A PHOTOGEOLOGIC STUDY OF THE REGIONAL STRUCTURAL GEOLOGY OF THE SOUTHERN ONE-HALF OF THE JUNCTION CITY QUADRANGLE

by

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A THESIS

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INTRODUCTION

Purpose of Investigation

The purpose of this investigation is three fold: first, to make a regional study of the surface or near surface structure of the southern one-half of the Junction City Quadrangle by the construction of a structural contour map on the rimrock of the Fort Riley limestone member of the Barneston formation of the Chase Group; second, a description and interpretation of the structure obtained from the structural contour map; third, to show the value of application of aerial photographs for reconnaissance work in exploration for oil.

Area Covered by This Investigation

The area of this investigation covers the southern one-half of the Junction City Quadrangle, which is located between 39° and 39° 30' north latitude and 96° 30' and 97° west longitude. This area is shown on Plate I and includes a major part of Riley and Geary Counties and a minor part of Clay, Dickinson, and Pottawattomie Counties. This area was selected because eight accurate topographic maps, made by the United States Corps of Engineers from aerial photographs by multiplex methods, were available. The maps

EXPLATAION OF PLATE I

Location of the Junction City Quadrangle

Area Investigated

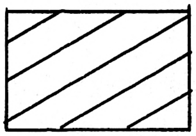
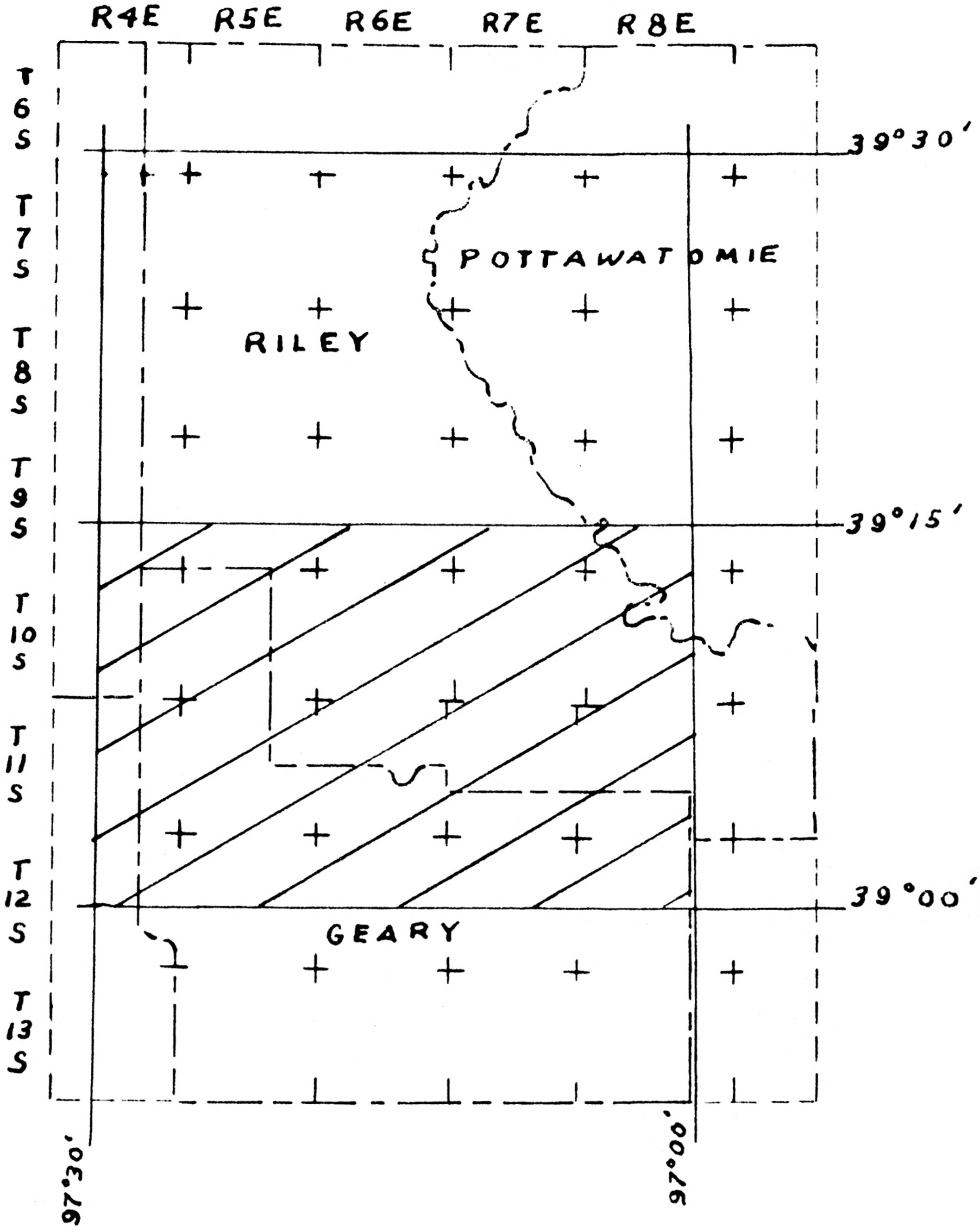


PLATE I


R4E
R5E
R6E
R7E
R8E
T 6 S
T 7 S
T 8 S
T 9 S
T 10 S
T 11 S
T 12 S
T 13 S
39°30'
39°15'
39°00'
POTTAWATOMIE
RILEY
GEARY
97°30'
97°00'

were vital in allowing the writer to map a large area, approximately 460 square miles, accurately and in a reasonable length of time.

Key Beds Used

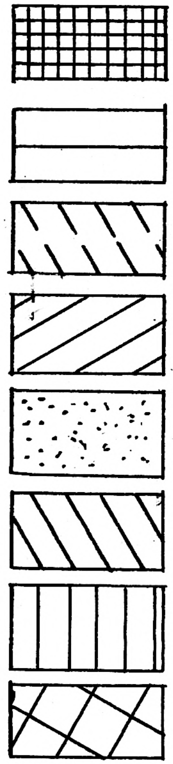
The key beds used in this investigation were the Cottonwood limestone member of the Beattie limestone formation of the Council Grove group, the Threemile limestone member of the Wreford limestone formation, the Florence and Fort Riley limestone members of the Barneston limestone formation, the Towanda limestone member of the Doyle shale formation, the Stovall and Cresswell limestone members of the Winfield limestone formation, and the Herington limestone member of the Nolans limestone formation, all of which belong to the Chase group.

The approximate area in which each key bed was used is indicated on Plate II. Plate II is not a geologic map as the boundaries do not follow outcrop lines.

According to Jewett (5) the revised classification prepared by Moore defines the Council Grove group as all beds from the base of the Foraker limestone to the top of the Speiser shale. Seven shales and seven limestones are included in this group. They are, named in upward order, the Foraker limestone, Johnson shale, Red Eagle limestone, Roca shale, Grenola limestone, Eskridge shale, Beattie limestone,

EXPLANATION OF PLATE II

Key bed map of area of investigation



....Herington

....Cresswell

....Stovall

....Towanda

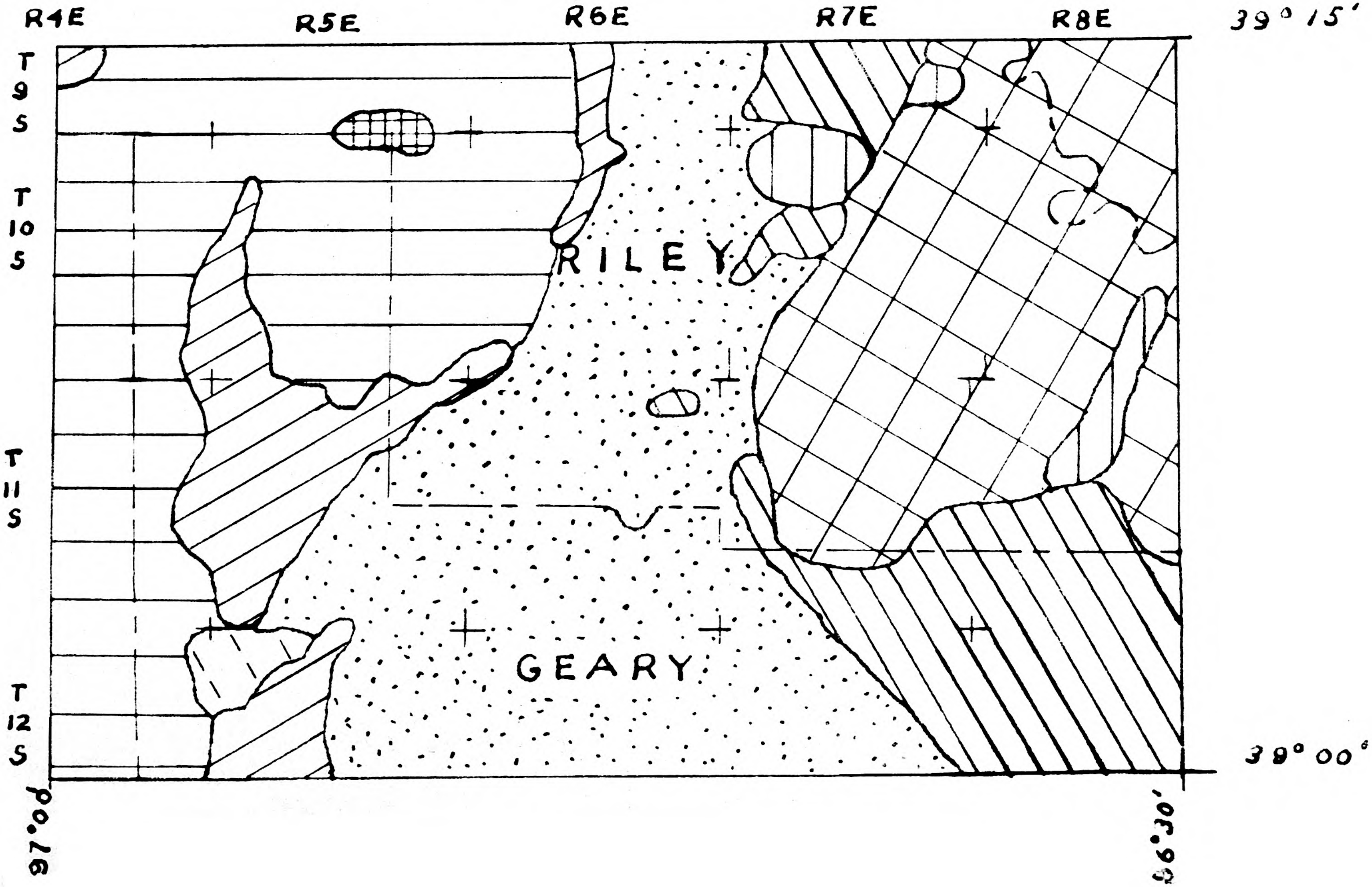
....Fort Riley

....Florence

....Threemile

....Cottonwood

PLATE II


R4E
R5E
R6E
R7E
R8E
39° 15'
T 9 S
T 10 S
T 11 S
T 12 S
RILEY
GEARY
39° 00'
97°00'
96°30'

Stearns shale, Bader limestone, Easly Creek shale, Crouse limestone, Blue Rapids shale, Funston limestone, and Speiser shale. The Council Grove group outcrops across the northeastern corner of the southern one-half of the Junction City Quadrangle. The average total thickness of the Council Grove group, along its outcrop, is 319 feet.

According to Jewett (5) the revised classification prepared by Moore defines the Chase group to include all beds from the base of the Wreford limestone to the top of the Nolans limestone. Four limestones and three shales are included in this group. They are, named in upward order, the Wreford limestone, Matfield shale, Barneston limestone, Doyle shale, Winfield limestone, Odell shale, and Nolans limestone.

The Chase group outcrops across the total of the southern one-half of the Junction City Quadrangle except for the northeastern corner where the lower Council Grove group is exposed. The average thickness, along its line of outcrop, is 348 feet.

MATERIALS USED IN INVESTIGATION

Aerial Photographs

The 244 vertical aerial photographs used were obtained from two sources, the Department of Geology and Geography, Kansas State College, and the Soil Conservation Service of Geary County, Kansas.

The scale of the negatives for all photographs was 1:20,000. The scales of the prints used included 1:20,000, 1:12,000, and 1:7,920. A list of the 244 photographs used in this investigation is included in Table 1 (Appendix).

Topographic Maps

Eight topographic maps were used, each of which covered an area 7 minutes and 30 seconds by 7 minutes and 30 seconds. The topographic maps were transverse mercator projections prepared under the direction of the Chief of Engineers by the Corps of Engineers, United States Map Service, Washington, District of Columbia. They were compiled in 1949 from vertical aerial photographs taken in 1947 by photogrammetric (multiplex) methods. The maps comply with the national standards map accuracy requirements and are field checked. The map scale is 1:25,000 and the contour interval 20 feet.

Stereoscopes

Two types of stereoscopes were used: the single lens type and the Ryker model, mirror type.

METHODS

Determining the Number of Spot Elevations and the Contour Interval

From information available from previous investigations in this area, the regional dip was assumed to be approximately 14 or 15 feet per mile. To get a regional picture of the structural geology of the area it was found, after a careful study, that one spot elevation for each section of base map, scale 1 inch equals one mile, would give a regional structural map with sufficiently accurate information for this type of investigation. A number of spot elevations in the Manhattan area were checked by work that had been done previously. These were also field checked with the topographic maps. All of the points checked within 10 feet and the majority within 5 feet. Therefore, it was decided that a ten foot contour interval should be used. With a contour interval of 10 feet and the average regional dip assumed to be 15 feet per mile, the average distance between contours would be equal to the contour interval divided by the regional dip or two-thirds of a mile. Thus, any structure two-thirds of a mile or more across would be indicated as an anomaly on the regional structural contour map. Not to be overlooked was the possibility of one of the spot elevations being selected on one of the smaller structures and thus indicating an anomaly.

Recognition of Key Beds

The recognition of key beds was accomplished by acquiring a knowledge of the stratigraphy of the area of investigation and making a number of field reconnaissance trips to compare key beds with the outcrop lines on the photographs.

Limestone outcrops on aerial photographs appear as white outlines. The massive beds of limestone will form a clean, distinct contact line. The cherty or platy limestones form a fuzzy, indistinct line due to the formation of a chert rubble when weathered. Some of the limestones that are good aquifers will show a characteristic bush line at the base. This is usually developed best on the down dip side. The intervening shales appear as tones of gray depending on the kind and amount of vegetation growing on them. Each limestone used for a key bed had a certain characteristic contact line by which it could be easily identified.

Obtaining Spot Elevation on Key Beds

There are many methods of determining the elevations of key beds on aerial photographs. The most important methods are: the contact line-topographic (multiplex) map, the parallax, the contact line-topographic contours, and the overlay.

In the contact line-topographic (multiplex) map method, the key beds' contact lines were traced on one of the two aerial photographs viewed by use of a stereoscope. The contour on the topographic map that was similar in shape to the contact line of the key bed or a point between two partially similar contours was selected as the spot elevation of the key bed at that point. The majority of the key beds used were the hill side bench forming formations and the changes in the slopes caused by the benches were an aid in locating many spot elevations.

The parallax method is a method of determining the difference in elevation of two points by the use of the stereo-comparagraph or contour finder, the essential part of which is a parallax bar with floating dots. Two photographs with approximately 60 per cent of overlap are used and, to get the difference of elevation between two points on the stereo-model, one brings the dots to float at the upper level and then at the lower level, reading the parallax dial at each place. The difference between the two readings is the amount of parallax and is converted into the elevation difference by use of parallax tables or by a mathematical formula. The elevation of one of the points used must have been predetermined by a field survey or from another photograph (3).

The method of using contact line-topographic contours is as follows: two alternate overlapping photographs one of which has had the contact lines of the key beds traced out, the other which has been topographically contoured, are placed under the stereoscope to give a stereo-model. The point of fusion or intersection of the topographic contour and the contact line of the key bed gives the spot elevation of the key bed at that point (3).

The overlay method is very similar to the contact line-topographic contour except the outline of the key bed is traced from a photograph to a transparent piece of overlay paper instead of on the photograph. One print is topographically contoured and the overlay which has the same scale is placed upon this. The point of fusion or intersection gives the elevation of the key bed. If a topographic (multiplex) map, with the same scale as the photographs, is available the overlay may be placed on the map and the elevation of the key bed read at the point of fusion or intersection (3).

The method used by the writer was the contact line-topographic (multiplex) map. This method was selected because the photographs used were borrowed and could not be heavily marked and, also, because the scales of the photographs and the topographic maps available were not the same. A number of points were field checked with the topographic maps, and all of the contours checked were found to be within one contour interval and the majority within one-half of a contour interval.

Plotting Elevations on Base Map

The elevations were plotted on the base map by scaling the distances from the spot elevation point on the topographic map to two section lines at right angles to each other. They were then reduced to the correct scale and plotted on the base map on which the section lines were indicated. An artificial section line grid system was extended on both the base map and the topographic map of the area of the Fort Riley Military Reservation that had not been sectioned previously by the government surveyors.

Stratigraphic Intervals Between Key Beds

The stratigraphic intervals were determined by field measurements and by taking the intervals off of the aerial photographs. The hand level method was used in the field to obtain the stratigraphic intervals between the key beds. The method used on the photographs was to locate a valley, with divides one to two miles apart, in a region of nearly uniform dip. The elevation of the upper key bed on each divide was determined. Next, the elevation of the lower key bed was determined at the point of outcrop lying in the vertical plane which includes the upper key bed elevations. The top key bed elevation at a point directly above the point of outcrop of the lower key bed was determined by interpolation assuming uniform dip. The amount of dip and its factor of increasing the thickness of the bed was omitted because the angle of the dip in all cases was too small to affect, mathematically, the thickness of the stratigraphic interval. The difference in the elevation of the upper key bed and the lower key bed was used as the stratigraphic interval.

The effect of convergence was noted in the measurement of stratigraphic sections from the Cottonwood limestone to the Florence. This convergence was to the northeast. The average convergence was about 2 feet per mile for a stratigraphic interval of approximately 210 feet. This would have a very slight effect on the migration of subsurface structure.

In the areas where the Fort Riley was eroded, the stratigraphic interval from an exposed key bed to the Fort Riley rimrock was measured at the nearest adjacent area and this interval was used to adjust the region to the Fort Riley rimrock elevation for structural contouring.

Interpolation and Structural Contouring

The mechanical method of interpolating points between known points was used in structural contouring. In structural contouring the points selected on the various key beds were adjusted to the Fort Riley rimrock by adding or subtracting the stratigraphic interval. The structural contours were drawn in the usual manner.

FACTORS OF ERROR IN METHODS

The human factor is the biggest chance for error in these methods. Some of the possible errors affecting the structural contour map are: the selection of wrong outcrop for key bed, plotting the spot elevation on the wrong contour, error in transferring spot elevations to the base map, miscalculation in stratigraphic intervals, and error in interpolation and contouring.

A careful study was made of the outcrop trace of the key beds. Frequent field trips were made to check the key beds. Thus, the chance for error was kept at a minimum.

Extreme care was used in selecting the location for a spot elevation. The point selected was usually a critical point on the topographic map such as the edge of a hill side bench. This enabled the writer to locate fairly exactly the spot elevation, thus reducing the chance for error.

The transfer of spot elevation from the topographic map was done by scaling the distance from section lines on the topographic map and reducing the distances to fit the scale of the base map. When mathematical computations are used, there is always chance for error. The locations of the points on the base map were checked by inspection and the chance for error reduced.

In calculating stratigraphic intervals, several calculations were made in each locality and checked against each other. This should reduce the amount of error in stratigraphic units to a negligible amount.

In the interpolation of spot elevations for structural contouring a scale was used to get intermediate points between two contours but it was possible that an error could have been made in reading the scale.

Taking all these possible errors into consideration and by making a careful attempt to keep them at a minimum, it was believed that a 10 foot contour interval for the structural contour map was justified.

REGIONAL GEOLOGIC SETTING

The Junction City Quadrangle is a part of the east flank of the Salina Basin. The Salina Basin was first defined by Barwick (1). It consists of a pre-Pennsylvanian syncline bound on the southwest by the Central Kansas uplift, on the east by the Nemaha ridge and on the south by a saddle between the Chautauqua arch and the Central Kansas uplift. It extends northward into Nebraska.

The Nemaha ridge, called the Granite Ridge of Kansas by Ley (8) is a pre-Cambrian buried mountain range, faulted on the east in late Mississippian or early Pennsylvanian time, extending from Oklahoma to Nebraska. In regard to the location of the Nemaha to Riley and Geary counties, Jewett states (5):

> The crest of the buried mountains trends to the southwest along a line passing near the southeast corners of both counties. A well drilled near Zeandale reached granite at a depth of 950 feet.

Lee, Leatherock and Botinelly state (6):

> The Nemaha anticline is the most striking of the new structural features produced in eastern Kansas by post-Mississippian folding. It extends with varying structural relief from near Omaha, Nebraska, southward beyond Oklahoma City, Oklahoma. Throughout its length the eastern limb of the anticline is notably steeper than the western limb. The northern end of the anticline was finally raised so high that the erosional beveling in northeastern Kansas exposed pre-Cambrian rocks in parallel bands on its flanks. Toward the south, where the structural relief decreases, the Mississippian limestones were only partly eroded from its crest except at places of exceptional deformation.

The structure of the Abilene zone of flexures and faulting, often called the Abilene anticline, is still uncertain. The Abilene anticline as located by Jewett (5)

> .....extends from a point near Kingman in Kingman County in the south-central part of Kansas northward into Nebraska. In Nebraska it is commonly called the Barneston arch.

Lee, Leatherock and Botinelly state (6):

> The prominent Abilene anticline on the northeast side of the Salina basin is recognized in the surface rocks in Riley County

> and extends southward into Dickinson County. It resembles the Nemaha anticline in that the beds dip steeply on its southeastern side and very gently to the northwest. Not many sub-surface data are available on the Abilene anticline.....

Taylor (11) believes that the Abilene anticline is a zone of flexures and faults and not a definite anticlinal structure throughout its entire extent. He points out that the frequent small flexures and faults in the overlying beds and the alignment of three ignous intrusion in Riley County suggest a strike slip fault along the Abilene zone of flexures and faulting. The location of the Nemaha anticline and the Abilene zone of flexures and faulting are shown on Plate III.

DESCRIPTION AND INTERPRETATION OF THE STRUCTURAL MAP

Regional Dip

Close examination of the structural contour map indicated that the regional dip of the area is almost due west, tending slightly to the northwest. At the western edge of the map there is a slight reversal of the dip as the Abilene zone of flexures and faults was approached. The average regional dip is about 17 feet

EXPLANATION OF PLATE III

The location of the Nemaha anticline and the Abilene zone of flexures and faulting

Area of Investigation

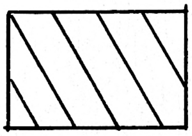
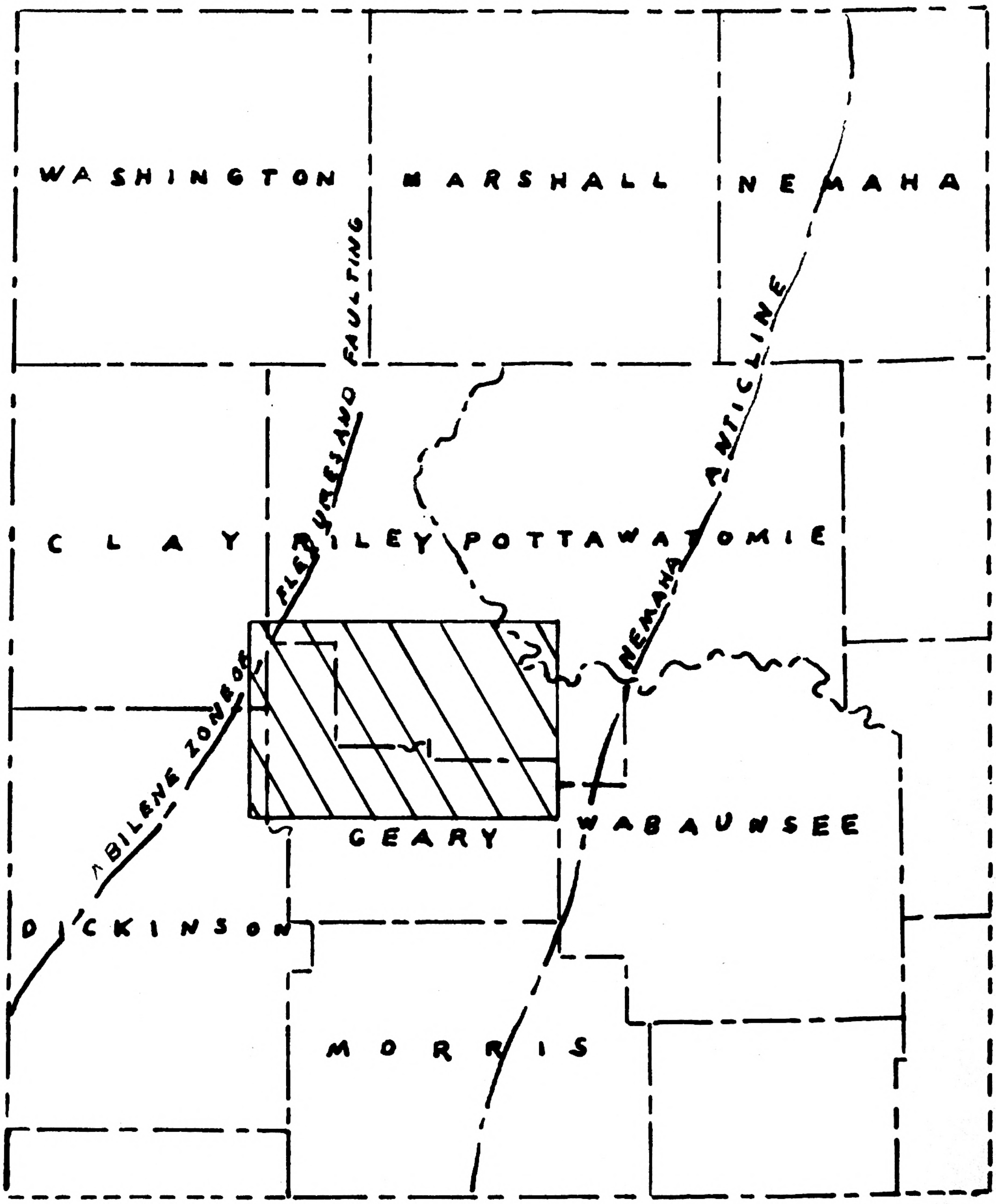


PLATE III


WASHINGTON
MARSHALL
NEMAHA
CLAY
RILEY
POTTAWATOMIE
GEARY
WABAUNSEE
DICKINSON
MORRIS
FLEXURES AND FAULTING
ABILENE ZONE OF
NEMAHA ANTICLINE

per mile. There is a general increase of dip as the Nemaha ridge is approached and a slight reversal as the Abilene zone of flexures and faulting is approached. Another area of local steepening is in Township 10 South, Range 6 East. This is a monoclinal structure possibly due to differential compaction over a buried hill or a thickening or thinning of the underlying beds.

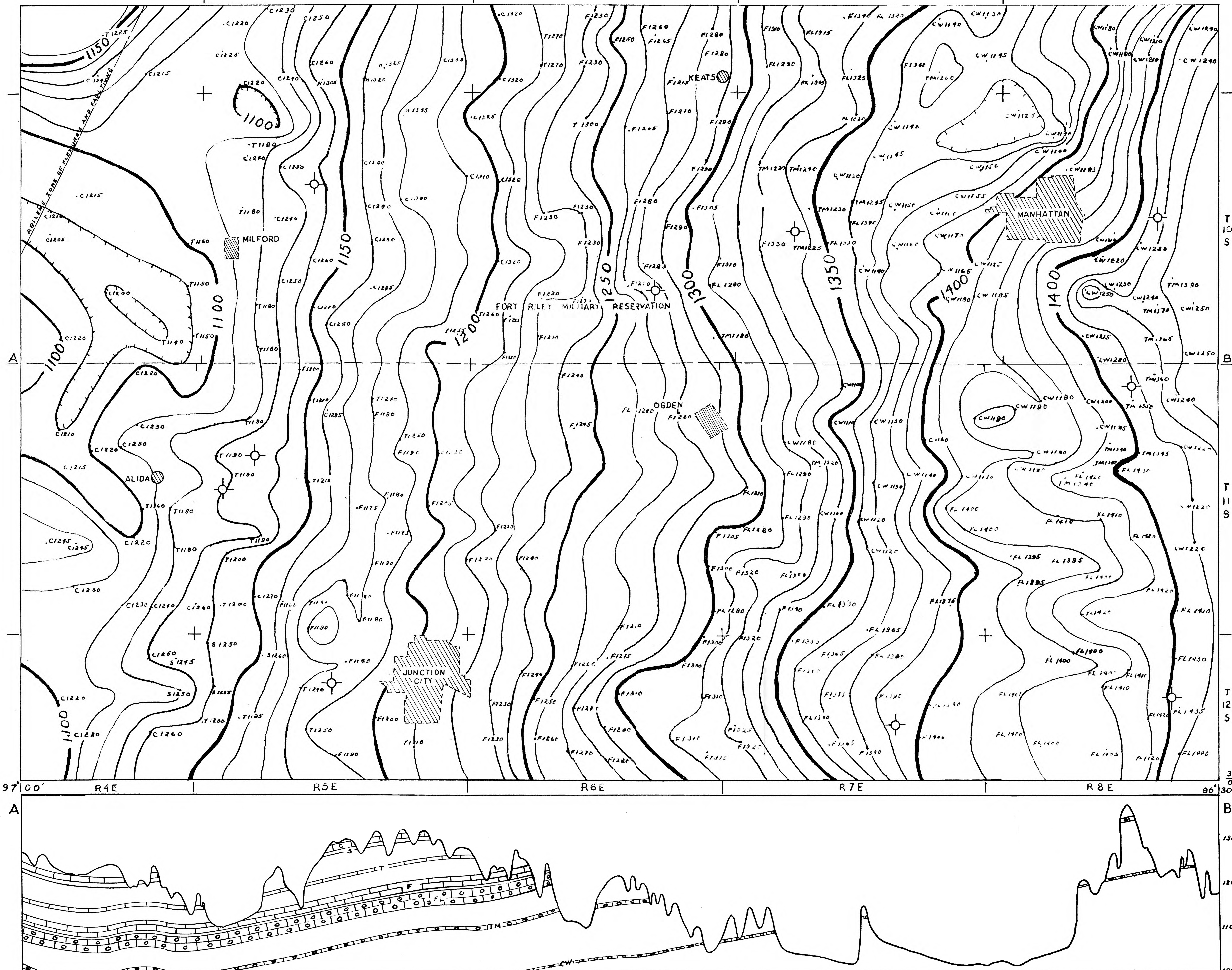
Major and Minor Structures

The major and minor structures of the area in investigation are indicated on the structural contour map of the Fort Riley rimrock, Plate IV. The major structures are noted on the east and west sides of the structural contour map. The structure on the east is apparently the east flank of the Salina basin or the west flank of the Nemaha anticline. The structure noted on the west is in the vicinity of the east side of the Abilene zone of flexures and faulting. The structure on the east was formed by deposition of sediments on a pre-Cambrian faulted buried granite ridge which has been rejuvenated from time to time since the pre-Cambrian. The thicker beds of sediments lying to the west of the ridge have, consequently, compacted a greater distance than the relatively thin sediments on top of the ridge

EXPLANATION OF PLATE IV

Structural contour map of the southern one-half of the Junction City Quadrangle, contours on top of the Fort Riley rimrock. Cross section from A to B

PLATE IV



LEGEND

H · · · HERINGTON

C · · · CRESSWELL

S · · · STOVALL

T · · · TOWANDA

F · · · FORT RILEY RIMROCK

FL · · · FLORENCE

TM · · · THREEMILE

CW · · · COTTONWOOD

⌖ · · · TEST HOLE, DRY

STRUCTURAL CONTOUR MAP
OF THE FORT RILEY RIMROCK
AND A CROSSECTION FROM A TO B
OF THE SOUTHERN ONE-HALF OF
THE JUNCTION CITY QUADRANGLE

0 1 2 3

DISTANCE IN MILES

H.S. 1: 63,360

V.S. 1: 1,200

V.E. 52.8

CONTOUR INTERVAL 10 FT.

causing an anticlinal structure.

The cause of the structure on the west is due to the Abilene zone of flexures and faulting. As few data are available about the Abilene zone of flexures and faulting, several theories are advanced about the possible structure. One theory is that it may have been caused by a buried granite ridge and compaction of the overlying sediments into an anticlinal type structure. There is also some evidence of faulting and flexures which indicate a strike-slip fault in the pre-Cambrian rocks, thus giving rise to the theory of a fault zone of weakness in the basement complex that has been reactivated at various times since the pre-Cambrian.

The larger minor structures indicated by anomalies on the structural contour map are noses, small domes, small basins, and monoclines. These are characteristic of the Plains type of folding. The closure on the domes is approximately 5 feet. The noses have a plunge at approximately a right angle to the strike of the beds. The amount of plunge is about 10 feet per mile.

The minor structures are probably due to a combination of the following: differential compaction of sediments, reflections of buried hills and mountains, and faulting in the underlying beds and stratigraphic convergence.

The previously drilled test wells for oil in the area of investigation are indicated on the structural contour map and the majority of them are located on or near an anomaly in the structural contour map, Table 2 (Appendix).

If the trend of convergence in the underlying sediments is to the west, the noses in the surface structure could easily be anticlinal or dome shaped structures in the subsurface.

A careful study of the structural features exhibited on the structural contour map, indicated to this writer that the surface structure in this area is due to and controlled by the pre-Cambrian Nemaha ridge and the Abilene zone of flexures and faulting.

APPLICATION OF AERIAL PHOTOGRAPHS FOR STRUCTURAL MAPPING

The application of aerial photographs for structural mapping has made enormous advances since the early twenties. It is widely used for oil field reconnaissance work. Stuart Moir is the authority for this statement (12):

> From the Dallas, Texas, headquarters (of Fairchild Aerial, Inc.) aerial maps were prepared of more than 30,000 square miles for oil reconnaissance. The areas included many of the major producing fields, such as Yates Pool, Winkler, Luling-Mexia fault line and the

> Balcones fault line in Texas, and the entire East Texas Basin. Hobbs field in New Mexico was completely mapped as were many of the domes in the Gulf region of Louisiana and Texas.

In regard to the detail shown on the structural contour map, Plate IV, the anomalies which show on the map should be checked by a field party for a detailed local structure picture.

E. C. Markham, chief geologist of the Carter Oil Company, states (7):

> In exploration, we use aerial photographs to help us in locating new surface structures. Anomalies located by the study of aerial photographs are later checked in the field by the party recommending the anomaly or by some field party working in this division. If the surface geology is actually developed so the anomaly can be checked, of course leasing follows if the structure turns out to be favorable enough.

The method of using aerial photographs is, undoubtedly, one of the best and fastest in areas where there are accurate, preferably multiplex, topographic maps and resistant outcropping beds because a great area can be covered at little cost per mile and in a short period of time. Also, much of the larger geologic features can be obtained from aerial photographs that would have been overlooked on the ground. This is because the photogeologist can get a three dimensional view of a large area instead of a limited view of a small area on the ground. River meanders and faults, which may be overlooked easily on the ground, are recognized easily in the photographs. It should be remembered, however, that this is a reconnaissance method and that all data obtained should be field checked.

CONCLUSIONS

The result of this investigation is a regional structural map which shows the regional structural trends of the surface geology features in the southern one-half of the Junction City Quadrangle, which this writer believes are due to and controlled by the pre-Cambrian Nemaha ridge and the Abilene zone of flexures and faulting, both of which have been rejuvenated at various times since the pre-Cambrian.

This investigation also indicates the worthwhile applications of aerial photographs for a reconnaissance study in developing the structural geology of an area of resistant outcropping beds and determining possible oil producing structures.

ACKNOWLEDGMENT

The writer wishes to express his appreciation to Dr. J. R. Chelikowsky, Department of Geology and Geography, Kansas State College, for his sincere interest and advice in directing this investigation. Acknowledgment is also extended to Mr. E. C. Betz, Soil Conservation Service, Geary County, Kansas, for making available certain aerial photographs used in this research.

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APPENDIX

The photographs listed in Table 1 may be ordered from the U. S. D. A., P. M. A., Western Region Laboratory, Salt Lake City, Utah. The following information is needed:

Aerial Explorations, Inc., New York, N. Y.

Sheet 107 or 107

U. S. Department of Agriculture

Soil Conservation Service

Project 1 F, CU

Republican River Watershed

Location: Kansas, Nebraska, and Colorado

Table 1. Aerial photographs.

Taken 11-26-36		Taken 5-9-37	
CU 2-45	CU 2-61	CU 8-17	CU 8-36
46	62	18	37
47	63	19	
48	64	20	CU 8-47
49	65	21	48
50	66	22	49
51	67	23	
52	68	24	CU 8-56
53	69	25	57
54	70	26	58
55	71	27	59
56	72	28	60
57	73	29	61
58	74	30	
59	75		
	76		
	77		
	78		
	79		

The photographs listed in Table 1 may be ordered from the U. S. D. A., P. M. A., Western Region Laboratory, Salt Lake City, Utah. The following information is needed:

Aero Service Corp., Phil., Pa.

U. S. Department of Agriculture, Agriculture Adjustment Administrations

Contract no. U. S. D. A. 5529

Table 1 (cont.)

Geary County, Kansas			
Taken 4-22-39			Taken 5-15-39
ZE 90-63	ZE 91-100	ZE 91-7	ZE 93-34
64	101	8	35
	102	9	36
ZE 90-106	103	10	
	104	11	ZE 93-50
ZE 90-119	105	12	51
120		13	52
	ZE 91-115		53
ZE 90-128	116	ZE 91-45	54
129	117	46	55
130	118	47	56
131	119	48	
132	120	49	
133		50	
134	ZE 91-167		
	168	ZE 91-61	
ZE 90-161	169	62	
	170	63	
ZE 90-212	171	64	
213	172	65	
214	173	66	
215		67	
216			

Table 1 (cont.)

Riley County, Kansas			
Taken 4-22-39			Taken 5-15-39
ZA 91-12	ZA 91-87	ZA 90-144	ZA 93-41
13	88	145	42
14	89	146	43
15	90	147	44
16	91	148	45
17	92	149	46
18	93	150	47
19	94	151	48
20	95	152	49
21	96		50
22	97	ZA 90-153	
23			
24	ZA 91-120	ZA 90-182	
	121	183	
ZA 91-32	122	184	
33	123	185	
34	124	186	
35	125	187	
36	126	188	
37	127	189	
38	128		
39	129	ZA 90-190	
40			
41	ZA 91-173	ZA 90-199	
42	174	200	
43	175	201	
44	176	202	
	177	203	
ZA 91-67	178	204	
68		205	
69	ZA 90-78	206	
70	79	207	
71	80		
72		ZA 90-135	
73	ZA 90-88	136	
74	89	137	
75	90		
76	91		
77			
78			

Table 2. Test oil wells drilled in southern one-half of Junction City Quadrangle.

Company and farms	Location Sec., T., R.
Pawnee Oil and Gas Marks 1	NE SW NW 26-10-6E
F. J. Mosley et al. Thier 1	NW NE NW 20-10-7E
Coronado Oil Parks 1	C SE SE 16-10-8E
W. R. Wilson et al. Rannels 1	SE SW NW 4-11-8E
Brinkley et al. Fawley 1	NWc NE 16-10-5E
Wright et al. Younkin 1	CNL NE NW 17-11-5E
Kerby and Wright Kurtze 1	CNL SW SE 18-11-5E
Carter Oil Munson 1	NE NW NW 10-12-5E
Pioneer Petroleum Chase Ranch 1	SEc SE 10-12-7E
Schou and Teague Aye 1	NW SW NW 10-12-8E

A PHOTOGEOLOGIC STUDY OF THE REGIONAL STRUCTURAL GEOLOGY OF THE SOUTHERN ONE-HALF OF THE JUNCTION CITY QUADRANGLE

by

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The purpose of this investigation was to make a photogeologic study of the regional structural geology of the southern one-half of the Juntion City Quadrangle and to show the value of aerial photographs for reconnaissance in oil exploration work.

The data for the construction of the structural contour map were taken from 244 vertical aerial photographs and eight topographic (multiplex) maps of the area of this investigation. The spot locations of the points selected were transferred from the topographic maps to the base map and the elevations of the key beds marked. The key beds of the base map were then adjusted to the elevation of the Fort Riley rimrock by the use of the stratigraphic intervals measured or calculated. The map was then contoured in the usual manner.

Close examination of the structural contour map prepared revealed that the structure of the Fort Riley rimrock was primarily due to and controlled by the Nemaha ridge and the Abilene zone of flexures and faulting, which have been rejuvenated at various times since the pre-Cambrian. It was noted also that the test wells that have been previously drilled in this area in the majority of cases coincide with an anomaly in the structural map. This would indicate the value of photogeologic structural maps for reconnaissance for possible oil exploration.