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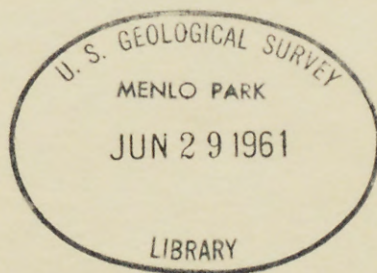
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Core from the Irish Creek Well, Ziebach  
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Tourtelot, Harry A. & Schultz, L. G.





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UNITED STATES  
DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY  
Washington 25, D. C.

CORE FROM THE IRISH CREEK WELL,  
ZIEBACH COUNTY, SOUTH DAKOTA

by

Harry A. Tourtelot and Leonard G. Schultz

Prepared with the cooperation of the South Dakota  
State Geological Survey



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This report is preliminary and has not been reviewed for conformity  
with U. S. Geological Survey standards and nomenclature.

March 1961



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# CORE FROM THE IRISH CREEK WELL, ZIEBACH COUNTY, SOUTH DAKOTA

By

Harry A. Tourtelot and Leonard G. Schultz

## INTRODUCTION

A 2-inch core from an exploratory well 2,049 feet deep in northern Ziebach County, S. Dak., was obtained in 1925 by the Irish Creek Oil Co. of Isabel, S. Dak. The hole was begun in the Fox Hills sandstone in SE $\frac{1}{4}$  sec. 17, T. 15 N., R. 20 E.; it penetrated a complete section of the Pierre shale and the Niobrara formation and entered about 80 feet into the Carlile shale. Nearly 1,100 feet of core was recovered. This remarkable stratigraphic record was donated to the South Dakota State Geological Survey, and it has been stored by that agency since that time. W. L. Russell (1925) presented a brief description of the core accompanied by identifications of more than 150 lots of fossils from the core by T. W. Stanton.

The core has been a source of stratigraphic information and has provided samples for geochemical investigations (Moxon, Olson, Searight, and Sandals, 1938; Moxon, Olson, and Searight, 1939; Moxon, Searight, Olson, and Sisson, 1944; Kepferle, 1959) but no detailed description of the core has been published since that of Russell. In 1957, as part of a study of the Pierre shale in South Dakota and adjoining states, the authors re-examined the core from

the upper 2,000 feet of the hole. The following description of the rocks observed in the core is presented to make the lithologic information available to others interested in the stratigraphy of the Pierre shale. It is not possible at this time to offer our interpretation of the core in terms of the subdivisions of the Pierre shale recognized in outcrops along the Missouri River (Searight, 1937; Petsch, 1946). An assignment of intervals to stratigraphic units, probably made by Searight, is shown in Moxon, Olson, Searight, and Sandals (1938, p. 797).

#### HISTORY OF DRILLING

In 1923, Wilson and Ward described an irregular structural feature in northern Ziebach County as part of the investigations carried out by the South Dakota Geological and Natural History Survey. Shortly thereafter, citizens of Isabel, S. Dak., the town nearest the reported structure, organized the Irish Creek Oil Co. The location for the hole seems to have been selected on the basis of the report by Wilson and Ward. The time drilling began is not known, but by September 1925, one core hole had been drilled to a depth of 1,550 feet and had been abandoned after an unsuccessful fishing job, and another hole located a few feet away had been drilled to a depth of 2,049 feet. The core from the first hole, to a depth of 1,550 feet, was placed in 25 wooden boxes numbered from 1 to 25, each holding 36 feet of core. Core from the second hole, from a reported depth of 1,535 feet to 2,049 feet, was placed in nine similar boxes numbered from 26 to 34. At this

point, Russell made the study on which his report is based and removed fossils from the core.

According to a memorandum note in the files of the South Dakota State Geological Survey, dated only "1925-1926," Freeman Ward, then State Geologist, and G. F. Moulton collected the core at the well site and brought the core to the offices of the State Survey. By this time, the hole had been deepened to 2,680 feet using a 1-inch core barrel. This core, from 2,050 to 2,680 feet, was placed in six boxes numbered from 1 to 6 and designated "second series."

As far as is known, the altitude of the collar of the hole has not been determined precisely. Morgan and Petsch (1945, p. 31) report that the altitude is approximately 2,150 feet. The location of the hole plotted on the McIntosh sheet of the 1:250,000-scale map series of the United States seems to be at an altitude of more than 2,200 feet.

#### CONDITION OF CORE

The core is unusually well preserved. Except for an interval between about 700 and 1,000 feet, where highly bentonitic shale has broken into angular pieces about 5 mm in greatest dimension, core pieces 1 to 3 inches long are common, and pieces as much as 6 inches long occur from place to place. Pyrite in the shale is quite fresh but in many places in the core the pyrite has a rim of iron oxide diffused through the shale. The iron oxide seems to be a secondary feature that developed after the core was stored.



## ARRANGEMENT OF THE CORE

Some of the core boxes are labeled with the depths in the hole represented by the core in that box; in addition, depth points are marked within many of the boxes on the rails separating the core troughs. Some boxes, however, have no depth intervals on the outside of the box although depth points may be marked within the boxes. A few boxes have no indications of either depth intervals or depth points; the position of the core is indicated only by the number of the box.

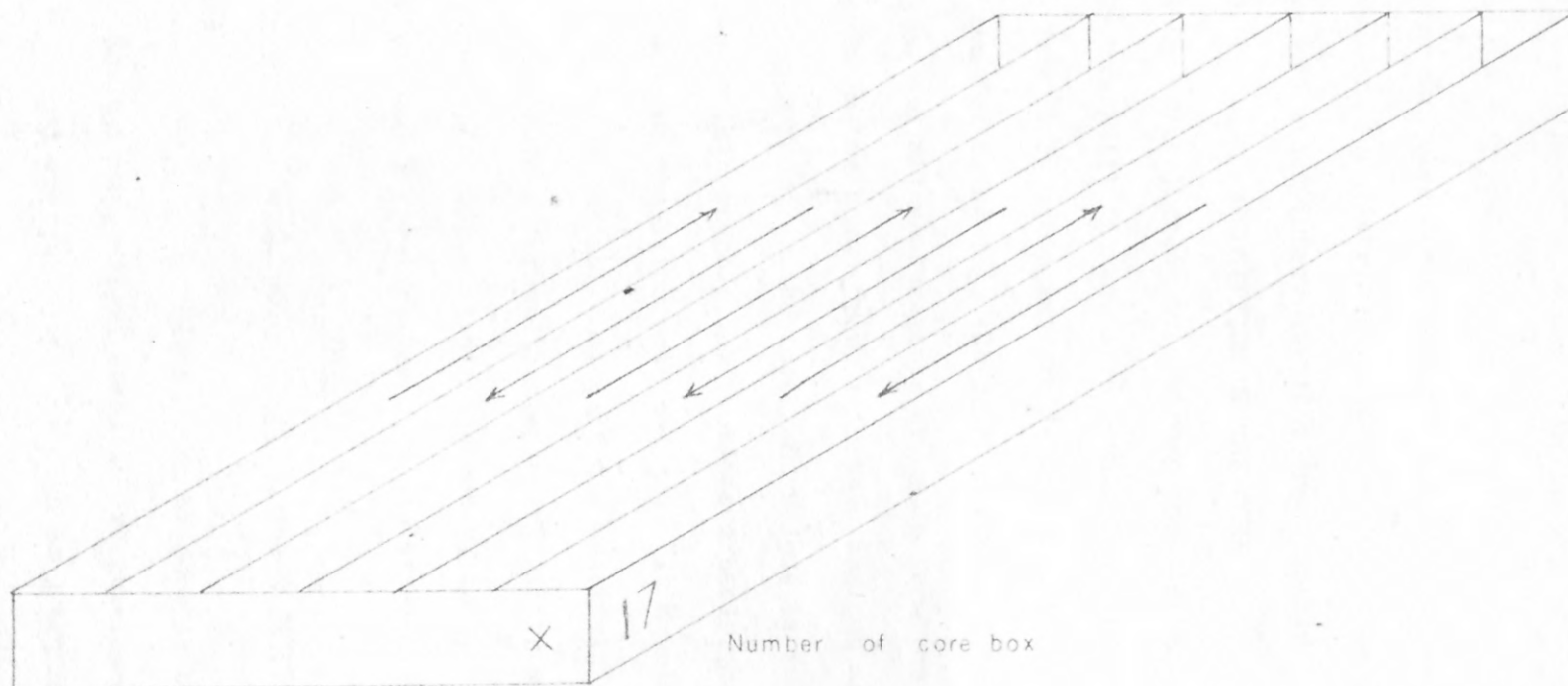
The core in the boxes is supposed to be arranged according to the plan shown in figure 1. The bottom of the first run of core in each box is supposed to be marked with an X on the outside of the box at the end of the first of the six core troughs in the box. The first run of core extends in a down-hole direction toward this X and then, in the adjacent trough, away from the end marked X, zig-zagging in this fashion through the box. In several boxes the footages marked on the rails between the core troughs contradicted this arrangement. In others, the lithology of the core seemed to indicate that the arrangement had been disordered. This disorder probably is a result of unsystematic handling of the core at the time it was taken from the core barrel (Russell, 1925, p. 6).

Core recovery to a depth of 2,049 feet averaged about 55 percent but varied markedly from box to box. In general, the core itself did not provide a basis for assigning core loss. Each box contained nearly 36 feet of core. Russell (1925, p. 6)

This report and/or map is preliminary and has not been edited or reviewed for conformity with Geological Survey standards or nomenclature.

Bottom of core here

Top of core starts here



X painted on box

Number of core box

Based on memorandum in files of the  
South Dakota State Geological Survey

Figure 1. Diagram showing arrangement of core in boxes,

distributed the loss between the marked footages on the core rails and believed that not more than 5 or 10 feet of uncertainty was involved. We followed the same procedure but believe that much larger uncertainties are probable; boxes 4, 12, and 24 (fig. 2) are examples. The distribution of core loss made by us is arbitrary and other interpretations are possible.

#### DESCRIPTION OF THE CORE

The core was logged under strong incandescent light in an otherwise dimly lit storage area. Hand lens and acid bottle were the only auxiliary equipment available.

In the following log, the core in each box is described objectively and all measurements are made from the apparent top of the core in the box. Depth intervals are not assigned here to the rock types found in the core. Core loss is indicated only on figure 2, and this graphic log provides a basis for inferring possible depths for the lithologic changes. It should be understood that these depths for the most part are uncertain to an unknown degree. All depth information available, either as labels on the boxes or as depth points within the boxes, is given and individual interpretations of core loss can be made if desired.

#### Box 1

Depth 80-136 ft. Depth point 92 ft marked 6 ft from top of core.

Thickness  
(ft)

Description of core in box

- |   |   |
|---|---|
| 7 | Shale, gray, silty; contains irregular seams of light-gray siltstone as much as 1 mm thick. |
| 1 | Sandstone, gray, very fine grained, silty, and clayey; laminated in 1- to 2-mm seams.       |

Box 1--continued

Thickness (ft)	Description of core in box
2	Shale, gray, silty; interlaminated with gray siltstone in 1-mm seams.
4	Shale, gray, silty, massive.
22	Shale, gray, silty; interlaminated with gray siltstone in 1-mm seams with some poorly defined more sandy seams; contains minute flecks of plant material and brown stains from oxidizing pyrite.

Box 2

Depth 136-180 ft. No depths marked in box.

Thickness (ft)	Description of core in box
3	Sandstone, light-gray, silty, very fine grained; contains some muscovite.
33	Shale, light-gray, silty; contains some muscovite and a 0.4-ft bed of hard limy sandstone 18 ft below top.

Box 3

Depth 180-220 ft. No depths marked in box.

Thickness (ft)	Description of core in box
13.5	Like preceding unit, but with increasing amounts of siltstone in lower 2 ft.
22.5	Siltstone, gray, clayey; contains some muscovite and irregular laminae and lenses of shale and siltstone with apparent flow structure.

Box 4

Depth 220-315.5 ft. Depth points 239, 266, and 270 ft marked at 11.5, 20, and 22.5 ft, respectively.

Thickness (ft)	Description of core in box
20	Like preceding unit, but with more intricate bedding structure resulting in greater breakage of core.
16	Interbedded gray shale and fine-grained gray clayey sandstone with the sandstone in poorly defined beds 0.1 - 0.15 ft thick. There is a 2-ft bed of fine-grained sandstone 30 - 32 ft from the top of the core.

Box 5

Depth 315.5-370 ft. Depth points 329.5 and 335.5 ft marked at 7.5 and 10 ft, respectively.

Thickness (ft)	Description of core in box
10	Like preceding unit, but slightly limy; contains 0.3-ft ferruginous limestone concretion at 9.6 ft.
23	Shale, gray, silty; contains irregular lenses and filled boring of fine-grained glauconitic sandstone in which there is some biotite and scattered fragments of fossils. Bedding structure is similar to bottom sediments reworked by mollusks.
3	Shale, gray, in 1- to 10-mm beds interlaminated with equal thicknesses of greenish-gray glauconitic fine-grained sandstone in which there is some biotite.



Box 6

Depth 370-455 ft. Depth points 393, 400, 423, and 427 ft marked at 11, 13.5, 24, and 25 feet, respectively.

Thickness  
(ft)

Description of core in box

- |    |  |
|----|--|
| 5  | Shale, gray, silty; contains sparse 0.5- to 1-mm irregular beds of siltstone.  |
| 31 | Shale, gray, silty; contains many irregular seams of siltstone and some laminated zones in lower 5 ft. Some of the siltstone is slightly limy. There is a bed of calcite cone-in-cone 0.2 ft thick at 24 ft. <u>Lingula</u> is abundant in the lower 18 ft and sparsely present above. |

Box 7

Depth 455-505 ft. Depth point 491 ft marked at 13 ft.

Thickness  
(ft)

Description of core in box

- |    |   |
|----|---|
| 36 | Shale, medium-gray, slightly to quite limy; contains irregular seams of glauconitic siltstone less than 1 mm thick and well-developed laminated zones in lower 5 ft. <u>Lingula</u> and fish scales are moderately abundant. Microfossils probably are present. |
|----|---|

Box 8

Depth 505-556 ft. Depth points 522 and 531 ft marked at 17.5 and 21.5 ft, respectively.

Thickness  
(ft)

Description of core in box

- |   |  |
|---|--|
| 3 | Shale, medium-gray, limy; contains scattered seams of siltstone less than 1 mm thick. Irregular root-like markings appear on bedding planes. |
|---|--|

Box 8--continued

Thickness (ft)	Description of core in box
8	Shale, medium-gray; interlaminated with siltstone.
25	Shale, medium-gray, slightly limy to nonlimy; interlaminated with siltstone and very fine grained glauconitic sandstone in less-than-1-mm beds. <u>Lingula</u> is abundant. Unit contains 1.2-ft dark-gray very limy fine-grained sandstone at 31 ft, a 0.1-ft seam of calcite cone-in-cone at 14 ft, and 0.05-ft buff limy fine-grained sandstone at 29.5 ft.

Box 9

Depth 556-599 ft. Depth points 557 and 588 ft marked at 1 and 28.5 ft, respectively.

(First run in box seems to be reversed, with top of run at end of box marked X; it was assumed that remaining runs were oriented according to the general pattern.)

Thickness (ft)	Description of core in box
27	Shale, medium-gray; like preceding unit, but not as sandy. Piece at bottom of this unit is marked 582 ft and consists of phosphatic nodules that may be pebbles in a matrix of cone-in-cone.
9	Shale, gray, silty, limy; contains some irregular patches of siltstone. <u>Lingula</u> is sparsely present. According to Russell (1925, p. 4) the interval 587-589 ft consists of dark-gray calcareous shale or a concretion containing <u>Lingula</u> .

Box 10

Depth 599-636 ft. Depth point 612 ft marked at 17.8 ft.

Thickness  
(ft)

Description of core in box

17.8 Shale, gray; contains irregular silty patches and some boring structures. Is irregularly limy. Shale breaks into "poker chips" less than 1 cm thick except for interval 1 - 13 ft, where it is broken into angular fragments less than 1 cm in maximum dimension.

18.2 Shale, gray; contains much disseminated silt and is irregularly slightly limy. Shale is well bedded and breaks into "poker chips" less than 1 cm thick except for intervals 24 - 30 and 33 - 35 ft, where the shale is broken as in preceding unit.

Box 11

Depth 636-690 ft. Depth points 647 and 670 ft marked at 1.5 and 35 ft, respectively.

Thickness  
(ft)

Description of core in box

36 Shale, gray; only slightly silty and slightly limy throughout from fossil fragments and microfossils. Badly broken in intervals 0 - 6, 9 - 10, 15 - 17, and 30 - 33 ft; remainder of core forms "poker chips." A bed of bentonite 0.1 ft thick is at 15 ft.

NOTE: Depth point 650 ft marked at 16.5 ft from top of core, but there is no record of this depth point in the memorandum of Ward and Moulton and the point is not in agreement with the 647-ft point.

Box 12

No depths marked.

Thickness  
(ft)

Description of core in box

- 36 Claystone, dark-gray, highly bentonitic; irregularly limy. Entire core is broken into fragments 5 to 20 mm in maximum dimension. A 0.2-ft siderite nodule is at 29 ft.

Box 13

Depth point 897 ft marked at 24.5 ft.

Thickness  
(ft)

Description of core in box

- 36 Claystone as in preceding unit. A 0.1-ft bed of calcite cone-in-cone is at 20.5 ft.

Box 14

No depths marked.

Thickness  
(ft)

Description of core in box

- 36 Claystone as in preceding unit; contains a 0.1-ft phosphatic nodule at 6.5 ft.

Box 15

Depth 943-998 ft. Depth points 959, 979, and 998 ft marked at 11, 31, and 35.5 ft, respectively.

Thickness  
(ft)

Description of core in box

- 36 Claystone as in preceding unit; contains fecal pellets at 16 ft. Shale is somewhat less broken than in preceding units at intervals 1 - 2, 3 - 5.5, 7.5 - 30, and 31.5 - 36 ft.

Box 16

Depth point 1017 ft marked at 10 ft. Lower 3 ft of core is missing.

Thickness (ft)	Description of core in box
33	Claystone, as in preceding unit, but slightly silty; contains scattered fossil fragments at 16 ft.

Box 17

Depth 1030 - 1100 ft. Depth points 1042 and 1076 ft marked at 1 and 32 ft, respectively.

Thickness (ft)	Description of core in box
36	Shale, light-gray, hard; forms "poker chips", but shows no other evidence of lamination. Contains fragments of <u>Inoceramus</u> shells at 24 - 26 and 34 - 36 ft; 0.05-ft beds of bentonite at 1.5, 5, 25, 26, 30, and 31 ft; and 0.3-ft siderite concretion at 22 ft.

Box 18

Depth 1100-1142 ft. Depth points 1101 and 1111 marked at 1 and 11 ft, respectively.

Thickness (ft)	Description of core in box
36	Shale, medium- to light-gray, hard, structureless; contains a few fragments of <u>Inoceramus</u> shell and 0.05-ft beds of bentonite at 5 and 17.5 ft.



Box 19

Top of box marked 1142 ft. No depths marked in box.

Thickness (ft)	Description of core in box
36	Shale like preceding unit, but more bentonitic and broken into 1- to 5-cm angular fragments in the intervals 3 - 6, 16 - 18, 27 - 28, and 29.5 - 30 ft. Contains a 1-ft concretion of siderite with septarian veins of yellow calcite at 9 ft.

Box 20

Depth points 1186 and 1247 ft marked at 5 and 28 ft, respectively.

Thickness (ft)	Description of core in box
15	Shale as in preceding unit, but broken into 1- to 5-cm pieces in the interval 1 to 2 ft.
21	Shale, medium- to light-gray, slightly silty, hard, structureless. Core sides have ropy texture.

Box 21

Depth point 1247 ft reported by Ward and Moulton to be in box, but it was not found.

Thickness (ft)	Description of core in box
30	Shale as in preceding unit, but somewhat mottled with brown from the oxidation of microscopic pyrite. Contains 0.3-ft siderite concretions at 19.5 and 22.5 ft.
6	Shale, medium- to light-gray, silty, massive; surface of core is ropy. Contains 0.3-ft siderite concretion with phosphate core at 34.5 ft.

Box 22

Depth point 1331 ft marked at 16.5 ft.

Thickness  
(ft)

Description of core in box

- 36 Shale, medium-gray, hard, bentonitic, slightly silty, slightly micaceous; surface of core is ropy. Contains 0.3-ft siderite nodule at 16.5 ft and ferruginous limestone nodule at 34 ft.

Box 23

Depth points 1372 and 1388 ft marked at 17.5 and 23.5 ft, respectively.

Thickness  
(ft)

Description of core in box

- 17.5 Shale, light-gray, slightly silty, slightly micaceous; has irregular conchoidal fracture and contains root-like markings. Contains a 0.4-ft limestone concretion with Inoceramus shell fragments at 12 ft.
- 18.5 Shale, light-gray, slightly silty to silty, slightly micaceous; has irregular fracture and is slightly limy with many fragments of fossils. Pyrite occurs both disseminated in the shale and as 1-mm concretions. Fecal pellets are sporadically present. Contains a 0.2-ft iron-oxide-rich nodule coated with green clay at 17.5 and a 0.2-ft limestone nodule at 18 ft.

Box 24

Depth points 1423 and 1445 are marked in box, but positions are not interpretable in relation to the two types of shale in the core.

Thickness (ft)	Description of core in box
15	Shale as in preceding unit but pyrite is more abundant.
21	Shale, dark-gray; has platy to hackly fracture and is rich in organic material. Fish scales and bone fragments are abundant.

Box 25

Depth point 1502 marked at 4 ft. Bottom of core probably is 1550 ft where first hole was abandoned.

Thickness (ft)	Description of core in box
25	Shale, very dark gray, organic-rich, flaky; contains fish scales.

Box 26

Core in this and following boxes is from the second hole (Russell, 1925, p. 3). Depth points 1535, 1584, and 1605 ft marked at 0, 14, and 14.5 ft, respectively.

Thickness (ft)	Description of core in box
14	Shale as in preceding unit.
22	Shale, medium-gray, silty; has irregular hackly fracture. Contains 0.2-ft siderite nodule at 30.5 ft and 0.3-ft siderite nodule at 34 ft.

Box 27

Depth point 1647 supposed to be marked in box but was not found.

Thickness (ft)	Description of core in box
18	Shale, gray, slightly silty.
18	Shale, gray, slightly silty, irregularly limy, probably because of microfossils. Contains 0.5-ft siderite nodule at 26 ft and 0.3-ft siderite nodule at 27 ft.

Box 28

Depth point 1720 supposed to be in box but was not found.

Thickness (ft)	Description of core in box
36	Shale, gray, slightly silty, quite limy.

Box 29

Depth point 1756 ft marked at 14 ft.

Thickness (ft)	Description of core in box
25	Marlstone, medium-gray; has irregular hackly fracture.
2	Chalk, bluish-gray; Foraminifera are very abundant.
9	Marlstone, medium-gray; has irregular hackly fracture.

Box 30

Depth point 1842 ft marked at 10 ft.

Thickness (ft)	Description of core in box
36	Shale, medium-gray, limy; has irregular hackly fracture. Contains a 1-ft siderite nodule at 10.5 ft.

NOTE: The following three boxes were not examined in detail.

Box 31

Depth point 1878 ft marked at 28 ft.

Thickness  
(ft)

Description of core in box

36 Shale, medium-gray, limy, interbedded with bluish-gray  
chalk.

Box 32

Depth point 1939 ft supposed to be in box, but not found.

Thickness  
(ft)

Description of core in box

36 Interbedded shale and chalk as in preceding unit.

Box 33

Depth point 1975 ft marked at 24.5 ft and 2000 ft at 29 ft.

Thickness  
(ft)

Description of core in box

36 Shale, dark-gray, not limy; contains a 0.5-ft siderite  
nodule with septarian calcite veins at 14 ft.

NOTE: Box 34 with indicated depths of 2035 to 2049 ft and boxes  
1 to 6 of the second series to a depth of 2672 or 2680 ft were  
not examined.



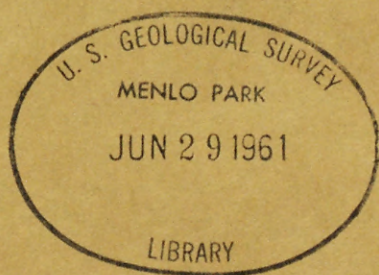
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