THE GEOLOGY OF AN AREA OF APPROXIMATELY FIVE
SQUARE MILES WEST OF AUSTIN, TEXAS

Approved:

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Dean of the Graduate School.

THE GEOLOGY OF AN AREA OF APPROXIMATELY FIVE

SQUARE MILES WEST OF AUSTIN, TEXAS

THESIS

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By

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Preface

Free use of the literature has been made in the preparation of this paper, and due credit is given in each case.

To Dr. F. L. Whitney, who suggested the problem, the writer is greatly indebted and wishes to express his appreciation for much valuable advice and also for consultations in the field.

The writer is also very greatly indebted to Mr. Robert Coltharp of the Southwest Aerial Surveys, Incorporated, for the donation of the excellent aerial mosaic of the area, which simplified the mapping in large measure.

To Mr. J. B. Wheeler, the writer expresses his appreciation for assistance in mapping and for company in the field.

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MAPS

Geologic Map

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Introduction

The purpose of this paper was to map in as great detail as practical the area assigned. By using a photostat of a mosaic of aerial photographs as a base map, the area was mapped in much greater detail and corresponding accuracy than would have been possible with an ordinary map. The many advantages of an actual photograph over a map in locating points are self-evident. The photography for the mosaic was done in 1928, so the roads, buildings, etc. are much more up-to-date than the available topographic sheets of the area.

The area assigned was to extend from Colorado River on the south to approximately 29th Street on the north. The western boundary was the main fault of the Balcones system. The area extended eastward to the Eagle Ford-Austin contact.

A large part of the area under consideration was covered by Pleistocene river gravel, through which it was not always possible to follow contacts. The gravel is mapped and the formations immediately underlying it are indicated.

Table of Cretaceous Formations in the Austin Region

Gulf Series	Montana	Navarro
		Taylor
	Colorado	Austin*
		Eagle Ford*
Comanche Series	Washita	Buda*
		Del Rio*
		Georgetown*
	Fredericksburg	Edwards*
		Comanche Peak
		Walnut
	Trinity	Glen Rose*
		Travis Peak

*Only those starred occur in the area mapped.

COMANCHE SERIES

Trinity Division

Glen Rose Formation

Since the Glen Rose does not outcrop in the area under consideration, but on the upthrown side of the main fault of the Balcones, which formed the west boundary of the area, only a brief description of it will be given. This also applies to the Austin, the basal contact of which forms the eastern boundary.

As opposed to the underlying Travis Peak, the Glen Rose is predominantly a calcareous formation, consisting chiefly of chalky yellowish limestone strata alternating with marl or marly limestone, and weathering to typical "bench and terrace" topography.

The basal contact is gradational from the Travis Peak, while the upper contact with the Walnut formation is unconformable.

In the southeast part of Austin there was more than 800 feet of the Glen Rose.[1] The formation thickens eastward, and in the eastern part of Travis County, near Elroy more than 1066 feet of it was measured in a well.[2]

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[1] Sellards, E. H., Adkins, W. S., and Plummer, F. B., Geology of Texas, University of Texas Bulletin 3232, 1932, p. 317.

[2] Ibid.

It is interesting to mention here that at Mt. Bonnel nearly the lower one-half of the exposed section contains numerous Miliolidae, certain strata being almost wholly composed of them. This occurrence is not generally noted.

Fredericksburg Division

Edwards Formation

The Comanche Peak formation passes up without break into the harder and more persistent Edwards limestone. In general the two formations can be distinguished by the fact that while the Comanche Peak strata are less consolidated, are slightly argillaceous, and possess a more marly texture, the Edwards limestone is largely a firm, white, ringing limestone of great hardness and durability....Finally the Edwards limestone is distinguished from the Comanche Peak by the occurrence in it of great quantities of flint nodules and certain peculiar fossils--aberrant mollusks of the genera *Monopleura*, *Requienia*, and *Radiolites*.... The separation line must usually be drawn at the point of the lowest occurrence of flints and the rudistean and requienian forms which are so characteristic of the Edwards.[3]

The Edwards was laid down far from land as evidenced by the almost total absence of any land debris, and the presence of great numbers of animals as the rudistids, which lived in clear waters.

The limestones of the formation vary from extremely hard ones to soft, chalky layers that weather to the consistency

3 Hill, R. T., *Geography and Geology of the Black and Grand Prairies, Texas*, United States Geological Survey, Twenty-First Annual Report, 1901, Part 7, p. 227.

of commercial lime.[4] One such bed is well exposed just east of the two Edwards limestone quarries which are about one-half mile up the river from the Lake Austin Dam.

Two types of weathering are characteristic of the Edwards, the "honeycomb rock," and the "karrenfelder" or miniature drainage system type. The latter is usually observed in places where the Edwards is exposed in broad flat outcrops, as when it caps hills.

In the upper part of the formation, hard limestone strata alternate with white marl or marly limestone.

A complete section of the Edwards is not available near Austin, because west of the Balcones, where the formation caps hills, only the basal portion is represented; the rest having been eroded. East of the fault, but in the zone of minor faulting, the formation is so complicated that a complete section can not be obtained. East of this zone, the Edwards is totally covered, and is not easily discriminated in wells.

Hill,[5] however, in a composite section from the mouth of Bee Creek, the bluffs at Deep Eddy, and from Barton Creek gives a partial thickness of 234 feet and assumes that the

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[4] Hill, R. T., Geography and Geology of the Black and Grand Prairies, Texas, United States Geological Survey, Twenty-First Annual Report, 1901, Part 7, p. 228.

[5] Ibid., pp. 232-234.

formation is at least 300 feet thick. Eifler[6] measured an exposed thickness of 223 feet in this composite section.

Washita Division

Georgetown Formation

The base of the Georgetown as exposed at Austin is a very hard, dense, crystalline, bluish limestone, which is hard to differentiate lithologically from the underlying Edwards. The Georgetown is somewhat more sandy, and less regularly bedded than the Edwards, but fossils must be relied upon for distinction between the two. At the top of the Edwards is an agglomerate called the Austin marble because it is composed chiefly of Toucasia and other shells in a matrix of crystalline limestone.

Fossils are by no means abundant in the Duck Creek equivalent, or basal Georgetown, at Austin. Neithea subalpina (Boese) and Kingena wacoensis (Roemer) occur sparingly. Other fossils found in the Duck Creek are:

Hamites comanchensis Adkins and Winton
Hamites nokonis Adkins and Winton
Hamites fremonti Marcou
Desmoceras brazoense (Shumard)
Inoceramus comancheanus Cragin
Schloenbachia trinodosa Boese
Scaphites worthensis Winton and Adkins

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[6] Eifler, G. K., The Edwards Formation in the Balcones Fault Zone. Thesis Manuscript, The University of Texas, 1930, p. 34

As a whole the Georgetown consists of more or less of alternating beds of hard impure white limestone and beds of marls or marly clays. Before exposure and weathering the limestone is hard and has a blue color, but after weathering it is yellowish white, some parts becoming nodular.[7]

The hill on State Street just back of the Camp Mabry rifle range is composed of Georgetown, which is about 79 feet thick. Cuyler[8] states that it is hard to say that any one section would hold as to thickness in the Austin region because the marl beds are localized and lens-like in occurrence.

From below upward the formation consists of 13 feet of rather soft, chalky limestone. Then follows 33 feet of alternating beds of yellowish hard and soft material, followed by a bed of reddish or yellow calcareous shale about 4 feet thick, then about 9 feet of hard marly material, which is yellow after exposure. Cuyler further states that the top at Austin is marked by a hard massive blue limestone which frequently caps hills.[9]

Del Rio Formation

Hill[10] describes the Del Rio as follows:

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[7] Cuyler, R. H., Georgetown Formation of Central Texas and Its North Texas Equivalents, American Association of Petroleum Geologists, 1929, Vol. 13, p. 1292.

[8] Ibid.

[9] Ibid., p. 1293.

[10] Hill, R. T., Geography and Geology of the Black and Grand Prairies, Texas, United States Geological Survey, Twenty-first Annual Report, 1901, Part 7, p. 284.

The formation is composed almost entirely of a peculiar greenish-blue, unctuous, laminated clay, gypsiferous in places, but apparently freer from carbonaceous matter such as characterizes the Denison beds of the northern section. When freshly exposed these clays are of a light bluish gray in color. They lose their original character very rapidly upon exposure, becoming dull yellow and making a black soil.

The clay contains iron pyrites in places. When the clay disintegrates these particles of pyrites oxidize and decompose, and the iron rust gives the dry surface of the clay beds a dull yellowish color. At the same time the sulphur component of the pyrites combines with the lime of the fossil shells and forms gypsum. Crystals of selenite from this source occur in abundance on the surface and are disseminated in the clay and in joints and small fissures at a certain stage in the disintegration of the clay into soil. Laminations also show in the clay on freshly weathered surfaces.

The chief and most readily distinguishable feature of the clay whereby it may always be easily identified is the presence in enormous quantities of the unique and easily recognizable fossil known as Exogyra arietina.

Near the top of the formation, and in the base of the overlying Buda limestone, Gryphaea mucronata occurs in abundance, sometimes forming a shell agglomerate at the contact.

As recorded by Hill[11] and others the thickness of the Del Rio at Austin is approximately 80 feet. On the road leading from State Street to Miss Huck's house, just east of Mt. Bonnel, Wheeler and the author measured 60 feet of Del Rio. The thinness of this section is probably explained by slumping of the Buda.

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[11] Hill, R. T., Geography and Geology of the Black and Grand Prairies, Texas, United States Geological Survey, Twenty-First Annual Report, 1901, Part 7, p. 284.

Buda Formation

Probably the most conspicuous feature of the Buda is its pinkish, "burnt rock" appearance. Hill[12] suggests that this is due to the oxidation of glauconite in the limestone.

Approximately the lower half of the Buda is, on fresh exposure, lighter in color than the upper portion, and is much softer; weathering back so that the upper part slightly overhangs it. The lower part is rather nodular, while the upper part is more evenly bedded and massive. The layers vary in thickness from one foot up to six feet.

The limestone is yellowish on fresh fracture, with many small pinkish spots. On weathering it turns a yellowish to pinkish buff. The Buda usually outcrops as bluffs, capping Del Rio slopes over which blocks of the limestone slump. Due to this slumping, it is rather hard exactly to locate the contact in some places.

The thickness of the formation at Austin is generally given as about 45 feet. In wells in Travis County the thickness is reported as being from 25 to 54 feet.[13] On Shoal Creek just southeast of the Austin Memorial Park, Wheeler

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[12] Hill, R. T., Geography and Geology of the Black and Grand Prairies, Texas, United States Geological Survey, Twenty-First Annual Report, 1901, Part 7, p. 289.

[13] Sellards, E. H., Adkins, W. S., and Plummer, F. B., The Geology of Texas, University of Texas Bulletin 3232, 1932, p. 398.

and the writer measured about 30 feet. The basal 11 feet of this section consisted of soft, nodular, light gray limestone, weathering yellowish buff. The upper portion was composed of harder, more resistant strata, weathering yellowish to pinkish buff.

GULF SERIES

Colorado Division

Eagle Ford Formation

On Bouldin Creek south of Austin, the Eagle Ford has about eleven feet of black, fissile shale at the base, followed by about eight feet of alternating flagstones and gray shale, with various layers of bentonite; this layer is followed in turn by about twenty-one feet of bluish, gray, splintery shale (see section on page 9).

Adkins[14] reports fifteen feet of black shale at the base of the Eagle Ford as exposed in a cut made at 19th and Nueces Streets in October, 1930. Dr. F. L. Whitney[15] says that under his house, on the west bank of Shoal Creek, just below the 29th Street bridge, there is a dark jointed clay and shale at the base of the Eagle Ford. Whether this would weather to the fissile, paper shale as exhibited on Bouldin Creek is not known. Just above the 34th Street bridge over Shoal Creek,

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[14] Sellards, E. H., Adkins, W. S., and Plummer, F. B., The Geology of Texas, University of Texas Bulletin 3232, 1932, p. 431.

[15] Whitney, Dr. F. L., Personal communication.

the basal black shale is apparently missing, but this may be due to slumping. North of Austin at Watter's Park the black fissile shale is again evident at the base of the formation (see section on page 10).

The Eagle Ford lies unconformably on the Buda and the Austin chalk in turn rests with unconformity upon the Eagle Ford.

In Travis County the formation is 42 to 47 feet in thickness at the outcrop.[16]

Durham[17] gives the following section of the Eagle Ford on Bouldin Creek, one-half mile south of the railroad bridge over the Colorado.

	Ft.	In.
Austin chalk		
Eagle Ford		
3. Bluish gray splintery shale, very thin laminae, layers of pyrite, or marcasite nodules in the upper part about seven feet below the base of the Austin Chalk.	21	6
2. Flagstones--thin calcareous limestones alternating with layers of gray shale. Bentonite layers (seven in number), largest about 6" thick, the smallest about one-fourth inch. Flags on weathering have brownish color, but on fresh exposure are blue black. Become increasingly more argillaceous near the upper third of the formation. Fish remains, phosphate nodules, fossil ice crystals imprints.	8	4
1. Bluish black fissile shale containing hard sandy calcareous concretions, sponge spicules.	11	8
	41	6
Buda		

[16] Sellards, E. H., Adkins, W. S., and Plummer, F. B., _The Geology of Texas_, University of Texas Bulletin 3232, 1932, p. 431.

[17] Durham, C. A., _The Stratigraphy of the Eagle Ford Formation from the Red River Southward to Austin_, Thesis Manuscript, The University of Texas, 1931, p. 13.

Section one-fourth mile south of Watter's Park, Travis County, on Walnut Creek. Taken from Durham.[18]

	Ft.	In.
Austin chalk		
Contact covered		
Eagle Ford		
3. Black fissile shale with thin flagstone partings--upper part covered.	20	0
2. Sandy calcareous flagstones alternating with shale partings and bentonite seams varying from seven inches on down. First flag is very sandy and contains seams of fish scales, phosphate nodules and teeth. Shale partings weather to light bluish gray. On fresh exposure, bluish black and looks bituminous. Very thinly laminated and very splintery.	15	0
1. Black fissile shale. Lower portion not exposed.	3	0
	38	0

Austin Formation

At the type locality the lower two-thirds of the Austin consists of irregular strata of variable thickness, from thin-bedded to massive, and with often indefinite limits, generally alternately harder and softer. They are composed of a gray-white chalky limestone in the harder layers, and a dark blue or blackish marly limestone or limey marl weathering dead white or light gray, and in texture unevenly flaky or laminated. A few of the limestones are indurated, some are shelly. Some contain much debris of oysters, inocerami and other shells. At certain levels considerable glauconite, dispersed as small specks, occurs; the formation contains imbedded balls,

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18 Durham, C. A., The Stratigraphy of the Eagle Ford Formation from the Red River Southward to Austin, Thesis Manuscript, The University of Texas, 1931, p. 14.

> cylinders and irregular botryoidal masses of pyrite with radiating internal structure; and locally veins, seams and joint cracks filled with calcite.... The upper part of the formation has considerable calcareous marl, in beds up to 30 feet thick, and some very shelly marl with *Exogyra*, generally in beds 5 feet or less thick. Such a marl in northern Travis County seems to be characterized by the presence of *Exogyra tigrina* Stephenson, and "*Ostrea*" *centerensis* Stephenson, and contains other species.[19]

The Austin finally weathers to the black residual soil of the typical "Black Prairie," with gently rolling topography.

According to Adkins,[20] the formation is 420 feet thick in Travis County.

Structure

While the regional dip is very gentle to the southeast, within the area mapped this dip is by no means constant, either as to direction or amount. Due to drag on faults, which are numerous, the amount and direction of dip has been changed locally.

Upstream from the Austin Dam the Edwards dips northward at an angle of about five degrees.

Small normal faults with vertical displacements up to about fifty feet are exceedingly numerous in this region.

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[19] Sellards, E. H., Adkins, W. S., and Plummer, F. B., *The Geology of Texas*, University of Texas Bulletin 3232, 1932, p. 445.

[20] *Ibid*.

In most instances it was found practical to map only those which were inter-formational.

There are several minor gentle folds within the area. In the railroad cut one block north of West Sixth Street, a small faulted anticline is exposed in the Georgetown limestone. About two blocks south of this place a small gentle syncline in the Georgetown is exhibited by a road cut about 100 yards east of the railroad underpass. At the top of the Lake Austin Boat Club bluff there is a small anticline in the Edwards limestone just east of the road.

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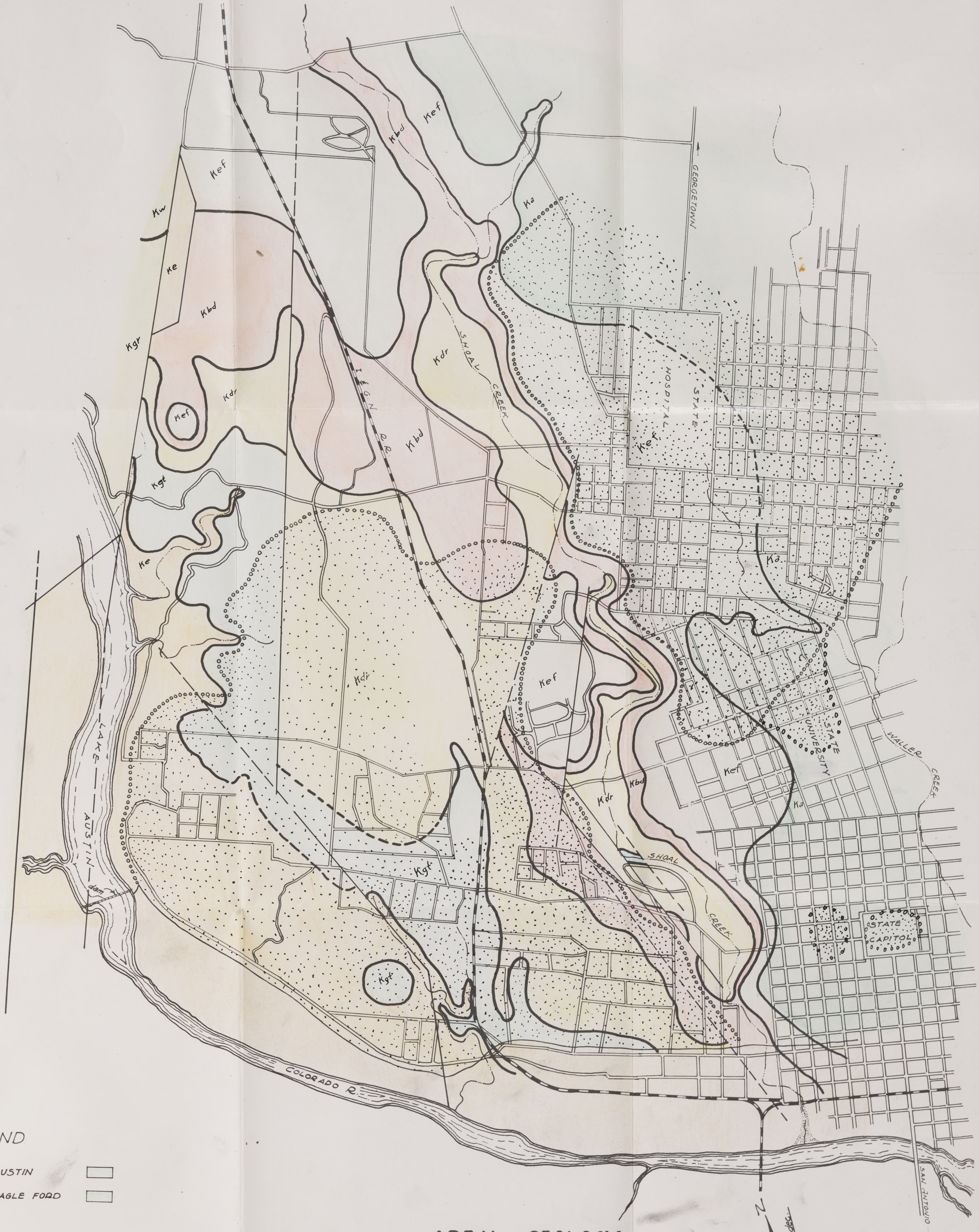
AERIAL VIEW
OF
WESTERN PORTION
OF
AUSTIN TEXAS

COURTESY OF
SOUTHWEST AERIAL SURVEY - INC.
AUSTIN, TEX.



AREAL GEOLOGY
WEST OF AUSTIN TEXAS

SCALE = 1/16800