GEOLOGY OF THE NORTHERN PART OF
THE SLATE MOUNTAINS, PINAL COUNTY, ARIZONA

by

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LOCATION

The Slate Mountains are located 23 miles southwest of Casa Grande within the boundaries of the Papago Indian Reservation in Pinal County. The area studied is located near the northern extremity of the range.

The Casa Grande-Covered Wells road passes within one-half mile of the area. The road affords easy transportation during good weather, but may sometimes be difficult to use during the rainy season.

The area is about 90 miles from Tucson. It may be reached by following State Highway 84 from Tucson to Casa Grande and turning south on the Covered Wells road.

PREVIOUS WORK

No detailed study of the Slate Mountains area has been made. However, the area is given brief mention by J. B. Tenney in an article entitled ECONOMIC GEOLOGICAL RE-CONNAISSANCE OF CASA GRANDE MINING DISTRICT. Mr. Tenney's paper was published by the Casa Grande Chamber of Commerce by permission of the Arizona Bureau of Mines. The paper covers broad geologic features and is economic in nature.

The general distribution of the rocks of the range is shown on the geological map of Arizona published by the Arizona Bureau of Mines.

CLIMATE

The nearest weather station is located at Casa Grande 100 feet lower than the base of Slate Mountain and the climates of the two areas are probably essentially identical.

Average annual precipitation at Casa Grande is 19.4 inches. Average monthly precipitation varies from a low of 0.05 inches in May to a high of 5.5 inches in July.

Mean annual temperature is about 70 degrees. The temperature varies from a mean maximum of 105 degrees in July to a mean average of 64 degrees in December.[1]

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1 The Climate of Arizona - H. V. Smith. Bull. 130, Agricultural Experiment Station, College of Agriculture, University of Arizona.

FLORA AND FAUNA

Vegetation and animal life present in the area consist of those forms typical of the Upper Sonoran zone.

Mesquite, catsclaw, and palo-verde are common, particularly along drainages. Ocatillo, cholla, sahuaro, prickly pear, and pinchshion, barrel, and hedgehog cacti are abundant. A few organ pipe cacti have been found. Very little grass is present in the region.

Most of the fauna common to the desert province have been observed. Jackrabbits, both blacktailed and the spotted variety common in Mexico, cottontails, coyotes, foxes, snakes, lizards, hawks, falcons, ravens, quail, buzzards, and many varieties of insects have been observed by the writer.

TOPOGRAPHY AND DRAINAGE

The area studied consists of a series of roughly parallel ridges and draws whose trend is about N. 45° E. The draws terminate in saddles which connect the parallel ridges.

Streams head in these saddles and flow northeast into a playa and southwest into Santa Rosa Wash, a tributary stream of the Santa Cruz River. The steep ridges are drained by streams some of whose locations are determined by rock character and by faulting.

The northwest slopes of the ridges approximate dip-slopes. The southeast scarps of these ridges cut across the bedding and are very steep.

The highest point in the area is 2300 feet above sea level. The valleys which surround the area have an elevation of about 1500 feet.

MISCELLANEOUS

The area studied would be of particular interest to archaeologists. The writer found numerous caves in the limestones which were once occupied by Indians. Pottery is abundant in and around the caves, and the amount of pottery indicates a rather long period of occupation. Sherds were identified by Dr. Emil W. Haury[2] as early Pima and dates about 1750.

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[2] Haury, Emil W. - Personal communication (Apr. 1940)

GENERAL GEOLOGY

Sedimentary Rocks

The core of the Slate Mountain range is made up of Pinal schist. The contact of the Pinal schist with the Apache Pioneer shale is on the southeast edge of the area mapped.

The youngest sedimentary rock in the area is the Escabrosa limestone, exposed in the northwest part of the area. The Escabrosa limestone disappears to the north under valley fill. If younger Paleozoic, Mesozoic, or Tertiary sediments were deposited in the area, they have been removed by erosion.

The sedimentary rocks above the Pioneer shale are conformable. All of the rocks in the Slate Mountain region have been tilted and now strike N. 50° E. and dip to the northwest at an angle of 30 degrees.

The sedimentary section as determined in the area is as follows:

Sedimentary Section

		Thickness Feet	
Quaternary	Recent Alluvium	0-30	Alluvium, caliche and valley fill
Mississippian	Escabrosa limestone	200	Thick-bedded gray and blue limestone with cherty lenses.
Devonian	Lower Ouray formation	96	Pink and yellow thin-bedded mudstone, limestone and sandstone.
	Martin limestone	49	Light blue-gray, tan and yellow limestone with cherty lenses.
Upper Cambrian	Abrigo formation	87	Thin bedded tan to gray limestone.
		75	Thin bedded limestone and light brown sandstone and shale.
		4	Pink sandstone weathering to tan.
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Middle Cambrian	Southern Belle quartzite	30	Dark brown to purple sandstone and quartzite.
Middle Cambrian	Santa Catalina formation	24	Thin-bedded buff limestone and tan grits and sandstone.
		4	Brown to purple quartzite
		141	Brown limestone and sandy shale.
		93 262	Gray and green micaceous shale.
Middle Cambrian	Troy quartzite	360	Maroon and red cross-bedded coarse-grained quartzite.
Proterozoic Apache group	Mescal limestone	240	Tan to dark banded cherty limestone.
	Dripping Springs quartzite	850	Light colored quartzite and sandstone; ripple marked.
	Barnes conglomerate	2-4	Ellipsoidal water worn pebbles of quartzite, vein quartz, and jasper in a sandy matrix.
	Pioneer shale	450	Red, gray, and maroon spotted sandstone and shale.
Archaeozoic	Pinal schist		Well foliated siliceous schist.

PINAL SCHIST

The Archaeozoic Pinal schist is the oldest rock in the area. It is well foliated and splits into thin sheets. The schistosity of the rock strikes N. 10° E. and dips 80 degrees to the southwest, at marked variance with the dip and strike of younger rocks in the area. Surfaces of the rock are shiny gray. In places layers of quartz occur parallel to the schistosity.

Microscopic examination of fragments shows that the rock consists predominately of sericite and quartz and a few small grains of magnetite.

PIONEER SHALE

The contact of the schist with the Pioneer shale is concealed by detritus except in a few places. In the exposed areas no Scanlan conglomerate has been found.

The Pioneer shale rests directly on the Pinal schist. The shale is predominately maroon but contains red, white, gray, and greenish beds. The shale has a highly characteristic mottled appearance due to the presence of circular gray and white spots exposed on the bedding plane. This feature of the Pioneer shale has been described by Ransome in the Globe district.[3]

Most of the formation is sandy and might better be termed sandstone than shale. A few horizons near the base have well developed shaly partings. These shaly beds are lighter in color than the maroon sandstones.

Near the base of the shale is a 5-foot bed of white, coarse-grained quartzite.

The shale has been intruded by a sill of Apache diabase. Adjacent to both contacts with the diabase the Pioneer shale is dense and brittle and is dark green to brown. Slight baking by the diabase is indicated.

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[3] Ransome, F.L., Some Paleozoic sections in Arizona and their correlation: U. S. Geol. Survey Prof. Paper 98k, p.136, 1916.

BARNES CONGLOMERATE

The Barnes conglomerate lies conformably on the Pioneer shale as it does in the type locality. It is composed of well rounded, smooth, ellipsoidal pebbles of vein quartz in a coarse-grained sandy matrix. The conglomerate contains poorly rounded to semi-angular fragments of bright red jasper. The pebbles vary in size up to six inches in maximum diameter.

The Barnes conglomerate ranges from two feet to slightly over four feet in thickness.

DRIPPING SPRING QUARTZITE

Conformably overlying the Barnes conglomerate is the Dripping Spring quartzite, a vari-colored quartzite and sandstone. The lower half of the formation is composed of coarse-grained and poorly cemented sandstones and grits, light colored on a freshly broken surface but weathering to red or brown. The basal 60 feet of the formation contains single pebbles or lenses of conglomerate whose pebbles exactly resemble those of the Barnes.

Above this zone is 70 feet of white coarse-grained grit composed of angular quartz fragments.

Grain size decreases toward the top of the Dripping Spring quartzite and the rock is more firmly cemented than the lower beds. The color remains predominately light, but there are numerous thin-bedded red, brown, and greenish-brown sandy and shaly layers.

Near the top of the formation is a 30-foot band composed of bright red ferruginous shales above and below which are white and brown sandstones. Hematite is concentrated along bedding planes and joints of the sandstones giving it a distinctive hatchured appearance.

Dip slopes of the Dripping Spring show excellent ripple marks and weak to well-developed cross-bedding where the rock is weathered across the beds, suggesting that at least part of the formation may have been deposited under delta conditions.

MESCAL LIMESTONE

The Mescal limestone lies conformably on the Dripping Spring quartzite. It is tan, buff, white, and gray and has a characteristic banded appearance due to the presence of cherty lenses. The lenses of silica are more resistant to weathering than the limestone and tend to stand out, giving the limestone a corrugated appearance when seen in section. The chert is dark in color and weathers dark brown to black.

Erosion leaves films of chert along the dip of the Mescal beds with the result that the formation looks much darker when seen from a point above the bedding than it does on scarps which cut across the beds.

The Mescal limestone contains two diabase sills. Immediately above the upper sill are a number of bands of white chert. They vary from 1 inch to 18 inches in thickness and are lenticular.

The dark chert, in portions of the Mescal limestone, is arranged in a curious but poorly developed pattern of concentric curves which may represent the so-called algal growths found in the Mescal limestone in other localities.

MIDDLE CAMBRIAN

Troy Quartzite

The Troy quartzite rests on the Mescal limestone with apparent conformity. No pre-Troy channeling of the Mescal has been observed in this area.

The base of the Troy quartzite is marked by a 5-foot bed of highly ferruginous grit and conglomerate. It consists of angular to poorly rounded particles of quartz and jasper held in a hematite-rich matrix. The particles are poorly sorted but a rough banding is apparent.

The entire Troy quartzite is distinctly red due to abundant ferric oxide. It is strongly cross-bedded and contains numerous lenses of grit and conglomerate. The entire formation is rather coarse grained. Bedding is not as well developed in the Troy quartzite as it is in the upper part of the Dripping Spring quartzite.

Near the top of the Troy are rough slabby brown beds containing irregular imprints referred to as worm casts by Ransome in other sections.[4]

Immediately above the worm casts small curved outlines may be seen where the rock is broken across the bedding. Small brachiopods are exposed by splitting the rock along the bedding. No specimens were found in a sufficiently good

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4 Ransome, F. L., Some Paleozoic sections in Arizona and their correlation: U. S. Geol. Survey Prof. Pap. 98k, pls. 51 and 25, 1916.

state of preservation to permit identification.

SANTA CATALINA FORMATION

Conformably overlying the Troy is the Santa Catalina formation.

At the base are 93 feet of thin-bedded gray and green micaceous shales. The bedding is uneven giving the bedding surfaces a gnarled crinkly appearance. A highly distinctive feature of the shales is the presence of abundant curved, cylindrical, worm-like concretions as much as one inch in diameter.

No fossils were recovered from this member.

Above the shaly member are 141 feet of chocolate brown to gray, thin-bedded limestones, red to tan quartzites, and thin-bedded dark brown sandy shales. Some of the limestone contains an unknown green mineral. The limestones appear rather similar to the Mescal limestone because of the presence of thin, conical lenses of chert. All of these chert bands are not exactly parallel to the bedding, and many of the lenses intersect at small angles. Near the top of this member is a 4-foot green arkosic bed containing calcite nodules.

Above the arkosic member is a four-foot bed of coarse-grained purple quartzite. Above the quartzite are 24 feet of thin-bedded buff limestones, tan grits and tan to gray friable sandstone.

The only recognizable fossil recovered from the formation was Lingulella. Countless small brachiopods are found throughout the entire formation, but none are sufficiently well preserved for positive identification.

About ten feet above the arkosic member is a thin sandstone bed which shows abundant trilobite fragments on the weathered surface. No recognizable forms were found, and the freshly split rock shows no trace of trilobites.

The formation was identified as the Santa Catalina formation rather than the Cochise formation because of its stratigraphic position and because of its similarity to the Santa Catalina formation in its type locality as described by Stoyanow.[5)]

An examination of the Cochise formation at Picacho de Calero twenty miles northwest of Tucson showed certain differences in lithology from the Slate Mountain section, notably the absence of the light blue limestone which characterizes the Cochise formation.

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5 Stoyanow, A.A., Correlation of Arizona Paleozoic formations: Geol.Soc. America Bull. vol. 47, p. 476, 1936.

SOUTHERN BELLE QUARTZITE

The Santa Catalina formation is conformably overlain by the Southern Belle quartzite which marks the top of the Middle Cambrian.

The Southern Belle was identified because of its stratigraphic position and lithology. It is 30 feet in thickness. It is a dark brown, coarse-grained sandstone and quartzite which weathers to black or purple. Some of the beds near the base contain a greenish mineral which may be glauconite. Cross-bedding may be observed near the top of the formation. It is very resistant to erosion and stands out in the series conspicuously.

UPPER CAMBRIAN

Abrigo Formation

The base of the Abrigo formation is marked by a 4-foot member composed of pink sandstone which weathers to tan.

Above the sandstone are 75 feet of very thin-bedded limestones and light brown sandy shales. Near the base of the formation is a thin sandy bed containing fragments of trilobites. No identifiable forms were recovered. As in the Santa Catalina formation the trilobite fragments may be seen only on a weathered surface. When the fossiliferous slabs are split no indications of trilobites can be seen on the fresh surface. At the top of the Abrigo formation are 87 feet of thicker-bedded tan to gray limestones containing cherty lenses. The limestones weather to a distinctive dark buff and brown.

The entire formation contains numerous small brachiopods in a poor state of preservation. Most of the forms are probably Obolus and Lingulella.

DEVONIAN

Martin Limestone

Above the Abrigo formation is the Martin limestone which is 49 feet in thickness and is made up of blue-gray and yellow limestones. The limestones are thick-bedded but contain horizons in which chert nodules and lenses give a banded appearance to the formation. This banding of the Martin limestone is more pronounced from a distance than it is upon closer inspection, as the chert bands are not closely spaced.

Near the top of the Martin limestone is a coral reef 11 feet in thickness consisting predominately of Cladopora prolifica.

Above the reef is a three-foot member composed of dark blue limestone.

The top of the formation is a light gray limestone containing an abundance of brachiopods. Specimens of Schuchertella, Productella, and Schizophoria have been collected from this member.

LOWER OURAY FORMATION

The Lower Ouray formation is composed of yellow and pink sandstones, mudstones, shales and thin-bedded, vari-colored limestones.

At the base of the Lower Ouray are 12 feet of yellow and pink, thin-bedded sandstone, limestone and shale. No fossils were recovered from this member.

Above it is a 4-foot bed of light blue fossiliferous limestone from which <u>Schizophoria</u> <u>striatula</u>, <u>Retzia</u> sp., <u>Schuchertella</u> sp. and several unidentified brachiopods were recovered.

The top 80 feet of the formation is composed of thin-bedded pink mudstone, sandstone, limestone and shale with some thicker yellow sandstone and light gray limestone beds. About 25 feet below the top of the formation is a 4-foot bed of coarse-grained, pink and yellow friable sandstone. Above this unit the thickness of individual limestone beds is greater than in the lower part of the formation.

Immediately above the fossiliferous limestone the pink mudstones and sandstones contain fossils which may be Bryozoa. They are not well enough preserved to permit identification.

The entire formation, with the exception of the fossiliferous limestone, erodes rapidly. Most of the formation is covered by rubble from the overlying Escabrosa limestone. It is possible that fossiliferous horizons exist in the upper part of the formation which have not been found because of the covering of detritus.

The formation was identified as Lower Ouray rather than an upper member of the Martin limestone by comparison with Lower Ouray sediments described by Stoyanow in Peppersauce Canyon [6] and on Pinal Creek, north of Globe, and from consideration of the stratigraphic position of fossiliferous horizons in the Upper Devonian as demonstrated by Merriam.[7]

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[6] Merriam, C. W., Devonian stratigraphy and paleontology of the Roberts Mountain Region, Nevada: Geol. Soc. America. Special Paper 25, 1940.

[7] Stoyanow, A. A., Op. Cit., p. 489.

Merriam gives the following relation in the Roberts Mountain area of Nevada (abbreviated):

Upper Devonian	Devils Gate formation in part	Cyrtospirifer zone	
		Phillipsastraea zone	Hypothyridina emmonsi
		Spirifer argentarius zone	Hypothyridina sp.

The Phillipsastraea zone described by Merriam is represented in Arizona by the silicified coral reef in the Martin limestone which has been described by Stoyanow and contains the same general assemblage of fossils notably Cladopora prolifica. This coral reef is also present in the Martin limestones of the Slate Mountain section.

The fossiliferous zone at the top of the Martin limestone in the Slate Mountains has produced specimens of Schizophoria striatula and Productella, both of which are found in the Cyrtospirifer zone of Merriam.

[8] Merriam, C. W., Op. Cit., p. 6

Merriam discusses the Martin limestone of Arizona, which is the equivalent of the Nevada Devils Gate formation, and the Lower Ouray formation of Arizona as described by Stoyanow. He concludes that the Lower Ouray formation has a very late Devonian age, later than the highest beds of the Cyrtospirifer zone.[9]

Merriam indicates the presence of _Phillipsastraea_ and _Cyrtospirifer_ zones in the Tucson area on a paleogeographical map of the west.[10]

Since the Cyrtospirifer zone marks the top of the Devils Gate formation of Nevada and the Martin limestone of Arizona, a Lower Ouray age is indicated for the sediments above the Cyrtospirifer zone in the Slate Mountains.

In addition, the pink and yellow sandstones and shales are suggestive of the Lower Ouray formation rather than the Martin limestone.

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9 Merriam, C. W., Op. Cit., p. 66.

10 Merriam, C. W., Op. Cit., p. 4.

ESCABROSA LIMESTONE

The Escabrosa limestone is a thick-bedded to massive gray, white and blue limestone. It is resistant to erosion and is the most prominent cliff-former in the entire district.

It contains silica which weathers more slowly than the limestone causing it to weather to myriad points of needle-like sharpness.It also contains irregularly shaped patches of dark chert and some patchees of poorly cemented to friable sandstone.

The top of the Escabrosa limestone in this area is a dip-slope and disappears beneath valley fill. The thickness of sediments which has been removed by erosion is unknown.

The limestone limestone is highly fossiliferous, but the fossils are not well preserved and are identifiable in relatively few places.

The presence of <u>Spirifer centronatus</u>, the guide fossils for the Escabrosa limestone, at the top of the remaining limestone shows the absence of Pennsylvanian Naco limestone. Only 200 feet of Escabrosa limestone have been left by erosion. It is not known whether Naco sediments have been removed by erosion or were never deposited in the area.

In an adjoining area, being studied by Mr. Hunter Goheen, there is a much greater thickness of Carboniferous limestones, and it is possible that Naco limestone may be present there.

Specimens of Spirifer centronatus, Syringopora sp., Composita opposita, and some species of Eumetria have been found in the Escabrosa limestone. The limestone also contains an abundance of small cup corals which have not yet been described and named.

IGNEOUS ROCKS

Apache Diabase

The Pioneer shale has been intruded by a sill of diabase 160 feet thick.

In the hand specimen the ophitic texture is readily apparent, especially on a weathered surface. Plagioclase feldspar laths show twinning striation on fresh surfaces. The grain size of the minerals composing the rock varies greatly. Near contacts the rock is dense and extremely fine grained, but in parts of the sill the felsdpar laths are as much as three millimeters long. The dark material between the feldspar laths could not be identified.

The ophitic texture is also seen under the microscope. The feldspar laths are labradorite as determined by extinction on albite-law twins. Most of the feldspars are highly sericitized. The mafic mineral is basaltic hornblende largely altered to chlorite and magnetite. Feldspar exceeds hornblende in abundance. Magnetite of secondary origin constitutes 15 per cent of the rock.

The Mescal limestone has been intruded by two sills of Apache diabase. Both sills are between 20 and 25 feet thick.

No formations above the Mescal limestone have been intruded by the diabase.

ANDESITE PORPHYRY DIKE

An andesite porphyry dike has been intruded along the Dividend fault at the northwest end of the area.

The rock is light gray on a fresh fracture and weathers to a light brown. About 10 per cent of the rock is made up of phenocrysts of plagioclase feldspar. Hornblende was the only other mineral recognizable in the hand specimen. Maximum diameter of phenocrysts is four millimeters.

Microscopically it may be determined that and~~es~~ite feldspar phenocrysts have been almost completely altered to sericite. Outlines of hornblende crystals are preserved, but the hornblende itself has been altered to chlorite, limonitic material and an unknown white mineral. The felspathic groundmass is largely sericitized, and very fine grained. The average index of the feldspar grains is greater than balsam indicating the feldspar is andesine or a more calcic variety.

ANDESITE PORPHYRY SILL

Fifteen feet above the base of the Dripping Spring quartzite is the base of a 10-foot sill of andesite porphyry.

The rock is distinctly porphyritic and the phenocrysts are feldspar and hornblende. Feldspar phenocrysts are rectangular in cross section with a maximum diameter of 5 millimeters. Hornblende crystals have a maximum length of 6 millimeters. The groundmass is very fine grained and indeterminable. The rock weathers to a rusty brown.

In thin section the rock is seen to be highly altered. The plagioclase crystals were determined to be andesine and show zonal structures.

About 30 per cent of the rock is composed of hornblende crystals, now almost completely altered to shlorite and an unknown white mineral. Magnetite constitutes about 10 per cent of the rock.

STRUCTURAL GEOLOGY

Folding

Folding has been of minor importance in the area.

Sediments have been regionally tilted. The average strike of the beds is N. 50° E. and the average dip is 30 degrees to the northwest. At a very few places south of Pima fault the beds deviate a few degrees from normal dip and strike. North of Pima fault the Dripping Spring quartzite retains its normal strike but dips at an angle of 38 degrees to the northwest.

At the Ramona Mine the Dripping Spring quartzite has been sharply twisted by movement along the Pima fault. However, this effect extends only a short distance from the fault.

FAULTING

General Features

Three distinct fault systems are apparent in the Slate Mountain area representing at least two periods of crustal disturbance. The exact age of faulting is not known. All faulting is post-Escabrosa.

The most prominent fault pattern has a northwest trend with fault strikes between N. 10° W. and N. 55° W.

Papago fault strikes N. 50° E. and the Dividend fault strikes N. 30° E. There are minor faults adjacent to Papago fault.

Most of the fault outcrops are covered and complete information concerning them could not be obtained. Several interpretations of the fault systems are possible.

NORTHWEST FAULTING

Most of the area studied is a rectangular fault block lying between Pima fault on the northeast and a parallel fault of large displacement on the southwest. Similar fault blocks to the north of the area are bounded by northwest faults.

Pima fault strikes N. 55° W. and has a horizontal displacement of 1800 feet. The fault dips 45 degrees to the southwest.

The displacement and dip of the southwest boundary fault of the area can not be calculated from evidence obtained within the area.

Other northwest faults, of small displacement, cut all formations from the Pinal schist to the Escabrosa limestone.

The traces of these faults on the surface are nearly straight lines, regardless of topography suggesting that the faults are vertical or nearly so.

PAGAGO FAULT

The Papago fault strikes in a northeasterly direction nearly perpendicular to the northwest fault system. The actual fault surface is concealed by alluvium so that the dip of the fault could not be determined. Displacement along the Papago fault has caused the southeastern part of the area to be dropped 380 feet vertically relative to the northwest part, and has resulted in the repetition of the Troy quartzite and Mescal limestone.

Possibly related to Papago fault is the low angle reverse Crotalus fault which strikes N. 65° W. and dips 20 degrees to the northeast.

Displacement along this fault has placed Dripping Spring quartzite on Troy quartzite and Mescal limestone.

DIVIDEND FAULT

The Dividend fault is the youngest fault in the area. It strikes N. 30° E. Its probable dip, determined in an adjoining area, is 70 degrees to the southeast.

The andesite porphyry dike which has been intruded along the Dividend fault can be traced for more than a mile into the adjoining area to the northeast. The Dividend fault crosses the Pima fault without being displaced and is, therefore, younger than the Pima fault system.

MINOR FAULTS

South of Papago fault are several faults of small displacement that bound triangular blocks of Mescal limestone and Dripping Spring quartzite and have displaced these blocks slightly from their normal position.

POSSIBLE INTERPRETATION

Incomplete data as to the dips of the various faults and their age relations precludes exact interpretation. Several interpretations will be discussed.

1) North of Papago fault overburden covers the formation beneath the Mescal limestone. However, this is the normal position of Dripping Spring quartzite and it is probable that Dripping Spring rocks do lie beneath the Mescal limestone in this area.

It is possibly an overthrust from the northwest bringing the Dripping Spring quartzite over Mescal limestone and Troy quartzite.

Normal faults of small displacement, dropped the triangular blocks of Mescal limestone and Dripping Spring quartzite into their present position. Erosion then uncovered the formations giving the present relations.

The Crotalus fault is a thrust fault that has placed Dripping Spring quartzite on the younger rocks. However, this fault dips to the north, while the Papago fault dips west. It may represent a warped fault surface connected with the Papago fault or it may have been produced by a greater component of thrust from the north.

The northwest faults may be tear faults connected with the overthrust movements. Adjacent blocks moving at different rates would fracture to give this northwest fault pattern.

Two interpretations are possible for the Papago fault:

1. The Papago fault may be a gravity fault that has dropped the southeastern part of the area a vertical distance of 380 feet. Later overthrusting from the north caused Dripping Spring quartzite to ride over younger beds. Normal faulting then dropped the triangular blocks into their present position and erosion removed the overthrust rocks to reveal the present relation.

2. The Papago fault may be a normal fault that has dropped the southeast part of the area differentially leaving the triangular blocks higher than most of the areas south of the fault. In this case over-thrusting along the Crotalus fault could be later or earlier than normal faulting.

The first interpretation is the most probable as it fits into the northwest fault pattern over the entire area.

The Dividend fault is later than Pima fault and is probably the youngest fault in the area.

ECONOMIC GEOLOGY

No important mines are within the area. The Red Chief and the Ramona mine are in the Pima fault and the Dividend mine is on the contact between the andesite porphyry dike and the Escabrosa limestone at the north end of the area.

The mines were prospected or worked on a small scale between 1900 and 1910 when the nearby Turning Point, Jackrabbit, and Desert Queen mines were being worked.

The Ramona mine was prospected in 1908 by the Turning Point Mining Company. At that time it was known as the McKinley Mine. It was later worked by Mr. Ramon Andrade who furnished this history of the mines in the area. Mr. Andrade shipped between 10 and 15 tons of carefully sorted lead ore to El Paso. This, apparently, was the largest shipment ever made from the mine. The mine is now held by Mr. H. M. Minnear who staked it in 1936.

The Red Chief mine was first located in 1900 by

Mr. Charles Bennet of Casa Grande. Assessment work and prospecting was done by Mr. Andrade until 1936 when it was abandoned. No ore was found.

The Dividend mine was worked in 1906 by Mr. John Reese. According to Mr. Andrade a few shipments of ore containing silver and a little copper were made. The mine has been idle since it was abandoned by Mr. Reese about 1910.

Most of the workings in all three of the mines are inaccessible.

RAMONA MINE

The Ramona mine was prospected by several shafts and tunnels most of which are now caved or dangerous to enter.

The only ore mineral which occurs in any abundance is cerussite. The writer found some exceedingly small crystals of vanadinite and a very little wulfenite. Hematite and limonitic minerals are abundant in the ore as are quartz and calcite.

The ore occurs in brecciated Dripping Spring quartzite adjacent to Pima fault.

All of the ore has been oxidized. No traces of sulphide minerals were found.

RED CHIEF MINE

The workings of the Red Chief mine are also inaccessible. It is located on the Pima fault. Hematite is concentrated along the fault zone, but no ore minerals were found by the writer. Mr. Andrade reported that he prospected the mine for 36 years for Mr. Bennet without finding ore.

DIVIDEND MINE

The Dividend mine is located on the hanging wall contact of an andesite porphyry dike with Escabrosa limestone.

A little malachite, azurite, and chrysocolla are on the dumps.

Hematite and quartz are abundant. No traces of ore minerals other than these were found by the writer. A prospector in the district stated that he once took samples from the mine that assayed more than $3.00 per ton in silver. The grade of the ore mined by Mr. Reese is not known.

The limestone adjacent to the dike has been replaced by silica. Associated with the silica is some copper and silver.

Replacement was selective. Fossil remains in the limestone escaped replacement and were later leached from the silicified rock. As a result, some of the ore contains molds of crinoid stems.

FUTURE OF DISTRICT

The mines were not profitable during their operation. Their development was apparently a reflection of the optimism which prevailed during the hey-day of the Jackrabbit, Turning Point, and Desert Queen Mines. Occasional rich pockets might be profitable to a lessee working on a small scale. No enough ore has been recovered from the mines to encourage large scale development.

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PLATE III.

Fig. I. Organ pipe cactus near Red Chief mine.

Fig. II. Dripping Spring quartzite at southwest end of area.

PLATE III

PLATE IV.

Fig. III. Cambrian, Devonian, and Mississippian beds. Looking north. Ɛsc, Santa Catalina formation; Ɛsb, Southern Belle quartzite; Ɛa, Abrigo formation; Dm, Martin limestone; DlO, Lower Ouray formation; Ce, Escabrosa limestone; Ɛt, Troy quartzite.

Fig. IV. View from a point west of the area.

PLATE IV

PLATE V.

Fig. V. Looking southwest at beds. Ꞓsc, Santa Catalina formation; Ꞓsb, Southern Belle quartzite; Ꞓa, Abrigo formation; Dm, Martin limestone; DlO, Lower Ouray formation; Ce, Escabrosa limestone.

Fig. VI. Mescal limestone and Dripping Spring quartzite.

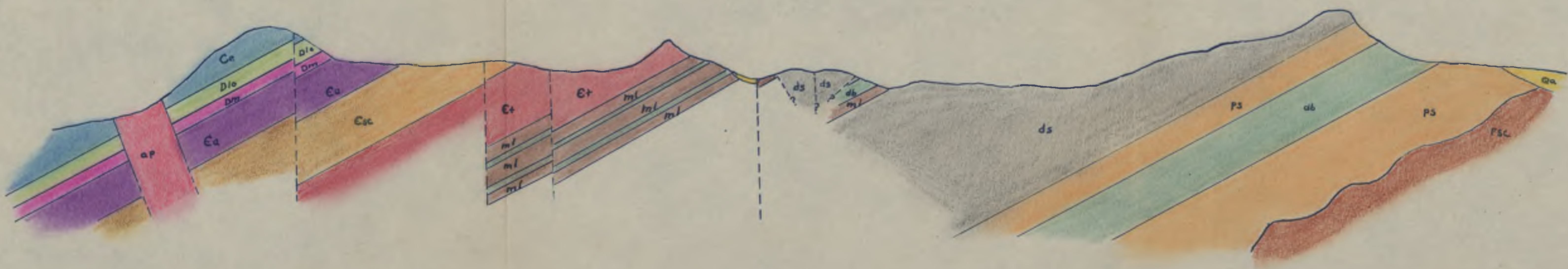
PLATE V

In POCKET
2 plates

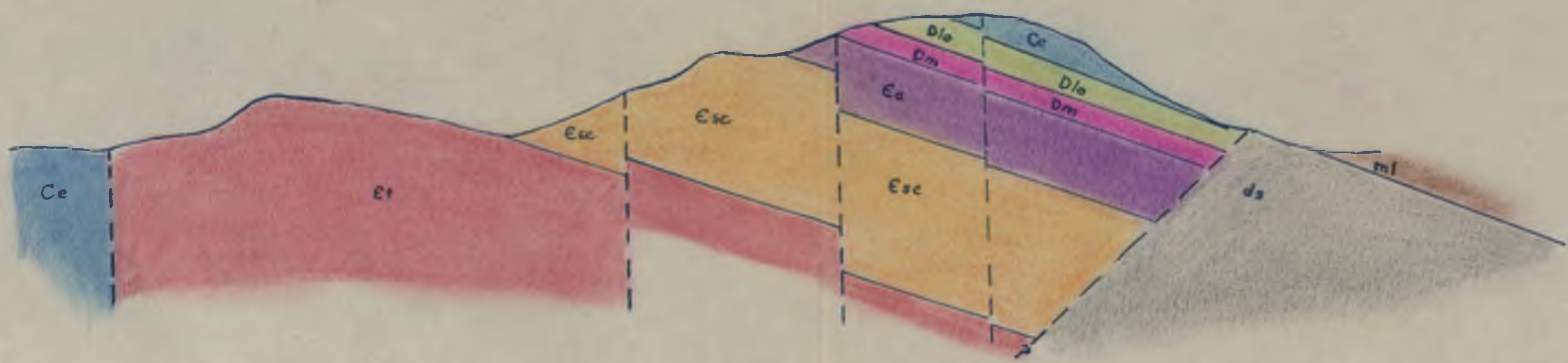
PLATE I


EXPLANATION
IGNEOUS ROCKS
ANDESITE PORPHYRY
POST-ESCABROSA
DIABASE
POST-TROY
SEDIMENTARY ROCKS
ALLUVIUM AND CALICHE
RECENT
ESCABROSA LIMESTONE
LOWER MISSISSIPPIAN
LOWER OURAY FORMATION
MARTIN LIMESTONE
UPPER DEVONIAN
ABRIGO FORMATION
UPPER CAMBRIAN
SOUTHERN BELLE QUARTZITE AND SANTA CATALINA FORMATION
TROY QUARTZITE
MIDDLE CAMBRIAN
MESCAL LIMESTONE
DRIPPING SPRING QUARTZITE
BARNES CONGLOMERATE AND PIONEER SHALE
PROTEROZOIC
METAMORPHIC ROCKS
PINAL SCHIST
ARCHEOZOIC
FAULT
PROBABLE FAULT
DIVIDEND FAULT
RAMONA MINE
DIVIDEND MINE
RED CHIEF MINE
PIMA FAULT
CHOTALUS FAULT
PAPAGO FAULT
111° 54'
32° 34'
1750
2000
N
AREAL GEOLOGY
NORTHERN PART OF
SLATE MOUNTAINS
PINAL COUNTY, ARIZONA
SCALE: 1 INCH = 500 FEET
500
0
500
1000
CONTOUR INTERVAL 50 FEET
DATUM IS MEAN SEA LEVEL
1940
TOPOGRAPHY AND GEOLOGY
BY
WILLIAM G. HOGUE

Plate I



SECTION ALONG LINE A–A′



SECTION ALONG LINE B-B′

SECTION ALONG LINE C-C′

EXPLANATION

SEDIMENTARY ROCKS

- Qa ALLUVIUM
- Ce ESCABROSA LIMESTONE
- Dlo LOWER OURAY FORMATION
- Dm MARTIN LIMESTONE
- Єa ABRIGO FORMATION
- Єsc SOUTHERN BELLE QUARTZITE AND SANTA CATALINA FORMATION
- Єt TROY QUARTZITE
- ml MESCAL LIMESTONE
- ds DRIPPING SPRING QUARTZITE
- ps BARNES CONGLOMERATE AND PIONEER SHALE

IGNEOUS ROCKS

- ap ANDESITE PORPHYRY
- db DIABASE

METAMORPHIC ROCKS

- psc PINAL SCHIST

- - - - FAULT

VERTICAL SECTIONS

SCALE : 1 INCH = 500 FEET

Plate 2