows and some production in wells drilled in the Crescent Junction area, at Cisco, and in other areas in northeastern Grand County, outside of the region of this report. Thin oil-saturated beds, cropping out southeast of the town of Green River, belong to the Morrison and Cedar Mountain Formations. Most of these occurrences apparently are the result of stratigraphic conditions, aided by local structure.

In a few wells oil shows have been found in the Entrada, Curtis, and other Jurassic formations, but to date these occurrences have been insignificant and have not indicated commercial possibilities.

All of the Jurassic and Lower Cretaceous formations can be found at shallow depths under sizeable portions of the region, especially in the area surrounding the San Rafael Swell and in the Henry Mountain Basin.

OIL AND GAS IN THE FERRON SANDSTONE

Distribution and General Features

The Ferron Sandstone Member of the Mancos Formation is Cretaceous in age and is found at relatively shallow depths under large segments of Grand, Emery, Carbon, Sevier, Wayne, and Garfield Counties. The Ferron gas field, south of the settlement of Ferron, Utah, produces from the Ferron Sandstone and is shut-in pending pipeline connections. The Ferron contains the productive gas interval at the Clear Creek field and at other fields on the Wasatch Plateau, but at depths greater than those considered in this report. The Ferron Sandstone is believed to correlate with the Frontier and Wall Creek Sandstones of Wyoming, which are prolific oil and gas producers at a number of fields in that state and are known to produce from both structural and stratigraphic traps. Figure 11 illustrates the areas in Utah where the Ferron Sandstone or its equivalents are adequately buried, yet less than 3,000 feet in depth.
Figure 12. Structure Map of the Ferron Anticline.
The Ferron Sandstone is predominantly a buff to gray calcareous marine sandstone containing beds of dark shale, siltstone, and coal. The unit ranges from 700 feet in thickness in the western part of the region, where it is dominantly a sandstone with some coal, to a few feet of shaly sandstone beds in the eastern part. At the Ferron gas field, the Ferron Sandstone is about 130 feet thick and is equally divided by a 30-foot shale into a 50-foot upper sandstone unit and a 50-foot lower sandstone. The lower sandstone unit appears to be best developed toward the south, whereas the upper sandstone unit is better developed toward the north. The eastward thinning of the Ferron Sandstone probably offers numerous stratigraphic traps for oil and gas in the areas north and west of the San Rafael Swell, as well as in the Henry Mountain Basin of central Wayne and eastern Garfield Counties, south and west of Hanksville.

Significant Wells and Areas

Ferron Field: The Ferron gas field is in T. 20-21 S., R. 7 E., Emery County (Figures 2 and 12), two to five miles southeast of the village of Ferron. The field is on an anticline which has two separate closures, the largest with approximately 100 feet of closure. About 4,800 acres have proved productive. There are five shut-in gas wells and one abandoned well in the field. The discovery well was drilled in 1957 by American Petrofina and English Oil in Sec. 22, T. 20 S., R. 7 E., and penetrated into the Dakota Sandstone at a depth of 1,575 feet. The well encountered approximately 50 feet of gas-bearing strata in the Ferron between 628 and 758 feet, and was completed as a gas well with an open flow potential of 4,700,000 cubic feet of 1,047 BTU gas per day. In the discovery well, the pressure of the Ferron gas from the shallow depth is 420 pounds per square inch. A well drilled by Pacific Natural Gas in 1963 penetrated to a depth of 3,387 feet and bottomed in the Entrada Formation, but was plugged back to the Ferron Sandstone. After hydraulic fracturing with liquid carbon dioxide, the well flowed 875,060 cubic feet per day from two zones between 592 and 596 feet and 678 and 682 feet. The well is shut-in pending a pipeline connection.

Aside from the shut-in gas production at the Ferron field, several other shallow wells in this part of Utah encountered oil or gas, or both, either in the Ferron Sandstone Member of the Mancos Formation or in the fractured Mancos Shale zones overlying the Ferron.

Shell No. 1 Miller Creek: Sec. 26, T. 15 S., R. 10 E., Carbon County (Figure 2). This well, drilled to a total depth of 10,853 feet in 1958, blew out when gas was struck at 580 feet. The flow of gas was stopped with mud, and drilling continued; but the producing potential of this zone was not tested. The show of gas was reported to be in the top of the Ferron Sandstone.

Oil Securities No. 1 Marakis: Sec. 22, T. 14 S., R. 12 E., Carbon County (Figure 9). The well is five miles northeast of the carbon dioxide gas...
Figure 13. Well digging before 1900 (Courtesy Utah Petroleum Council).

Figure 14. Early Cable Tool Drilling.
production in the Farnham-Mounds field. The well was drilled in 1955 to a depth of 2,335 feet in the Morrison Formation. A minor oil show was reported in the Ferron Sandstone at 1,174 feet, and the interval between 1,100 and 1,252 feet contained 100,000 cubic feet of gas per day. The well was abandoned after an attempt was made to increase the gas flow by shooting with nitroglycerin.

**Duke No. 1 Federal:** Sec. 28, T. 19 S., R. 7 E., Emery County (Figures 2 and 12). Drilled four miles north of the village of Ferron, this well encountered sufficient gas at 1,264 feet to produce a 10-foot flame. The zone was in the Mancos Formation, approximately 720 feet stratigraphically above the Ferron Sandstone Member.

**Baldwin No. 1 Worthen:** Sec. 35, T. 19 S., R. 7 E., Emery County (Figure 12). This well was drilled in 1956 three miles north of the limits of production at the Ferron gas field. The well, which bottomed at 1,450 feet, encountered gas in the Ferron Sandstone. As much as 250,000 cubic feet of gas per day reportedly was tested; but the well was not completed as a commercial producer. Three other wells in the immediate area had subcommercial gas shows in the Ferron Sandstone and were abandoned.

**Minton No. 1 Snow:** Sec. 9, T. 19 S., R. 8 E., Emery County (Figure 2). Drilled in 1960, this well encountered an estimated 5,000 cubic feet of gas per day from the Ferron Sandstone at 340 feet. The gas show was subcommercial and the well was abandoned.

**Cleveland Area:** Three shallow wells were drilled between 1952 and 1954 in Sec. 12, T. 17 S., R. 9 E., Emery County, near the village of Cleveland (Figure 2). Operators reported 60,000 cubic feet of gas per day at one of the wells in the Ferron Sandstone, but all wells were ultimately abandoned.

**Wells Southeast of Green River, Utah:** Several old shallow wells were drilled in Grand County, southeast of the town of Green River, which encountered oil and gas shows in several zones in Jurassic and Cretaceous rocks. Shows were recorded in the Mancos (including the Ferron Sandstone), Dakota, Cedar Mountain, and Morrison Formations. The Ferron and Dakota Sandstones are poorly developed in this area, and no large reserves of oil or gas are expected. Fractured Mancos Shale has possibilities which cannot be discounted, and the possibility for finding commercial oil and gas in the Cedar Mountain and Morrison Formations is good. In the Little Grand Wash area, five to eight miles southeast of Green River, there are several oil seeps and outcrops of oil-saturated sandstones in the Mancos, Cedar Mountain, and Morrison Formations.

Aside from the Ferron gas field and the area surrounding it, no especially good oil or gas shows have been encountered in wells penetrating the Ferron Sandstone within the region under discussion. However, only twenty wells have been drilled at locations away from the Ferron area, and only one of
Figure 15. Early Cable Tool Drilling (Courtesy Utah Petroleum Council).

Figure 16. Modern Cable Tool Drilling (Courtesy Humble Oil and Refining Company).
these (Superior No. 1 Swap Mesa, Section 2, T. 34 S., R. 9 E., Garfield County, see Figure 9) tested the Ferron Sandstone and other Cretaceous rocks in the Henry Mountain Basin.

Outside of the report area, six deep wells have tested differing thicknesses of basal Cretaceous rocks at shallow depths and in the enormous expanse of the Kaiparowits region in Kane and Garfield Counties, the Cretaceous remains essentially untested.

CONCLUSIONS

1. There are excellent possibilities for the further development of shallow to moderate depth oil or gas production in sizeable areas in east-central and southern Utah.

2. The principal formations of interest are the Permian White Rim, or "Coconino," Sandstone; the Permian Kaibab Limestone; the Triassic Moenkopi Formation, including the Sinbad Limestone Member; and the Ferron Sandstone Member of the Cretaceous Mancos Formation. Other formations of interest include the Moss Back Member of the Chinle Formation (incorrectly called "Shinarump"), the Jurassic Navajo, Entrada, Curtis, and Morrison Formations, and the Cretaceous Cedar Mountain and Dakota Formations, which in places have oil-stained outcrops or contain subsurface oil and gas shows.

3. Drilling costs generally would be low for tests of most of the aforementioned formations, since they occur at shallow depths and the rocks, for the most part, are easy to drill. Most of the region lies at elevations between 4,500 and 6,500 feet, is semi-arid to arid, and is accessible throughout the year.

4. Many of the known closed anticlinal structures or fault traps have been drilled, but the nature of most of the formations considered makes them highly conducive to development of stratigraphic traps which would not require structural closure.

5. Most drilling to date has been clustered in a few areas. There has been an average of only one well per township, or one well every 36 square miles. There is one area of over 1,500 square miles, encompassing parts of Wayne and Garfield Counties, where no wells have been drilled; and the entire region has just been scratched in regard to determining its oil and gas potential.
SELECTED REFERENCES


Gilluly, James, 1928, Geology and oil and gas prospects of part of the San Rafael Swell, Utah: U.S. Geol. Survey Bull. 806c, p. 69-130.


APPENDIX
APPENDIX

List of Samples Available from Test Wells in East-Central Utah

The Oil Well Sample Library of the Utah Geological and Mineralogical Survey has complete or partial sets of samples from some of the wells in Utah where shallow oil and gas production from the White Rim-"Coconino," Moenkopi, Ferron, and other formations is possible. A listing of the wells from which samples are available is as follows:

Carbon County:

18-14S-8E Pacific Western No. 2 Gordon Creek
10-14S-12E Oil Securities Marakis No. 2
22-14S-12E Oil Securities No. 1 Fee
8-15S-12E Shell No. 1-A Farnham
12-15S-11E Mountain Fuel No. 1 Farnham
18-15S-12E Equity No. 3 Mounds
33-15S-12E Equity No. 1 Mounds
11-15S-13E Pan American No. 1 U.S.A. Cullen
1-16S-12E Cities Service No. 1 Grassy Trail
27-16S-12E Carter No. 1 Government
25-17S-7E Utah So. No. 1 State
15-17S-8E Phillips No. 1 Huntington
12-18S-12E El Paso No. 1 Packsaddle
8-18S-14E Lemm-Maiatico No. 1 Woodside
30-18S-14E Humble No. 2 Woodside
12-19S-13E Humble No. 7 Woodside
35-19S-14E Carter No. 1-A Sphinx
24-21S-15E Superior No. 14-24 Unit
28-22S-15E Equity No. 1 Government
17-23S-9E Amerada No. 1 Colman-U.S.A.
11-23S-14E Equity No. 1 Forest Government
19-23S-14E Lion Oil No. 1 Government
21-23S-15E Shell No. 1 Chaffin
2-24S-13E Superior-Standard No. 23-2 Iron Wash
21-24S-14E Carter No. 1 Dugout Creek
5-24S-15E General Pet. No. 45-5-G
19-24S-16E Shell No. 1 Gruvers Mesa
34-25S-12E Delhi No. 1 Russell
22-25S-15E Continental No. 2 Moonshine Wash
32-25S-15E Standard No. 1 Moonshine Wash
29-25S-16E Standard No. 1 Lookout Point
13-26S-7E Byrd Frost No. 1-A Rath
18-26S-7E Mountain Fuel No. 1-A Last Chance
18-26S-7E P. B. English No. 1 Government
18-26S-7E Ramsey No. 1
25-26S-13E Tidewater No. 6-25 Flat Top
Carbon County (continued)

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Sevier County:

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Wayne County:

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