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**Bureau of Economic Geology
and Technology**
J. A. Udden, Director

**ANNUAL REPORT FOR THE YEAR
ENDING DECEMBER 31, 1915**

PREPARED BY
MISS M. E. STILES, Secretary

GEOLOGICAL MAPS IN TEXAS

BY
J. A. UDDEN



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The benefits of education and of useful knowledge, generally diffused through a community, are essential to the preservation of a free government.

Sam Houston.

Cultivated mind is the guardian genius of democracy. . . . It is the only dictator that freemen acknowledge and the only security that freemen desire.

Mirabeau B. Lamar.

CONTENTS.

ANNUAL REPORT FOR THE YEAR ENDING DECEMBER 31, 1915.

	PAGE.
History	5
Work during the year of 1915.....	7
Field work	7
Consulting work	9
Laboratory work	9
Tests made in Engineering Laboratory.....	10
Analyses made in the Chemistry Laboratory.....	11
Determinations in the Geological Laboratory.....	11
Office work	12
Museum	15
Work in progress	15

GEOLOGICAL MAPS IN TEXAS.

Contents.

Detailed mapping	17
Reconnaissance mapping	17
Exploratory mapping	18
Part of state not mapped.....	19
Table showing number of square miles in Texas which have been geologically mapped in detail, by reconnaissance, and by exploratory surveys	20

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ANNUAL REPORT FOR THE YEAR ENDING DECEMBER 31, 1915.

PREPARED BY MISS M. E. STILES, SECRETARY.

HISTORY.

The Bureau of Economic Geology and Technology was established by the Board of Regents of the University of Texas in September, 1909.

Subsequent to the old Texas Geological Survey, whose term of service dated from 1888 to 1892, there had been undertaken the University of Texas Mineral Survey. This was established in 1901, but was supported for only four years. For some time after the dissolution of this organization in 1905, no movement was made to aid, by similar undertakings, the growth of the State, and it was with the hope of supplying the great need for some means of investigating and placing before the people the varied mineral resources of Texas, that the Board of Regents inaugurated the present Bureau.

Dr. Wm. B. Phillips, whose interest and activity as director of the University of Texas Mineral Survey had made him familiar with the resources of the State, was appointed to direct the new organization. The laboratory of the Bureau was opened in September, 1910, under the charge of Mr. S. H. Worrell as chemist; and in September, 1911, Dr. J. A. Udden was appointed geologist.

The demands made upon the Bureau for information on a wide variety of materials, and the work entailed by an arrangement made with the State Purchasing Agent to analyze the fuels furnished the State, soon necessitated the employment of another chemist in the laboratory, and in January, 1913, Mr. J. E. Stullken was appointed to this position. In the summer of 1914 Mr. Worrell resigned his charge of the laboratory to become Dean of the State School of Mines at El Paso, and Mr. E. L. Porch, Jr., was appointed assistant chemist.

At about this time it was decided that some step should be taken to meet the demand for technical information on the

nature and availability of road-building materials in this State. To this end, Mr. James P. Nash, of the United States Office of Public Roads, was engaged as testing engineer, to equip and take charge of a road materials testing laboratory. This work was begun in September, 1914.

At the same time, in order to take care of the increasing geological work of the Bureau, Mr. C. L. Baker was appointed assistant geologist, and Mr. W. F. Bowman was engaged as field assistant.

In June, 1915, Dr. Emil Böse, then head geologist of the Mexican Geological Survey, was engaged to take care of some of the consulting work which had been demanded of the Bureau.

In August, 1915, Dr. Wm. B. Phillips resigned from the Bureau to become president of the Colorado School of Mines, and Dr. J. A. Udden took charge of the work as acting director. At the meeting of the Board of Regents in the following October he was appointed director of the Bureau. It was decided at this meeting to somewhat extend the functions of the Bureau and to affiliate it more closely with other technological departments of the University. This was done by appointing separate heads for the divisions of Geology, Engineering and Chemistry; Dr. J. A. Udden, Prof. F. E. Giesecke, and Dr. E. P. Schoch being assigned to these respective duties. Professors J. M. Bryant, S. P. Finch and H. C. Weaver were appointed research associates in the engineering division, and Dr. Emil Böse was appointed a geologist.

The present staff of the Bureau is as below:

Director, J. A. Udden.

Secretary, M. E. Stiles.

Head of Division of Economic Geology, J. A. Udden.

Geologist, Chas. L. Baker.

Geologist, Emil Böse.

Assistant Geologist, E. L. Porch, Jr.

Head of Division of Engineering, F. E. Giesecke.

Testing Engineer, Jas. P. Nash.

Research Associates, J. M. Bryant, S. P. Finch, H. C. Weaver.

Head of Division of Chemistry, E. P. Schoch.

Chemist, J. E. Stullken.

Chemist, W. T. Read.

WORK DURING THE YEAR OF 1915.

With the resignation of Dr. Wm. B. Phillips, the Bureau lost the able and experienced judgment of its first administrator; but the orderly and systematic arrangement of the Bureau's affairs, perfected under his management, enabled his successor to take up the administrative duties at once, and continue without perceptible interruption the work planned for the year.

In the pages that follow it is attempted to give to those interested in the activities of the Bureau some idea of the work done during 1915, the objects for which it was undertaken, and the results attained.

Field Work.

The first work of the year was the investigation made by Dr. Udden of the potash prospects in the Panhandle of Texas. This was undertaken as a complement to the study previously made of the deep boring at Spur. The field examinations in this case were confined principally to Potter and Randall counties, but well records and data were collected from Childress, Dickens, Upton, Reeves, Garza, Scurry, and other counties. All these data were carefully studied, and the results of the observations made were set forth in a paper on "Potash in the Texas Permian," published as Bulletin 17, March 20, 1915.

About the middle of May, Prof. Baker was detailed to make a reconnaissance survey of an area in West Texas comprising parts of Brewster, Presidio, Jeff Davis, Culberson and Reeves counties. Mr. W. F. Bowman accompanied Prof. Baker as assistant in this work. This survey was for the purpose of making a map of the area mentioned, for use on the general geological map now in course of preparation. Early in September, Dr. Böse relieved Mr. Baker for his vacation, and continued, together with Mr. Bowman, the work in that part of the State, measuring with some accuracy a section of the Permo-Carboniferous and the Permian rocks in the Gilliam canyon of the Glass Mountains. Prof. Baker and Dr. Böse together spent a week on a study of the Rustler Springs formation and the Castile Gypsum, and incidentally made a small collection of fossils from these forma-

tions. It was the desire of the Bureau to secure definite proof of the age of these formations. The results show conclusively that they belong to the Permian, and thus corroborate the tentative determination made by Mr. G. B. Richardson some years ago for the United States Geological Survey.

The return trip at the close of this field work, in November, was made overland with the camping outfit. Dr. Böse utilized this opportunity to acquaint himself more thoroughly with the general geology of the Edwards Plateau, while Mr. Bowman was engaged in collecting and forwarding samples of road materials for testing in the laboratory. These samples represented practically every economically available gravel and sand pit or stone quarry along the route, which passed through Pecos, Crockett, Sutton, Kimble, Gillespie and Blanco counties. The return occupied about two weeks' time.

In addition to the material collected on this trip, other road materials were collected by Mr. G. A. Parkinson, roads laboratory assistant, on several visits which he made to sections where particular interest in road matters was shown on the part of the public. All commercially valuable deposits of road materials found within considerable distances around such localities were sampled for testing. These trips included Denton, Dallas, Wood, Harrison, Rusk, Anderson, Llano and Burnet counties.

Early in the summer a field party was sent out to the Thrall oil field, in Williamson county, under the direction of Dr. Udden. The field was carefully surveyed and topographically mapped by Mr. W. D. Dockery and Mr. H. E. Gatlin. Numerous well samples were taken, and the collections were studied in detail. It was discovered that most of the oil in this field comes from a body of serpentine, or a highly altered basic volcanic rock. It is the alteration product of a submarine volcanic eruption, which was contemporaneous with the deposits in which it is now imbedded. This is a condition so unique that later in the season Dr. H. P. Bybee was engaged to secure further data on the field. A study is being made with special reference to the nature and extent of the oil-bearing rocks there.

Consulting Work.

The almost State-wide interest in oil discoveries during 1915 resulted in a great number of requests for reports by the Bureau on tracts of land in all parts of Texas. The financial resources of the Bureau could not be stretched to admit of attending to all these demands. The number of citizens and groups of citizens who desire to have the services of geologists in the search for oil, gas, and water, and to secure various other information is too large to be attended to by the regular staff of the Bureau, and it is necessary to refer applicants for such service to private professional geologists. Dr. Emil Böse, formerly head geologist of the Mexican Geological Survey, was engaged to help with some work of this kind in June. He went at once to Guadalupe county for a brief examination, and then spent the months of July and August in Wise county, examining a large area there. Upon his return from regular field work in West Texas, in November, he reported also on some lands in Anderson county.

During the year Dr. Udden made brief visits to Milam, Washington, Falls, Llano, El Paso, Tom Green, Nolan and Bexar counties, and Prof. Baker examined some lignite and oil prospects in Lampasas, Bastrop and Colorado counties.

It is hoped that in the future the work of the Bureau can be confined more exclusively to the regular duties assigned to the members of the force. It is true that the number of good consulting geologists in this State is yet small; that many of them are in permanent employ of large companies; and that it is often difficult for the general public to procure the needed service of competent geologists. The Bureau gladly recommends reliable professional men, whenever called upon to do so. Meanwhile, its principal energies must be directed to such general geological work as is indispensable for the first steps in the intelligent development of any of our mineral resources by our citizens at large.

Laboratory Work.

The work demanded of the road materials and general testing laboratory has been unceasing throughout the year. At times it was found necessary to run an extra night shift in order

to keep up, in some measure, with the samples awaiting attention. In addition to samples sent in by interested parties, covering a wide range of materials, there have been secured by our collector, Mr. Parkinson, and by Dr. Böse and Mr. Bowman on their trip from West Texas, samples of clays, sands, gravels, stones, and conglomerates from the counties of Pecos, Crockett, Sutton, Kimble, Gillespie, Blanco, Denton, Dallas, Wood, Harrison, Rusk, Anderson, Llano, Hays, Travis and Burnet.

In September, it was decided to undertake an investigation of the suitability of various Texas materials for concrete aggregate. To that end, samples were requested from every known producer of sand, stone or gravel in the State. The amount required for such tests as were proposed was 500 pounds of crushed stone or 600 pounds of sand or gravel. The response to our requests was gratifyingly prompt and general. This work is now well under way, and a number of the tests have been completed.

The work done in the engineering laboratory during the year may be roughly tabulated as below:

Tests Made in the Engineering Laboratory, 1915.

Material	Number of samples tested
Gravel	170
Limestone	*148
Concrete	58
Cement	49
Steel	35
Sand	29
Conglomerate	12
Dolomite	*12
Clay	*12
Granite	*12
Sandstone	*9
Brick	6
Marble	5
Tile	4
Traprock	4
Adobe	2
Miscellaneous	18
	<hr/>
	585

*Chemical analyses also were made on these samples.

The work of the chemical laboratory has been to some extent co-operative with the testing laboratory, as many of the stones and clays tested there were also chemically analyzed and reported under the same file number. Many oil analyses have been called for by drillers and well owners, as well as by the State Purchasing Agent. An unusual number of waters, earths, etc., has been sent in to be tested for potash. A roughly classified table of the analyses made is given below:

Analyses Made in the Chemical Laboratory, 1915.*

Material	Number of samples analyzed
Oil	123
Potash	68
Coal	20
Water	17
Lignite	12
Fuller's earth	12
Tungsten	7
Bituminous material.....	6
Gas	6
Serpentine	5
Greensand	5
Garbage briquettes	5
Shale	5
Lime	4
Adobe	2
Miscellaneous	15

312

*This table does not include analyses made on roads laboratory samples.

Determinations made in the Geological Laboratory.

The work done in the geological laboratory in the identification of materials of all sorts is not recorded under the analysis number system applied to the work of the engineering and chemical laboratories, and for that reason cannot well be tabulated. This work consists largely of the examination of cuttings from wells, classification of fossils, and identification of a variety of rocks and minerals daily received from correspondents from all parts of the State.

It is our aim to make this work in the examination of speci-

mens an aid to all the citizens of the State. Any sample of mineral from this state, if sent to us plainly labelled with a statement of the locality from which it was taken, and the name and address of the sender, is promptly reported on, without charge. In the majority of cases, such a visual examination is all that is necessary to determine the nature of the material and its probable value. Many samples, sent in with a request for assay, are not considered worth so detailed an examination. In such cases we have been accustomed to report the results of a visual examination and to refer the sender to some commercial assayer. In future, however, we will be equipped for making assays in the Chemistry Division of our Bureau, and in cases where material sent in seems to warrant an assay, we will so notify the sender, and state our charge for the test.

Office Work.

The bulletins published during 1915 entailed a large amount of office work upon the authors as well as on the office force. Dr. Udden was occupied during the first months with the preparation of Bulletin 17. Dr. Phillips' bulletin, No. 365, "The Mineral Resources of Texas," was sent to press shortly after No. 17 was issued. Mr. Baker spent the early months in the preparation of his report on "The Geology and Underground Waters of the Northern Llano Estacado," Bulletin No. 57; and Mr. Nash completed the manuscript for his bulletin, No. 62, on "The Road Materials of Texas," early in the fall. Bulletin No. 17, "Potash in the Texas Permian," issued from the press early in May; Bulletin No. 365 was much delayed in press and was not delivered until the latter part of August; Bulletins Nos. 57 and 62 were sent to press early in October and November, respectively, and were issued during the latter part of January of the following year. The preparation of these manuscripts, the proof-reading, revision, and other details, constituted a large part of the clerical work of the office during the year.

Much time has also been spent on the preparation of data for a general review of the geology of the State and on the drafting of a geological map of the State, which the Bureau hopes to issue during the current year. The base for this map is now nearing completion.

There was also prepared in the office, during the latter part of June and early July, a map of the Thrall oil field, giving the names and locations of all borings to that date, and ownership of lands. This was blue-printed in order to have it quickly available for distribution.

A review of the correspondence for the year gives some idea of the great variety of matters on which the Bureau is addressed. Early in 1915, the letters received regarding publications of the former geological surveys, our own bulletins, and printed matter of all sorts on all kinds of subjects, had accumulated in such number that they have since been discarded upon being replied to, except in unusual instances. No attempt is made to give any indication of the extent of this correspondence in the following table, but it may conservatively be reckoned as about one-third of the entire correspondence.

The classification of the correspondence is roughly as follows:

Administrative and unclassified correspondence.....	600
Road materials	594
Petroleum and natural gas.....	576
Petroleum	357
Examination of drill cuttings.....	125
Oil analyses	40
Well drilling and well logs.....	32
Natural gas	19
Earth mounds	2
Salt domes	1
Industrial and structural materials.....	573
Potash	172
Water supply and water analyses.....	50
Clay	40
Kaolin	32
Sulphur	24
Cement	23
Concrete	23
Fuller's earth	23
Brick	23
Limestone	20
Asphalt	17
Building stone, generally.....	15
Glass sand and other sand.....	13
Phosphate	11
Marble	9
Radio-active minerals	8
Calcite	7
Lime	7

Celestite	7
Fertilizers	6
Salt	6
Volcanic dust	5
Bituminous sandstone	4
Flint and flint pebbles	3
Dolomite	2
Granite	2
Jet	2
Magnesite	2
Mica	2
Mineral paint	2
Nitrates	5
Pearls	2
Quartz	2
Gravel	1
Graphite	1
Greensand	1
Lithographic stone	1
Ochre	1
 Ores, minerals and metal mining.....	 561
Identification of minerals.....	241
Lead ore	66
Zinc ore	54
Iron ore	35
Assays	32
Mining	26
Molybdenum	26
Tungsten	26
Mining laws	16
Quicksilver	12
Manganese	10
Platinum	5
Copper	5
Minerals in general.....	3
Ores in general.....	3
Silver	1
 Coal and lignite.....	 155
Coal	90
Lignite	65
Miscellaneous matters	150
Geology of Texas, in general.....	81
Meteorites	26
Map of Texas.....	14
Garbage briquetting	10
Soils analyses	10
Medicinal herbs	5
Steel tests	4

Report of Bureau of Economic Geology and Technology 15

The division of this correspondence among the three branches of the Bureau is about as follows:

Division of Economic Geology.....	2,126
Division of Engineering.....	745
Division of Chemistry.....	189
Business matters of the office.....	352*

3,412

*Exclusive of correspondence regarding publications.

Of these communications, 650 have come from correspondents out of the State, and 2,762 from Texas. The distribution of the State correspondence, by counties, is roughly shown on accompanying map (Plate 1).

Although the more general interest in geologic and economic matters was evidenced by the central and north central counties, it will be noted that some of the heaviest correspondence has been from the western counties. This is on account of the interest in the prospecting for minerals in the Quitman and Eagle Mountains and the active interest in mineral development of that entire region.

Museum.

The museum of the Bureau has been enlarged during the year by the addition of specimens of gravels, sands, stones, clays, and conglomerates representing the road materials of the State which have been tested in the laboratory. These are exhibited in special cases for reference in conjunction with the physical and chemical tests on file in the office. There have also been added two collections of rocks and fossils incidentally obtained in connection with the field work of the Bureau in the western part of the State.

Work in Progress.

Work which is already under way, but not yet completed, comprises a report and a general map covering the geology of Texas, by Dr. Udden, Prof. Baker and Dr. Böse; a report on the Thrall oil field, by Dr. Udden and Prof. Bybee; a report on some deep borings in the State, by Dr. Udden; a report on the geology of Glass Mountains, by Drs. Udden and Böse; a report

on the geology of certain parts of West Texas, by Prof. Baker; descriptions of some Permian fossils, by Dr. Böse; a geological report on Hays and Comal counties, by Prof. F. L. Whitney; and a report on lime and cement by Prof. D. J. Jones.

GEOLOGICAL MAPS IN TEXAS.

BY J. A. UDDEN.

Detailed Mapping

The State of Texas has an area of 265,780 square miles. Only a very small part of this area has been mapped with sufficient detail to be of real local economic value. About 7,188 square miles have been thus mapped by the United States Geological Survey, and about 3,424 square miles by the old Texas Geological Survey. This makes about 10,600 square miles, in all, mapped in detail; or about one-twenty-fifth part of the entire area of the State. The location of these fairly satisfactorily mapped areas is indicated on the accompanying map (Plate 2) and specified in the following table.

Reconnaissance Mapping.

Most of the geological mapping so far done may be characterized as reconnaissance mapping. The Geological Survey of Texas mapped some 15,220 square miles, mostly in the central part of the State. In these maps, especially in the map made by N. F. Drake, many details appear, but the area covered necessitated the adoption of small scale maps. The same may be said about eight maps published by the United States Geological Survey, covering areas varying from 3,700 to 32,600 square miles. Some of these maps overlap each other, and also overlap regions worked by the Geological Survey of Texas. In part they are reproductions of the maps previously published, and modified so as to serve the purpose of various reports on special subjects or areas. In all this work it has been necessary to cover large areas in brief field seasons. For the time given to the work, the results obtained in this mapping must be considered very creditable to the surveys and individuals who did the work, but the maps are altogether inadequate for economic and practical purposes. Minor structures such as those usually involved in the accumulation of oil or gas, have necessarily been almost entirely neglected. At the time most of these maps were made, very little

underground information from well records was available. The maps and sections and the descriptions in the accompanying texts represent mainly the conditions as seen in the outcrops examined, but the information given in these publications regarding the physical nature of the underlying beds is necessarily quite limited and scattered. Economic matters are discussed, but the treatment is often limited to some single subject, such as water or coal. The total area covered by these reconnaissance maps is some 112,887 square miles; considerably less than one-half the total area of the State.

Exploratory Mapping.

Considerable exploratory mapping was done by the Geological Survey of Texas. The reconnaissance map of the Staked Plains, made by Cummins in 1891, covered 27,300 square miles, and the field work in this area was done in one season. Another map, made by Cummins, tentatively located the lines of outcrop of the Cisco and the Canyon coals and the east limit of the Permian in the north-central part of the State. A map made by Comstock of the Central Mineral Region was of this class. All of these were important advances of geological knowledge in their day.

We may class as exploratory surveys most of the work done in the west part of the State by the University of Texas Mineral Survey. This survey deserves the credit of having undertaken the greater part of its work in the most difficult part of the State. West Texas is mountainous, and the geologic structure is complicated, requiring much travel. It is largely a dry and in part inaccessible country, where all field work proceeds under great handicaps. The geological work done on these maps was by necessity confined to delineating general outlines only, and even these are not sufficiently clear in all localities. So far as economic subjects were concerned, very small contributions could be made by such general work. Valuable mineral deposits are strictly local phenomena, and require local, detailed treatment. The examination of these regions was necessarily limited to viewing the more conspicuous and supposedly most significant localities. The exploratory maps cover about 53,735 square miles, or less than one-fifth of the area of the State.

Part of the State Not Mapped.

Taken together, these three classes of maps cover an area of 178,413 square miles. There are thus 87,367 square miles, or nearly one-third of the area of the State, on which no reports have been published. During the last few years the Bureau of Economic Geology has made extensive observations in some of this territory for the purpose of sufficiently reconnoitering the ground to secure the data necessary for a preliminary general map of the State. Some of the unknown part of the State is also being mapped by the Federal Survey. These data will be incorporated in the general map and the general description of the geology of Texas, now in preparation by this Bureau.

Considering the vast expanse of this State, and having in mind the unfortunate interruptions, during the past, in the work of various State organizations inaugurated for the study of Texas geology, the general progress made is by no means unimportant, even though the stage has not yet been reached where the best kind of economic work can be undertaken. The immediate need in this State is the surveying and mapping of each county in sufficient thoroughness and detail to ascertain the economic resources of each such unit. There now are 252 counties in Texas. Some of these are of large size. If ten counties could be finished in each season, it would take 25 years to complete the areal work needed, before an adequate economic investigation of the whole State could be undertaken to the best advantage.

Table showing the number of square miles in Texas which have been geologically mapped in detail, by reconnaissance, and by exploratory surveys.

Areas covered by detailed maps.

	Area in sq. miles
Maps published by the U. S. Geological Survey:	
Nueces Folio, by Hill and Vaughan, 1898.....	1,035
Uvalde Folio, by Vaughan, 1900.....	1,040
Austin Folio, by Hill and Vaughan, 1902.....	1,030
El Paso Folio, by Richardson, 1909.....	1,014
Llano-Burnet Folio, by Sidney Paige, 1912.....	2,050
Van Horn Folio, by Richardson, 1914.....	1,019

Maps published by the Texas Geological Survey:	
Houston County, by Kennedy, 1891.....	1,231
Grimes, Brazos and Robertson Counties, by Kennedy, 1892....	2,193

Total area covered by detailed maps..... 10,612

Areas covered by reconnaissance maps.

Maps published by the Geological Survey of Texas:	
Map of the Cretaceous area north of the Colorado River (south part), by J. A. Taff and S. Leverett, 1892....	2,630
Map of the Colorado Coal Field, by N. F. Drake and assistants, 1892	4,000
Map of the Cretaceous area north of the Colorado River (north part), by J. A. Taff and S. Leverett, 1892....	8,590

Maps published by the U. S. Geological Survey:	
Map of the Black and Grand Prairies of Texas, by R. T. Hill, 1898, (not including territory mapped by Taft and Leverett)	32,600
Map of Northeast Texas, by C. H. Gordon, 1911 (not including area previously mapped by Hill in 1899).....	3,699
Map of a portion of the Gulf Coastal Plain, by Wm. Kennedy, 1903 (not including the territory previously mapped)	19,000
Map of the eastern portion of the Panhandle of Texas, by C. N. Gould, 1906.....	10,800
Map of the western portion of the Panhandle of Texas, by C. N. Gould, 1907.....	9,360
Map of portions of Louisiana, Texas and Arkansas, G. D. Harris, 1910 (not including areas previously mapped)	6,000
Sketch map of the Wichita region, by C. H. Gordon, 1913 (not including territory previously mapped).....	10,500
Map of Texas, east of the 97th meridian, by A. Deussen, 1914 (not including areas previously mapped).....	4,000
Geological map and section of LaSalle and McMullen counties, by A. Deussen	2,887

Total areas covered by reconnaissance maps..... 114,066

Report of Bureau of Economic Geology and Technology 21

Areas covered by exploratory maps.

Maps published by the Geological Survey of Texas:

Map of the central mineral region, by Theo. B. Comstock in 1890 (not including the areas subsequently mapped by the United States Geological Survey).....	1,300
Map of the coal-measures and Permian, by Cummins (in north-central Texas).....	4,679
Map of the Staked Plains and adjacent area, by W. F. Cummins and N. F. Drake, 1891.....	27,300

Maps published by the University of Texas Mineral Survey:

Maps of trans-Pecos Texas, north of the Texas and Pacific Railway, by G. B. Richardson, 1903.....	9,000
Map of the Shafter area, by J. A. Udden, 1904.....	456
Map of part of West Texas, south of the Southern Pacific Railroad, by B. F. Hill and J. A. Udden, 1904.....	8,000

Map published by Augustana College:

Map of the New York and Texas Land Company, Ltd., in the Upper Rio Grande embayment, by J. A. Udden, 1907...	3,000
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Total area covered by exploratory maps..... 53,735

Area not covered by any published geological maps..... 87,367

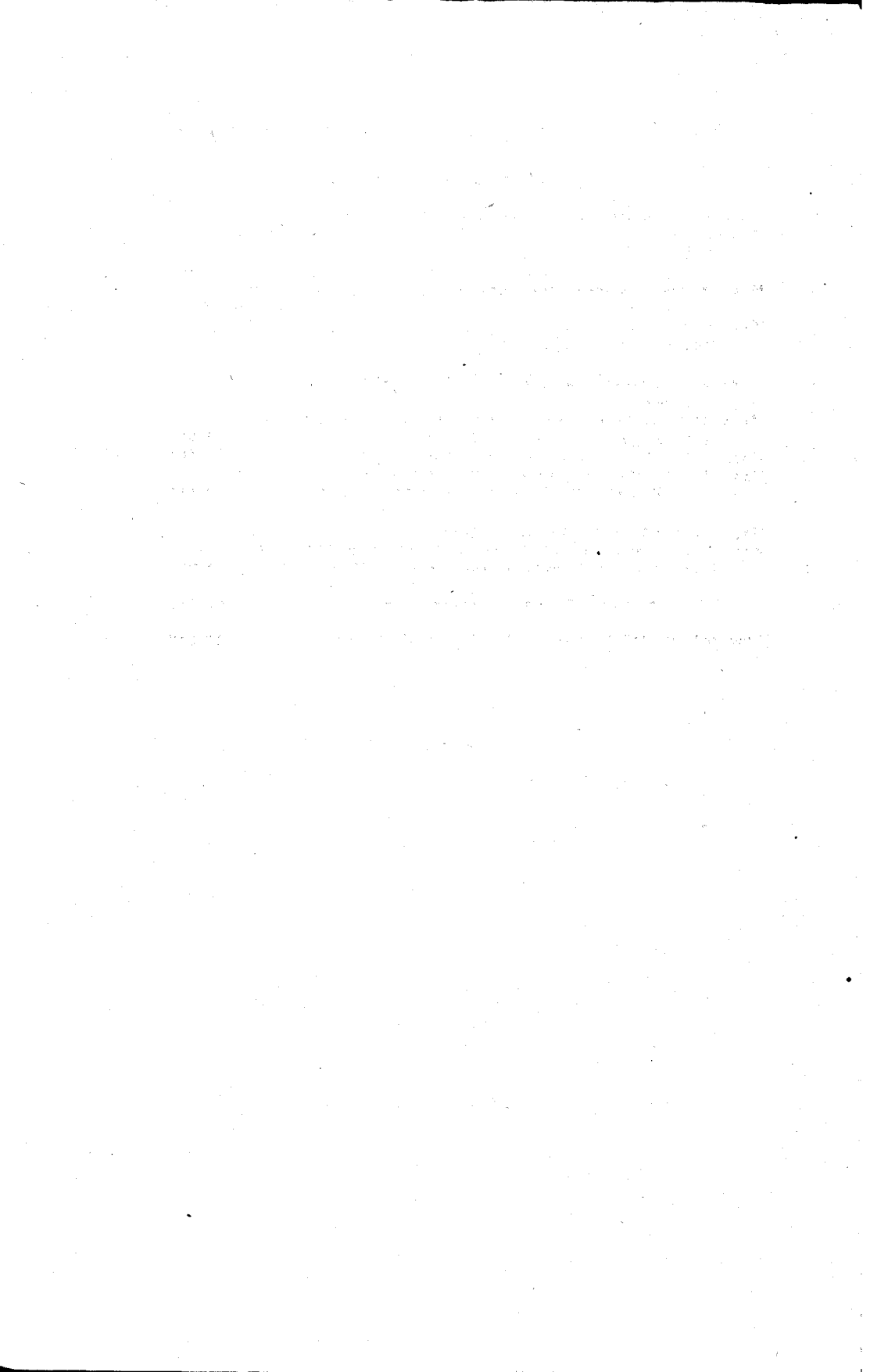
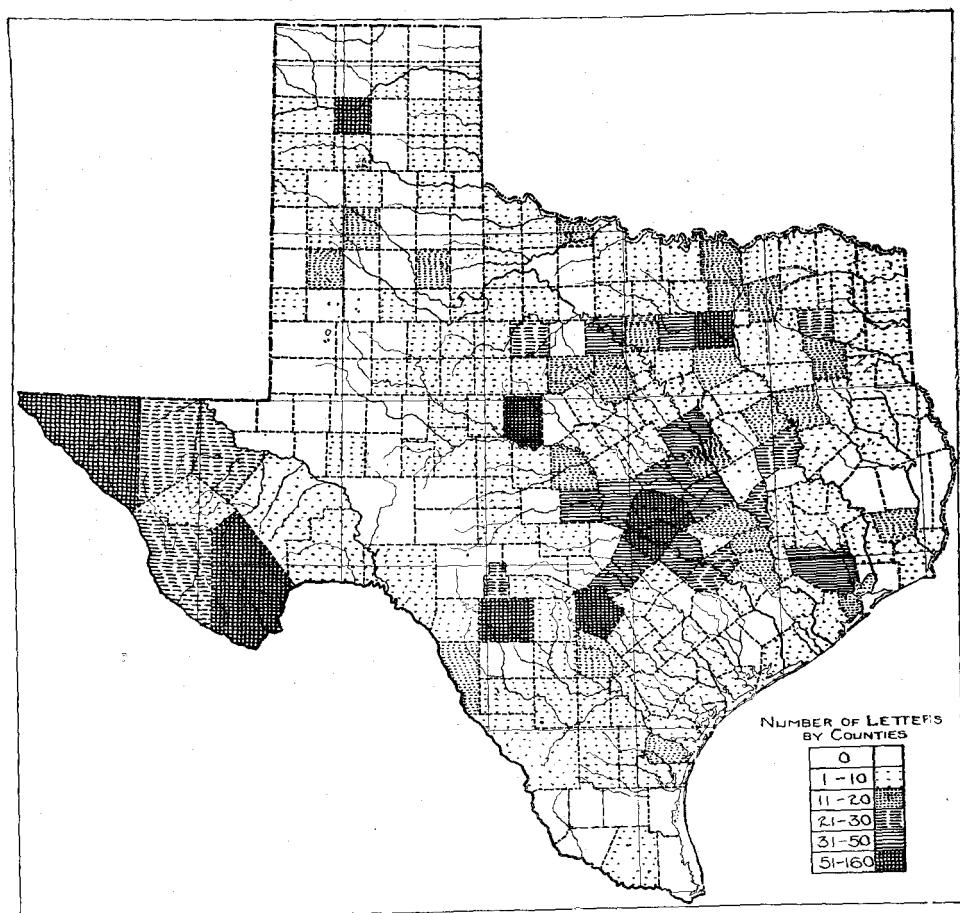


PLATE 1.



Map of Texas showing the distribution of the Texas correspondence of the Bureau of Economic Geology and Technology for the year 1915.

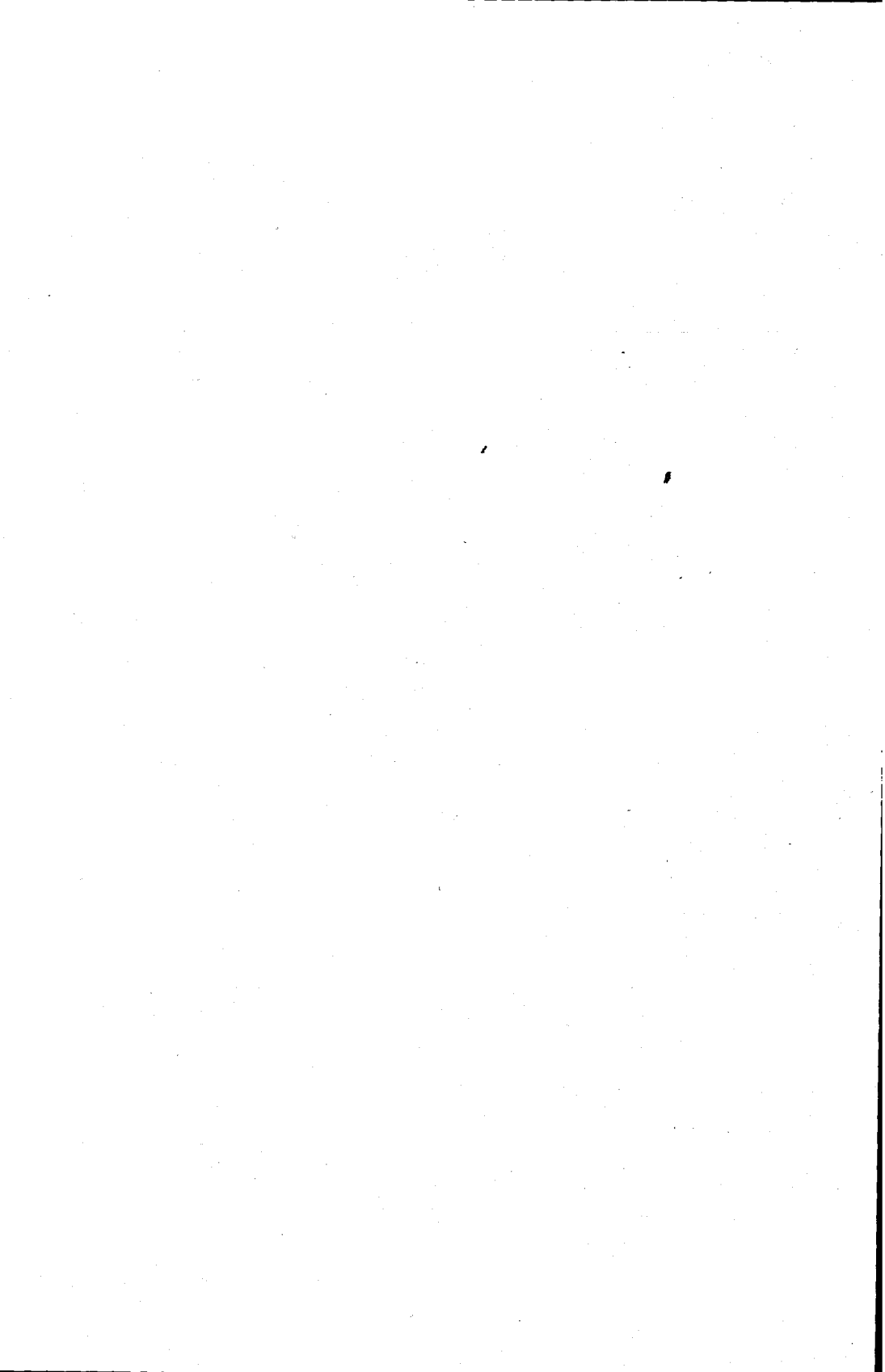
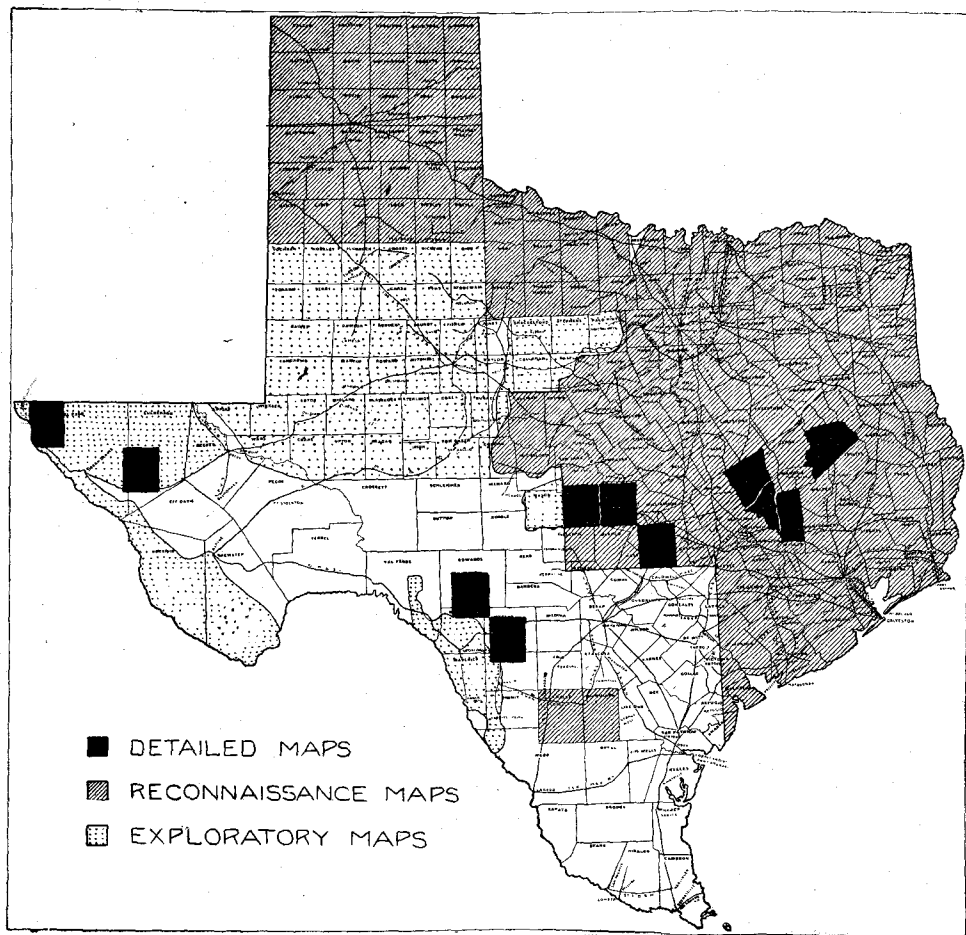


PLATE 2.



Map showing the areas in Texas which have been geologically mapped in detail, by reconnaissance, and by exploratory surveys.

