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TECHNICAL REPORT NO. 3-630

ANALOGS OF YUMA TERRAIN IN THE MIDDLE EAST DESERT

Report 4

by

C. R. Kolb

W. K. Dornbusch, Jr.



TECHNICAL REPORT NO. 3-630

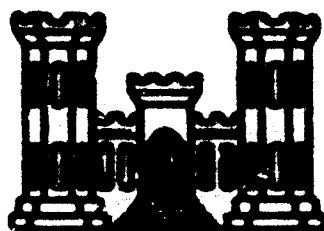
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Volume II

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Hypsometry

Raisz's Landform Map

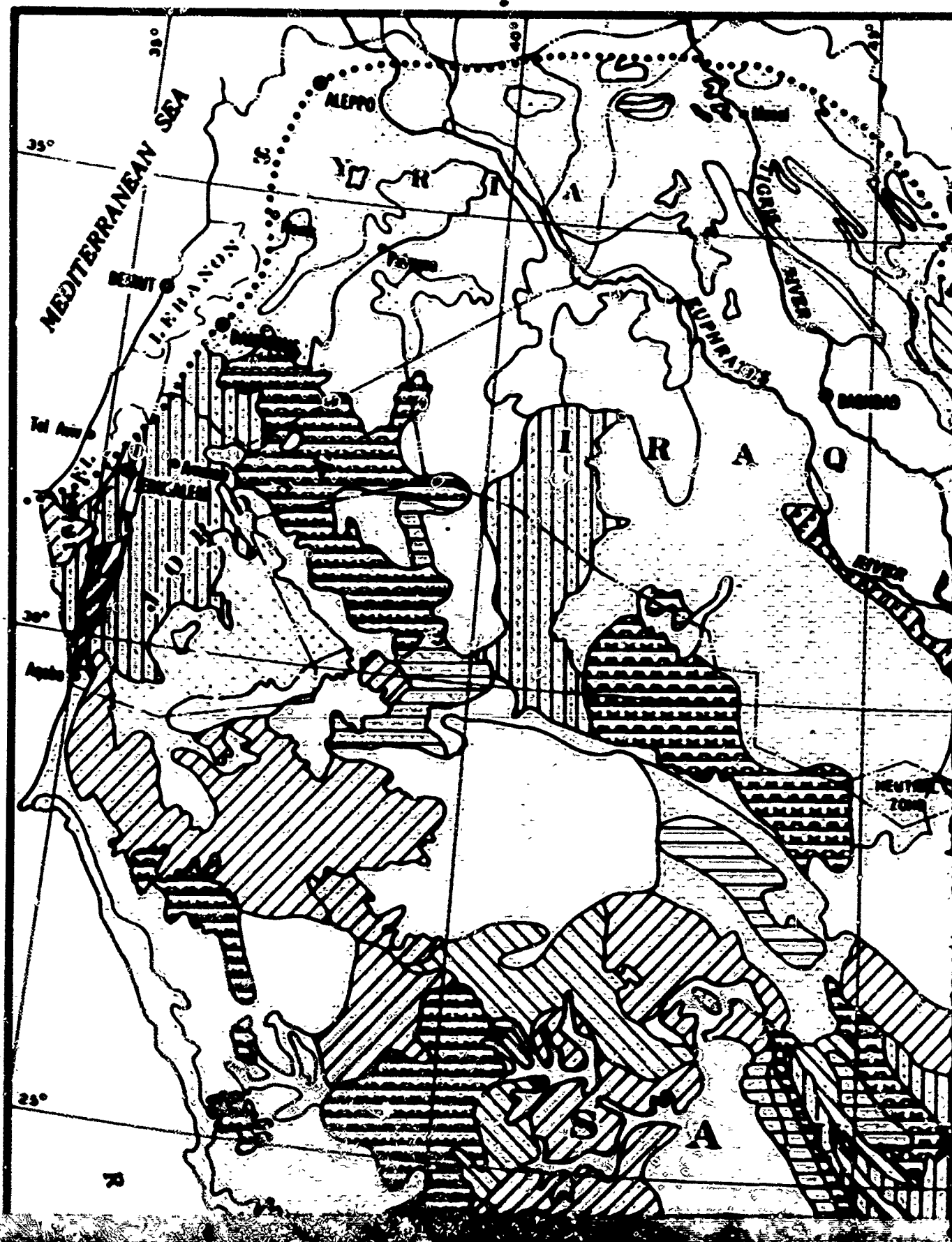
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ANALOGS OF YUMA TERRAIN IN
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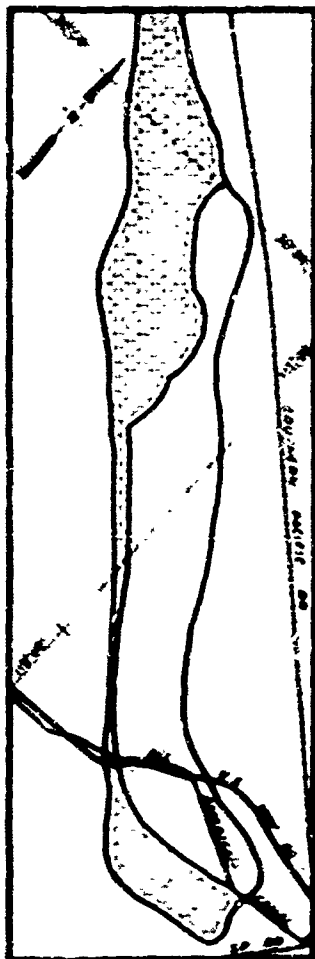
RAIN IN THE MIDDLE EAST DESERT

AIN FACTOR AND ANALOG MAPS

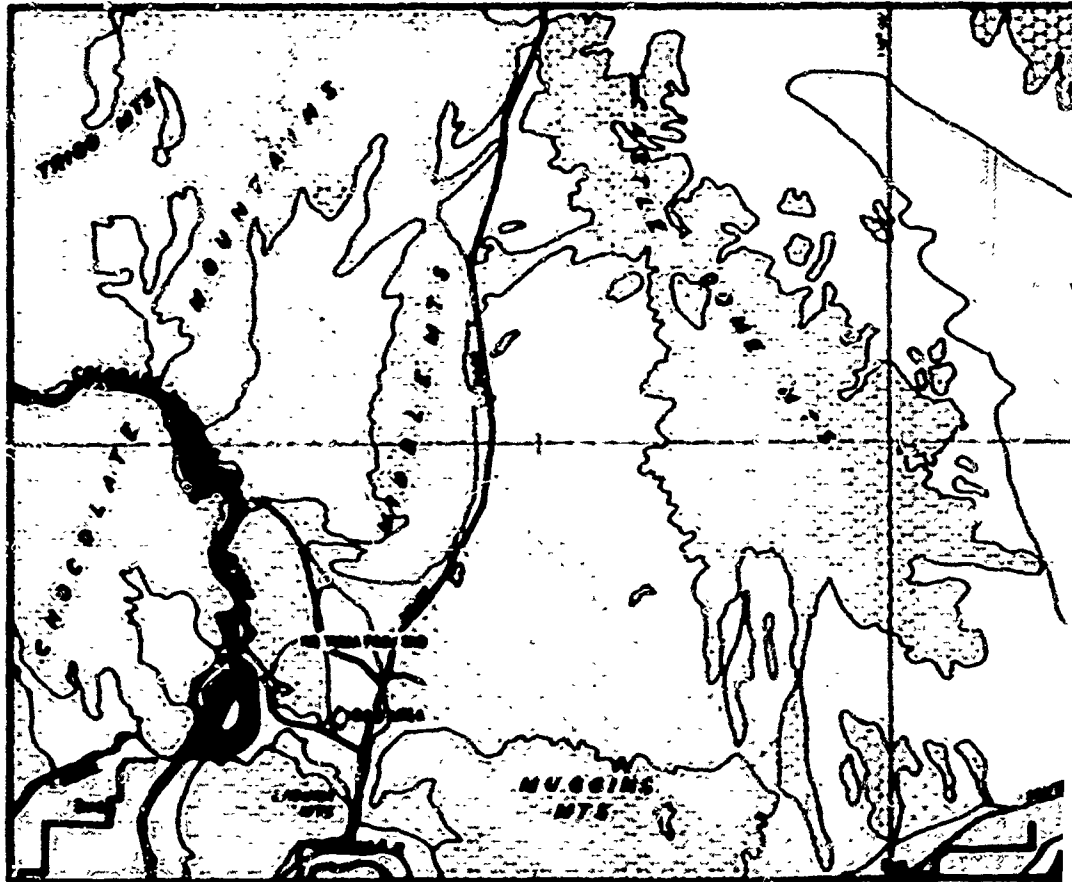




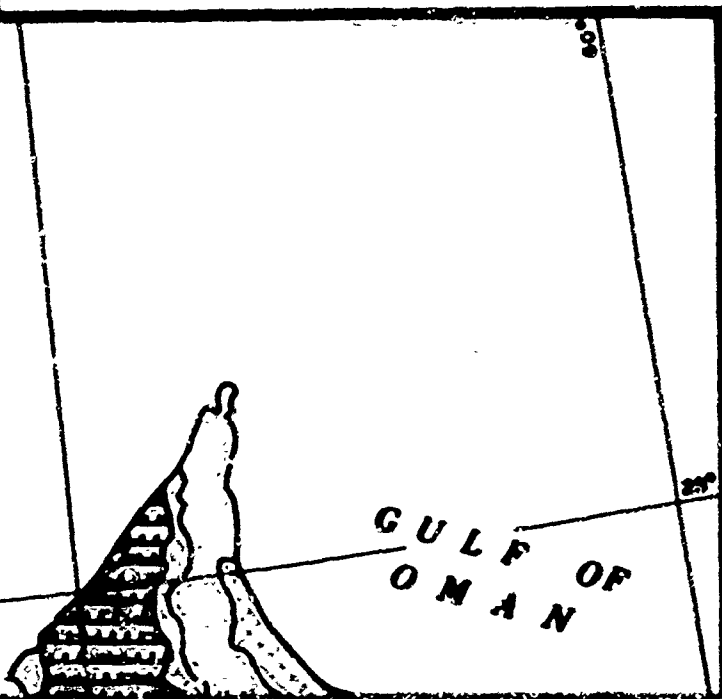
YUMA SAND
(GROSS PLAN-PRO)



YUMA SAND HILLS
(GROSS PLAN-PROFILE: SL)



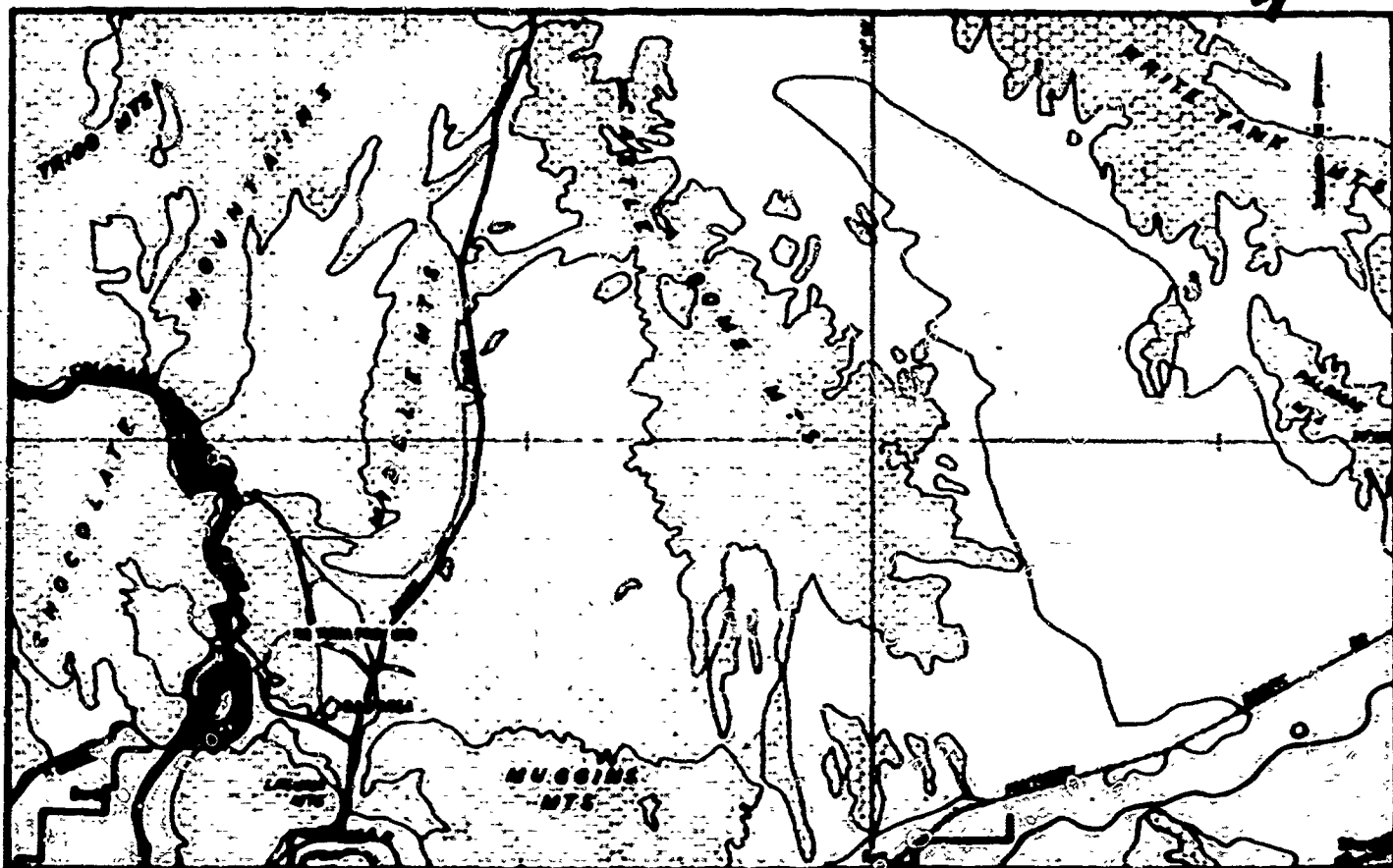
YUMA PROVING GROUND
(GROSS PLAN-PROFILE: SL/1)



CHARACTERISTIC PLAN-PROFILE

The characteristic plan-profile is the most commonly found plan-profile may be either restrictive or gross. The restrictive plan-profile is based on circles 1 mile in diameter. Local relief of less than 10 ft is not considered. The gross plan-profile is based on random sampling with circles 3/4 miles in diameter. The gross plan-profile is not considered. The prominence in such a plan-profile are very intervening features; prominent lines.

Height of Occupancy	LEGEND			
	Height of Occupancy	Restrictive and Random	Random	Random
100% of area				
60-80% of area				
<60% of area				



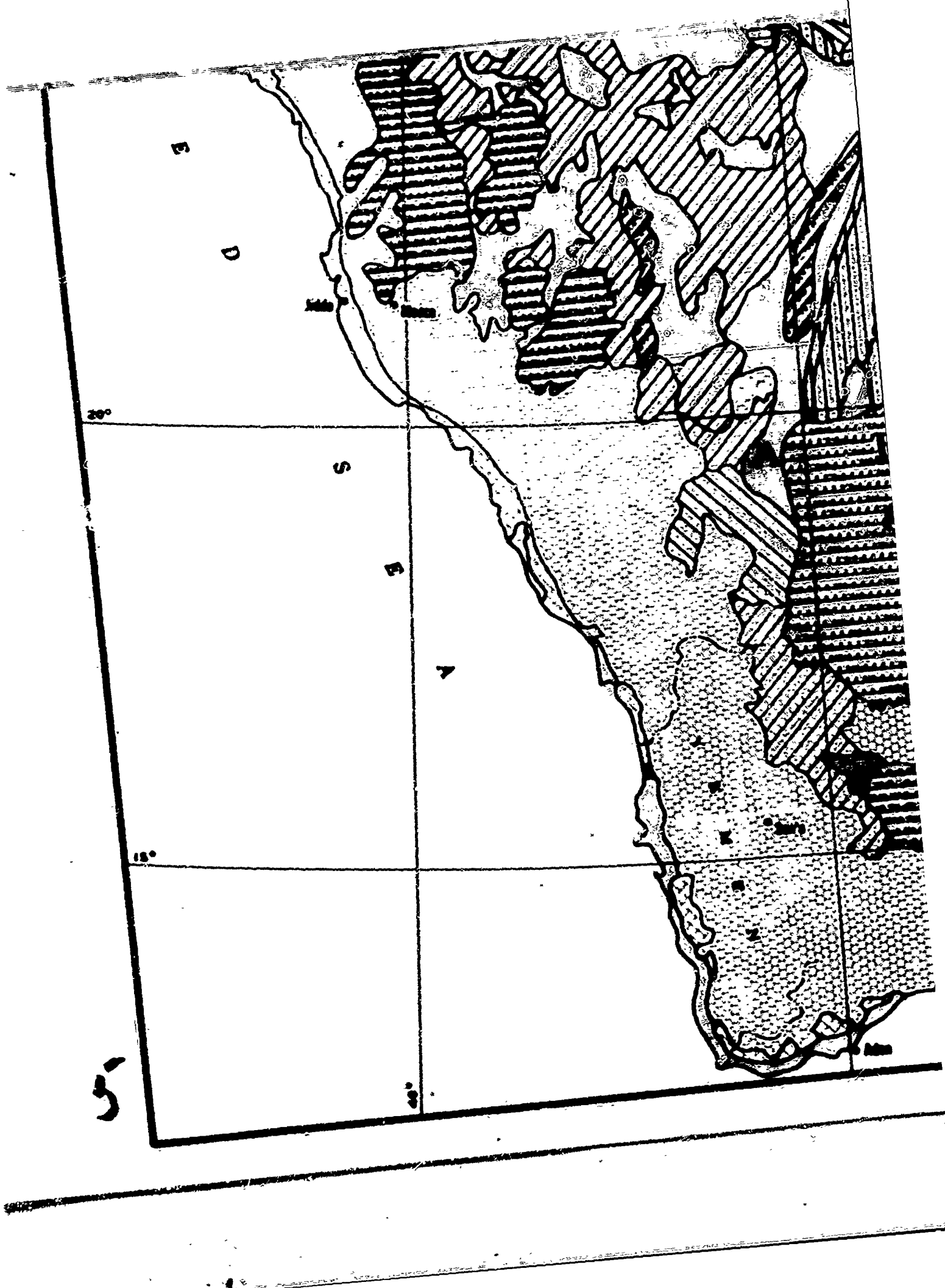
YUMA PROVING GROUND

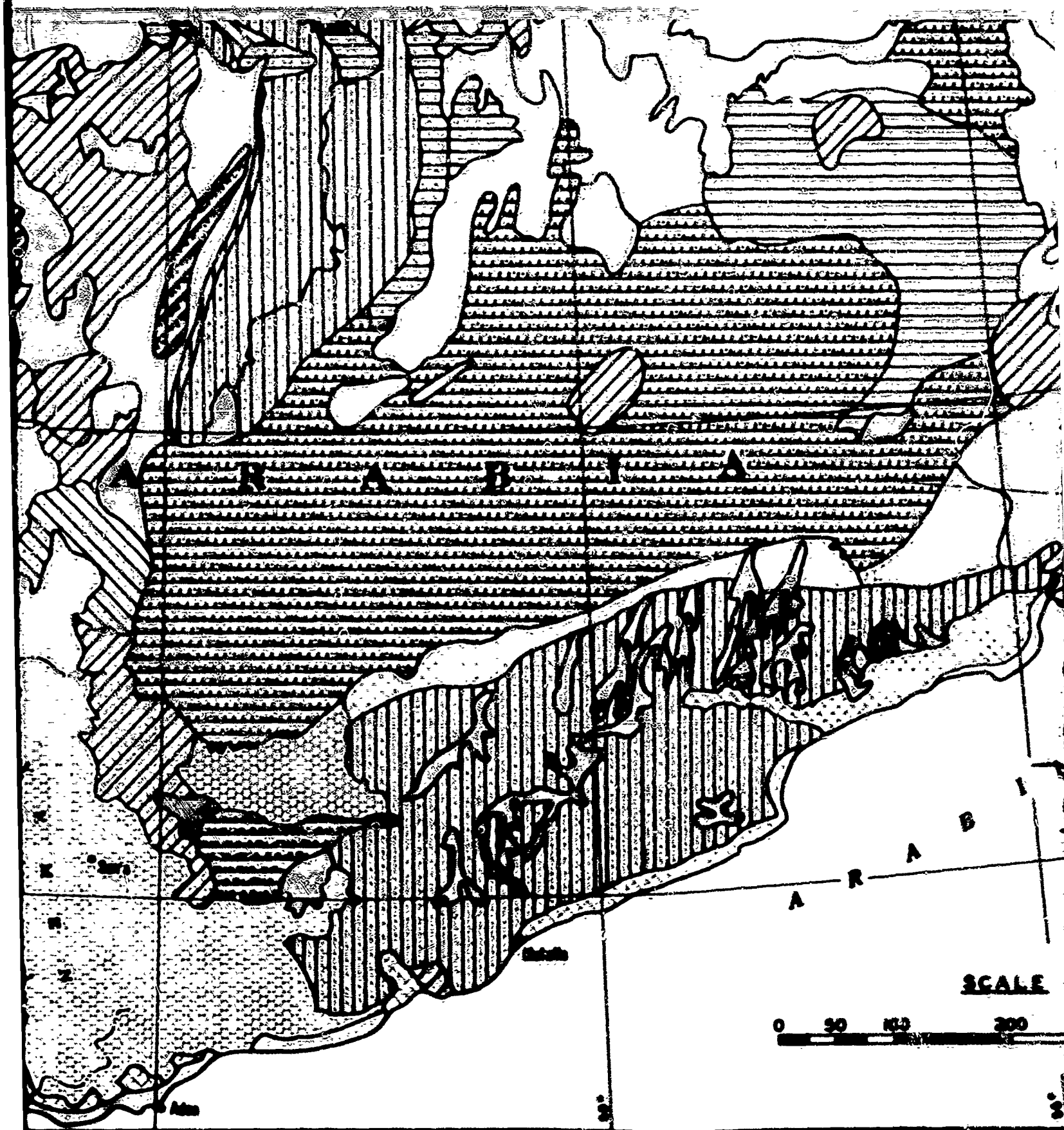
(GROSS PLAN-PROFILE: 5L//)

CHARACTERISTIC PLAN-PROFILE:

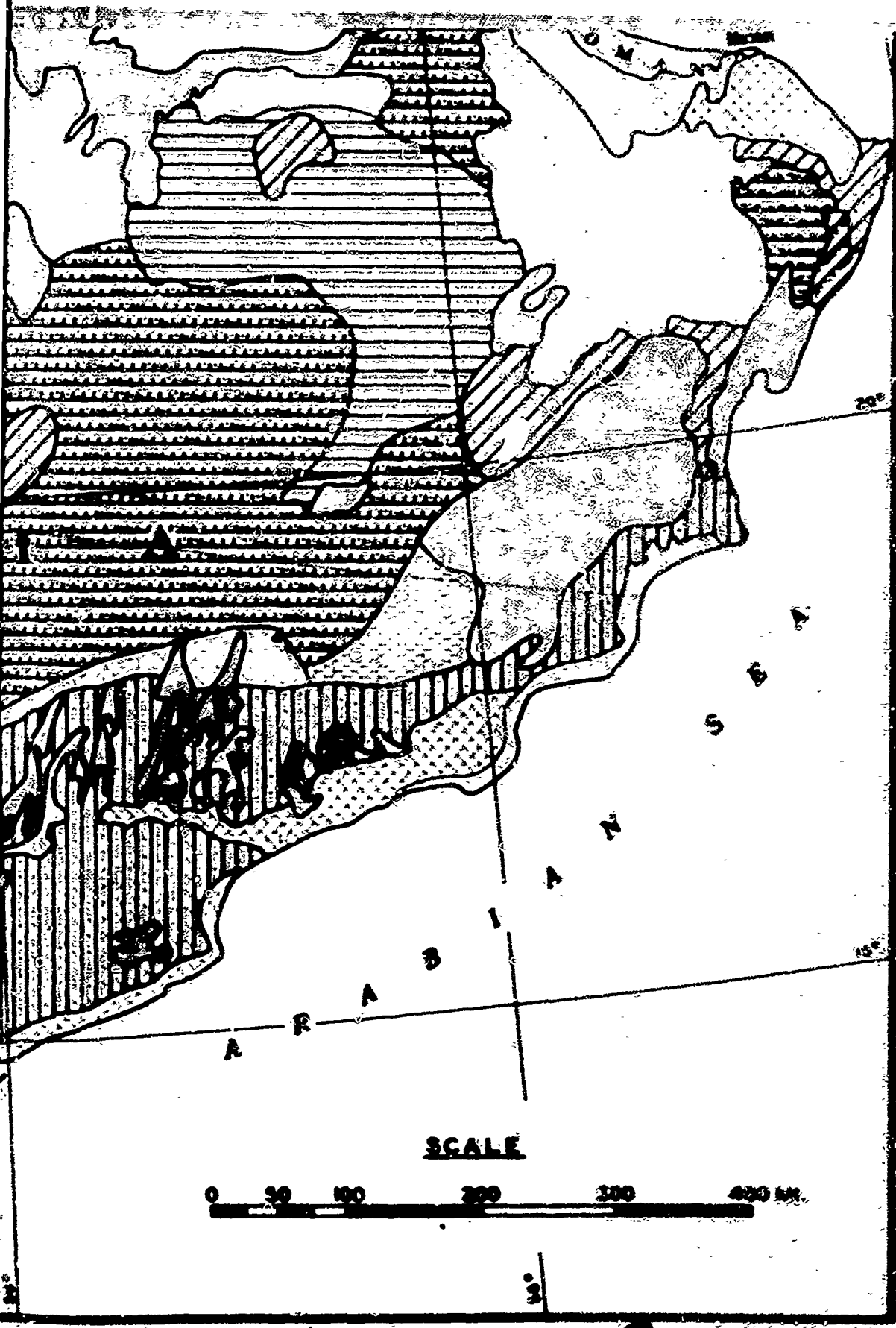
The characteristic plan-profile is the most commonly found plan-profile within a region. It may be either restrictive or gross. The restrictive plan-profile is based on random sampling with circles 1 mile in diameter. Local relief of less than 10 ft is not considered. The gross plan-profile is based on random sampling with circles 1/2 mile in diameter. Relief of less than 100 ft is not considered. The prominence in both a plan-profile are termed component high, the intervening lowlands component low.

LEGEND					
Higher Occupancy	Higher are ———>	Schematic Plan			
		Schematic Profile	Random and Random	Linear and Random	Random and Parallel
100% of area					
10-60% of area					
<10% of area					





6



100% of area	Cross-hatched	
50-100% of area		
10-50% of area		
No predetermined type or form		

PLAN-PROFILE COMPLEX

- Aerial Complexes
- 1/1
 - 1/2
- Group-complexes
- 1/1
 - 1/2
- Signs are not added to the map unless the area is bounded by a line.
- L indicates boundary greater than 5 miles.
- H indicates roughly

Some of the following plan-profile types, in the variety of landscape shown.



ANAL

CHARACT

>50% of area					
25-50% of area					
<25% of area					
No pronounced highs or lows					

PLAN-PROFILE COMPLEXES

Areal Complex: Confined to areas where two major, areally restricted plan-profiles, both of the restrictive type, are mapped.

- 1/4 Plan-profile of the areally predominant low.
- 1/4 Plan-profile of the areally predominant high.

Graben-component Complex: Confined to areas where a graben and a restrictive plan-profile of either a component high or a component low are mapped.

- 1/4 Graben plan-profile.
- 1/4 Restrictive plan-profile of component low.
- 1/4 Graben plan-profile.
- 1/4 Restrictive plan-profile of component high.

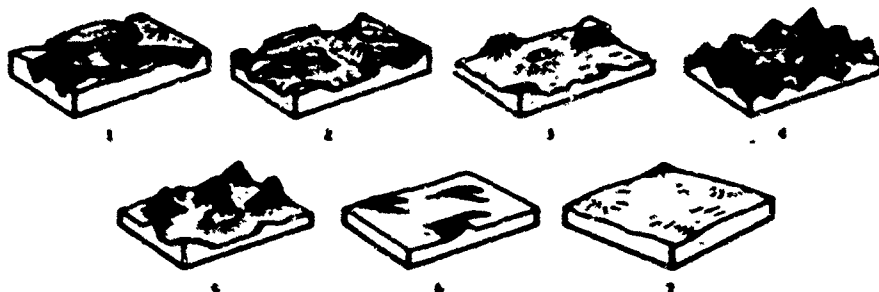
- Highs are considered to be (1) peaks or crested prominences which exhibit characteristic slopes greater than 4 degrees or (2) thick flat-topped prominences or high-level areas bounded by slopes in excess of 10 degrees.

- L indicates linearity of highs. A high is considered to be linear when its length is greater than 5 times its width.

- H indicates roughly parallel arrangement of highs or aligned highs.

REPRESENTATIVE PLAN-PROFILES

Each of the following block diagrams illustrates a landscape representative of a specific plan-profile type. It should be emphasized that, within the defined limits of each type, a wide variety of landscape configurations are possible.



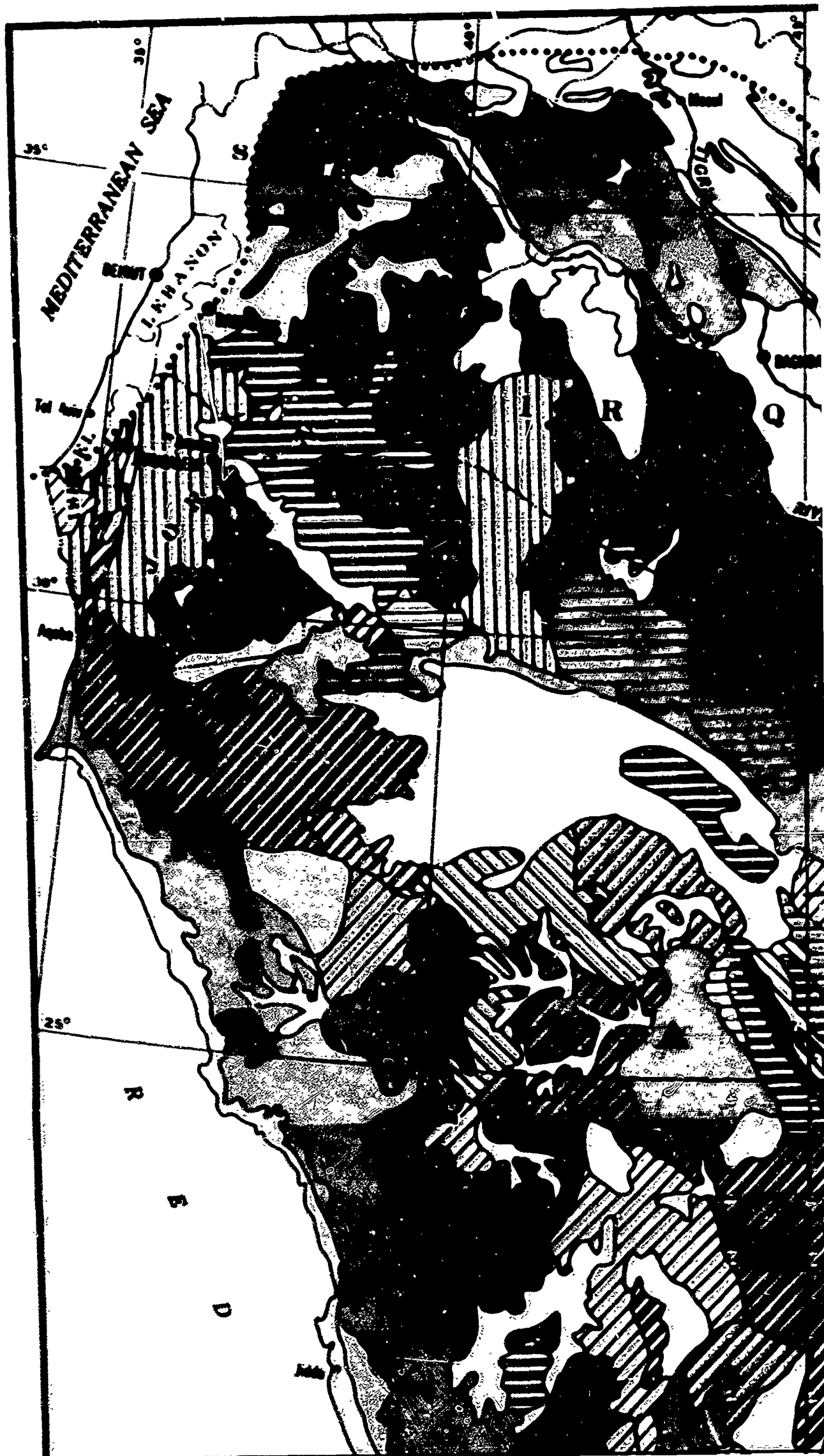
ANALOGS OF YUMA TERRAIN

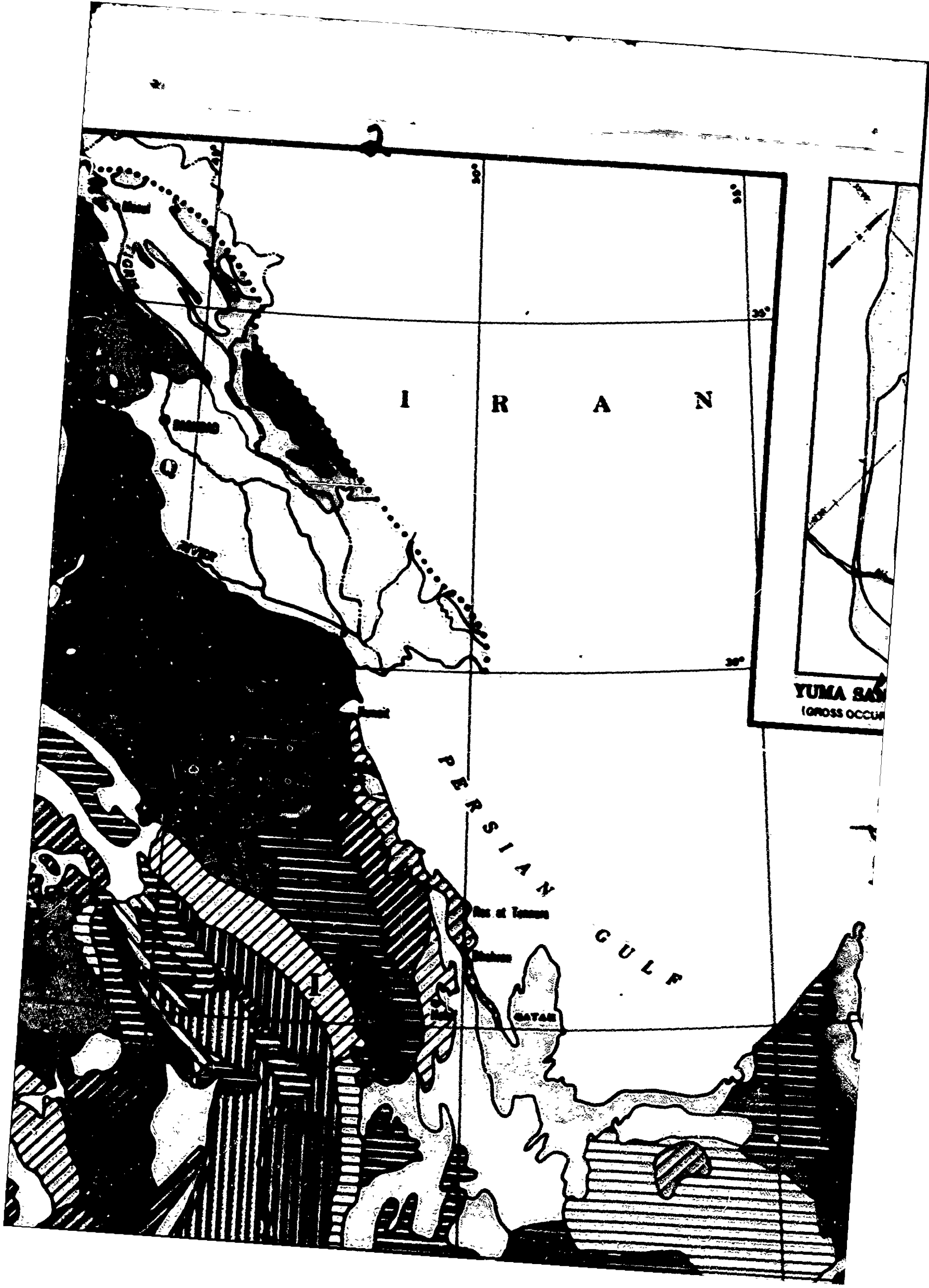
IN THE

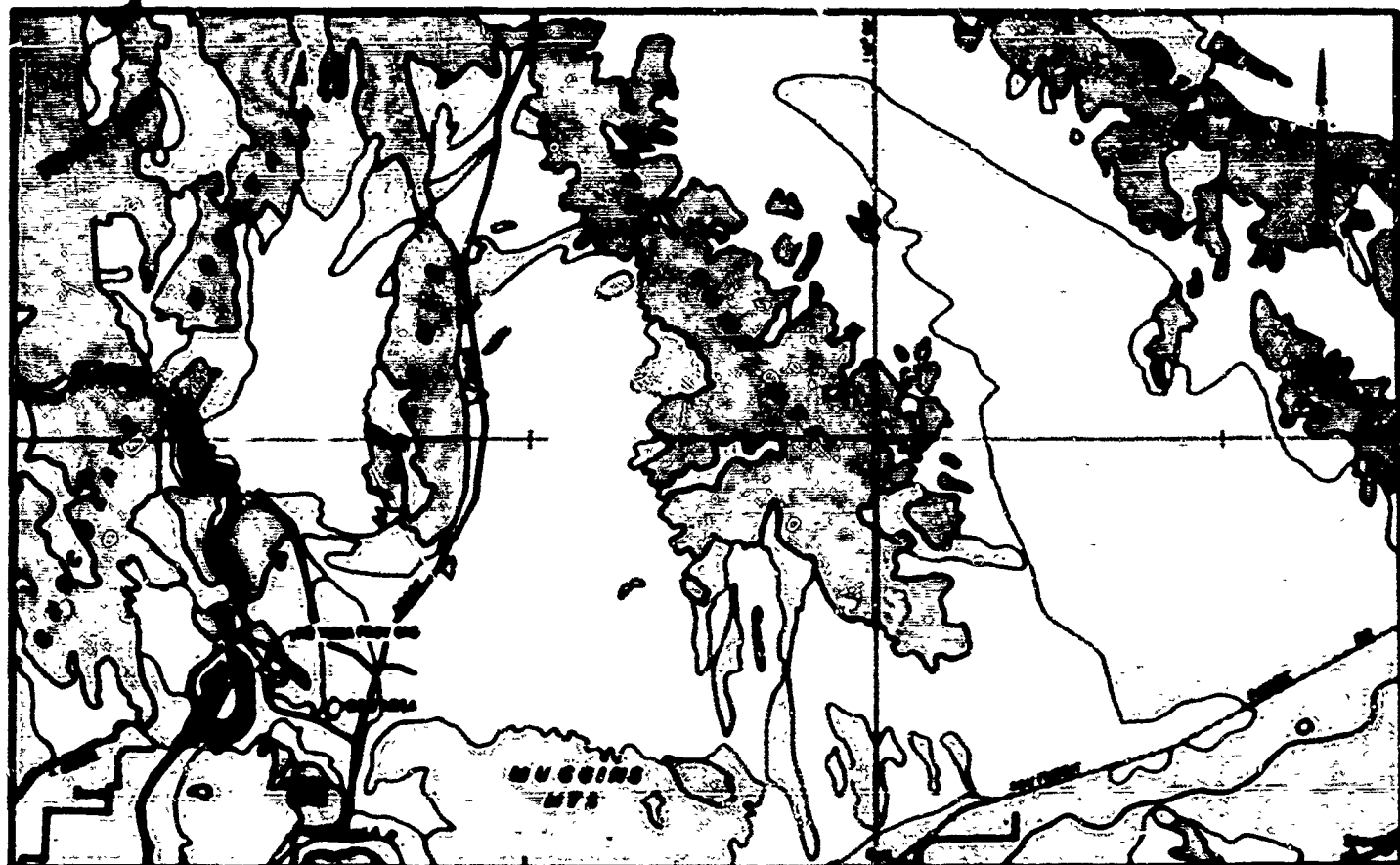
MIDDLE EAST DESERT

CHARACTERISTIC PLAN-PROFILE

PLATE I

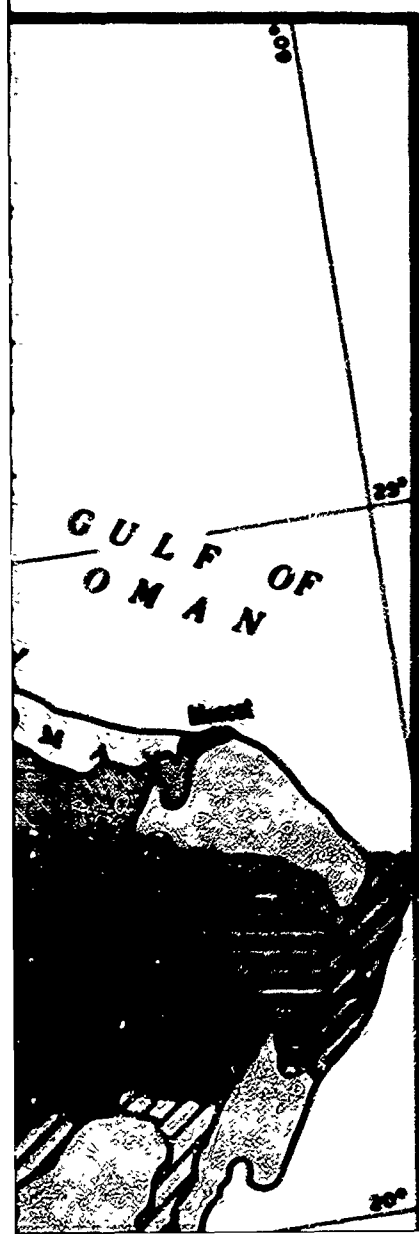






YUMA PROVING GROUND
(GROSS OCCURRENCE OF COMPONENT HIGHS: 1)

HILLS
E: 1)



OCCURRENCE OF SLOPES GREATER THAN 50 PER CENT

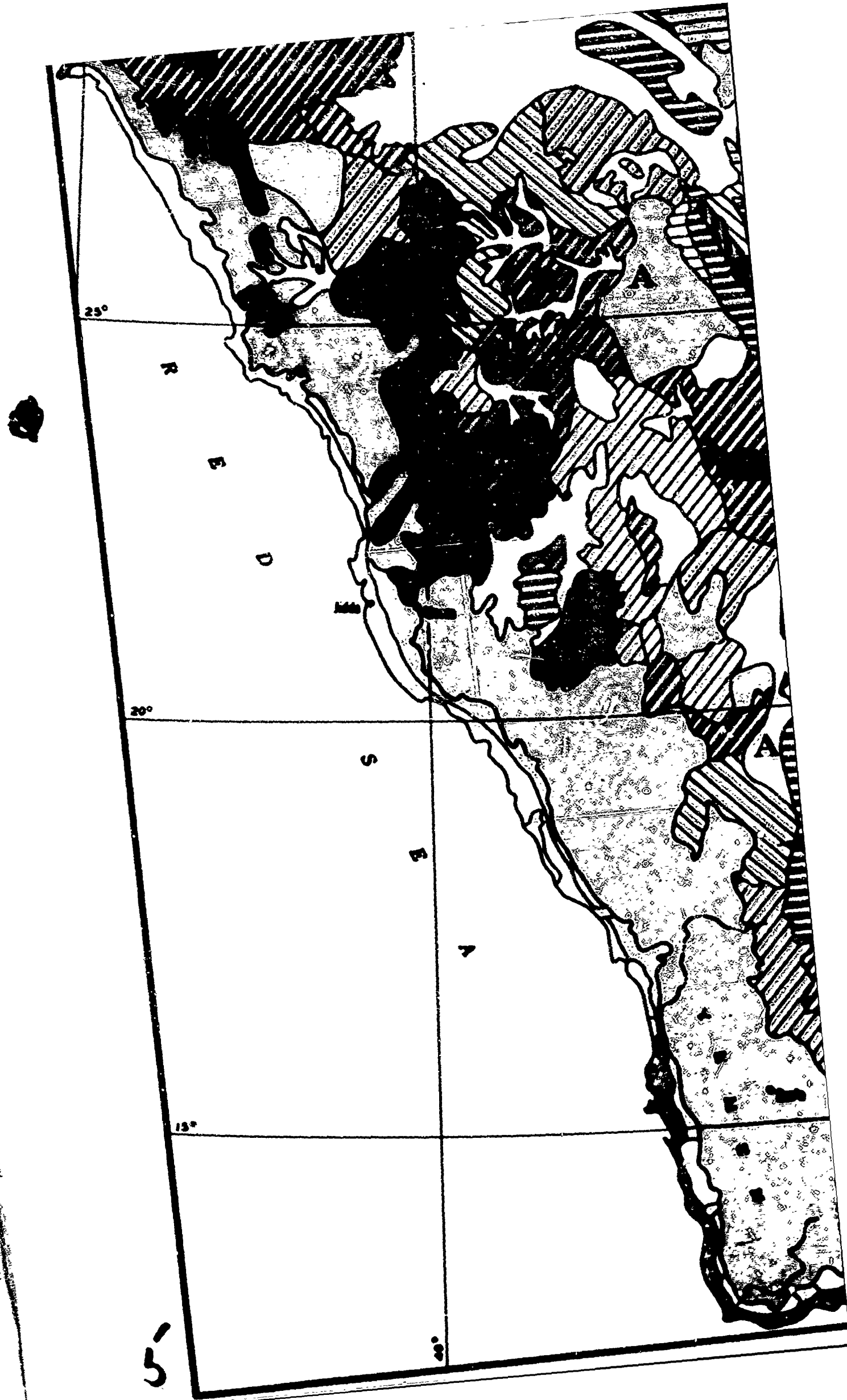
Occurrence may be either restrictive or gross. A restrictive occurrence class indicates a small range of slopes greater than 50 per cent found along traverses containing the maximum number of such slopes. Slopes of less than 50 per cent are not considered. A gross occurrence indicates the small distance between component highs or component lows. Slopes of less than 50 per cent are not considered.

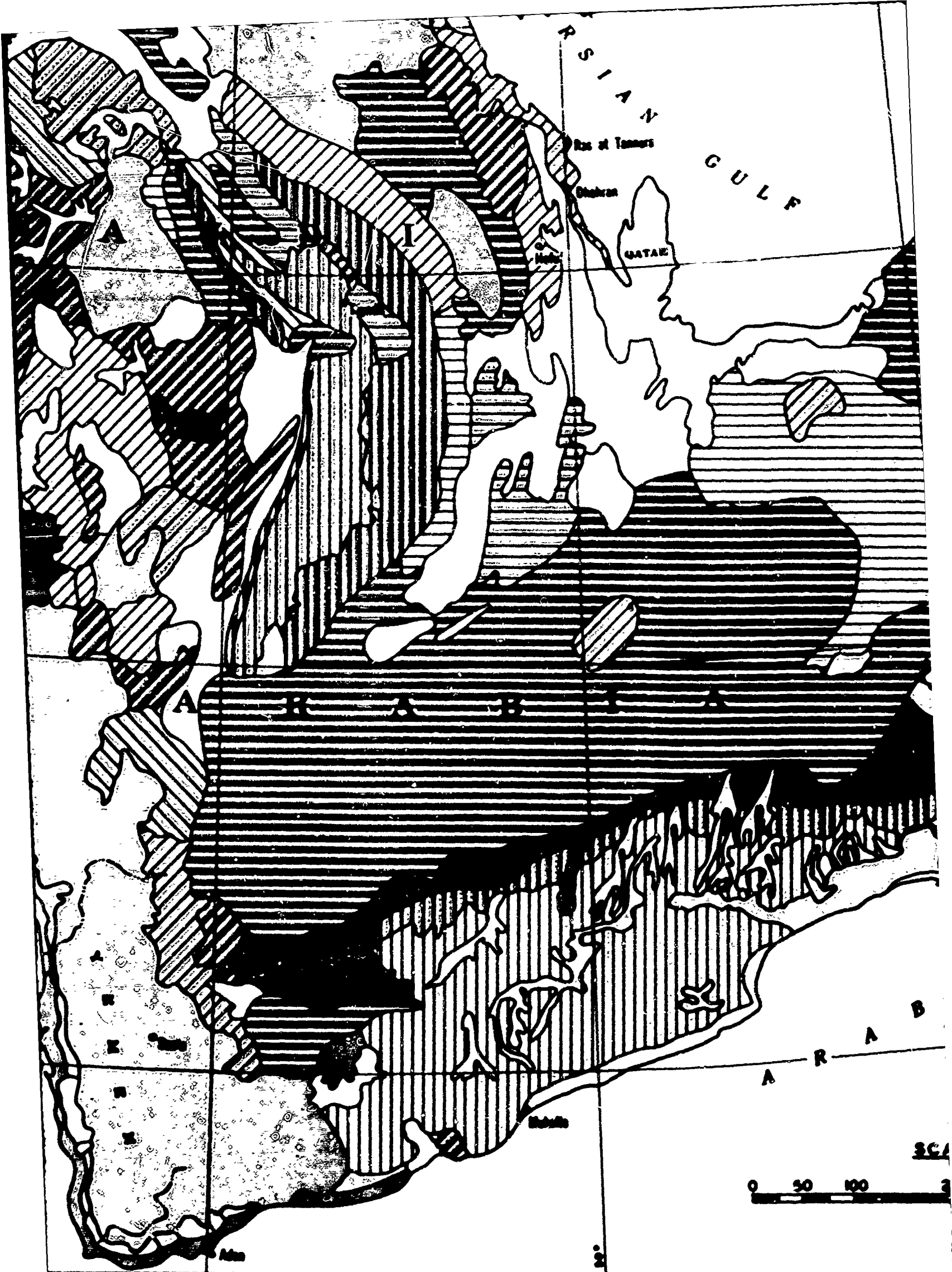
1. The number of slopes steeper than 50 per cent on less than 2 per 10 miles or in areas, less than 10 miles in maximum dimension, where both slopes are lacking.
2. The number of slopes steeper than 50 per cent ranges from 1 to 2 per 10 miles.
3. The number of slopes steeper than 50 per cent ranges from 3 to 50 per 10 miles.
4. The number of slopes steeper than 50 per cent ranges from 50 to 100 per 10 miles.
5. The number of slopes steeper than 50 per cent ranges from 100 to 200 per 10 miles.
6. The number of slopes steeper than 50 per cent exceeds 200 per 10 miles.

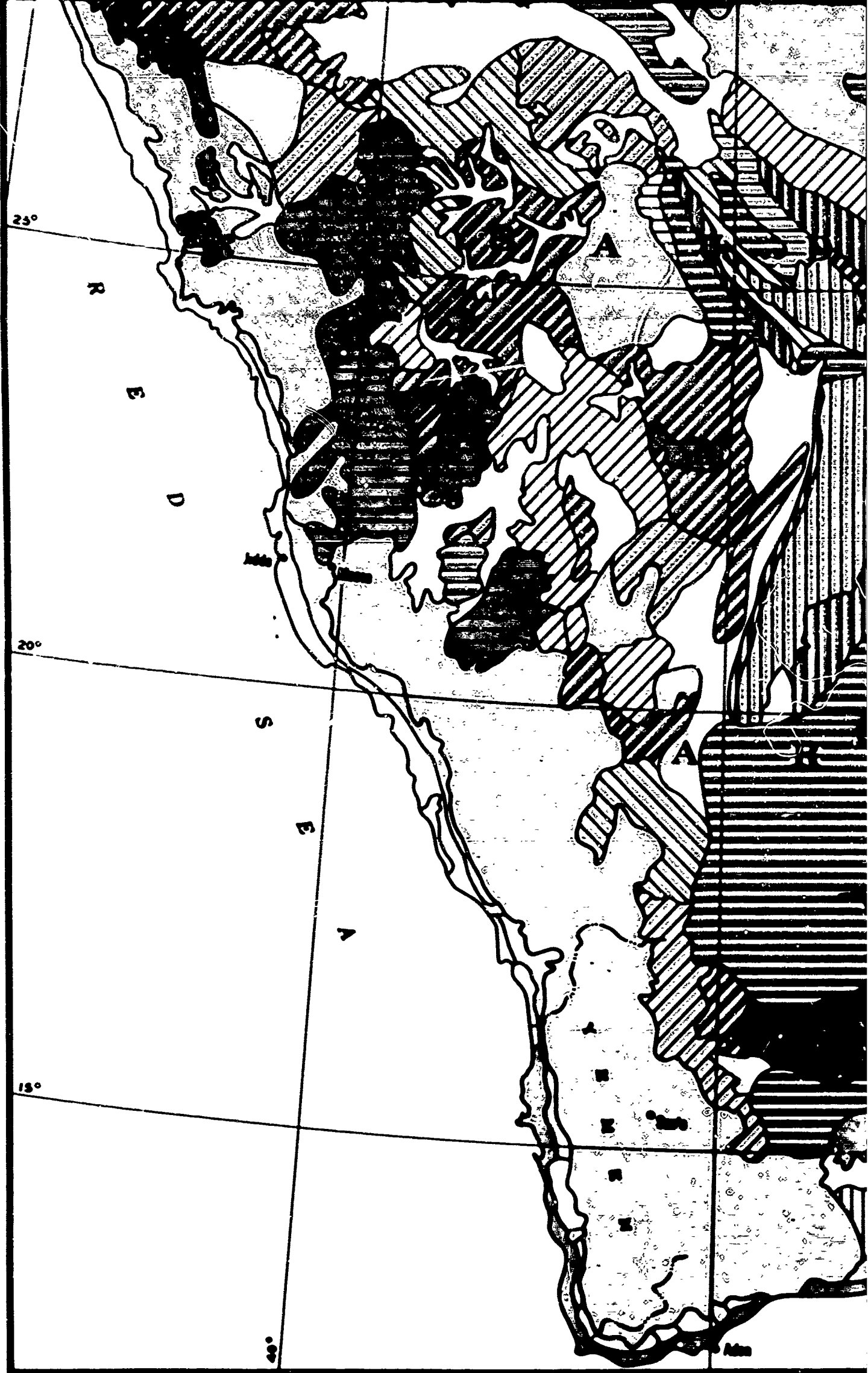
OCCURRENCE COMPLEXES: Mapped only where plan-profile complexes are mapped.

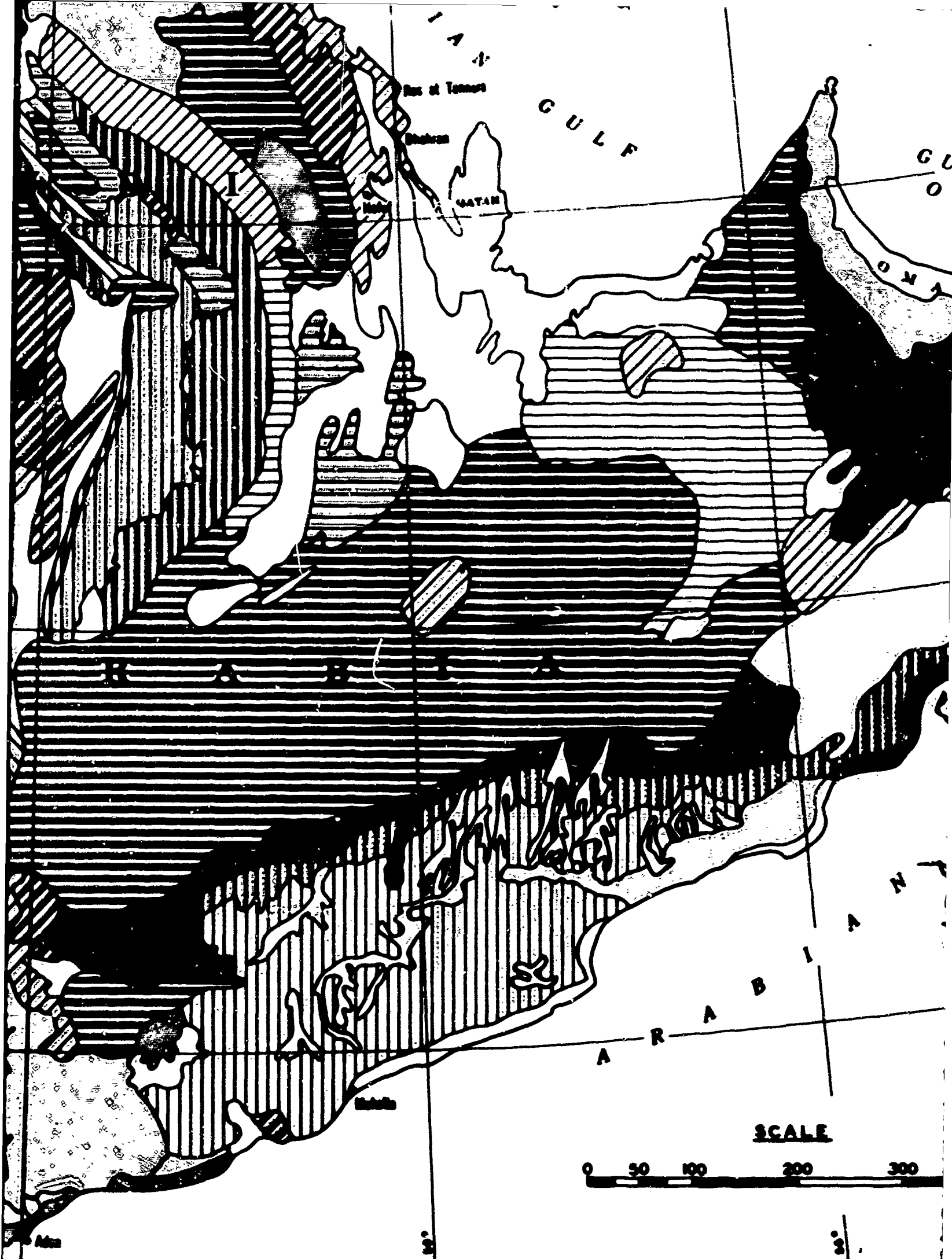
Area Complexes: Confined to areas where two major, greatly restricted occurrence units, both of the restrictive type, are mapped.

- ✓ Slope occurrence of greatly predominant lows.
Slope occurrence of greatly subordinate highs.
- ✓ Slope occurrence of greatly predominant highs.
Slope occurrence of greatly subordinate lows.











OCCURRENCE OF SLOPES GREATER THAN 50 PER CENT

Occurrence may be either restrictive or gross. A restrictive occurrence class indicates a modal range of slopes greater than 50 per cent found along traverses containing the maximum number of such slopes. Relief of less than 10 ft is not considered. A gross occurrence indicates the modal distance between component highs or component lows. Relief of less than 100 ft is not considered.

1. The number of slopes steeper than 50 per cent is less than 1 per 10 miles or in areas less than 10 miles in maximum dimension, where such slopes are lacking.
2. The number of slopes steeper than 50 per cent ranges from 1 to 5 per 10 miles.
3. The number of slopes steeper than 50 per cent ranges from 5 to 20 per 10 miles.
4. The number of slopes steeper than 50 per cent ranges from 20 to 100 per 10 miles.
5. The number of slopes steeper than 50 per cent ranges from 100 to 200 per 10 miles.
6. The number of slopes steeper than 50 per cent exceeds 200 per 10 miles.

OCCURRENCE COMPLEXES: Mapped only where plan-profile complexes are mapped.

Areal Complexes: Confined to areas where two major, areally restricted occurrence units, both of the restrictive type, are mapped.

- ✓ Slope occurrence of areally predominant low.
- ✓ Slope occurrence of areally subordinate high.
- ✓ Slope occurrence of areally predominant high.
- ✓ Slope occurrence of areally subordinate low.

Green-component Complexes: Mapped only where green-component plan-profile complexes are mapped.

- Green occurrence of component high.
- Restrictive occurrence within component low.
- Green occurrence of component low.
- Restrictive occurrence within component high.

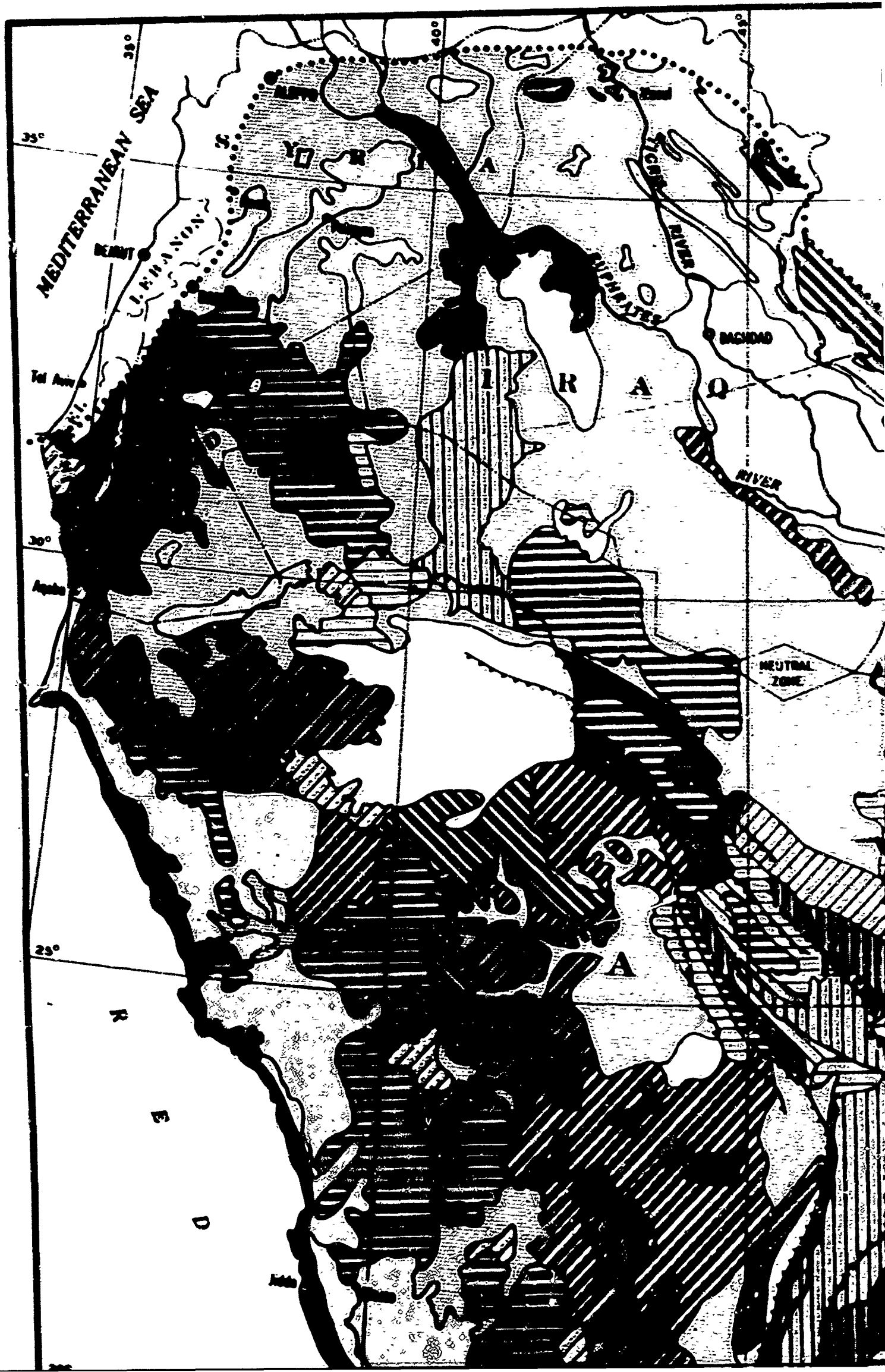


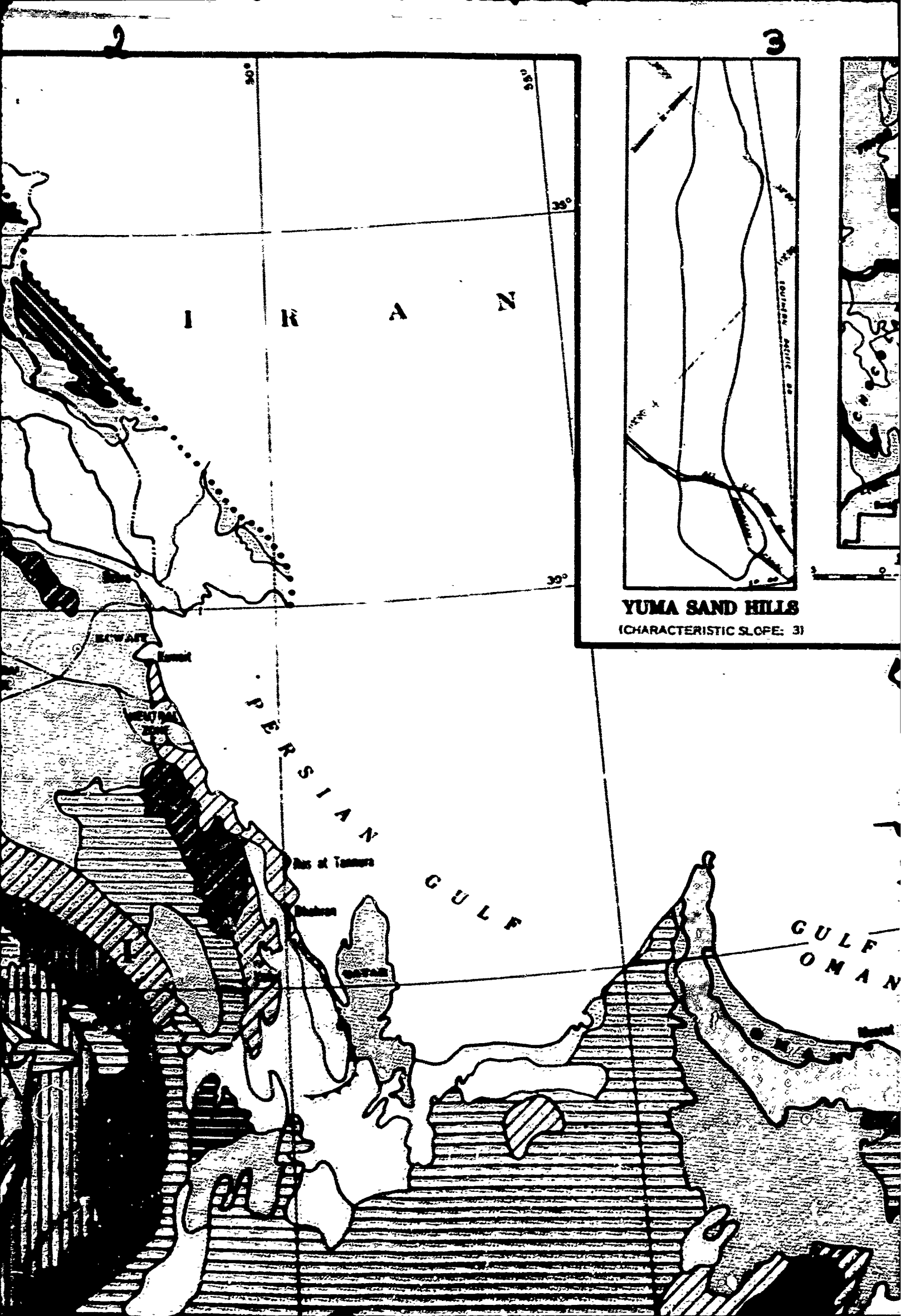
ANALOGS OF YUMA TERRAIN

IN THE

MIDDLE EAST DESERT

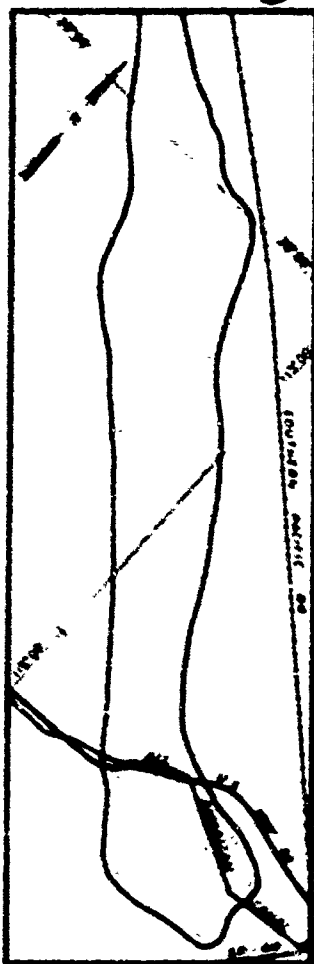
OCCURRENCE OF SLOPES GREATER THAN 50 PERCENT



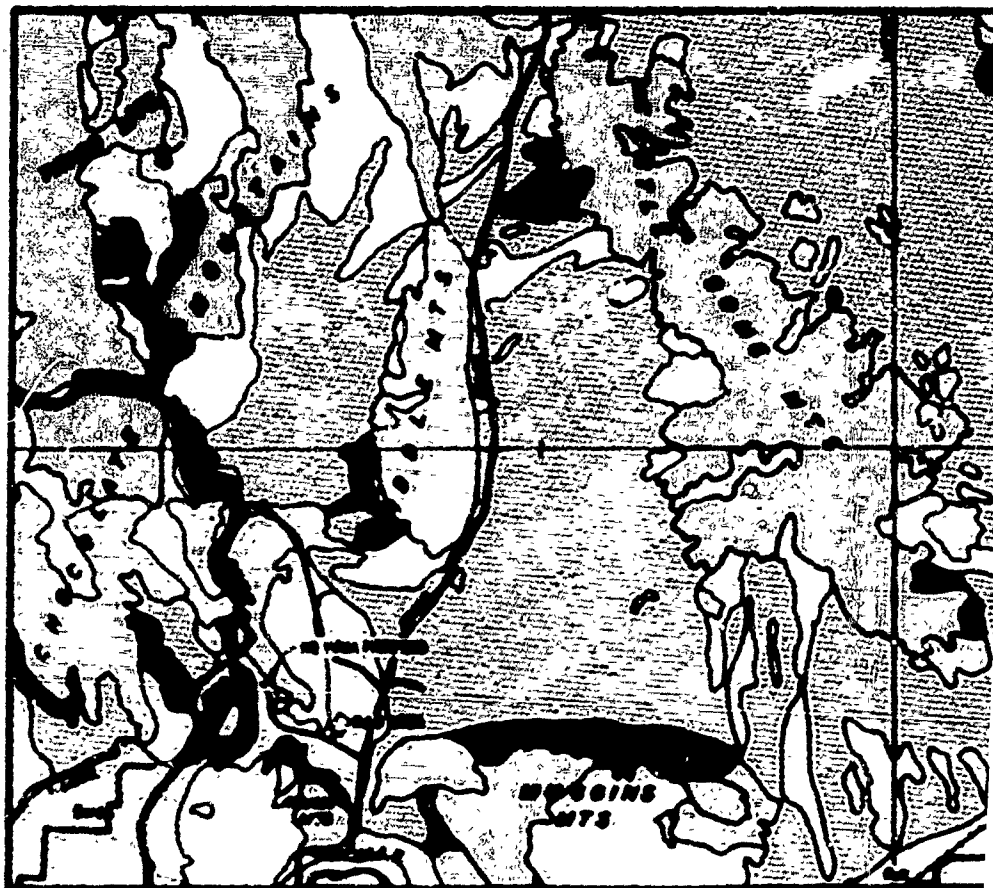


YUMA SAND HILLS
(CHARACTERISTIC SLOPE: 3)

3

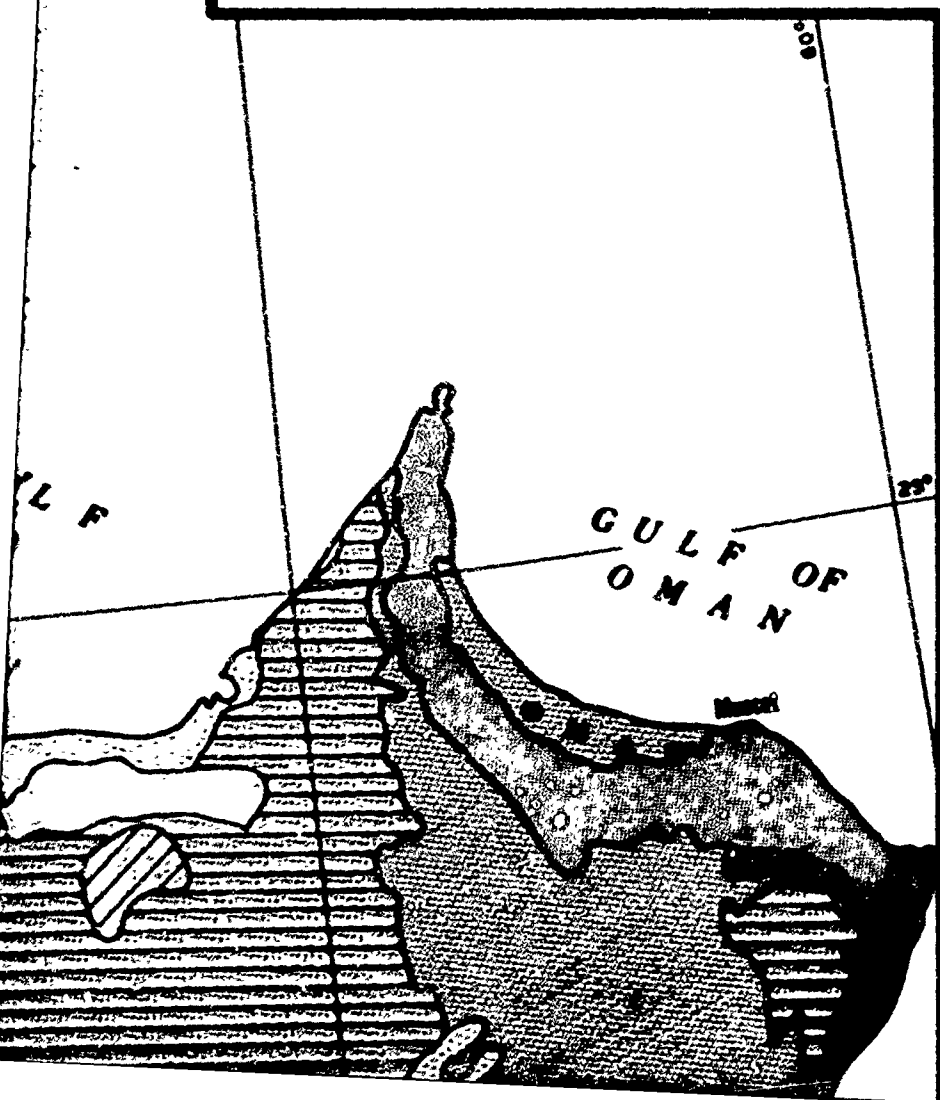


YUMA SAND HILLS
(CHARACTERISTIC SLOPE: 3)



YUMA PROVING GROUND
(CHARACTERISTIC SLOPE WITHIN COMPONENT HIGH)

SCALE 0 1000 2000



CHARACTERISTIC SLOPE

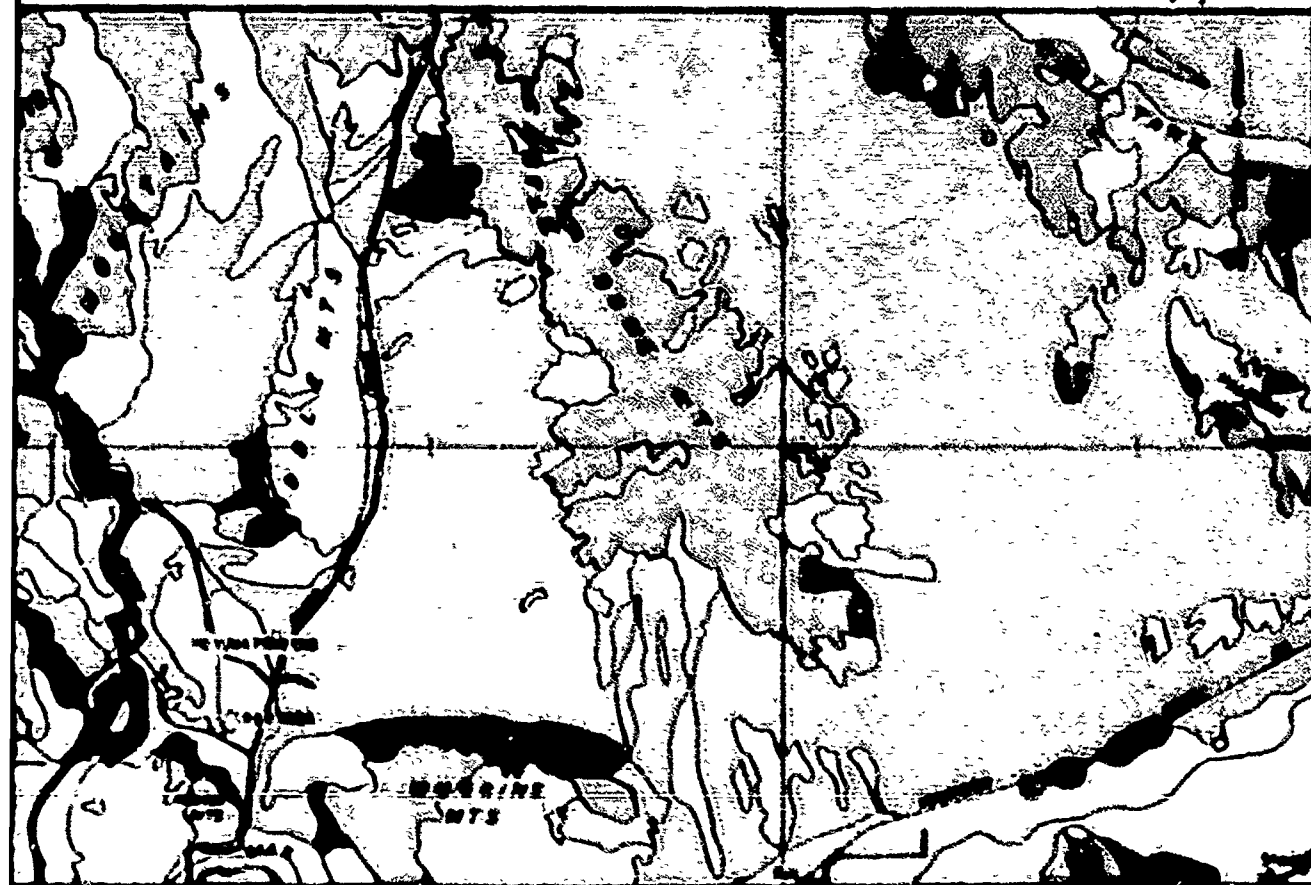
Slope is defined as a certain identifiable deviation from the horizontal. Characteristic range of slopes which predominates or is in increasing a distinctive aspect, arranged mapped with a 10-ft contour interval.

Flat: Characteristic slope between 0 and 0 - 1.9%.

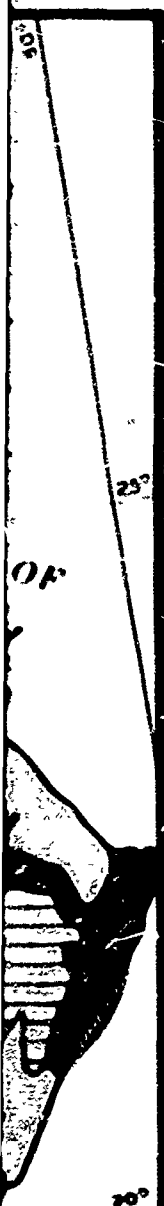
- 10 Between 0 and 1/2 degree (47)
- 15 Between 1/2 and 2 degrees (47)
- 2 Gentle: Characteristic slope between 2 3.5 - 10%.
- 3 Moderate: Characteristic slope between 10 - 25%.
- 4 Backward: Characteristic slope between 25 - 50%.
- 5 Steep: Characteristic slope between 50 - 100%.
- 6 Precipitous: Characteristic slope greater than 100%.

SLOPE CONTOURS: (Shaded) only where plan Area Complex: Contour to area a slope type or a mapped.

SPACED: Characteristic slope of actually or



YUMA PROVING GROUND
 CHARACTERISTIC SLOPE WITHIN COMPONENTS HIGHWAY 63



CHARACTERISTIC SLOPE

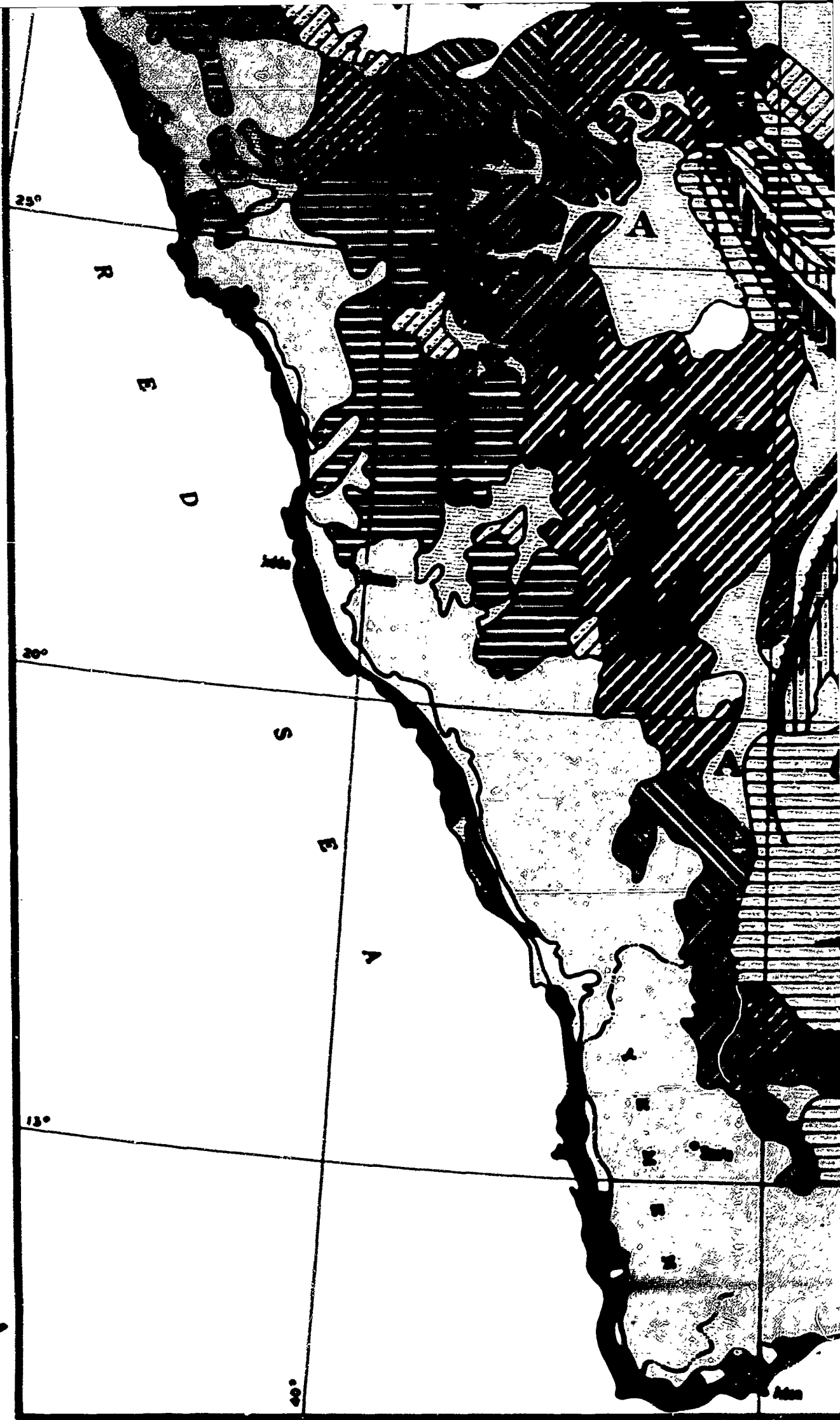
Slope is defined as a section of surface as described in terms of the deviation from the horizontal. Characteristic slope is defined as a narrow range of slopes which predominates in a given common area. A region possessing a distinctive spacing, arrangement, or pattern of surface lines mapped with a 1:25,000 scale is selected.

1:25,000 Characteristic slope between 0 and 2 degrees (approx. 0 - 3.4%)

- 1a [] Between 2 and 3 degrees (approx. 3.4 - 5.7%)
- 1b [] Between 3.7 and 5 degrees (approx. 5.7 - 9.5%)
- 2 [] Gentle Characteristic slope between 2 and 6 degrees (approx. 3.4 - 10.4%)
- 3 [] Moderate Characteristic slope between 6 and 10 degrees (approx. 10.4 - 17.6%)
- 4 [] Disturbed Characteristic slope between 10 and 25.4 degrees (approx. 17.6 - 50%)
- 5 [] Steep Characteristic slope between 25.4 and 45 degrees (approx. 50 - 100%)
- 6 [] Precipitous Characteristic slope greater than 45 degrees (approx. more than 100%)

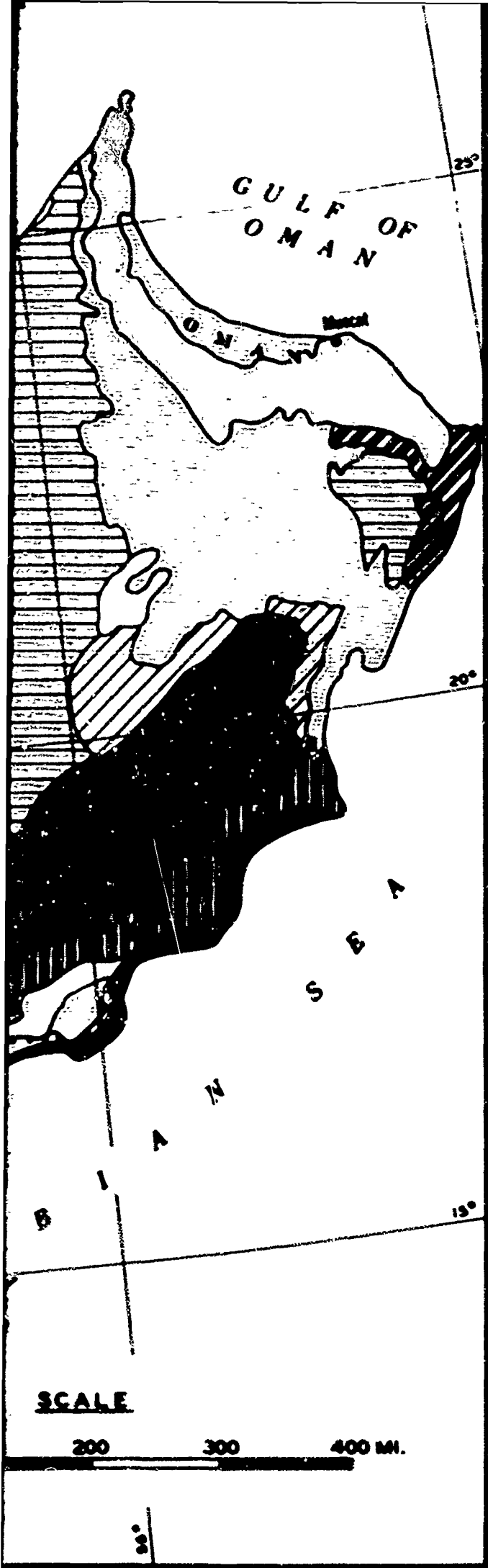
SLOPE COMPLEXES (Shaded only where plan profile complexes are mapped)
 Area Complexes (Shaded to areas where two major slope types are mapped)

- 7a [] Characteristic slope of locally predominant low
 Characteristic slope of locally predominant high
- 7b [] Characteristic slope of locally predominant high
 Characteristic slope of locally predominant low



5





CHARACTERISTIC SLOPE

Slope is defined as a surface identified or designated in terms of its deviation from the horizontal. Characteristic slope is defined as a narrow range of slopes which predominates or is most common within a region possessing a distinctive spacing, arrangement, or pattern of contour lines mapped with a 15-ft contour interval.

Flat: Characteristic slope between 0 and 2 degrees (approx. 0 - 3.5%).

- 0a Between 0 and 1/2 degree (approx. 0 - 1%).
- 1b Between 1/2 and 2 degrees (approx. 1 - 3.5%).
- 2 Gentle: Characteristic slope between 2 and 5 degrees (approx. 3.5 - 10%).
- 3 Moderate: Characteristic slope between 5 and 10 degrees (approx. 10 - 25%).
- 4 Discontinuous: Characteristic slope between 10 and 16.5 degrees (approx. 25 - 50%).
- 5 Steep: Characteristic slope between 16.5 and 45 degrees (approx. 50 - 100%).
- 6 Precipitous: Characteristic slope greater than 45 degrees (greater than 100%).

SLOPE COMPLEXES: Mapped only where plan-profile complexes are mapped.
Areal Complexes: Confined to areas where two major, locally restricted slope types are mapped.

- 2/4 Characteristic slope of locally predominant low.
Characteristic slope of locally subordinate high.
- 1b/3 Characteristic slope of locally predominant high.
Characteristic slope of locally subordinate low.

Grass-Complexes Complexes: Mapped only where grass-encumbered plan-profile complexes are mapped. The symbols in the complex are arranged vertically or horizontally depending on the plan-profile.

- 1/15 Characteristic slope within encumbered high.
Characteristic slope within encumbered low.
- 5/2 Characteristic slope within encumbered crest.
Characteristic slope within encumbered high.

Important Slopes: An important slope is defined as a more or less continuous precipitous slope exhibiting more than 100 feet of relief. Only the better known slopes which extend for considerable distances have been mapped. Slope height is indicated where known.

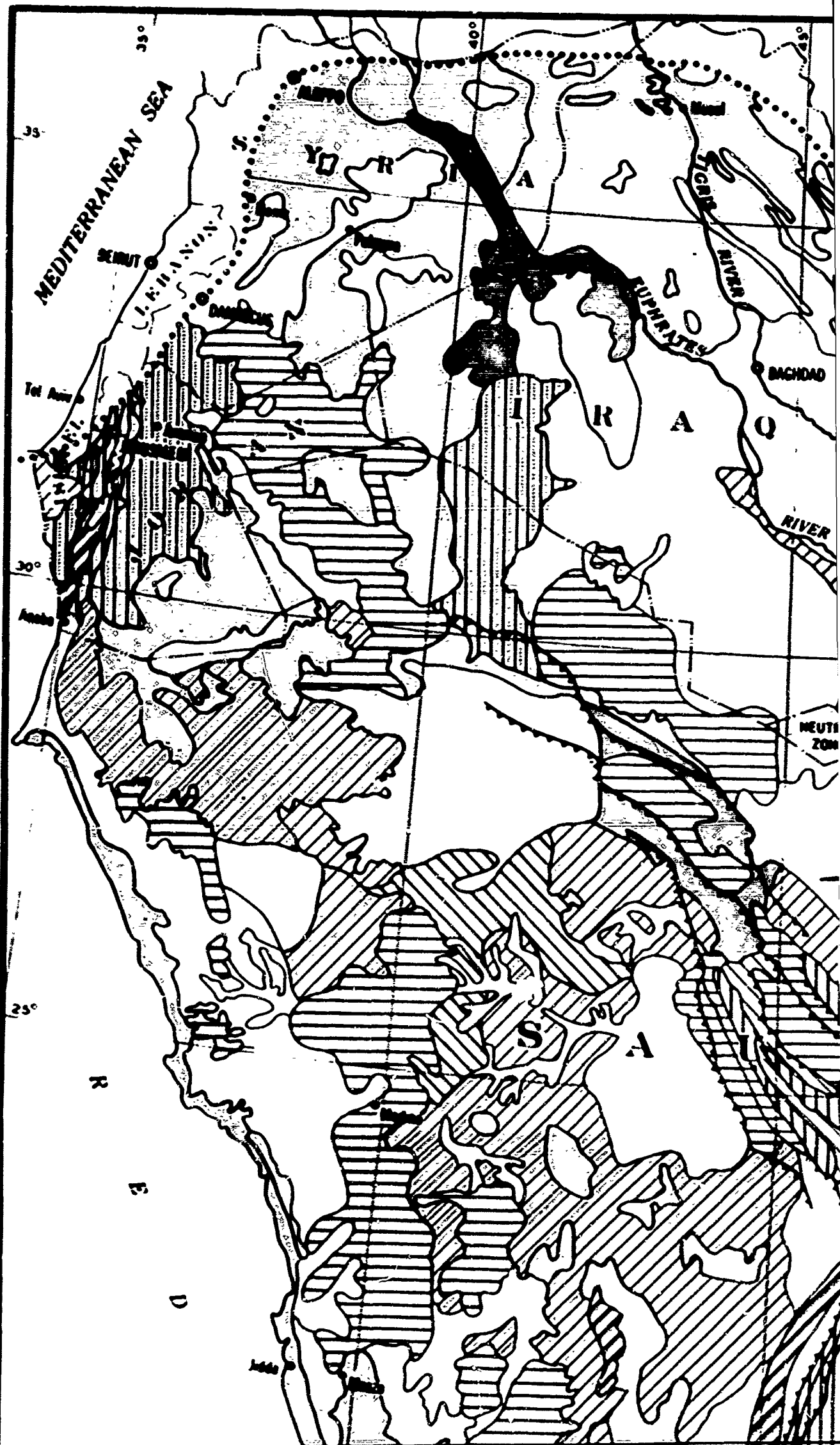
* In cases where the grass plan-profile is flat-topped or flat-bottomed the characteristic slope is considered to be the modal slope of the bounding slopes.

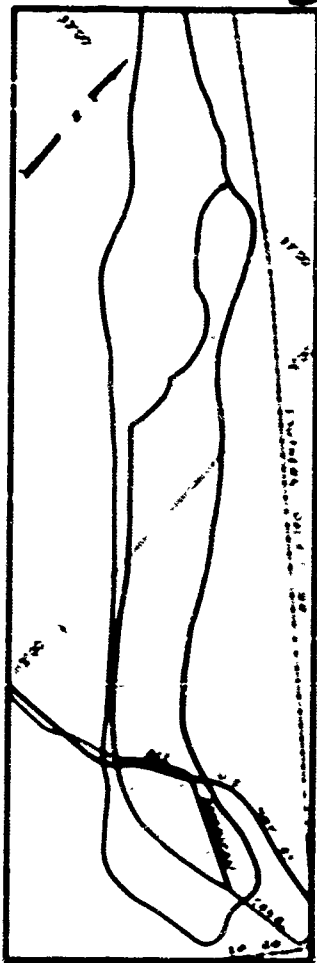
ANALOGS OF YUMA TERRAIN

IN TIME

MIDDLE EAST DESERT

CHARACTERISTIC SLOPE

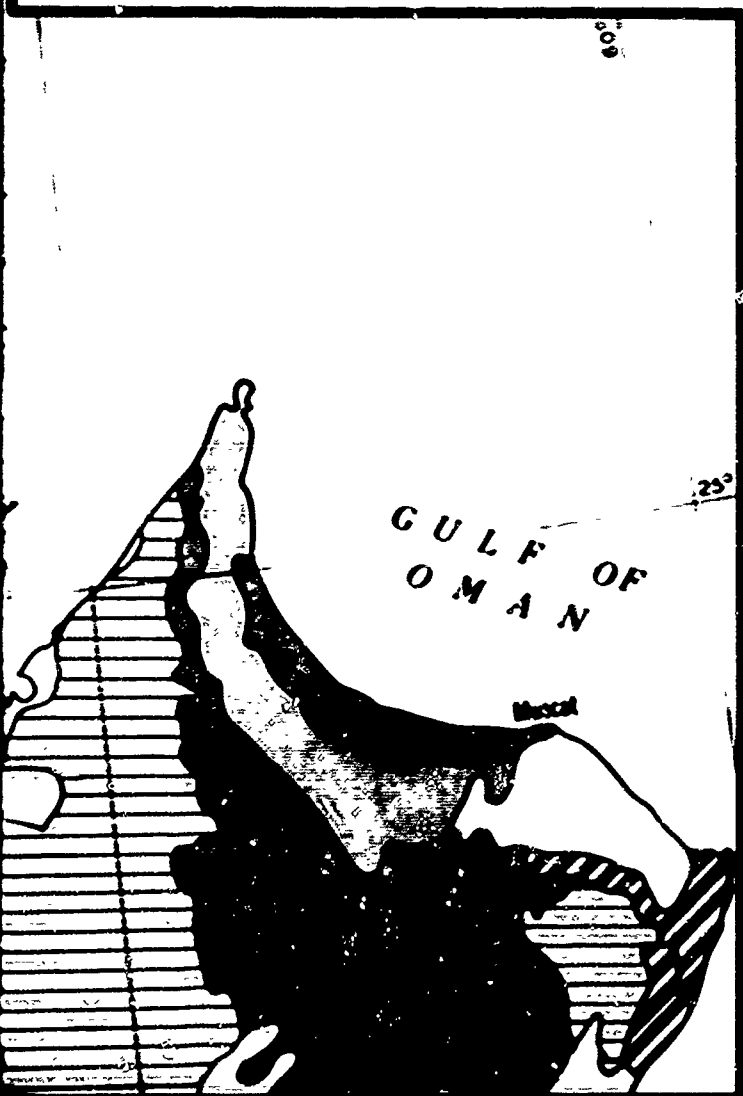




YUMA SAND HILLS
(GROSS RELIEF: 5)



YUMA PROVING GROUND
(GROSS RELIEF OF COMPONENT HIGHS: 71)



CHARACTERISTIC RELIEF

Characteristic relief is defined as the relief which is typical of a given area. It is based on the relief of the area, not on the relief of the surrounding area. The relief is defined as the difference in elevation between the highest and lowest points of the area. The relief is defined as the difference in elevation between the highest and lowest points of the area.

1. RELIEF IN AREAS WHERE THE CHARACTERISTIC SLOPE IS LESS THAN 6 DEGREES (APPROX. 10 PER CENT)

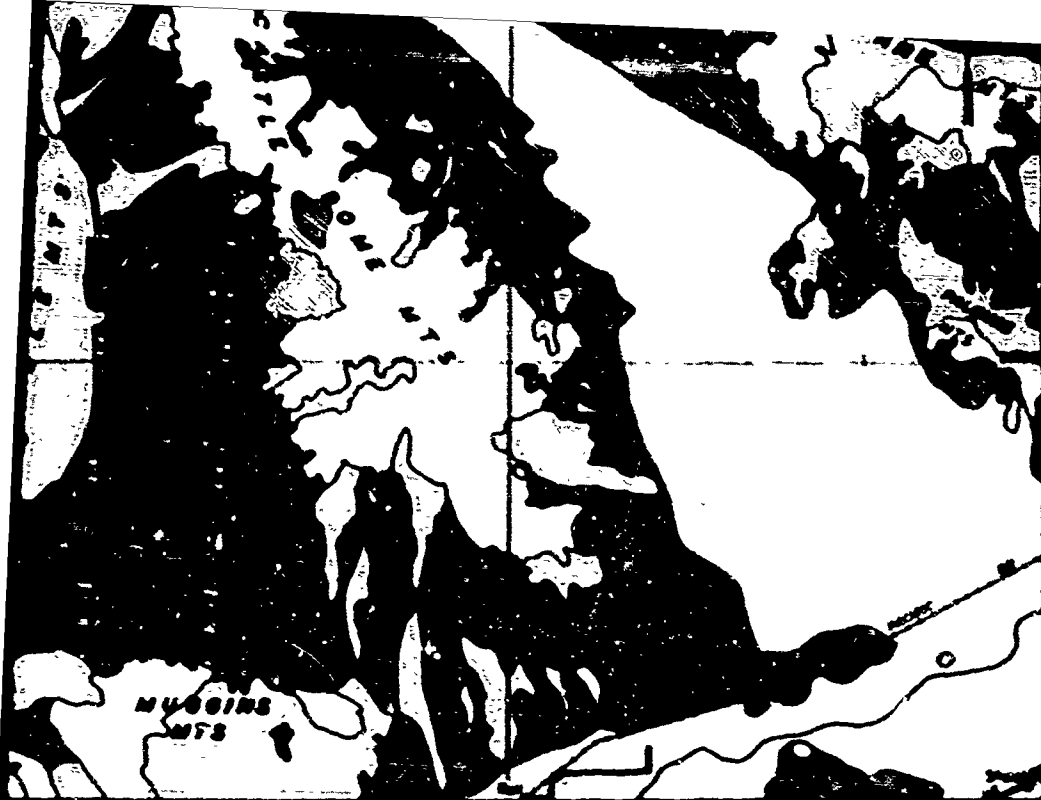
Relief is defined as the difference in elevation between the highest and lowest points of the area. The relief is defined as the difference in elevation between the highest and lowest points of the area.

- 1. Characteristic relief between 0 and 10 feet
- 2. Characteristic relief between 10 and 20 feet
- 3. Characteristic relief between 20 and 30 feet

2. RELIEF IN AREAS WHERE THE CHARACTERISTIC SLOPE IS GREATER THAN 6 DEGREES (APPROX. 10 PER CENT)

Relief is defined as the difference in elevation between the highest and lowest points of the area. The relief is defined as the difference in elevation between the highest and lowest points of the area.

- 4. Characteristic relief between 30 and 40 feet
- 5. Characteristic relief between 40 and 50 feet
- 6. Characteristic relief between 50 and 60 feet



YUMA PROVING GROUND

(GROSS RELIEF OF COMPONENT HIGHS: 7)

CHARACTERISTIC RELIEF

Characteristic relief may be defined as the difference in elevation between the highest and lowest points of a given area. It is determined by the difference in elevation between the highest and lowest points of a given area. It is determined by the difference in elevation between the highest and lowest points of a given area.

1. RELIEF IN AREAS WHERE THE CHARACTERISTIC SLOPE IS LESS THAN 5 DEGREES (APPROX. 10 PER CENT)

Relief is defined as the mean contour distance to the nearest contour line. It is determined by the difference in elevation between the highest and lowest points of a given area.

- 1. Characteristic relief between 0 and 25 feet
- 2. Characteristic relief between 25 and 50 feet
- 3. Characteristic relief between 50 and 100 feet

2. RELIEF IN AREAS WHERE THE CHARACTERISTIC SLOPE IS GREATER THAN 5 DEGREES (APPROX. 10 PER CENT)

Relief is defined as the mean contour distance to the nearest contour line. It is determined by the difference in elevation between the highest and lowest points of a given area.

* Usually restricted to land data areas - minimum height of datum as shown where shown.

- 1. Characteristic relief between 0 and 500 feet
- 2. Characteristic relief between 500 and 1,000 feet
- 3. Characteristic relief between 1,000 and 2,000 feet
- 4. Characteristic relief greater than 2,000 feet

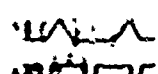
RELIEF COMPLEXES (Mapped only where planographic complexes are mapped)

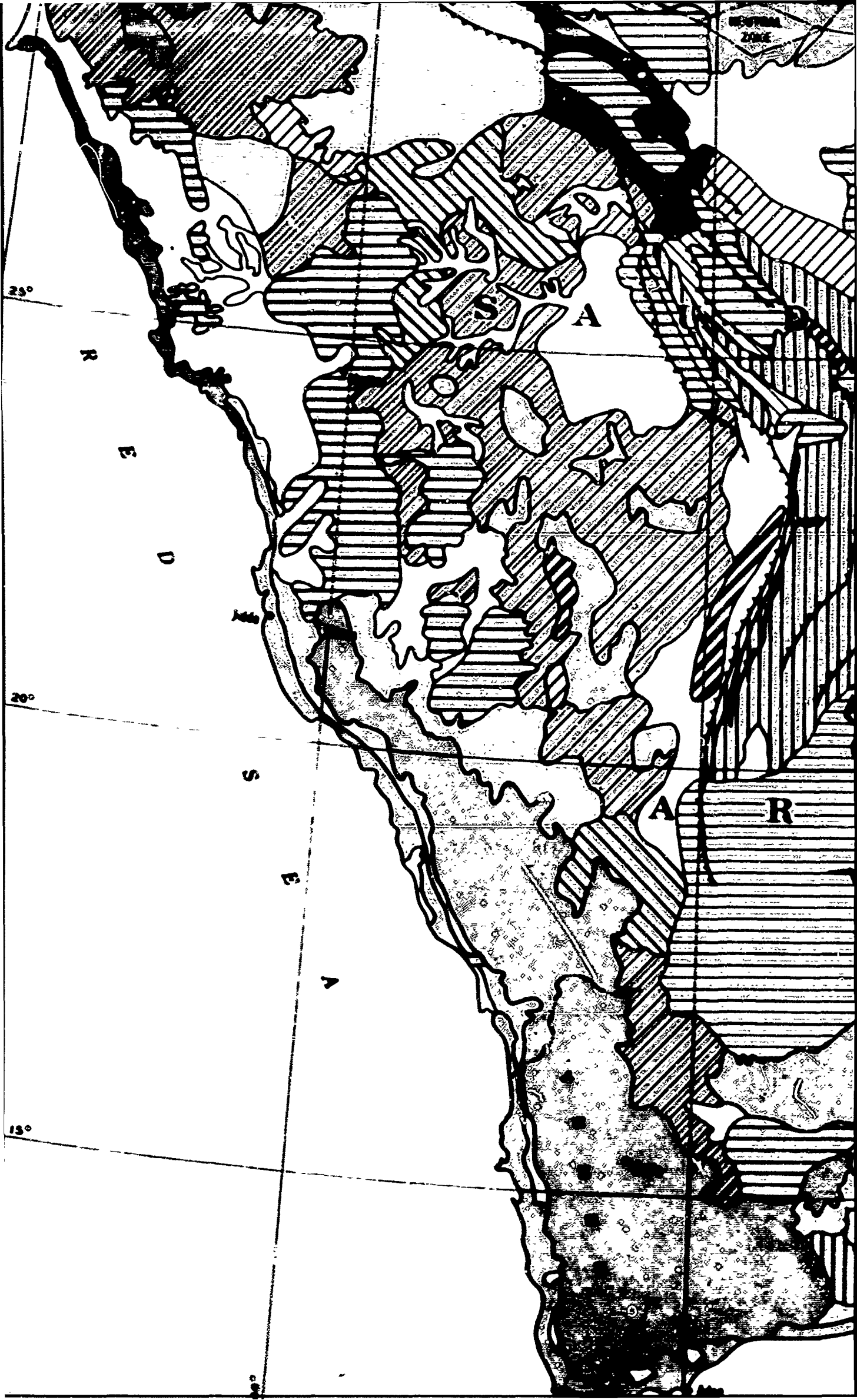
Area Complexes: Confined to areas where two mapped relief complexes occur, both of the same type, are mapped.

- 1. Relief of usually predominant low
- 2. Relief of usually predominant high

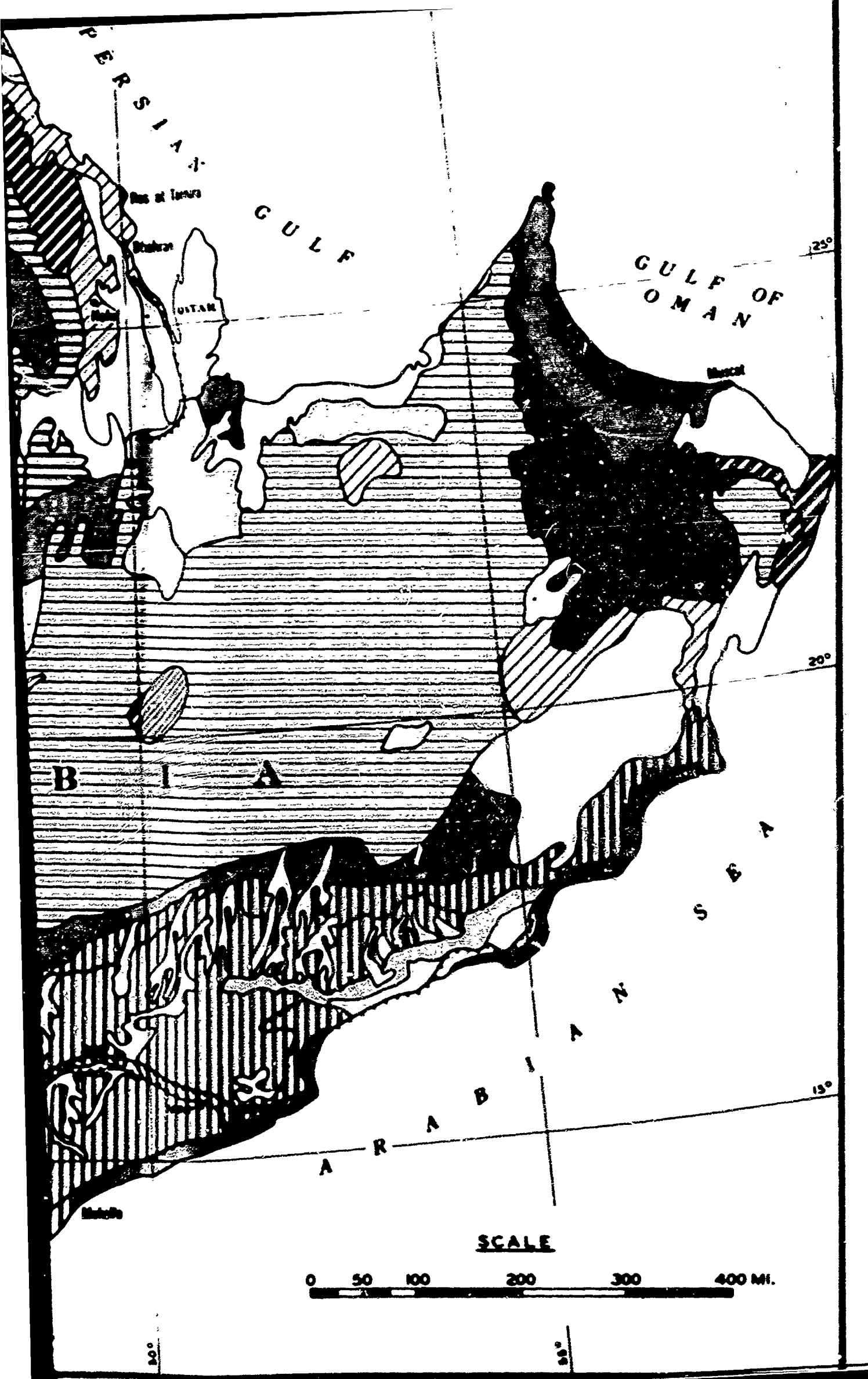
Grass-Quadrant Complexes: Mapped only where grass-Quadrant complexes are mapped.

- 1. Grass relief of component high
- 2. Grass relief of component low









CHARACTERISTIC RELIEF

Characteristic relief may be either restorative or gross. Restorative relief is based on modal classes of stream depth, streambed elevation, and stream, or prominence height. This is further defined under type I and type II relief, below. Gross relief indicates the modal height of prominent features of the modal class of streambeds.

I. RELIEF IN AREAS WHERE THE CHARACTERISTIC SLOPE IS LESS THAN 6 DEGREES (APPROX. 10 PER CENT)

Relief is defined as the modal vertical distance from streambed to the immediately adjacent low land or stream where drainage lines are poorly developed or lacking,* from stream to adjacent low

- 1  Characteristic relief between 0 and 10 feet
- 2  Characteristic relief between 10 and 50 feet
- 3  Characteristic relief > 50 feet

II. RELIEF IN AREAS WHERE THE CHARACTERISTIC SLOPE IS GREATER THAN 6 DEGREES (APPROX. 10 PER CENT)

Relief is defined as the modal maximum difference in elevation per square mile or in areas where drainage lines are poorly developed or lacking,* from stream to adjacent low

* If mostly restricted to headwater stream maximum height of stream in basin where known

- 1  Characteristic relief between 0 and 100 feet
- 2  Characteristic relief between 100 and 400 feet
- 3  Characteristic relief between 400 and 1,000 feet
- 4  Characteristic relief greater than 1,000 feet

RELIEF COMPLEXES (Mapped only where geomorphic complexes are mapped)

Arval Complexes. Confined to areas where two major locally restricted relief units, both of the same type, are mapped.

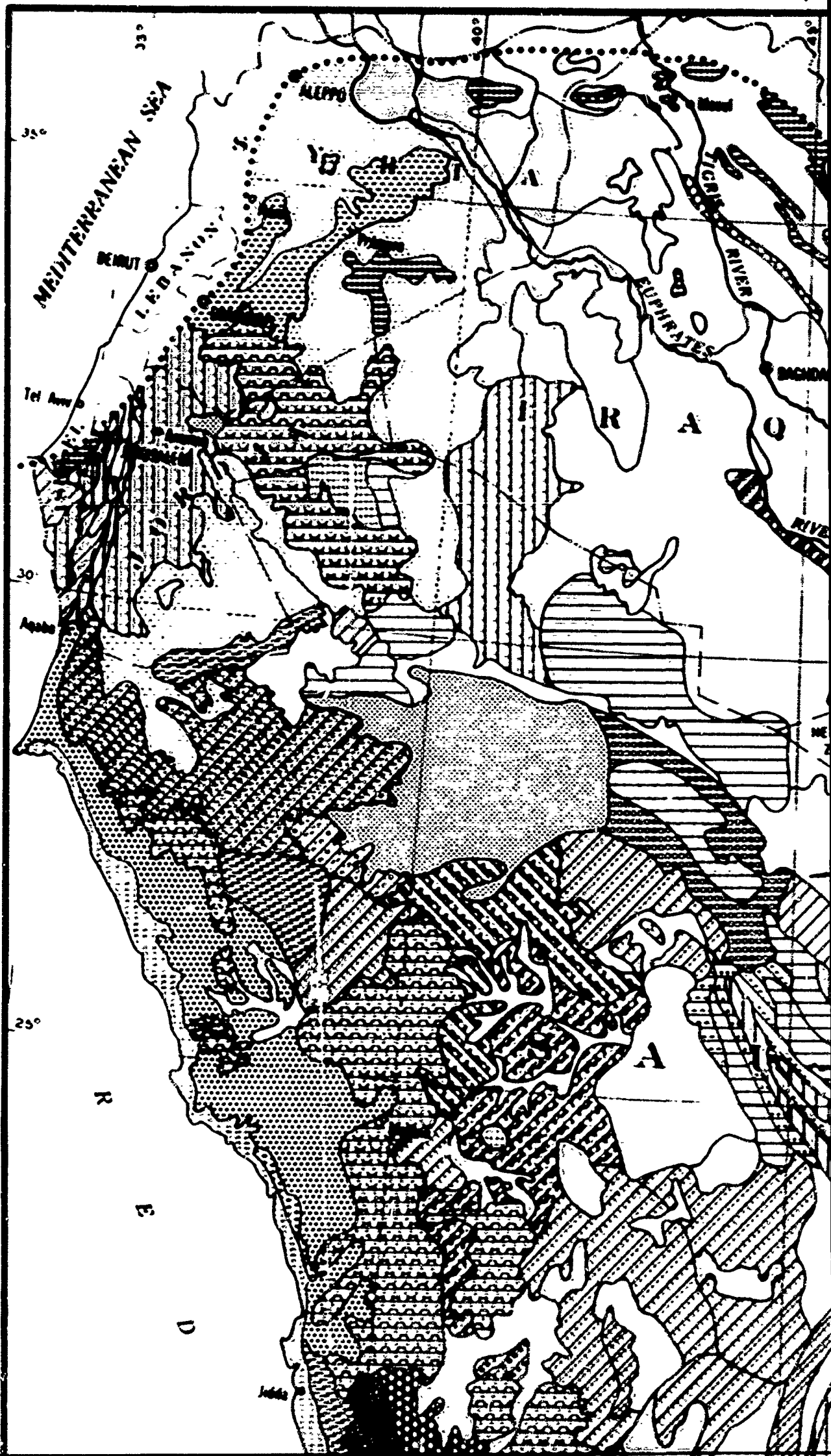
- 1  Relief of locally predominant low
- 2  Relief of locally subordinate high
- 3  Relief of locally predominant high
- 4  Relief of locally subordinate low

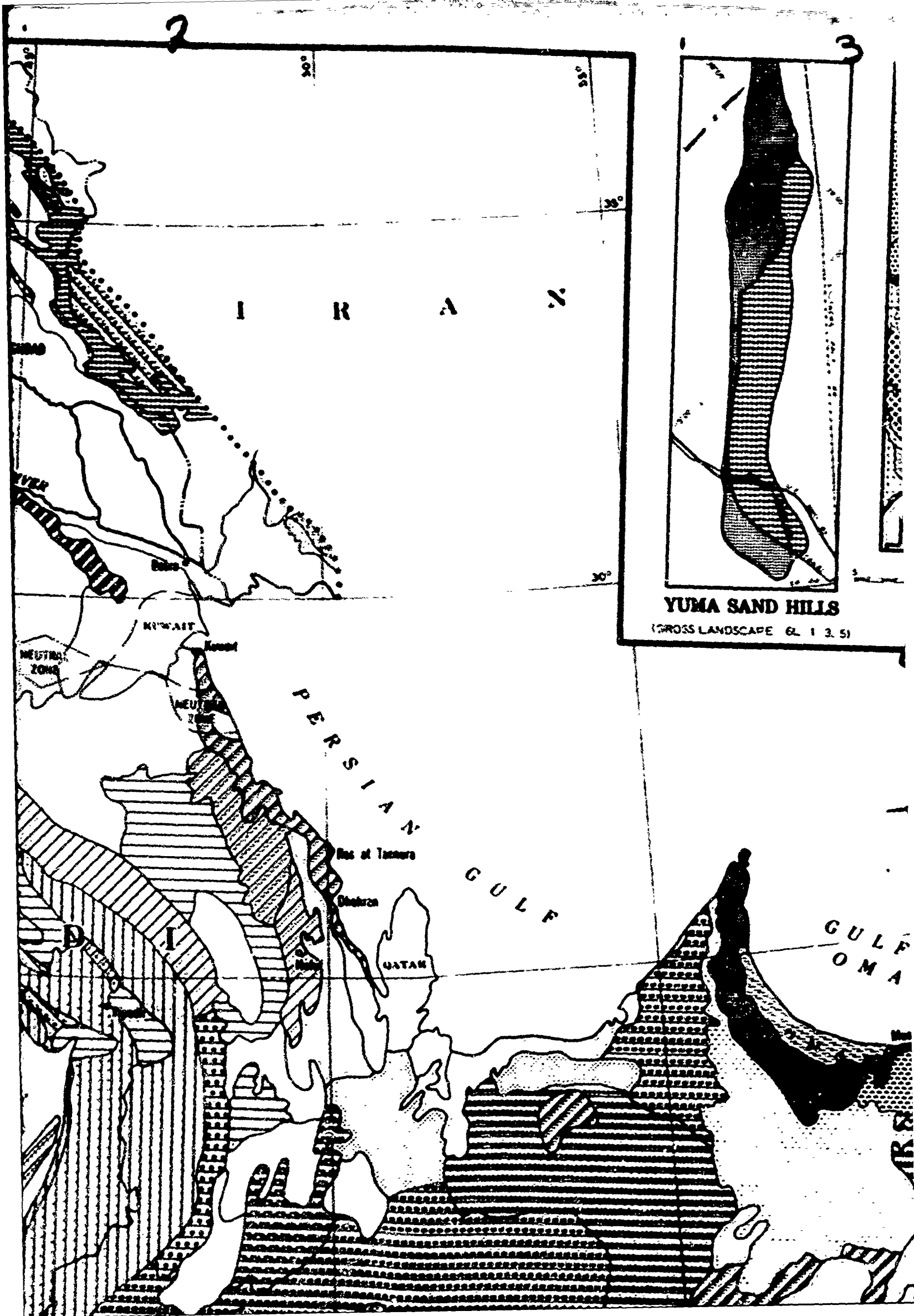
Geosynclinal Complexes. Mapped only where gross geomorphic complexes are mapped.

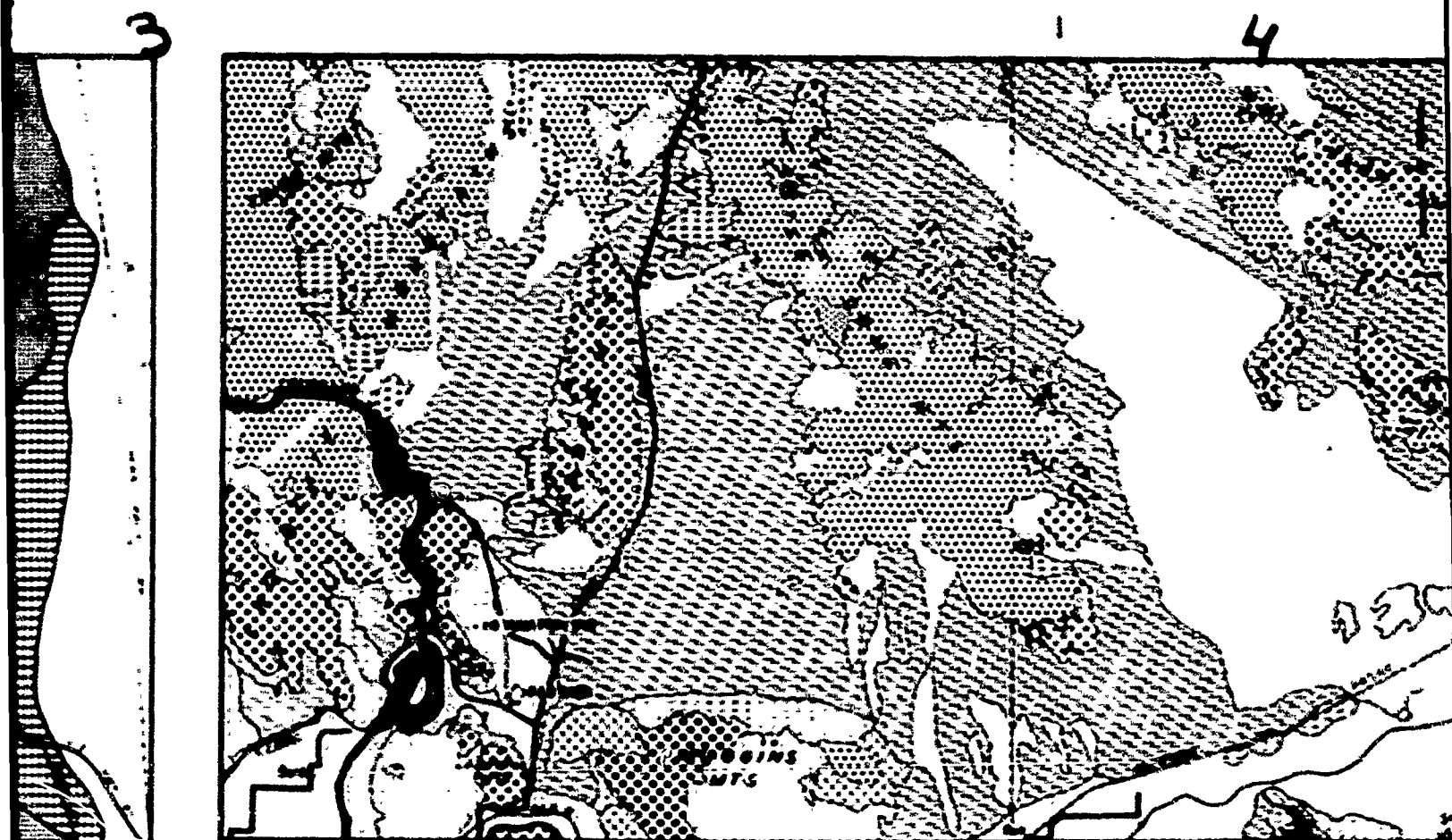
- 1  Gross relief of prominent high
- 2  Restorative relief within complex low
- 3  Gross relief of prominent low
- 4  Restorative relief within complex high

Important Scarps. A scarp is defined as a slope of less than 100 feet per 100 feet or less than 10% slope extending more than 100 feet of relief. Only the better known scarps which extend for considerable distances have been mapped. Scarp height is indicated where known.

ANALOGS OF YUMA TERRAIN IN THE MIDDLE EAST DESERT CHARACTERISTIC RELIEF

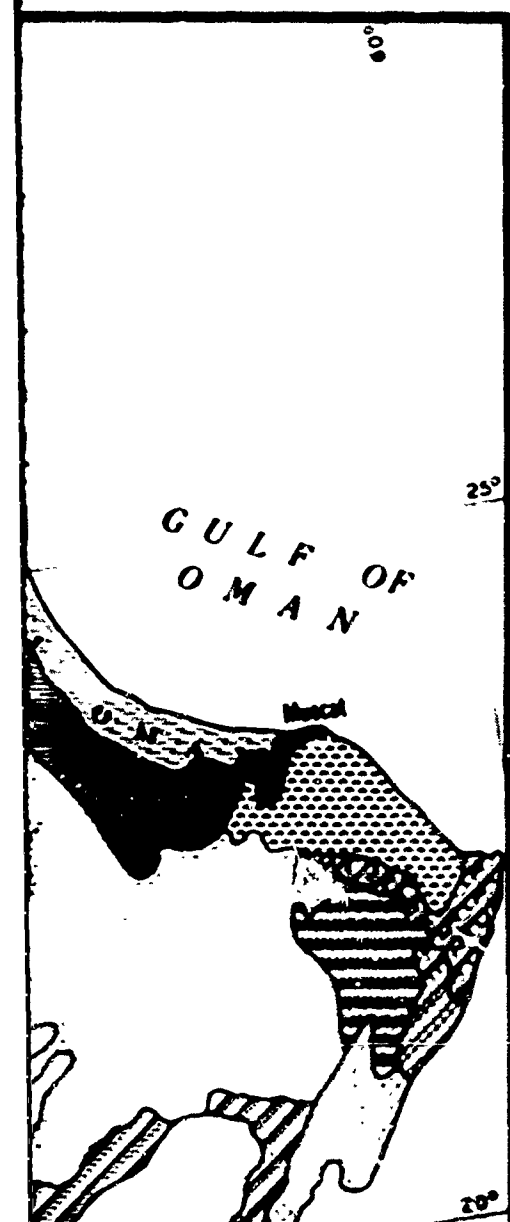


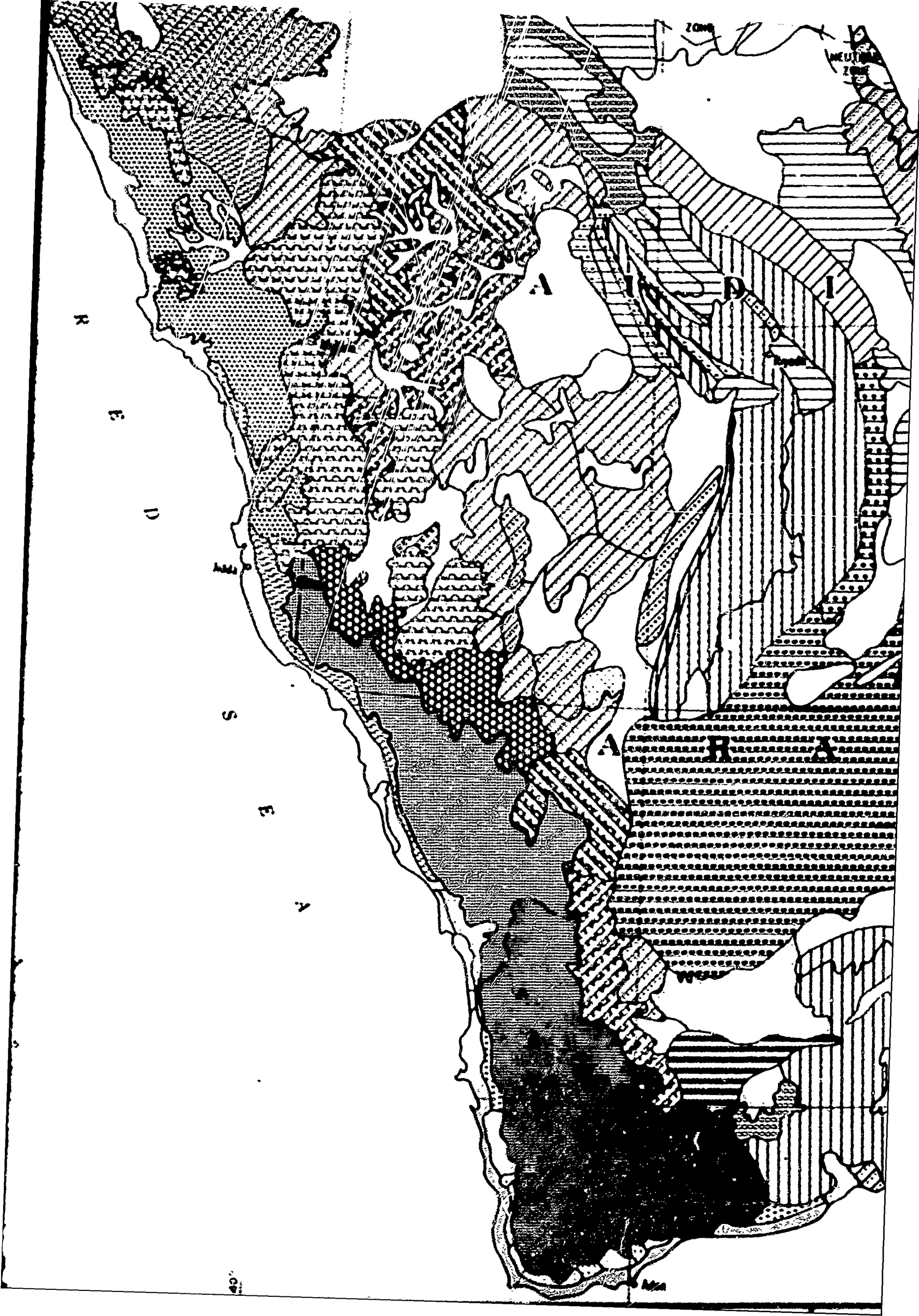


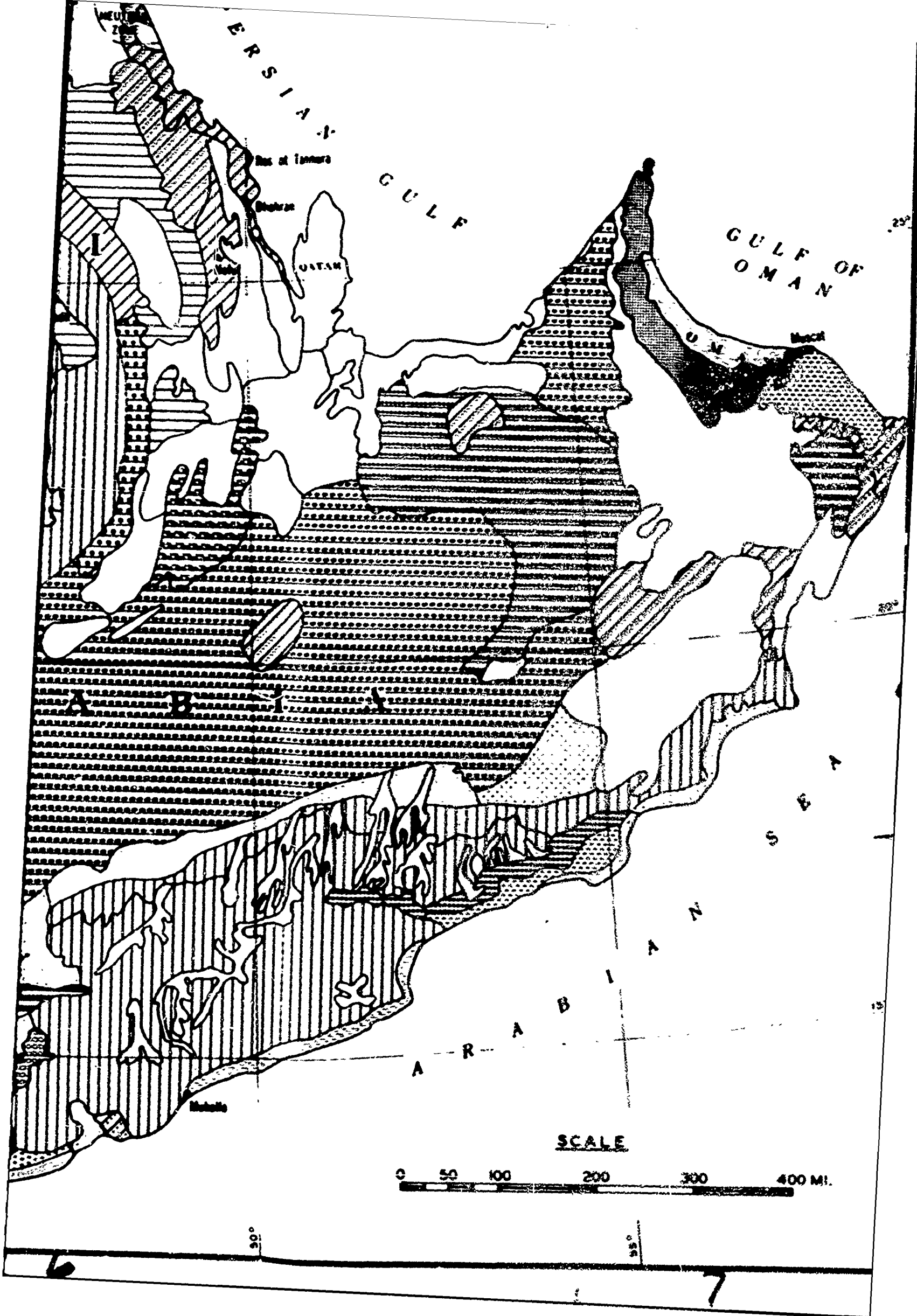


YUMA PROVING GROUND

GROSS LANDSCAPE 5. / 1 5 7.

[illegible]







15"

[REDACTED] b6
b7C

and the surrounding landscape is subject to some minor erosion and a small amount of water
is contained in the soil and is contained in the soil

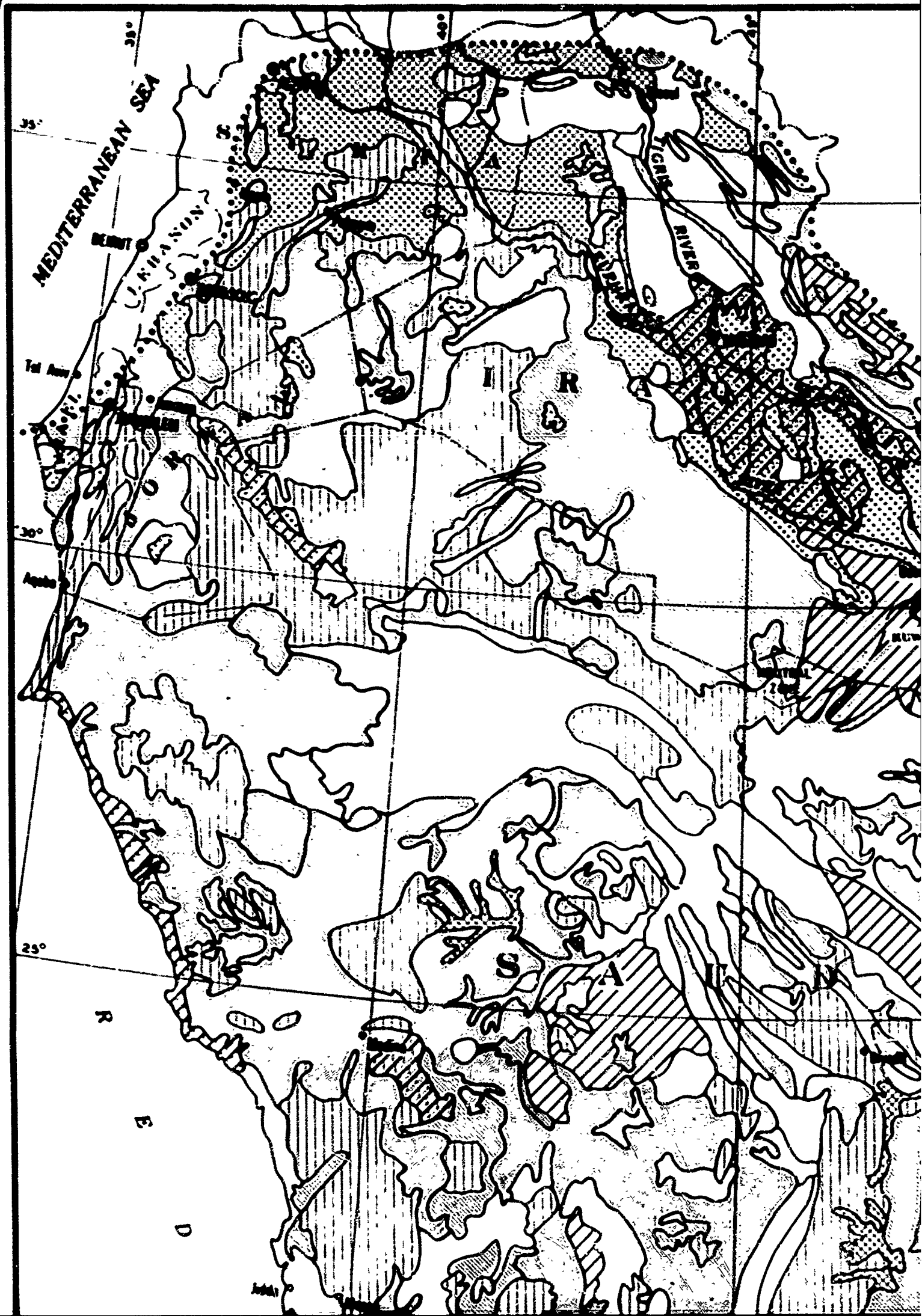
1. The first part of the document is a letter from the President of the United States to the Congress, dated January 3, 1862. It is a very long letter, and it contains a great deal of information about the state of the country at that time. It is a very important document, and it is one of the most interesting documents in the collection.

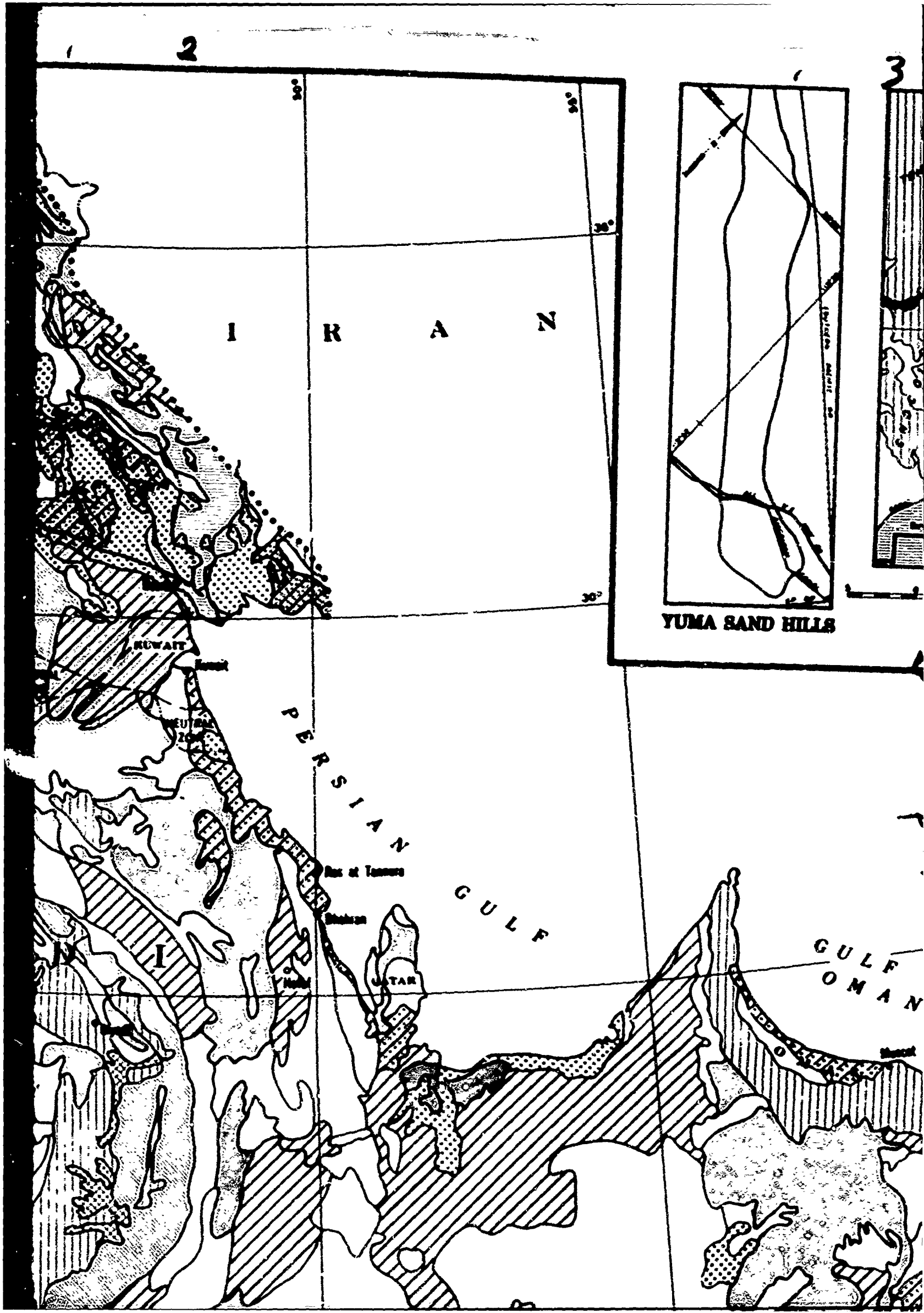
[illegible]

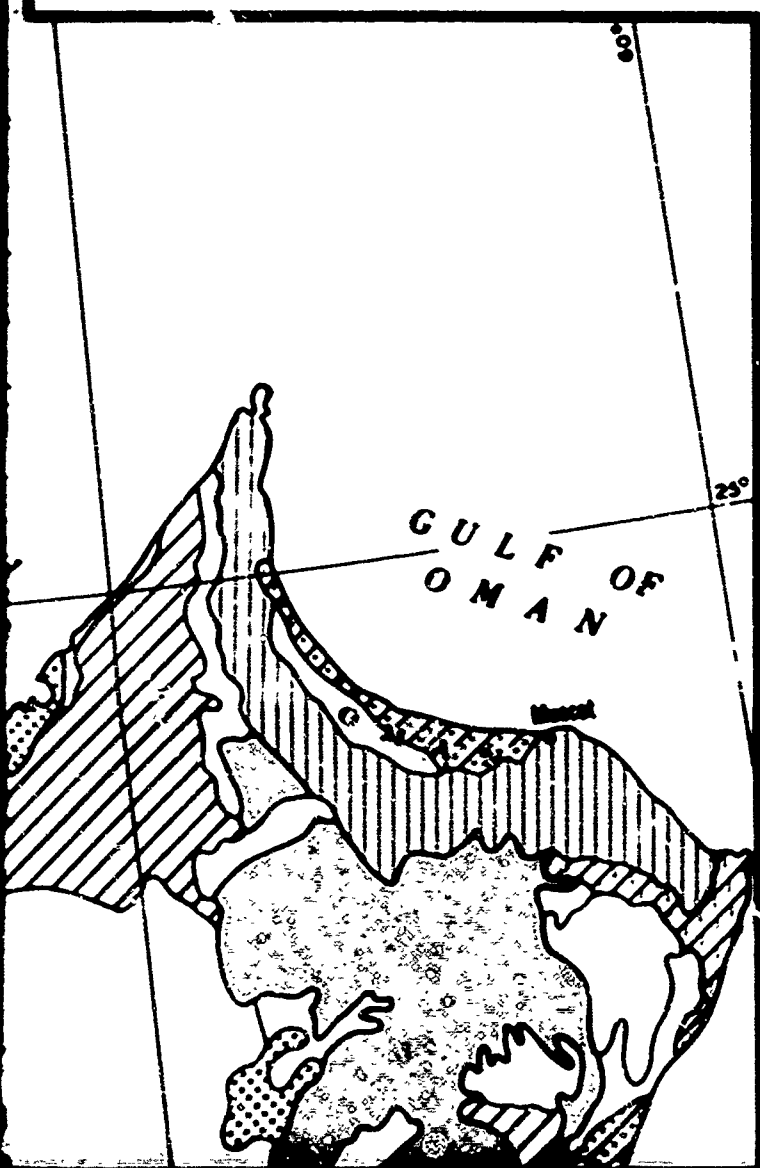
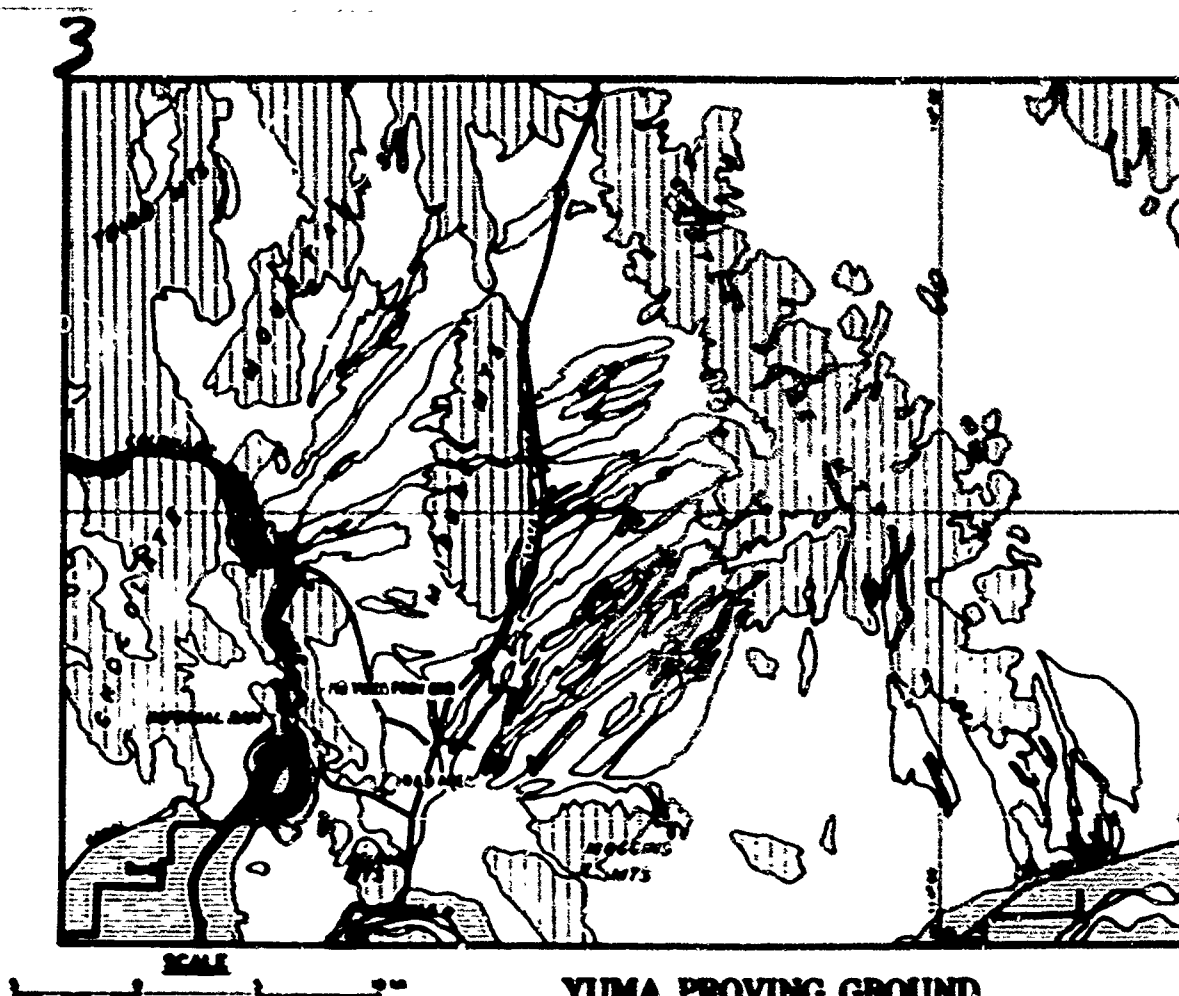
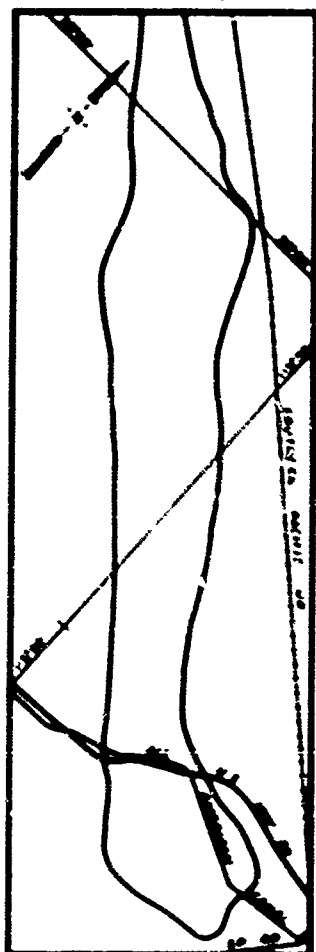
** Major groupings of generalized landslides are based on photographs and comparisons with the earth's surface. A three scale independent of photographs classification

MI.









SOIL TYPE

I. SOIL-ROCK ASSOCIATIONS

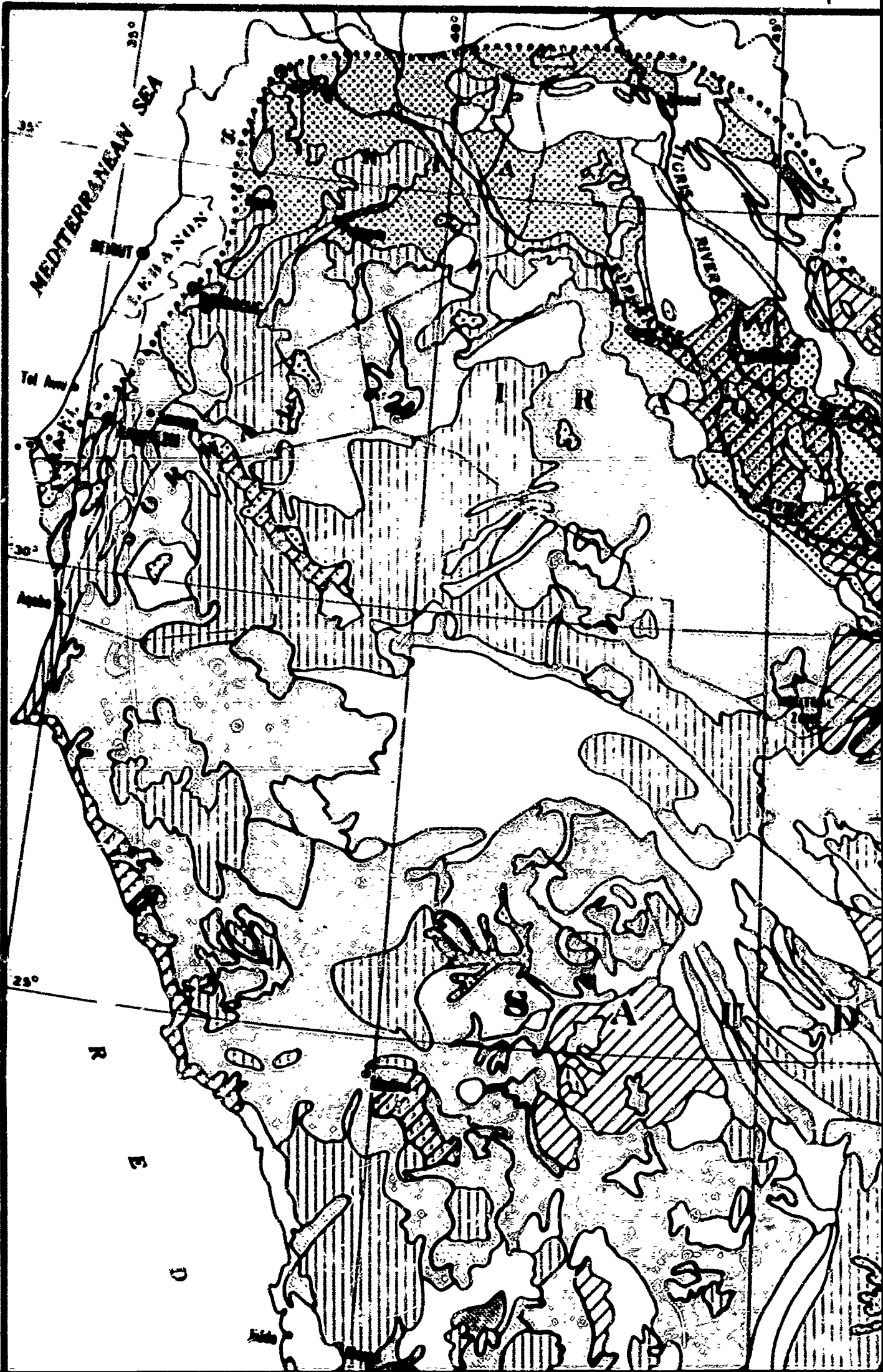
1. Areas characterized by a mosaic of bare rock and stony soils with a few scattered patches of coarse and fine-grained soils. Bare rock and stony soils cover more than 90 per cent of the area mapped.
2. Areas characterized by a mosaic of bare rock and stony soils with numerous patches of coarse and fine-grained soils. Bare rock and stony soils cover from 50 to 90 per cent of the area mapped.
3. Areas characterized by a mosaic of coarse and fine-grained soils with numerous rock and stony soil outcrops. Bare rock and stony soils cover from 10 to 50 per cent of the area mapped.
4. Areas where patches of soil consist of unconsolidated deposits of volcanic ash or tephra.

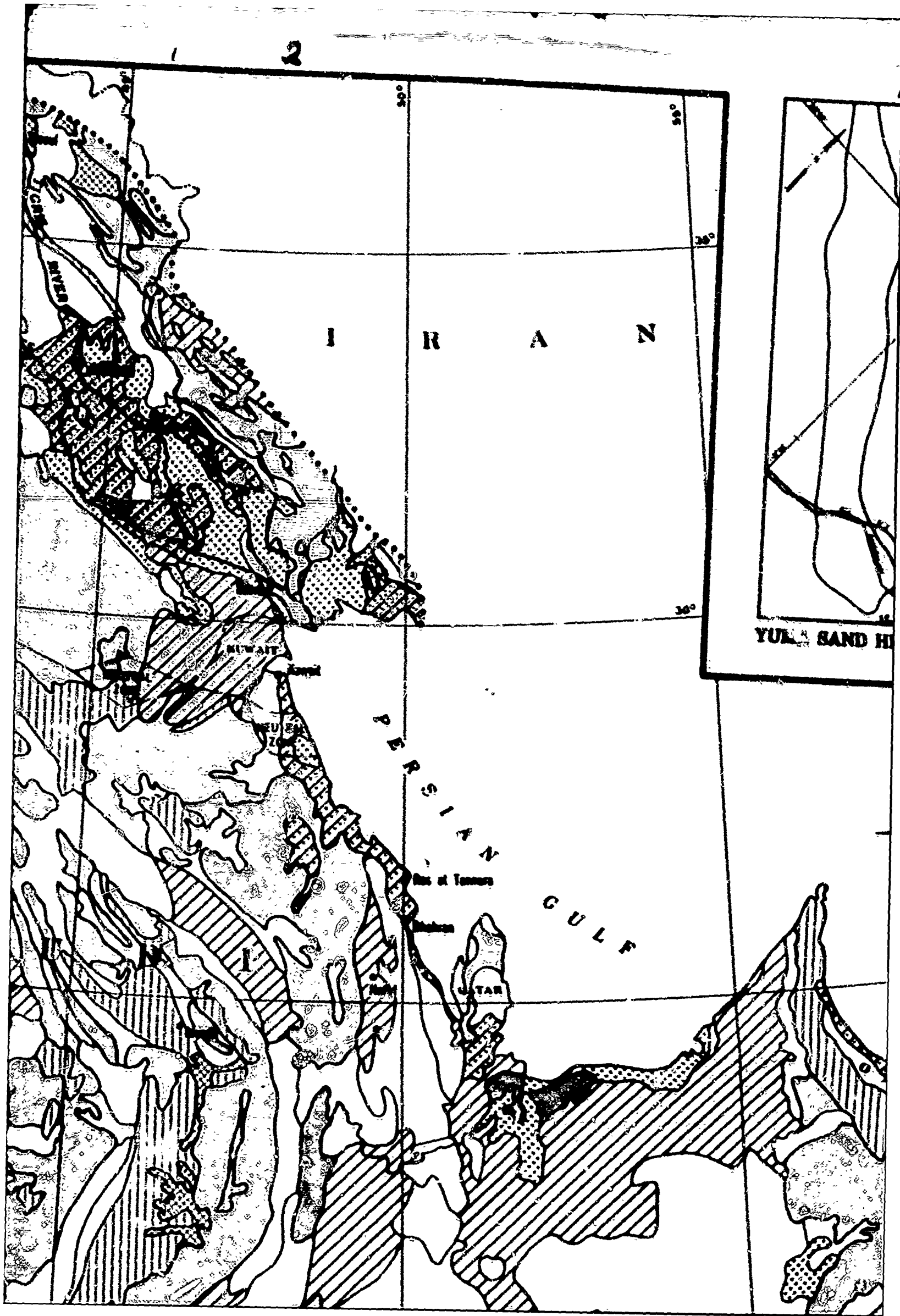
"Stony soils. More than 75 per cent of a typical sample consists of material coarser than gravel. Coarse-grained soils. More than 50 per cent of a typical sample consists of sand and/or gravel. Fine-grained soils. More than 50 per cent of a typical sample consists of silt and/or clay.

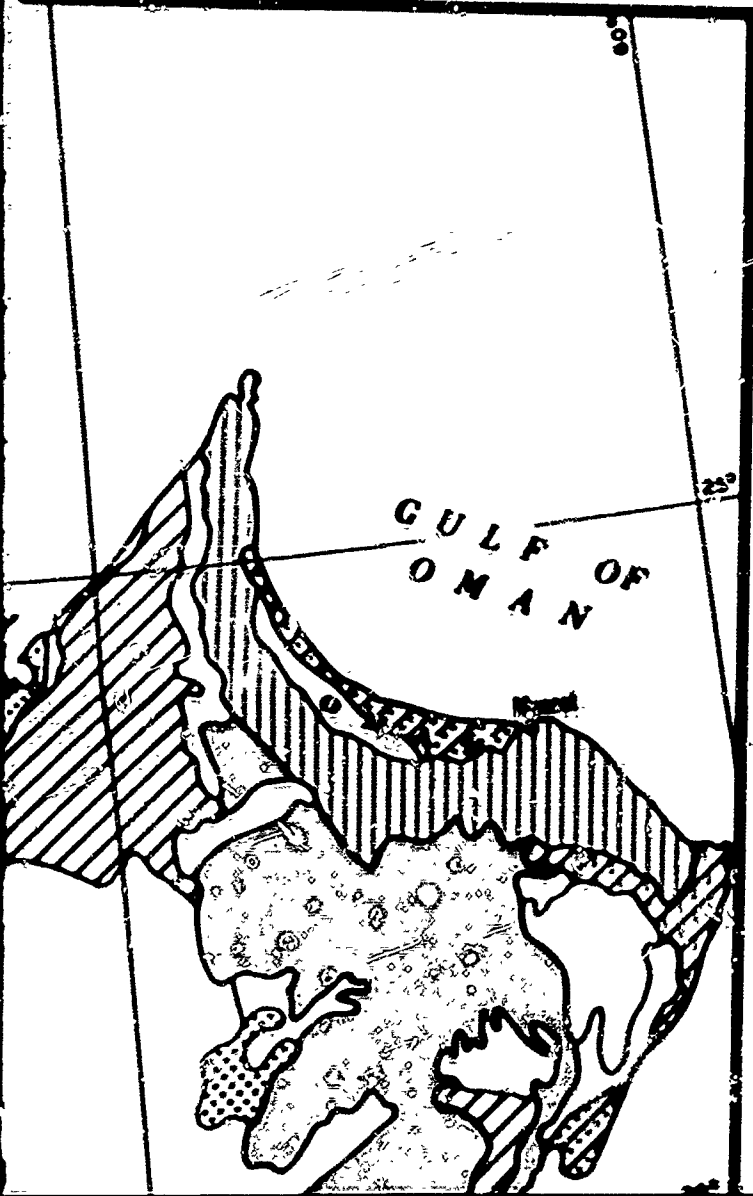
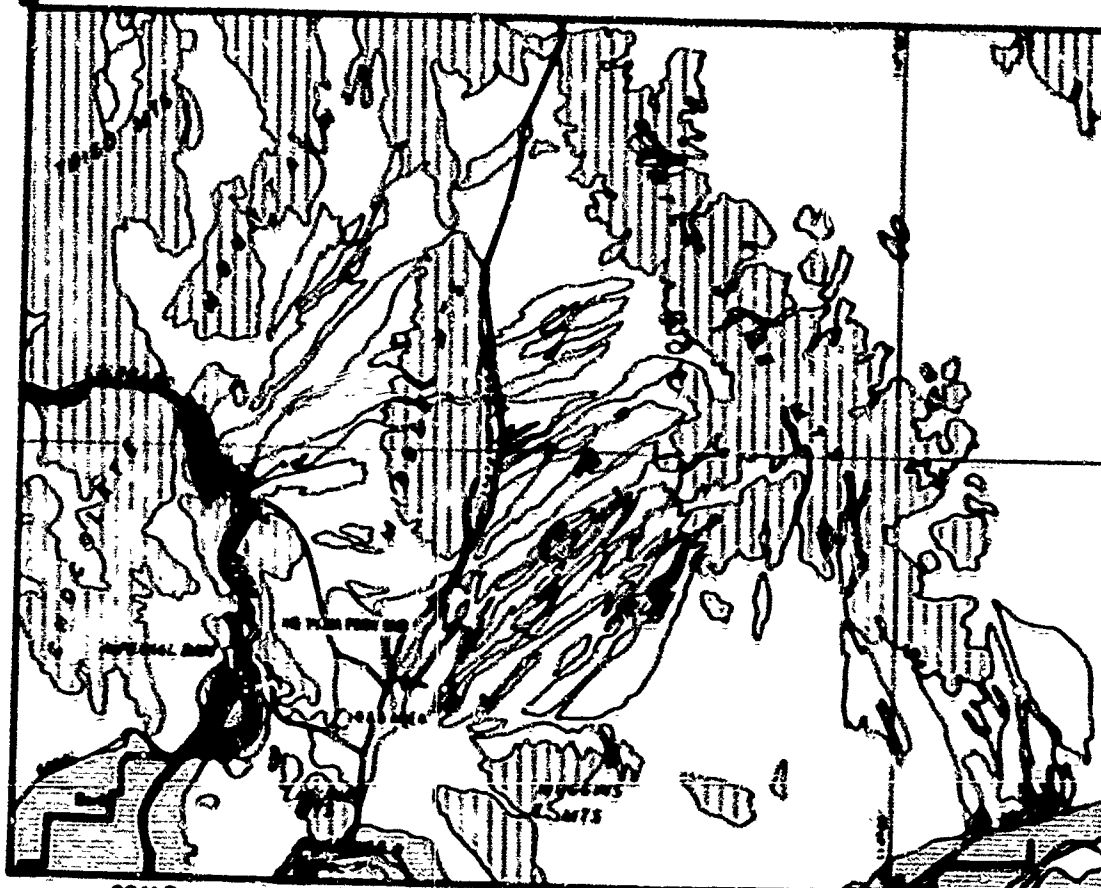
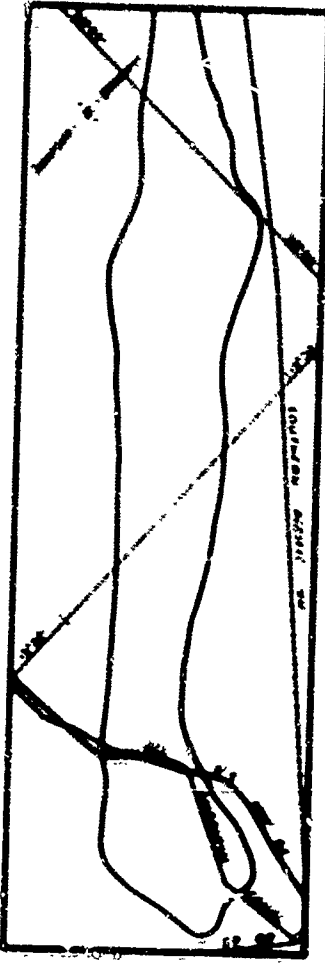
II. SOIL ASSOCIATIONS

Area's predominance (75 per cent or more) and type mapped. Area mapped where more than 25 per cent bare rock and stony soils.

- COARSE:
1. Gravel. More than 50 per cent of a typical sample consists of gravel.
- GRAINED:
1. Sand. More than 95 per cent of a typical sample consists of sand.
- SOILS:
1. Sand and gravel mixed with minor amounts of clay material. More than 50 per cent of a typical sample consists of sand and gravel.







SOIL TYPE

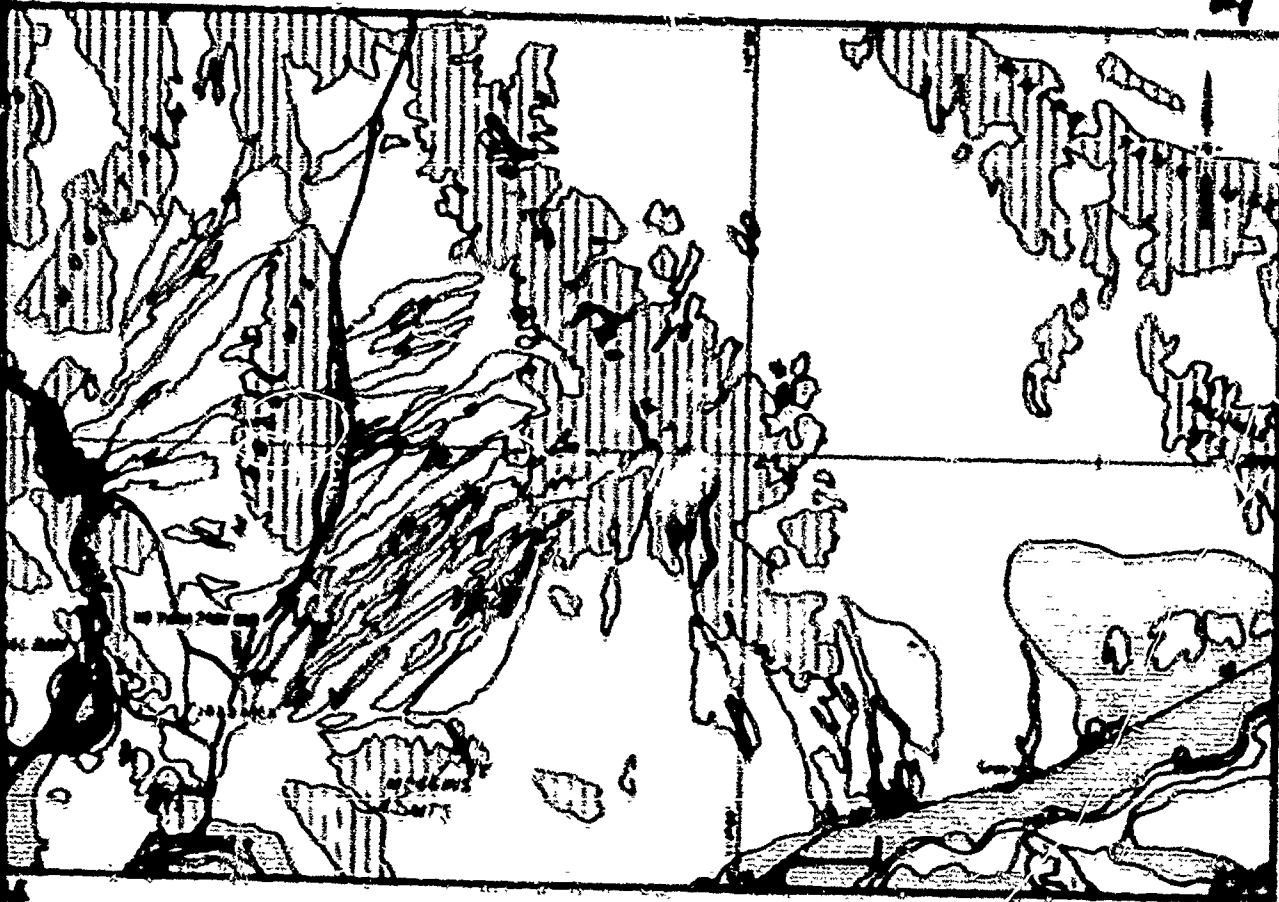
1. SOIL-ROCK ASSOCIATIONS

- 1. Areas characterized by a mosaic of bare rock and stony soils with a few scattered patches of coarse and fine-grained soils. Bare rock and stony soils cover more than 50 per cent of the area mapped.
 - 2. Areas characterized by a mosaic of bare rock and stony soils with numerous patches of coarse and fine-grained soils. Bare rock and stony soils cover from 50 to 90 per cent of the area mapped.
 - 3. Areas characterized by a mosaic of coarse and fine-grained soils with numerous rock and stony soil outcrops. Bare rock and stony soils cover from 20 to 50 per cent of the area mapped.
 - 4. Areas where patches of soil consist of unconsolidated deposits of volcanic ash or tephra.
- "Stony soils. More than 75 per cent of a typical sample consists of material coarser than gravel. Coarse-grained soils. More than 50 per cent of a typical sample consists of sand and/or gravel. Fine-grained soils. More than 50 per cent of a typical sample consists of silt and/or clay.

2. SOIL ASSOCIATIONS

Areally predominant (75 per cent or more) and type mapped. Area mapped never includes more than 25 per cent bare rock and stony soils.

- COARSE- 1. Gravel. More than 90 per cent of a typical sample consists of gravel.
- GRAINED- 2. Sand. More than 90 per cent of a typical sample consists of sand.
- SOILS 3. Sand and gravel mixed with minor amounts of fine material. More than 50 per cent of a typical sample consists of sand and/or gravel.



YUMA PROVING GROUND

SOIL TYPE

1. SOIL-ROCK ASSOCIATIONS

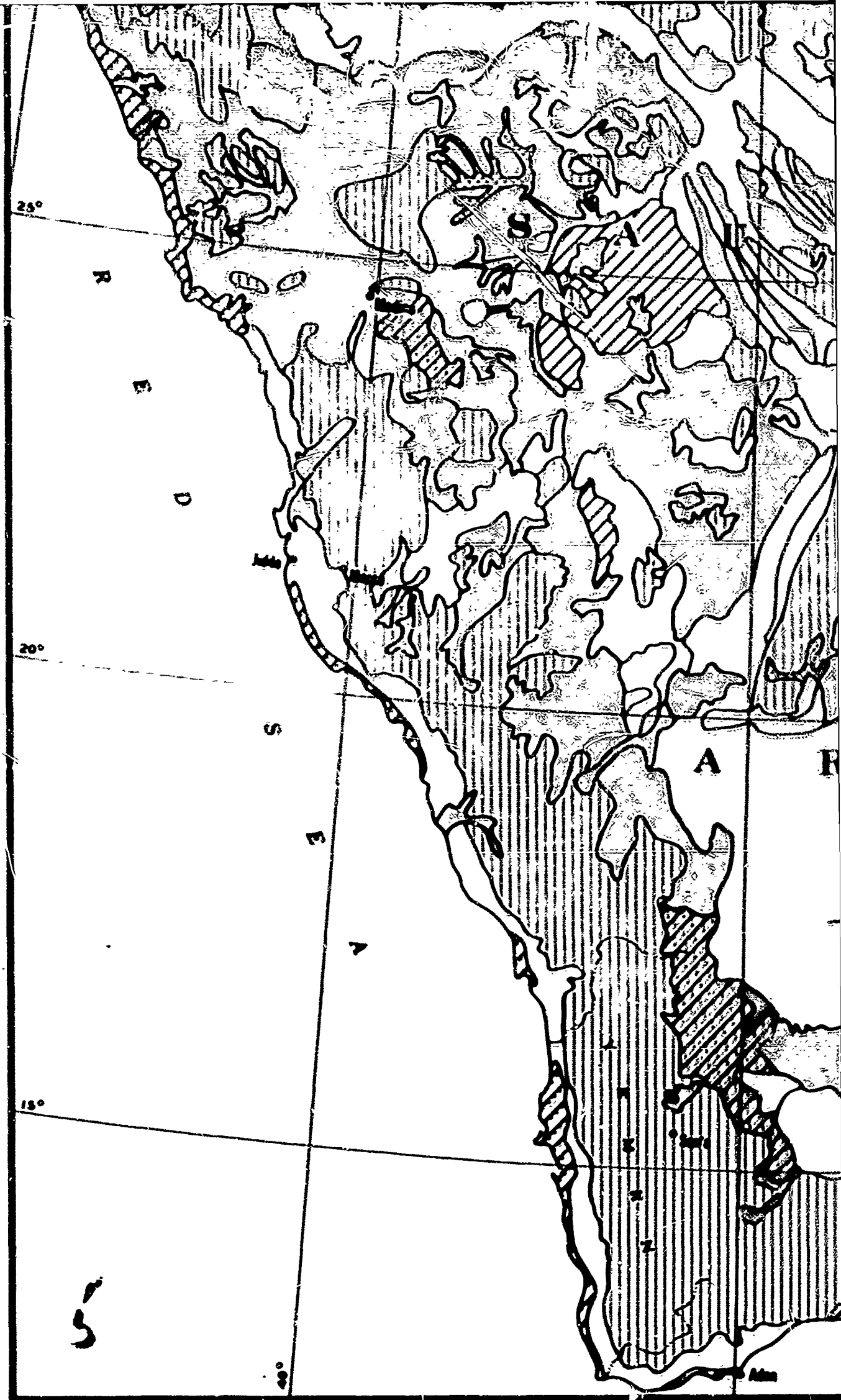
1. Areas characterized by a mosaic of bare rock and stony soils with a few scattered patches of clayey and fine-grained soils. Bare rock and stony soils cover more than 50 per cent of the area mapped.
2. Areas characterized by a mosaic of bare rock and stony soils with numerous patches of coarse and fine-grained soils. Bare rock and stony soils cover from 50 to 90 per cent of the area mapped.
3. Areas characterized by a mosaic of sand or silty loam soils with numerous patches of bare rock and stony soils. Bare rock and stony soils cover from 25 to 50 per cent of the area mapped.
4. Areas where patches of soil consist of materials derived from the erosion of volcanic ash or tephra.

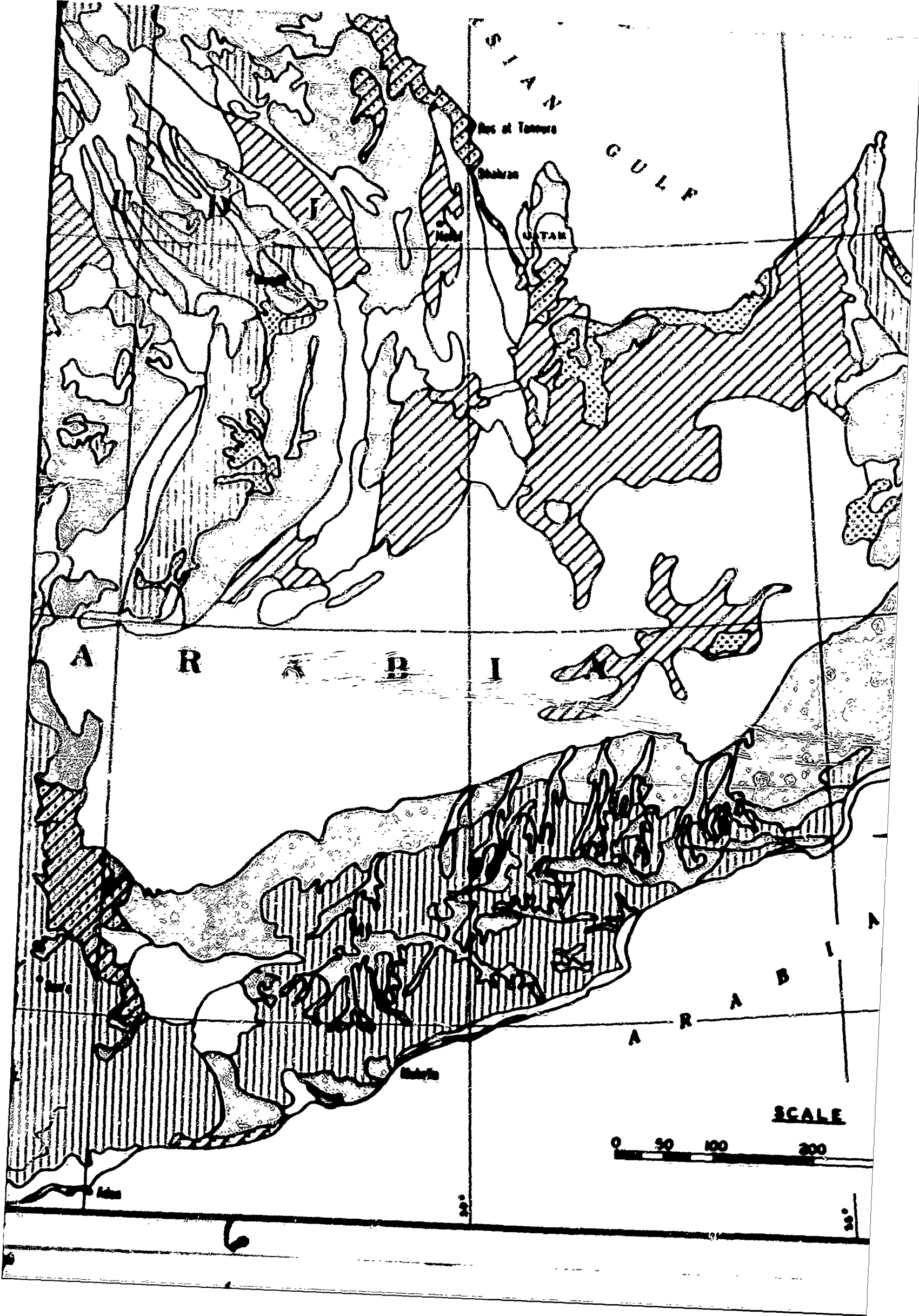
"Stony soils. More than 75 per cent of a typical sample consists of material coarser than gravel. Coarse-grained soils. More than 50 per cent of a typical sample consists of sand and/or gravel. Fine-grained soils. More than 50 per cent of a typical sample consists of silt and/or clay.

2. SOIL ASSOCIATIONS

Areas predominantly (75 per cent or more) of one type mapped. Areas mapped above includes more than 50 per cent bare rock and stony soils.

- | | | |
|---------|----|---|
| COARSE- | 1. | Gravel. More than 75 per cent of a typical sample consists of gravel. |
| GRAINED | 2. | Sand. More than 50 per cent of a typical sample consists of sand. |
| SOILS | 3. | Sand and gravel covered with many amounts of fine material. More than 50 per cent of a typical sample consists of sand and/or gravel. |







SOIL TYPE

I. SOIL-ROCK ASSOCIATIONS

1. Areas (shaded) marked by a mosaic of bare rock and stony soils with a few scattered patches of coarse and fine-grained soils. Bare rock and stony soils cover more than 75 per cent of the area mapped.
 2. Areas characterized by a mosaic of bare rock and stony soils with numerous patches of coarse and fine-grained soils. Bare rock and stony soils cover from 75 to 95 per cent of the area mapped.
 3. Areas characterized by a mosaic of coarse and fine-grained soils with numerous patches of bare rock and stony soils. Bare rock and stony soils cover from 25 to 50 per cent of the area mapped.
 4. Areas chiefly patches of sand and gravel or sand and gravel deposits of volcanic ash or tephra.
- Stony soils. More than 25 per cent of a typical sample consists of material coarser than gravel. Coarse-grained soils. More than 50 per cent of a typical sample consists of sand and/or gravel. Fine-grained soils. More than 50 per cent of a typical sample consists of soil and/or clay.

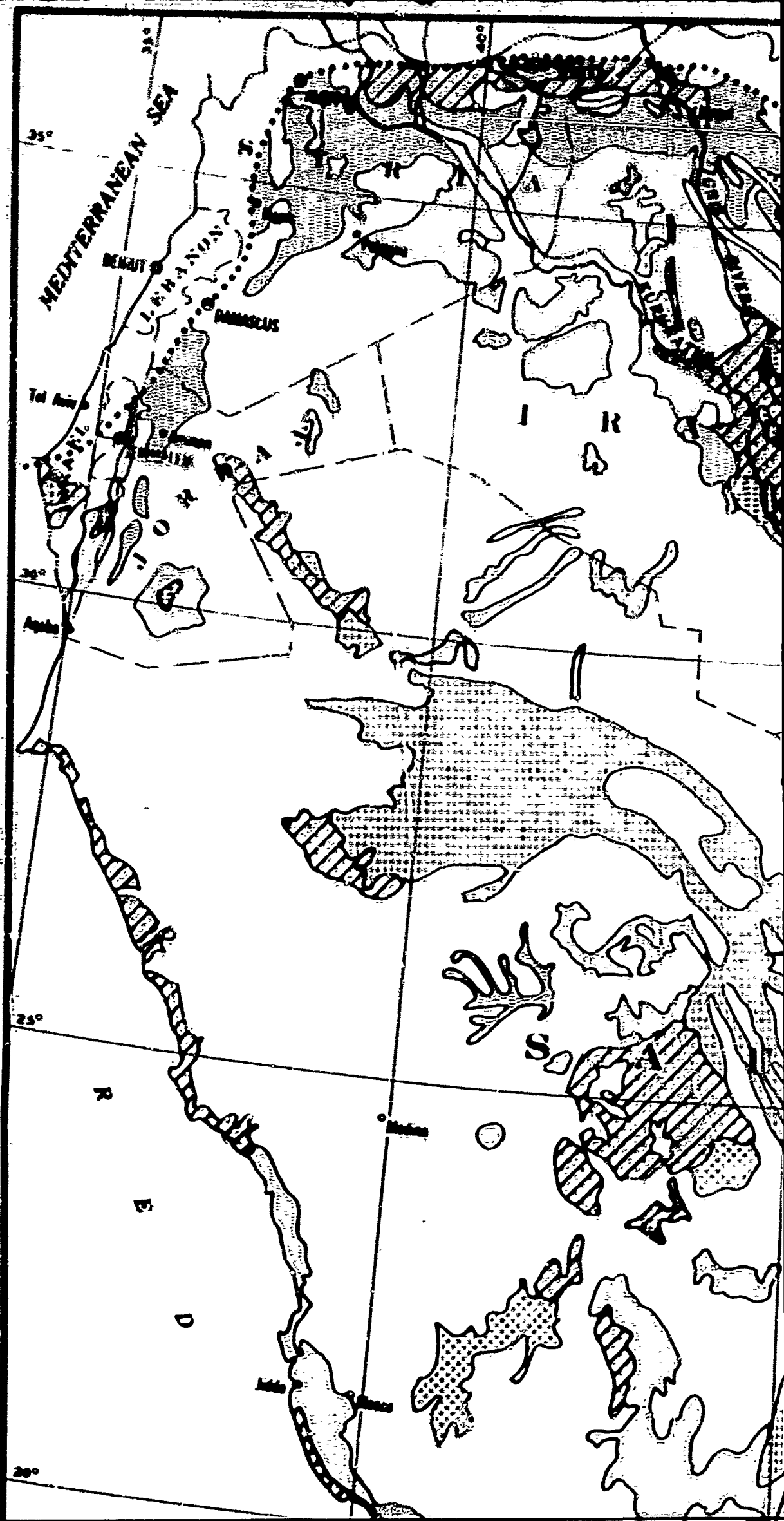
II. SOIL ASSOCIATIONS*

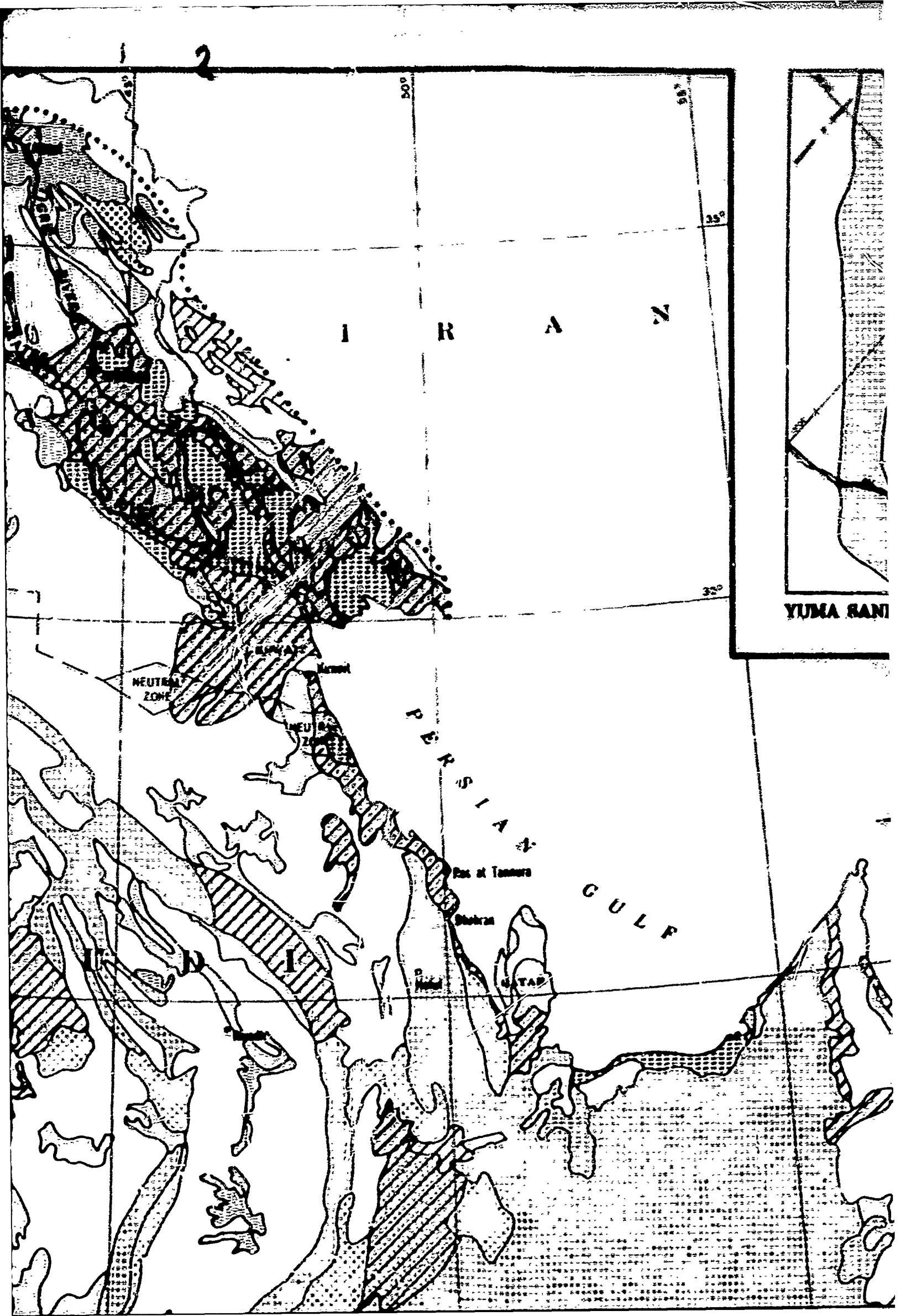
Locally predominant (75 per cent or more) soil type mapped. Area mapped never includes more than 25 per cent bare rock and stony soils.

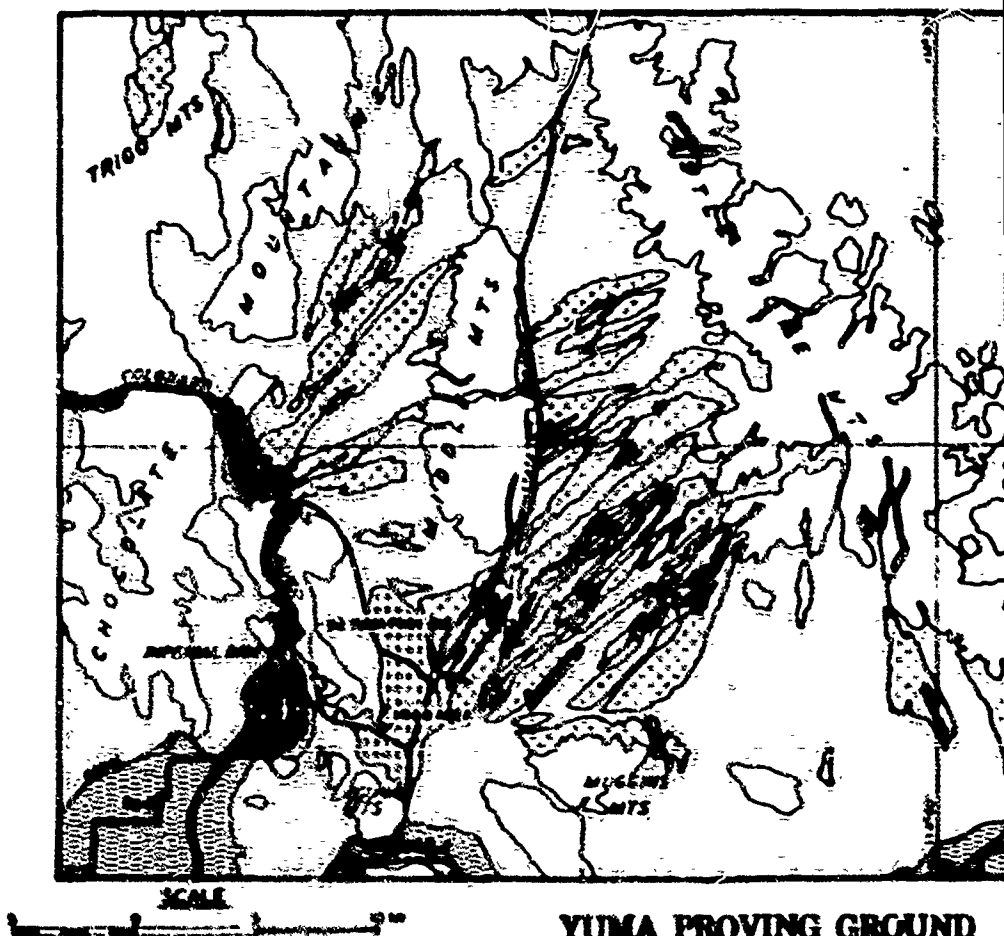
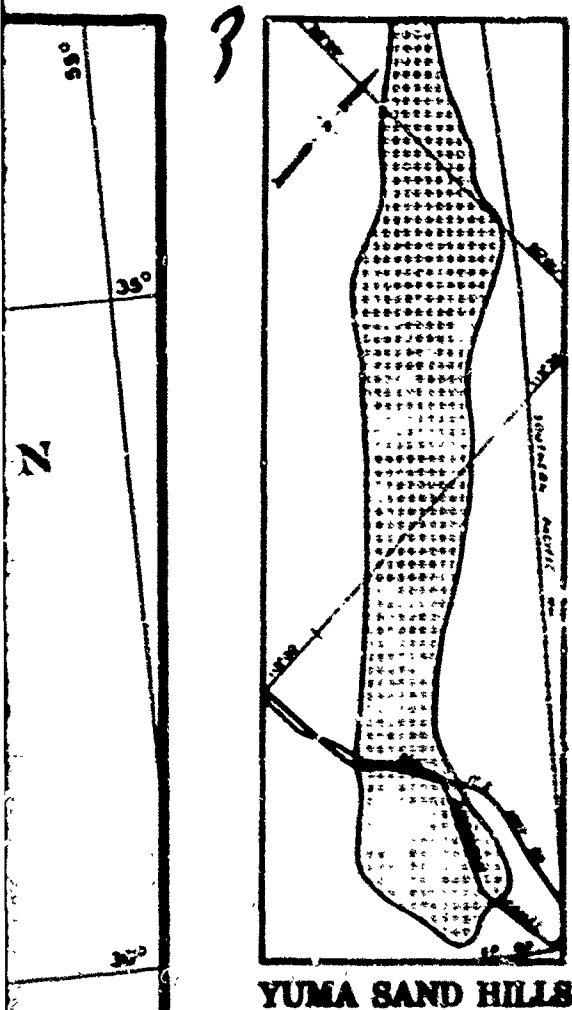
- | | | |
|-----------------------------|---|---|
| COARSE-
GRAINED
SOILS | 1 | Gravel. More than 75 per cent of a typical sample consists of gravel. |
| | 2 | Sand. More than 75 per cent of a typical sample consists of sand. |
| | 3 | Sand and gravel mixed with minor amounts of heavy material. More than 75 per cent of a typical sample consists of sand and/or gravel. |
| FINE-
GRAINED
SOILS | 4 | Silt and clay with minor amounts of coarser material. More than 50 per cent of a typical sample consists of silt and/or clay. |
| | 5 | Silt. More than 75 per cent of a typical sample consists of silt. |
| | 6 | Clay. More than 75 per cent of a typical sample consists of clay. |
| | 7 | Solons. A typical soil sample has a soil content of more than 25 per cent—usually associated with silt and clay. |
| | 8 | SOIL COMPLEXES: Soil complexes are mapped where no locally predominant (75 per cent or more) soil type occurs. In such instances, the two most commonly occurring soil types are mapped, the predominant is shown in the dominant color, the subordinate in the dominant color. |

* In general soil associations exhibit soil thicknesses greater than 10 feet.

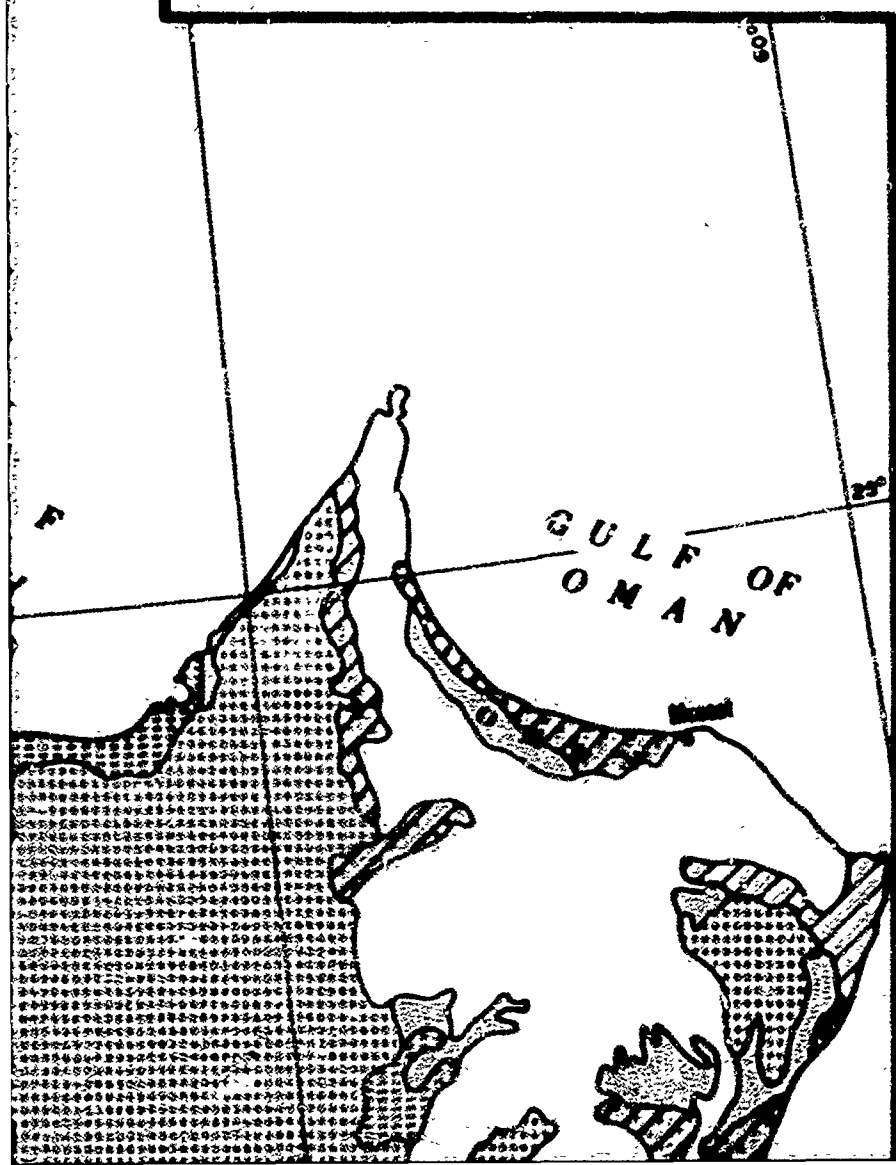
ANALOGS OF YUMA TERRAIN IN THE MIDDLE EAST DESERT SOIL TYPE







YUMA PROVING GROUND



SOIL CONSISTENCY

Soil consistencies are mapped only where they are actually predominant (70 per cent or more) soil cover.

I. HOMOGENEOUS CONSISTENCY: Soil changed consistently to depth greater than 12 inches.

A. Noncohesive: Materials in which the particles do not adhere to each other.

1. Loose: The ratio of voids to solids is close to a naturally occurring material; grains are loosely packed.

2. Dense: The ratio of voids to solids is close to a naturally occurring material; grains are closely packed.

B. Cohesive: Materials in which the particles adhere to each other, either because of the particles themselves, or because of a cementing material.

3. Soft: Usually permanently wet; low bearing capacity.

4. Firm: Moderate bearing capacity.

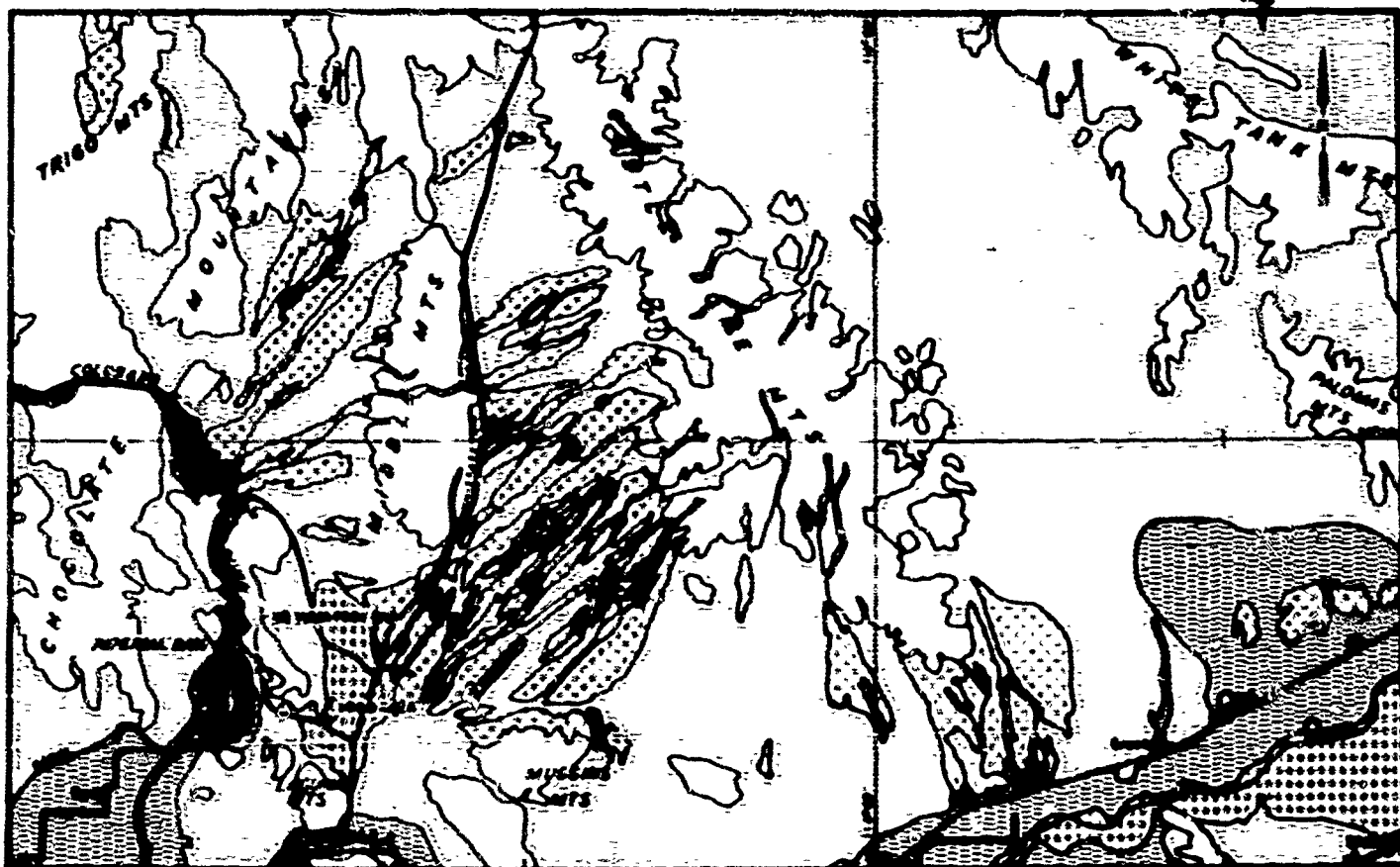
5. Hard: High bearing capacity.

II. LAYERED CONSISTENCY: Soils pass relatively distinct layers within 12 inches.

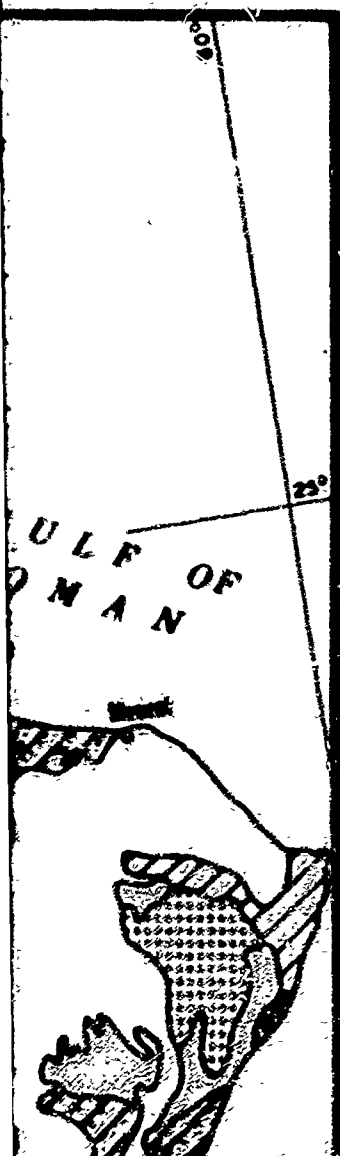
A. Gravelly Surface: Surface is a gravelly material.

6. Gravelly Surface: Surface is a gravelly material.

7. Hard Crust: Consists of a cementing material from which the surface material is removed.



YUMA PROVING GROUND



SOIL CONSISTENCY

Soil consistencies are mapped only where soil associations occur. Areally predominant (75 per cent or more) soil consistency mapped.

1. **HOMOGENEOUS CONSISTENCY:** Soils of essentially unchanged consistencies to depth greater than 12 inches.

A. **Noncohesive:** Materials in which the constituent particles do not adhere to each other.

1. **Loose:** The ratio of voids to constituent grains is close to a naturally occurring maximum, i.e., the grains are loosely packed.

2. **Dense:** The ratio of voids to constituent particles is close to a naturally occurring minimum, i.e., the grains are closely packed.

B. **Cohesive:** Materials in which the constituent particles adhere to each other, either because of surface attraction of the particles themselves, or because of the presence of a cementing material.

3. **Soft:** Little or no bearing capacity.

4. **Firm:** Moderate bearing capacity.

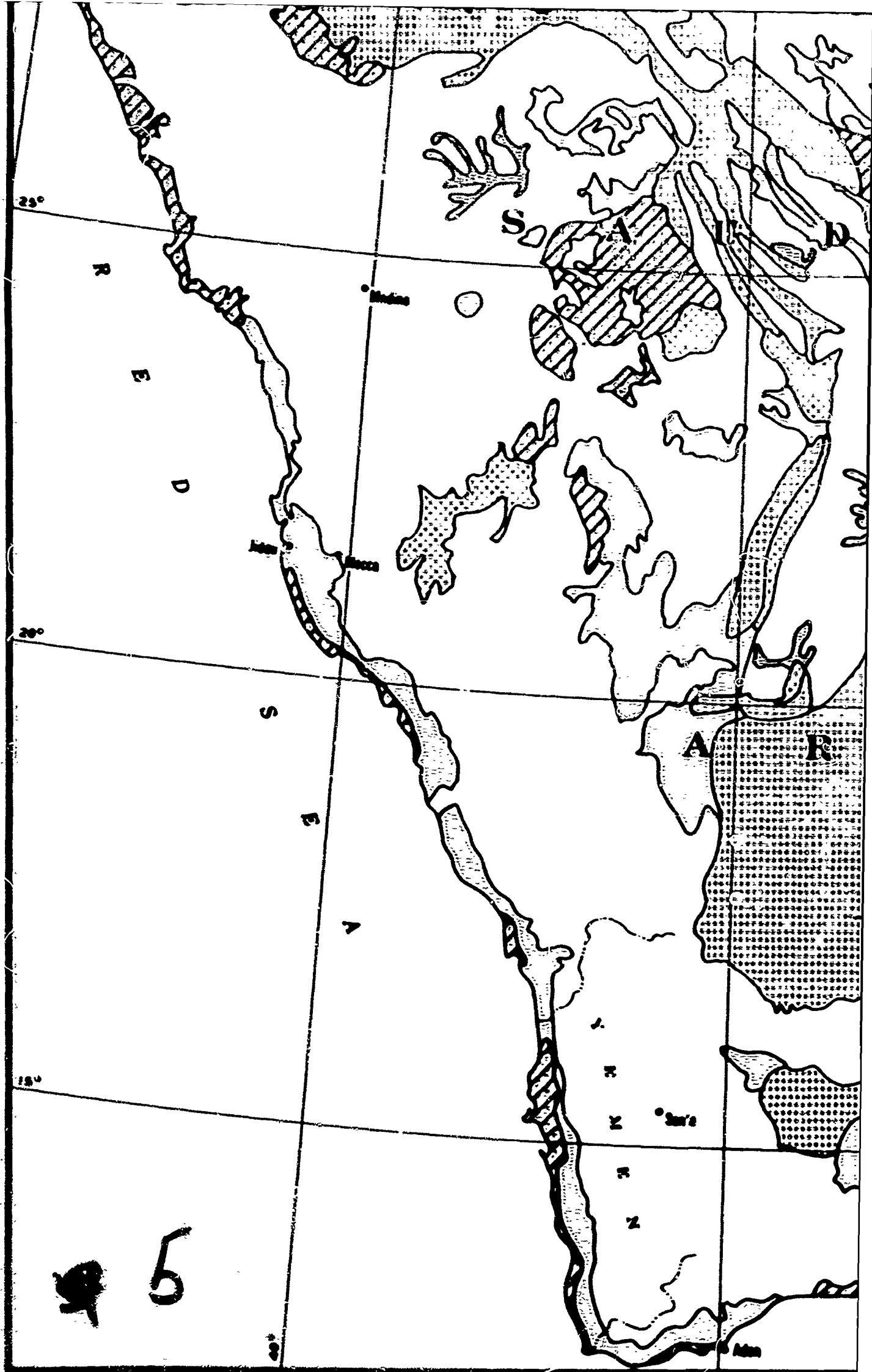
5. **Hard:** High bearing capacity.

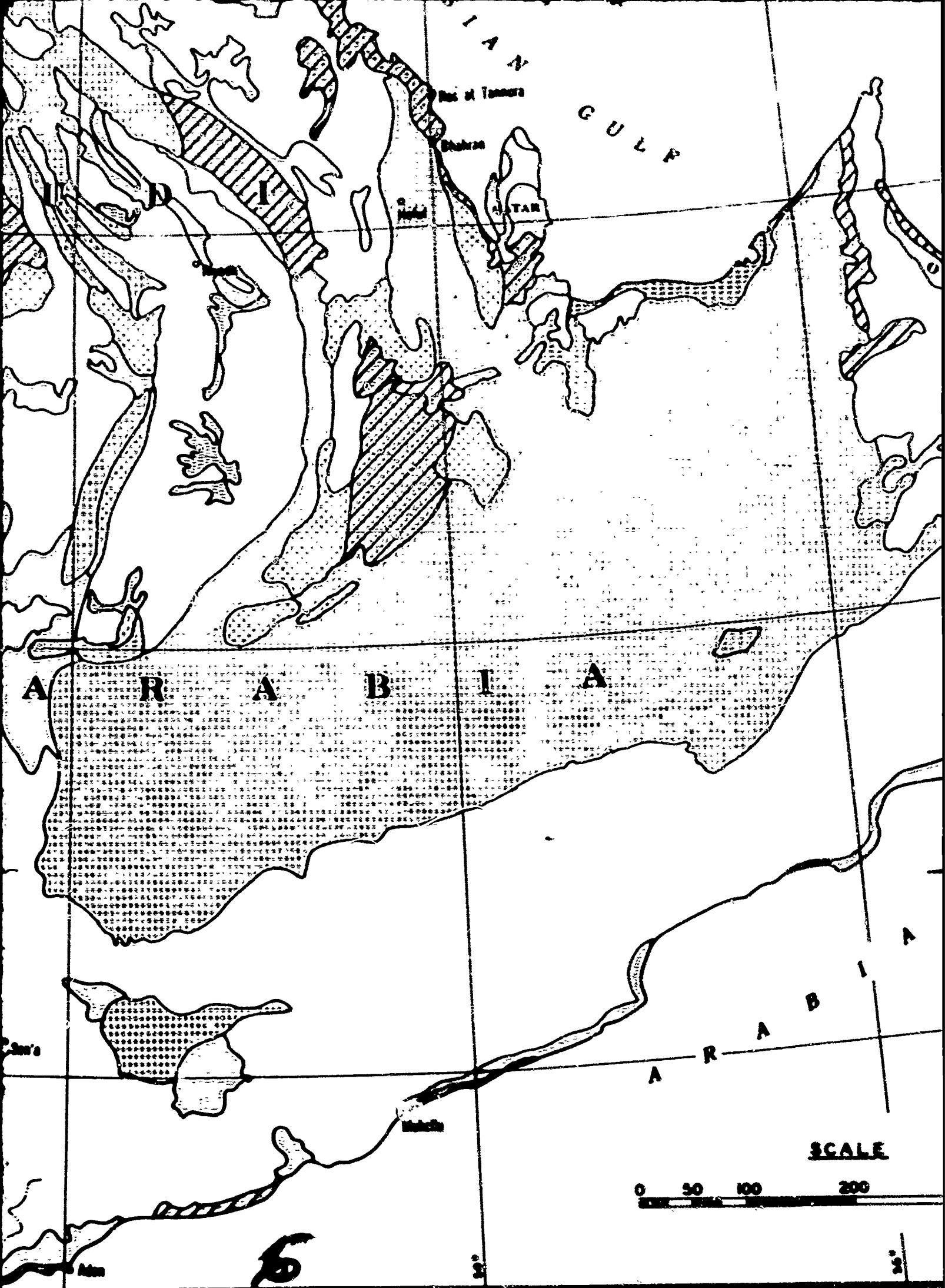
2. **LAYERED CONSISTENCY:** Soils possessing two or more relatively discrete layers within 12 inches of the surface.

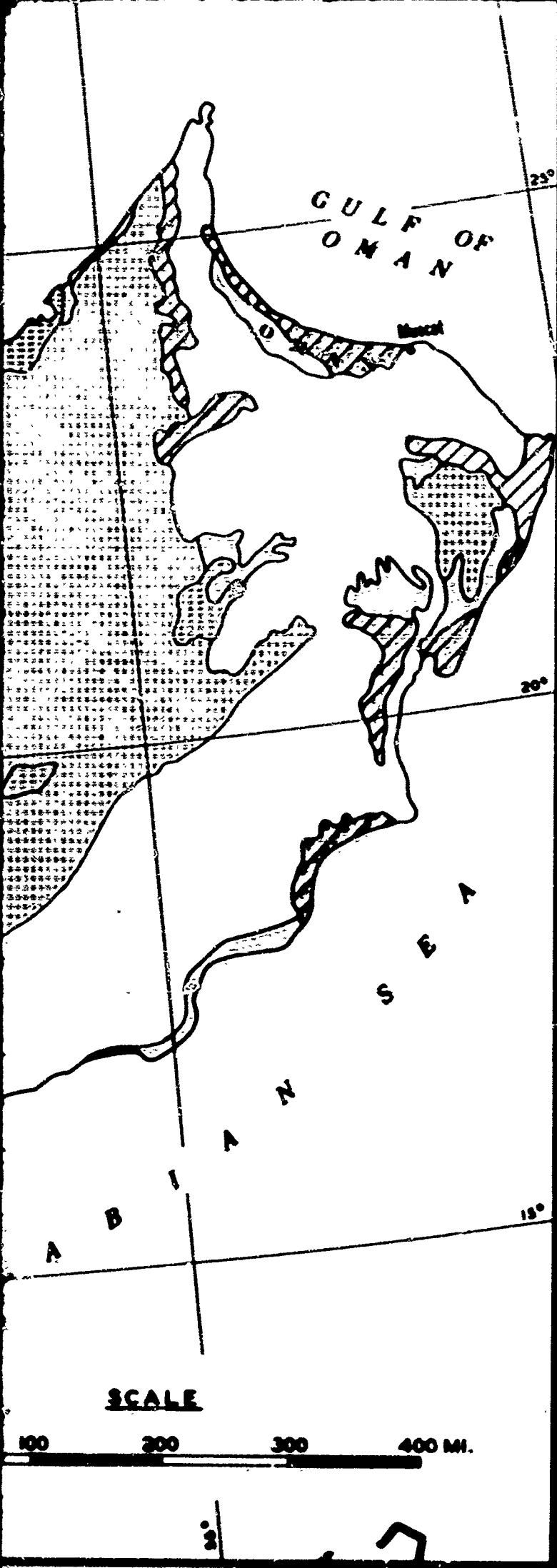
A. **Crusted Surface:** Surface crust may be either cohesive or noncohesive.

6. **Hard thin crust:** Consists of cemented materials overlying soft materials (commonly sand, silt, or silty sand).

7. **Hard crust:** Consists of cemented materials overlying noncohesive materials (commonly sand or silt).







SOIL CONSISTENCY

Soil consistency is mapped only where soil structure is actually predominant (75 per cent or more) and consistency suggests

I. HOMOGENEOUS CONSISTENCIES: Soils of essentially changed consistency to depth greater than 12 inches.

A. Nonchreave: Materials in which the constituent parts do not adhere to each other.

1. **Loose:** The ratio of voids to constituent grains close to a naturally occurring maximum, i.e., grains are loosely packed.

2. **Dense:** The ratio of voids to constituent particles close to a naturally occurring minimum, i.e., grains are closely packed.

B. Chreave: Materials in which the constituent parts adhere to each other, either because of mutual attraction of the particles themselves, or because of the presence of cementing material.

3. **Soft:** Usually permeable with little or no bearing capacity.

4. **Firm:** Moderate bearing capacity.

5. **Hard:** High bearing capacity.

II. LAYERED CONSISTENCIES: Soils possessing two or more relatively distinct layers within 12 inches of the surface.

A. Crusted surface: Surface crust may be either nonchreave.

6. **Hard thin crust:** Commonly of cemented material overlying soft materials (commonly much, unsaturated soils).

7. **Hard crust:** Commonly of cemented material lying nonchreave material (commonly sand or silt).

8. **Thin zone of firm material over nonchreave materials:** (Most common development in areas of dunes, with more or less continuous vegetation cover.)

9. **Surface of closely-filled nonchreave pebbles or gravel overlying nonchreave materials (from sand or silt):** Such "desert pavements" also over bedrock or materials of firm consistency (this is less common.)

B. Nonchreave surface layer less than 12 inches thick:

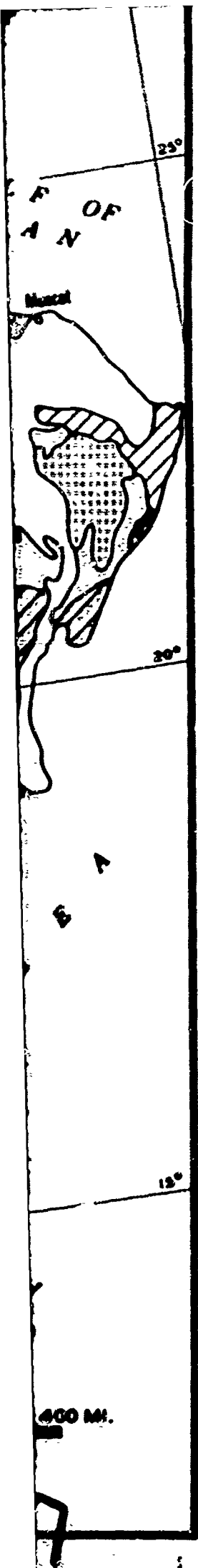
10. **Dense layer within 12 inches of the surface.**

11. **Hard layer within 12 inches of the surface:** Same as always (above).

12. **CONSISTENCY COMPLEXES:** Consistency cannot be mapped where no locally predominant (75 per cent or more) consistency occurs. In such cases the two most commonly occurring consistencies are mapped; the predominant is shown as the background, the subordinate as the dominant in the local pattern.

In complexes (e.g., 1/4) the first digit always refers to the locally dominant crust.

**ANALOGS OF YUMA TERRA
IN THE
MIDDLE EAST DESERT
SOIL CONSISTENCY**



SOIL CONSISTENCY

Soil consistencies are mapped only where soil associations occur. Areas predominantly (75 per cent or more) soil consistency mapped.

I. HOMOGENEOUS CONSISTENCIES: Soils of essentially un- changed consistencies to depth greater than 12 inches.

A. Monochrome: Materials in which the constituent particles do not affect in each other.

- 1 Loose: The ratio of voids to constituent grains is close to a naturally occurring maximum, i.e., the grains are loosely packed.
- 2 Dense: The ratio of voids to constituent particles is close to a naturally occurring minimum, i.e., the grains are closely packed.
- 3 Cohesive: Materials in which the constituent particles affect in each other, either because of mutual attraction of the particles themselves, or because of the presence of a cementing material.

- 4 Soft: Usually premineralized. Little or no bearing capacity.

- 5 Firm: Moderate bearing capacity.

- 6 Hard: High bearing capacity.

II. LAYERED CONSISTENCIES: Soils possessing two or more relatively distinct layers within 12 inches of the surface.

A. Crusted Surface: Surface crust may be either cohesive or noncohesive.

- 7 Hard thin crust (consistency of cemented materials) overlying soft materials (consistency much, loose, or isolated cells).
- 8 Hard crust (consistency of cemented materials) overlying noncohesive material (consistency sand or silt).
- 9 Thin zone of firm materials over noncohesive materials. (Effect: channel development in areas of hard dunes, with more or less continuous vegetation cover.)
- 10 Surface of closely-fused noncohesive pebbles or gravel overlying noncohesive materials (consistency sand or silt). Such "desert pavements" also occur over bedrock or materials of firm consistency, but due to loose condition.

B. Noncohesive surface layer less than 12 inches thick.

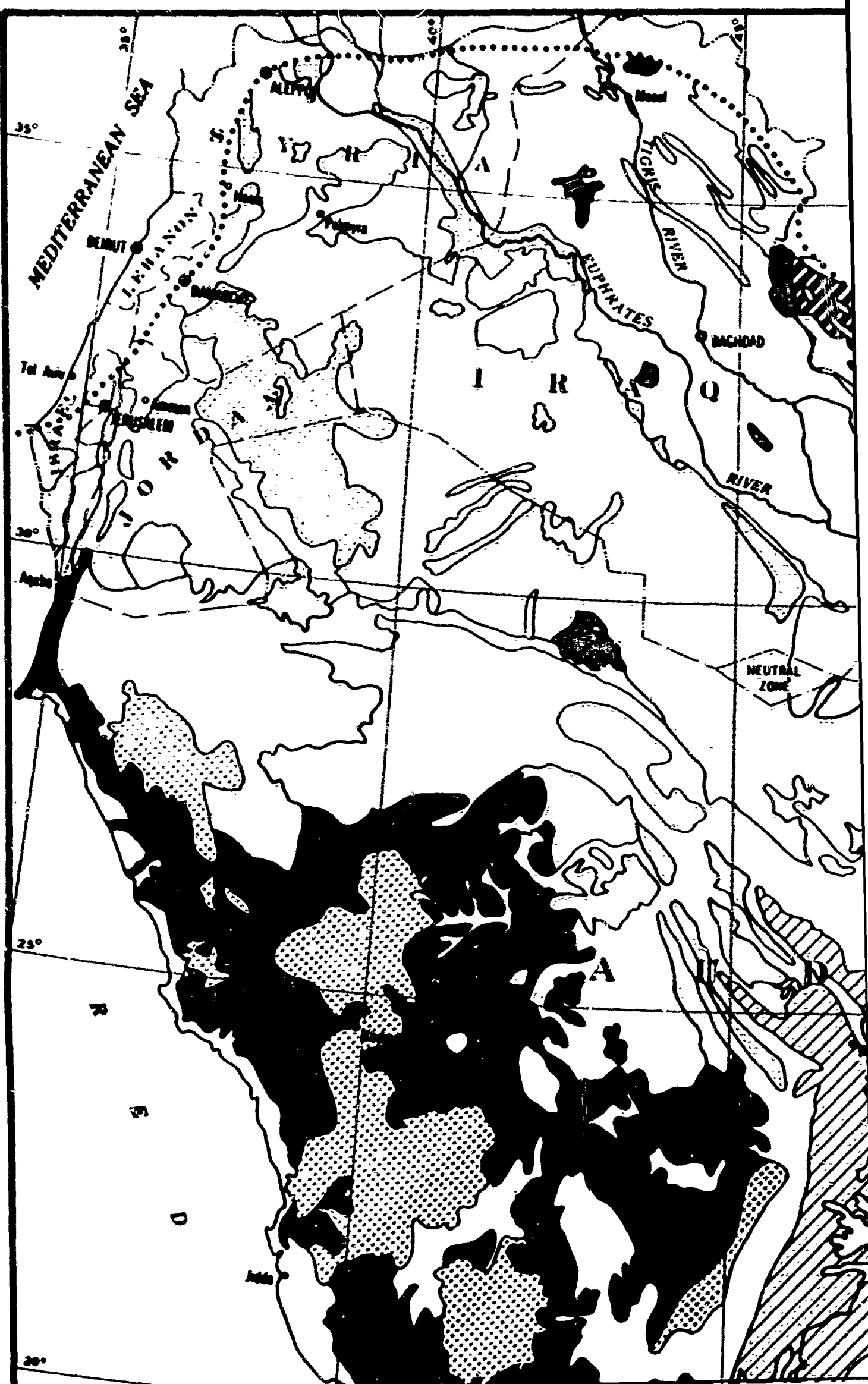
- 11 Dense layer within 12 inches of the surface.
- 12 Hard layer within 12 inches of the surface locally but not always visible.

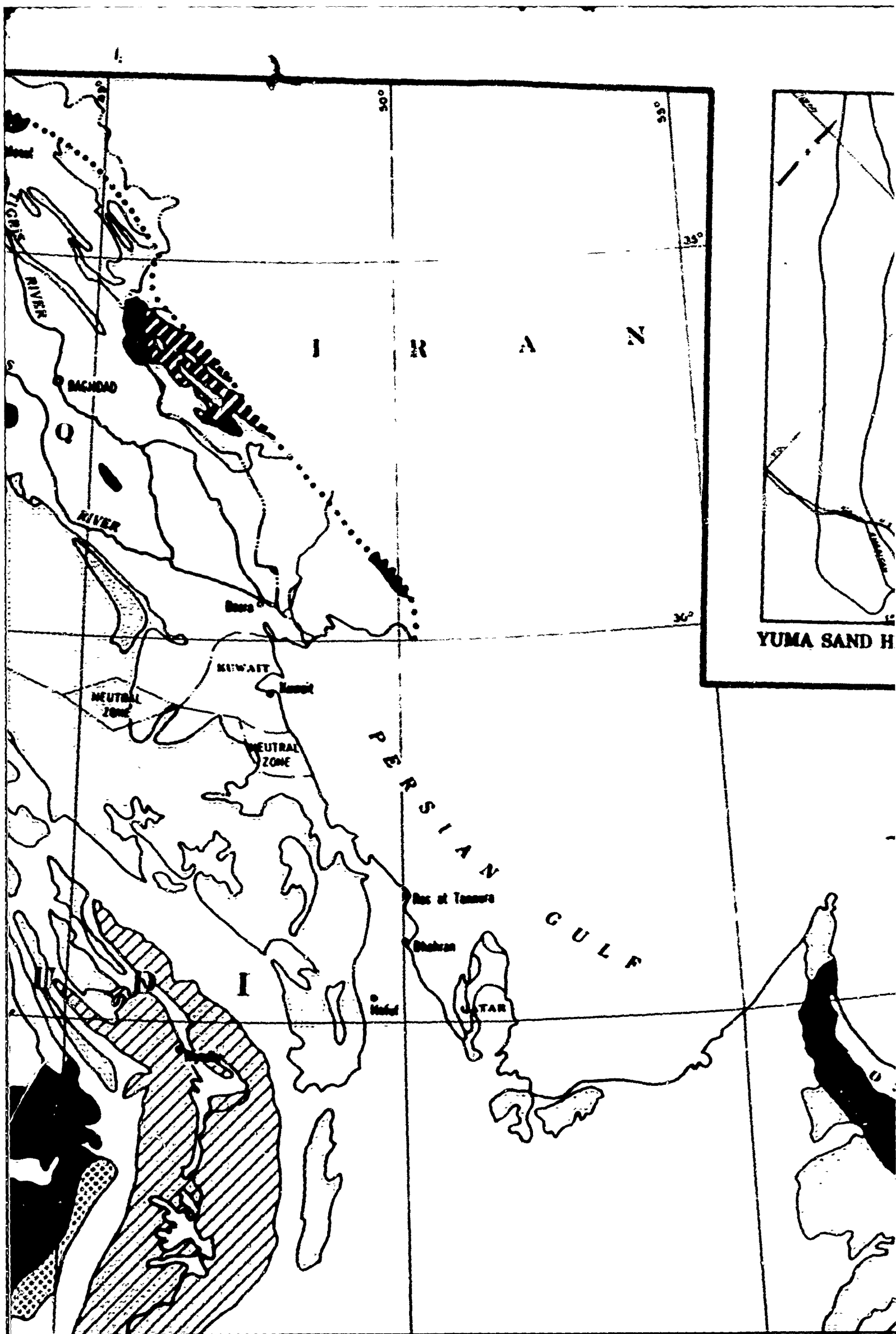
- 13 COMPLEXITY COMPLEXES: Consistency complexes are mapped where no single predominance (75 per cent or more) consistency occurs. In such instances, the two most commonly occurring consistencies are mapped, the predominant is shown as the numerator, the subordinate as the denominator in the fractional pattern.

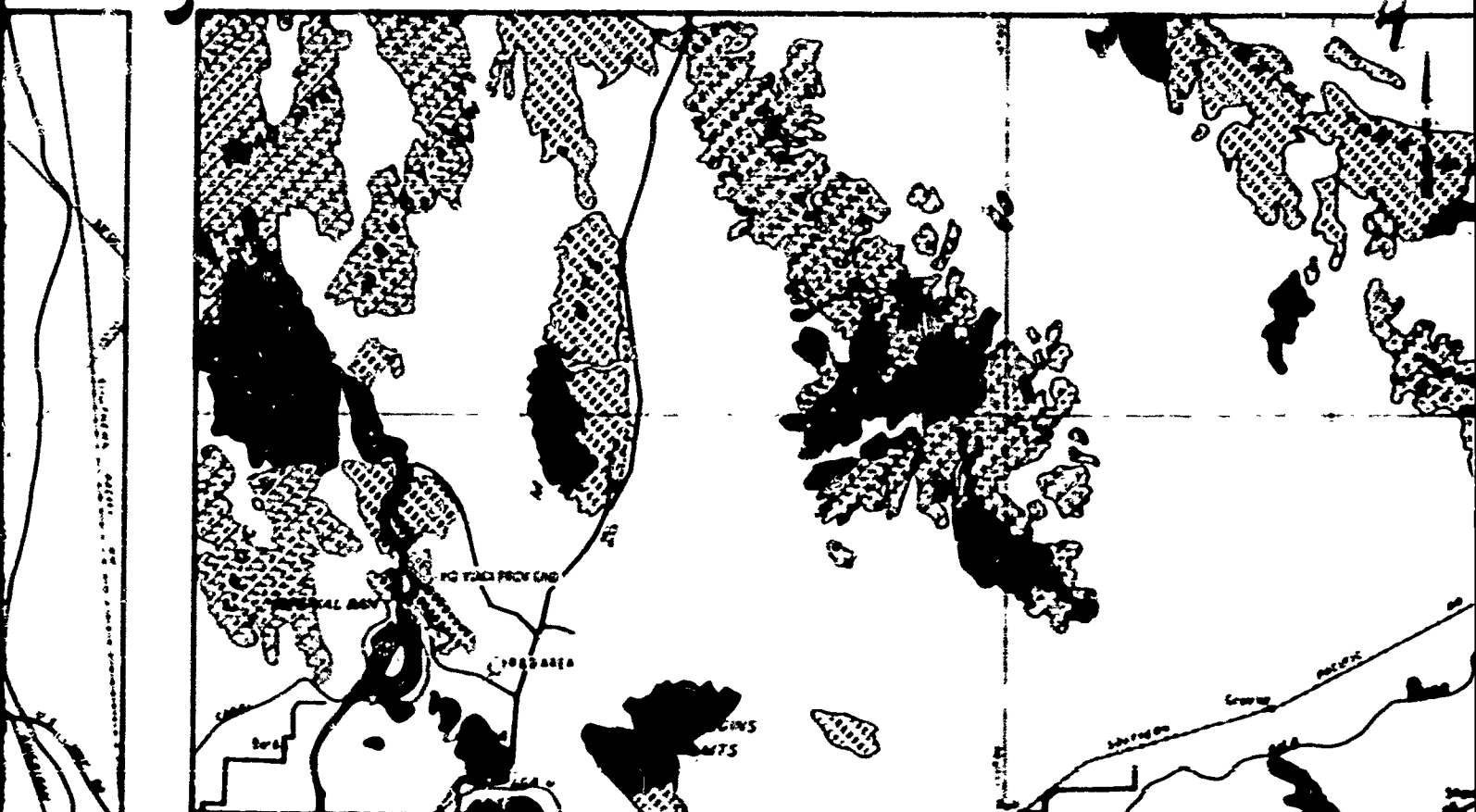
In complexes (e.g., 13/12) the first digit always refers to the locally predominant unit.

ANALOGS OF YUMA TERRAIN IN THE MIDDLE EAST DESERT SOIL CONSISTENCY

8







YUMA PROVING GROUND

LEWIS & CLARK

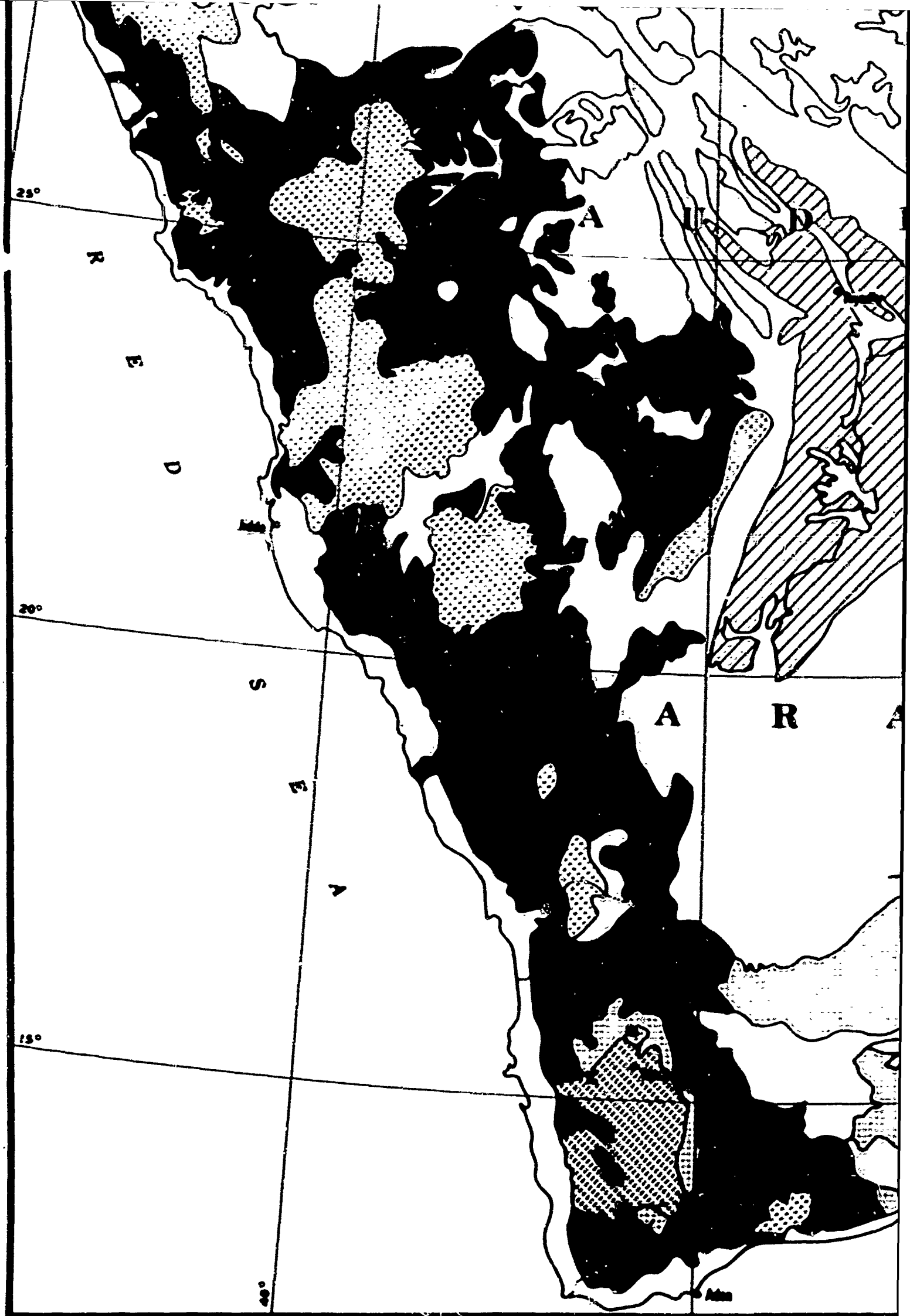
Mappey is a person who said to Wagner and at whom Wagner is a I do not know the character of the act in effect this person is the subject of various laws and laws applied as I do not know Jan 1950

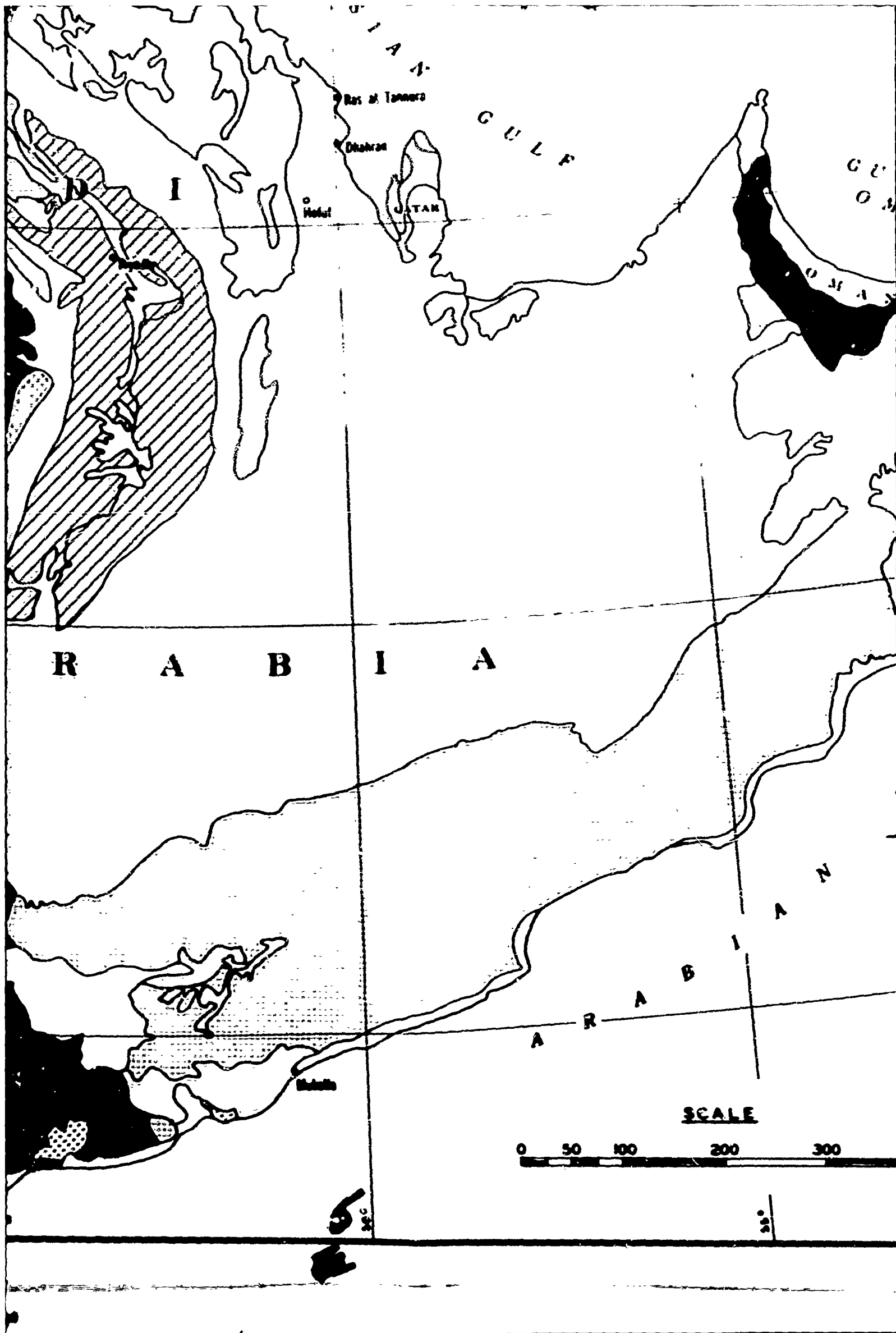
മി.ജി.എസ്. ഉപനിവേശം, 1978 പ്രകാരം 10 ലക്ഷം രൂപ 0 പന്ത്രണ്ട് പൈസകൾ

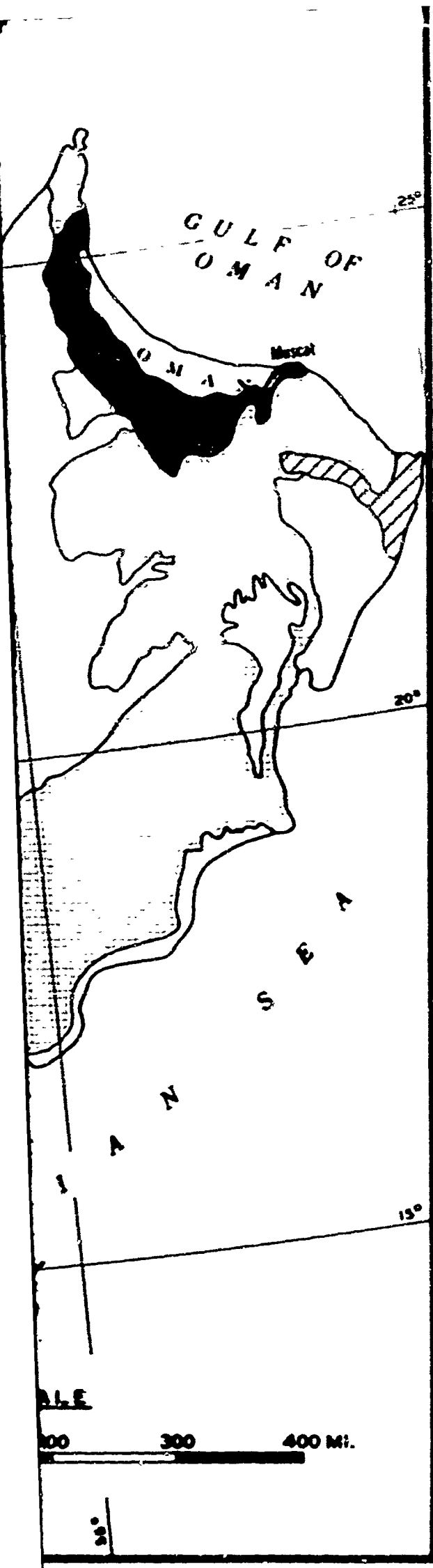
1. **IGNEOUS ROCKS (DIFFERENTIATED):** Rocks formed by crystallization of a molten substance. A hot body of molten material.
2. **INTRUSIVE:** Igneous rocks, typically crystalline, which have formed by cooling below the surface of the earth (granite, syenite, diorite, etc.).
3. **EXTRUSIVE (VOLCANIC):** Igneous rocks which have formed by cooling at the surface of the earth.
4. **PLUTONIC:** Intrusive rocks formed by solidification of molten material that poured out on the surface of the earth (e.g., basalt, andite, etc.).
5. **DIORITIC:** Rocks formed by secondary consolidation of basaltic deposits of volcanic ejecta (e.g., tuff, agglomerate, etc.).
6. **METAMORPHIC ROCKS (DIFFERENTIATED):** Rocks formed from original igneous or sedimentary rocks through alterations produced by pressure, heat, or the infiltration of other materials at depths under the surface zones of weathering and crystallization. The alterations are continuous complete throughout the body of the rock to produce a well-defined new type (gneiss, schist, slate, etc.).
7. **SEDIMENTARY ROCKS (DIFFERENTIATED):** Rocks formed from material laid down in a water or air body, divided into, or sedimented, through the agency of water, wind, or glaciers.
8. **SANDSTONE:** A sedimentary rock predominantly composed of sand grains cemented together.
9. **LIMESTONE:** A sedimentary rock consisting essentially of calcium carbonate.
10. **SLATE:** A sedimentary rock in which the mineral particles are predominantly of clay size.
11. **EXPOSURE:** A sedimentary rock whose origin is largely due to evaporation and subsequent precipitation of salt from water. (Gypsum, halite, etc., and rock salt are the only exposures of quantitative importance.)
12. **ROCK COMPLEXES:** Rock complexes are mapped where no really predominant (75 percent or more) rock type occurs. In such instances, the two most commonly occurring rock types are mapped; the predominant is shown at the center, the subordinate as the dominant at the fractional pattern.
- It should be recalled that the scale of mapping precludes delineation, especially in mountainous regions, of many different basins where the thickness of each is so much greater than 10 feet.

GENERALIZED ROCK PROPERTIES

[illegible]







Map of the Gulf of Oman and Arabian Sea region. The map shows the coastline of the Gulf of Oman and the Arabian Sea. A scale bar at the bottom left indicates distances of 100, 300, and 400 miles. Latitude lines for 15° and 20° North are marked. The map is divided into several regions labeled with letters A, B, C, D, E, and F. A legend on the right side of the map provides a key for the different geological features and rock types.

LEGEND

1. INTRUSIVE (UNDIFFERENTIATED) Rocks which have been intruded into the country from below the surface of the earth. They are usually of igneous origin and are composed of one or more of the following types:

- a. Granite** - A coarse-grained igneous rock composed of quartz, feldspar, and mica.
- b. Diorite** - A coarse-grained igneous rock composed of plagioclase feldspar and hornblende.
- c. Gabbro** - A coarse-grained igneous rock composed of plagioclase feldspar and pyroxene.
- d. Basalt** - A fine-grained igneous rock composed of plagioclase feldspar and pyroxene.

2. METAMORPHIC (DIFFERENTIATED) Rocks which have been transformed by heat and pressure into new forms. They are usually of igneous origin and are composed of one or more of the following types:

- a. Schist** - A metamorphic rock composed of mica, quartz, and feldspar.
- b. Gneiss** - A metamorphic rock composed of plagioclase feldspar and quartz.
- c. Amphibolite** - A metamorphic rock composed of hornblende and plagioclase feldspar.
- d. Soapstone** - A metamorphic rock composed of talc and quartz.
- e. Soapstone** - A metamorphic rock composed of talc and quartz.
- f. Soapstone** - A metamorphic rock composed of talc and quartz.

3. SEDIMENTARY (UNDIFFERENTIATED) Rocks which have been deposited from a liquid state and are composed of one or more of the following types:

- a. Sandstone** - A sedimentary rock composed of sand and cementation.
- b. Limestone** - A sedimentary rock composed of calcium carbonate.
- c. Shale** - A sedimentary rock composed of clay and cementation.
- d. Evaporite** - A sedimentary rock composed of salts and cementation.

4. ROCK COMPLEXES Rocks which are composed of two or more of the above types. They are usually of igneous origin and are composed of one or more of the following types:

- a. Granite** - A coarse-grained igneous rock composed of quartz, feldspar, and mica.
- b. Diorite** - A coarse-grained igneous rock composed of plagioclase feldspar and hornblende.
- c. Gabbro** - A coarse-grained igneous rock composed of plagioclase feldspar and pyroxene.
- d. Basalt** - A fine-grained igneous rock composed of plagioclase feldspar and pyroxene.

5. METAMORPHIC (UNDIFFERENTIATED) Rocks which have been transformed by heat and pressure into new forms. They are usually of igneous origin and are composed of one or more of the following types:

- a. Schist** - A metamorphic rock composed of mica, quartz, and feldspar.
- b. Gneiss** - A metamorphic rock composed of plagioclase feldspar and quartz.
- c. Amphibolite** - A metamorphic rock composed of hornblende and plagioclase feldspar.
- d. Soapstone** - A metamorphic rock composed of talc and quartz.
- e. Soapstone** - A metamorphic rock composed of talc and quartz.
- f. Soapstone** - A metamorphic rock composed of talc and quartz.

GENERALIZED ROCK PROPERTIES

TABLE 1. CHARACTERISTICS OF ROCKS

Rock Type	Color	Texture	Hardness	Specific Gravity	Fracture	Other Properties
1. INTRUSIVE						
a. Granite	Light to dark	Coarse-grained	Hard	2.6-2.7	Conchoidal	Quartz, feldspar, mica
b. Diorite	Light to dark	Coarse-grained	Hard	2.8-3.0	Conchoidal	Plagioclase feldspar, hornblende
c. Gabbro	Light to dark	Coarse-grained	Hard	3.0-3.2	Conchoidal	Plagioclase feldspar, pyroxene
d. Basalt	Dark	Fine-grained	Hard	3.0-3.2	Conchoidal	Plagioclase feldspar, pyroxene
2. METAMORPHIC						
a. Schist	Light to dark	Medium-grained	Hard	2.6-2.7	Conchoidal	Mica, quartz, feldspar
b. Gneiss	Light to dark	Medium-grained	Hard	2.6-2.7	Conchoidal	Plagioclase feldspar, quartz
c. Amphibolite	Dark	Medium-grained	Hard	3.0-3.2	Conchoidal	Hornblende, plagioclase feldspar
d. Soapstone	Light to dark	Fine-grained	Soft	2.8-3.0	Conchoidal	Talc, quartz
3. SEDIMENTARY						
a. Sandstone	Light to dark	Medium-grained	Hard	2.6-2.7	Conchoidal	Sand, cementation
b. Limestone	Light to dark	Medium-grained	Hard	2.6-2.7	Conchoidal	Calcium carbonate
c. Shale	Light to dark	Fine-grained	Soft	2.6-2.7	Conchoidal	Clay, cementation
d. Evaporite	Light to dark	Fine-grained	Soft	2.6-2.7	Conchoidal	Salts, cementation
4. ROCK COMPLEXES						
a. Granite	Light to dark	Coarse-grained	Hard	2.6-2.7	Conchoidal	Quartz, feldspar, mica
b. Diorite	Light to dark	Coarse-grained	Hard	2.8-3.0	Conchoidal	Plagioclase feldspar, hornblende
c. Gabbro	Light to dark	Coarse-grained	Hard	3.0-3.2	Conchoidal	Plagioclase feldspar, pyroxene
d. Basalt	Dark	Fine-grained	Hard	3.0-3.2	Conchoidal	Plagioclase feldspar, pyroxene

TABLE 2. CHARACTERISTICS OF ROCKS

Rock Type	Color	Texture	Hardness	Specific Gravity	Fracture	Other Properties
1. INTRUSIVE						
a. Granite	Light to dark	Coarse-grained	Hard	2.6-2.7	Conchoidal	Quartz, feldspar, mica
b. Diorite	Light to dark	Coarse-grained	Hard	2.8-3.0	Conchoidal	Plagioclase feldspar, hornblende
c. Gabbro	Light to dark	Coarse-grained	Hard	3.0-3.2	Conchoidal	Plagioclase feldspar, pyroxene
d. Basalt	Dark	Fine-grained	Hard	3.0-3.2	Conchoidal	Plagioclase feldspar, pyroxene
2. METAMORPHIC						
a. Schist	Light to dark	Medium-grained	Hard	2.6-2.7	Conchoidal	Mica, quartz, feldspar
b. Gneiss	Light to dark	Medium-grained	Hard	2.6-2.7	Conchoidal	Plagioclase feldspar, quartz
c. Amphibolite	Dark	Medium-grained	Hard	3.0-3.2	Conchoidal	Hornblende, plagioclase feldspar
d. Soapstone	Light to dark	Fine-grained	Soft	2.8-3.0	Conchoidal	Talc, quartz
3. SEDIMENTARY						
a. Sandstone	Light to dark	Medium-grained	Hard	2.6-2.7	Conchoidal	Sand, cementation
b. Limestone	Light to dark	Medium-grained	Hard	2.6-2.7	Conchoidal	Calcium carbonate
c. Shale	Light to dark	Fine-grained	Soft	2.6-2.7	Conchoidal	Clay, cementation
d. Evaporite	Light to dark	Fine-grained	Soft	2.6-2.7	Conchoidal	Salts, cementation
4. ROCK COMPLEXES						
a. Granite	Light to dark	Coarse-grained	Hard	2.6-2.7	Conchoidal	Quartz, feldspar, mica
b. Diorite	Light to dark	Coarse-grained	Hard	2.8-3.0	Conchoidal	Plagioclase feldspar, hornblende
c. Gabbro	Light to dark	Coarse-grained	Hard	3.0-3.2	Conchoidal	Plagioclase feldspar, pyroxene
d. Basalt	Dark	Fine-grained	Hard	3.0-3.2	Conchoidal	Plagioclase feldspar, pyroxene

Abbreviations for all effects on rock properties (tools and equipment):

- A. Extreme
- B. Severe
- C. Moderate
- D. Slight
- E. Minimal or none

Tools and procedures required to make rock tests:

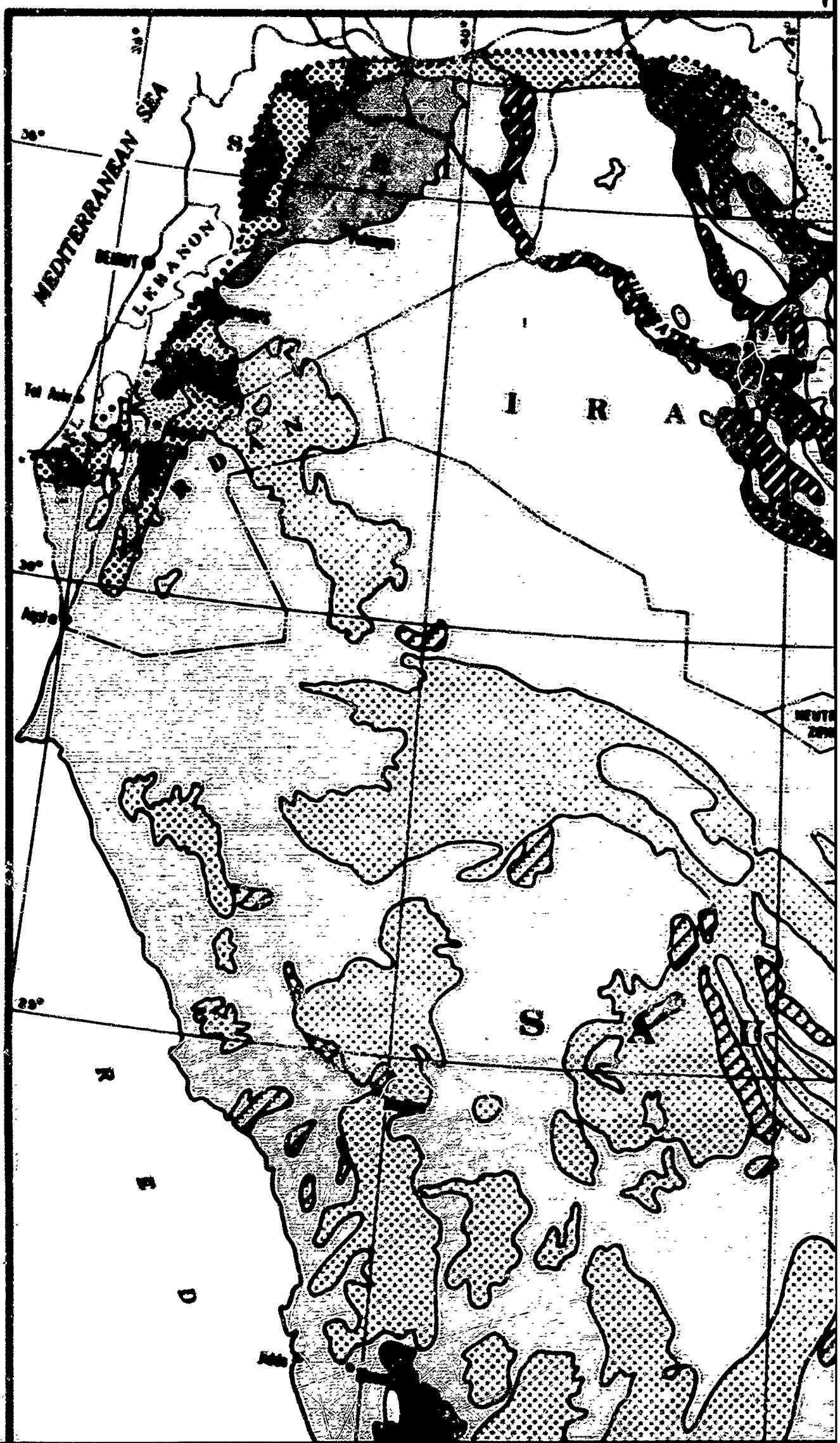
- a. Split and observe
- b. Pick and observe
- c. Pick, scratch, or scratch
- d. Rep. used drilling and blasting
- e. Almost continuous drilling and blasting

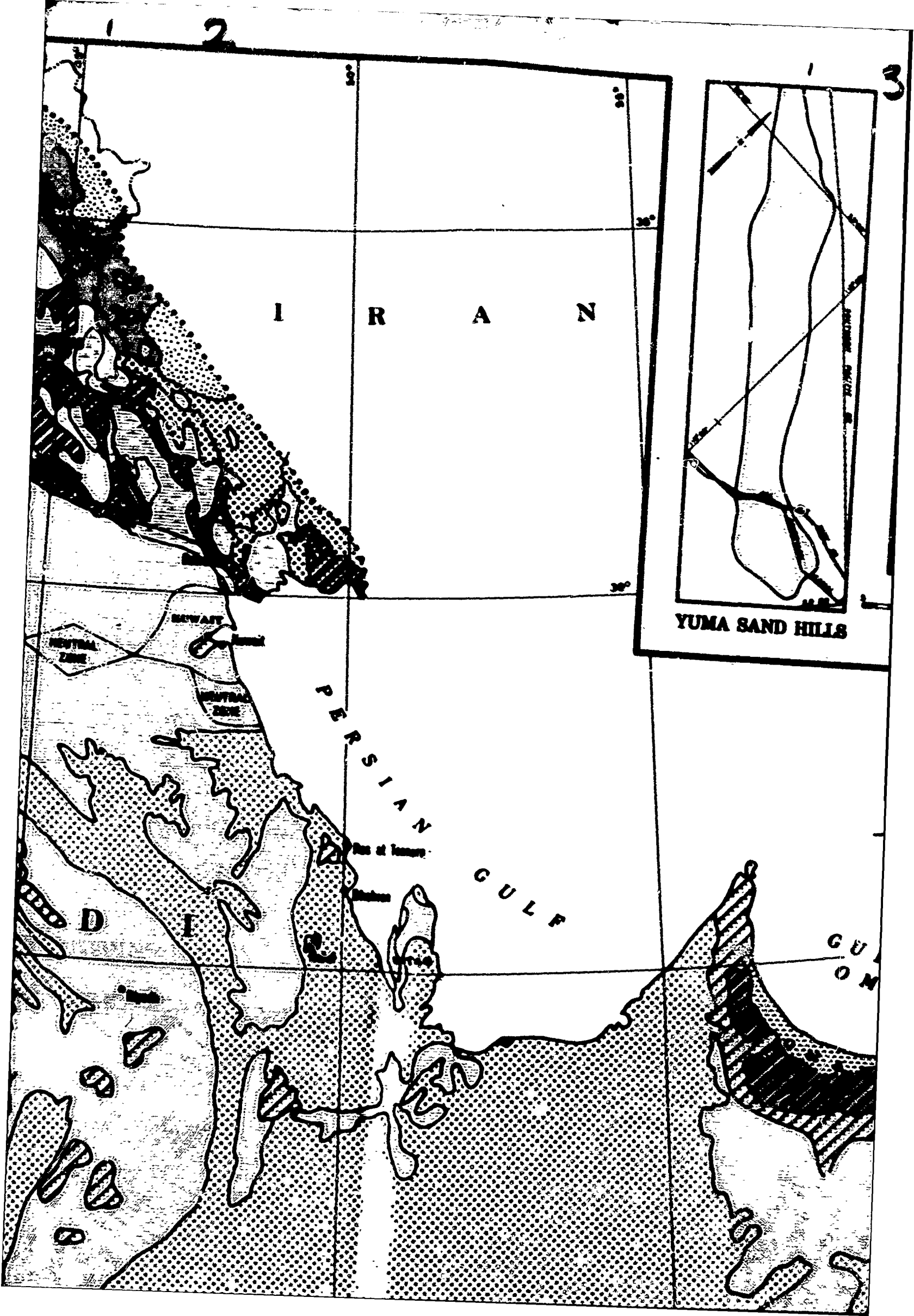
Marked from the Bureau of Mines, Portland, Oregon, 1955

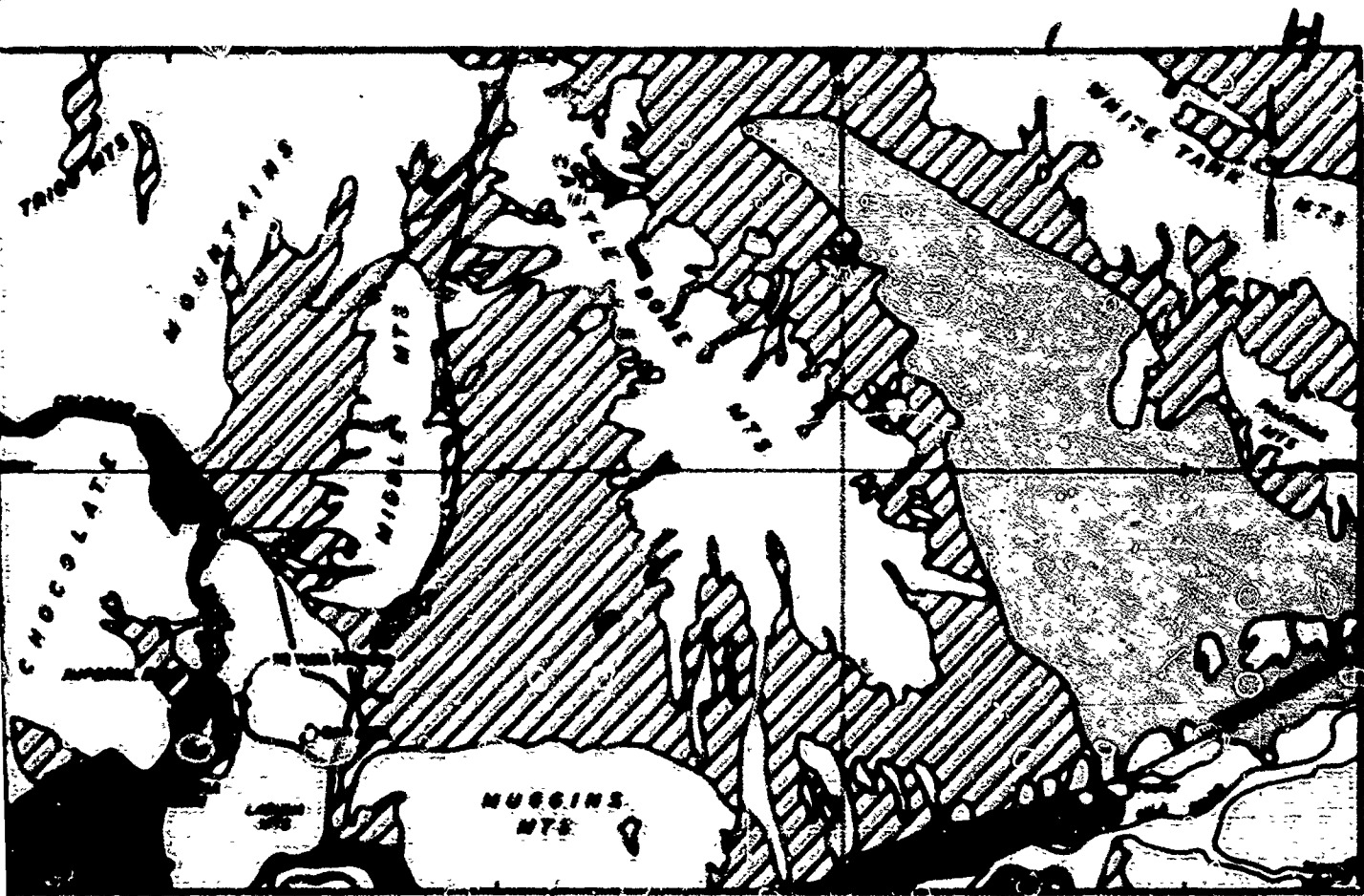
All other properties:

- 1. Fracture
- 2. Color
- 3. Luster or lustre
- 4. Hard or hardness (Mohs or otherwise)
- 5. Indurated, crystalline, or fibrous

ANALOGS OF YUMA TERRAIN **IN THE** **MIDDLE EAST DESERT** **SURFACE ROCK**

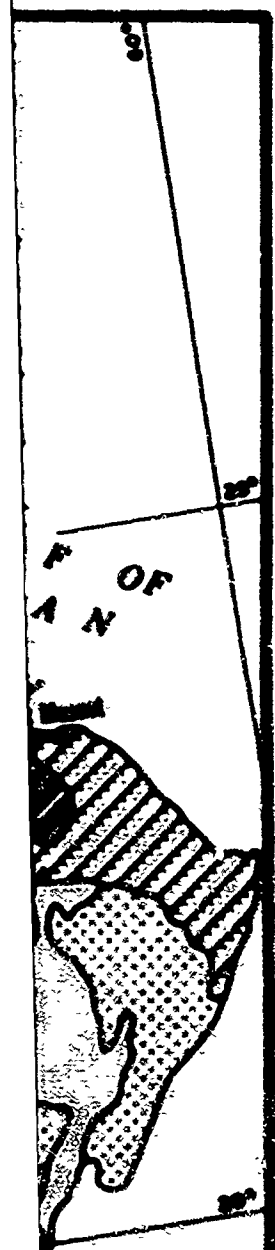






SCALE

YUMA PROVING GROUND



VEGETATION

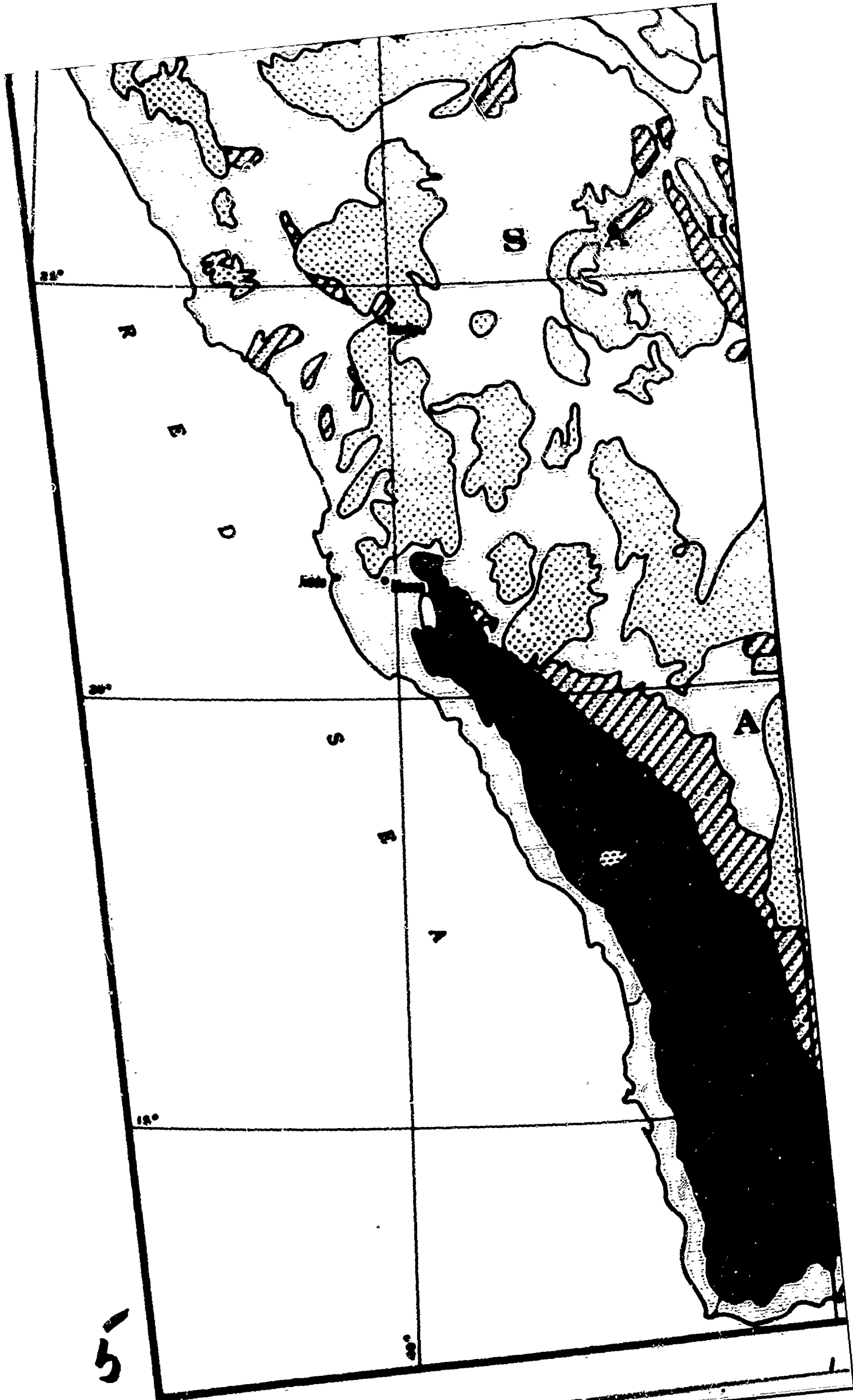
Already predominant (75 percent or more) vegetation type mapped.

Key	Description
1. Barren	Desert or nearly devoid of vegetation.
2. Sparse shrub & grass	Widely spaced thorny shrubs, bushes, low scrubby trees, herbs, or clumps and open stands of coarse grass. (Also includes cacti in the U. S.)
3. Scattered shrub & grass	Moderate spacing of forms mentioned under cat 2.
4. Scattered shrub and/or scrubby trees	Thin stands of shrubs and scrubby trees, undergrowth (if present) consists of low shrubs, bushes, and grasses.
5a. With scattered 1st-story trees	Dense stands of shrubs and scrubby trees, undergrowth (if present) consists of low shrubs, bushes, and grasses.
5b. With scattered 1st-story trees	Orchard trees with grain-herb cultivation forming the 1st story.
6. With grain-herb cultivation	Dense palm groves, 1st-story grain-herb cultivation may or may not be present.
7. Palm with or without grain-herb cultivation	Low grass cover, may or may not include scattered low scrubby trees and shrubs. Height of grass ranges from a few in. to 2 ft.
8. Steppes	High continuous grass cover, includes scattered scrubby trees and shrubs. Height of grass averages 3-5 ft.
9. Steppes-scrub	Cultivated plots of grains, vegetables, etc.
10. Grass-herb cultivation	Dense growth of grains, etc., etc.
11. Marsh	Vegetation complexes are mapped where no actually predominant (75 percent or more) vegetation type occurs. In each instance, the two most commonly occurring types are mapped; the predominant is shown as the numerator, the subordinate as the denominator in the fractional pattern.
12. Vegetation complexes	
13. Pines	

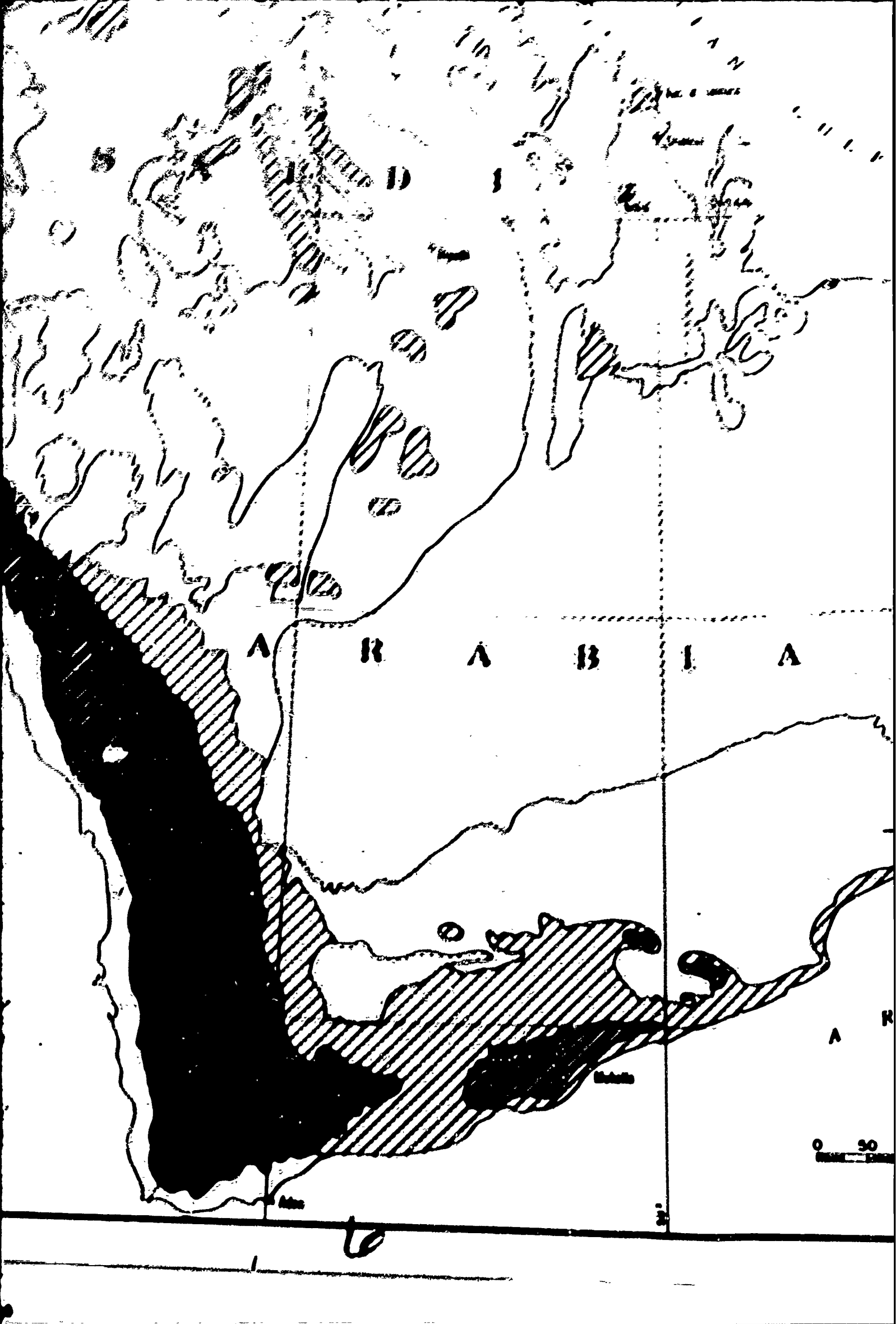
VEGETATION

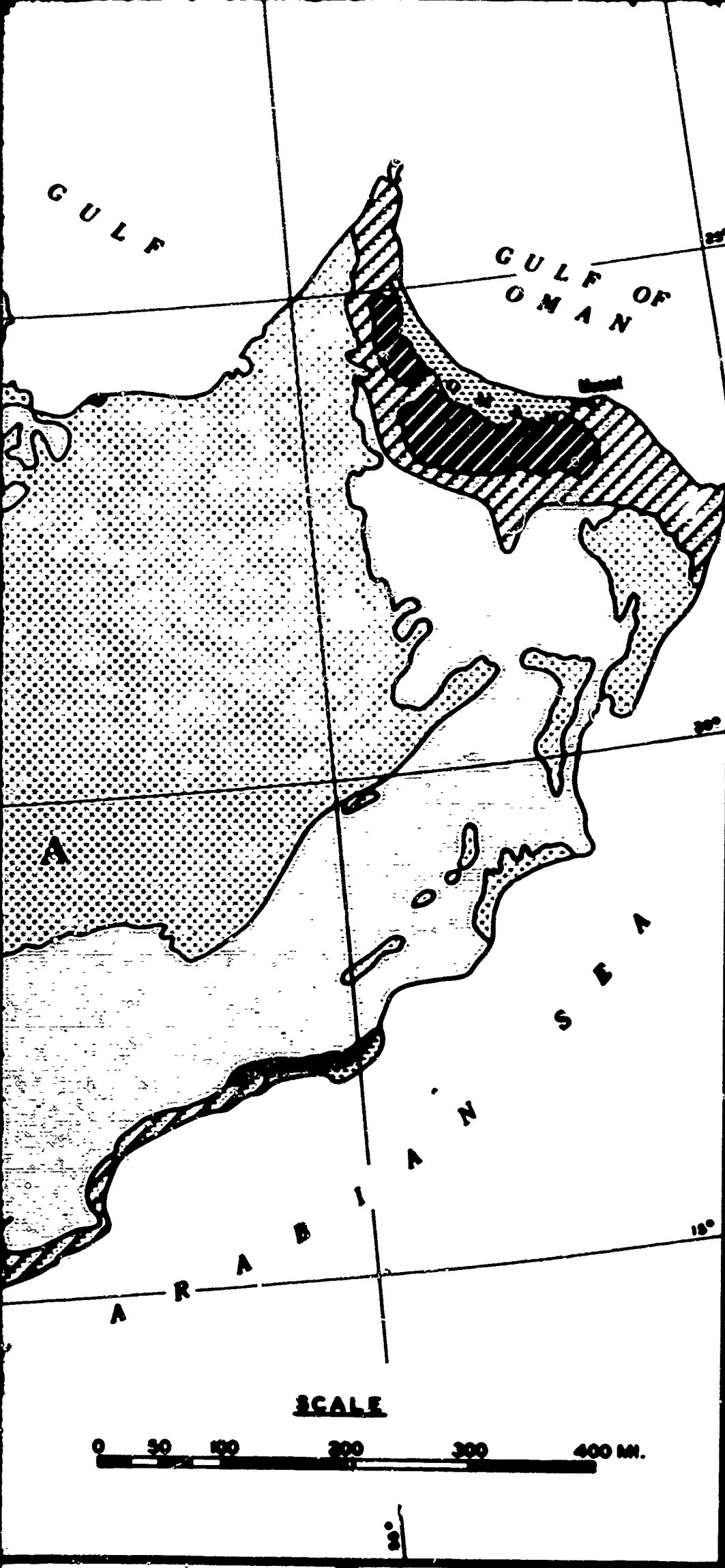
Supplementary Data

Key	Ground Cover	Grass	Shrub	Tree	Vegetation	Complex
1	100	0	0	0	100	0
2	100	0	0	0	100	0
3	100	0	0	0	100	0
4	100	0	0	0	100	0
5a	100	0	0	0	100	0
5b	100	0	0	0	100	0
6	100	0	0	0	100	0
7	100	0	0	0	100	0
8	100	0	0	0	100	0
9	100	0	0	0	100	0
10	100	0	0	0	100	0
11	100	0	0	0	100	0
12	100	0	0	0	100	0
13	100	0	0	0	100	0



5





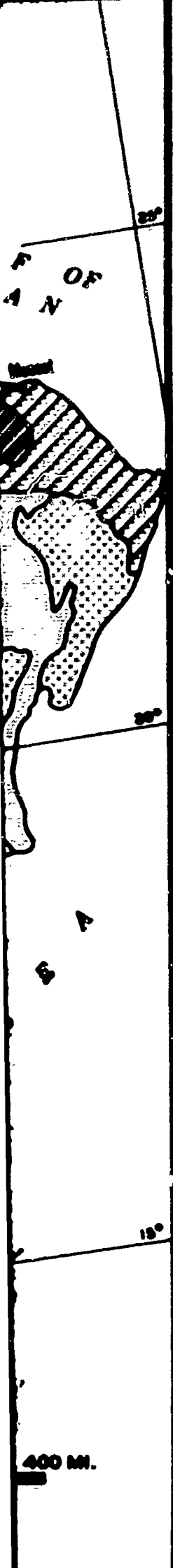
- Areally predominant (25% or more)
- Dist
- 1. Barren
 - 2. Sparse shrub & grass
 - 3. Scattered shrub & grass
 - 4. Scattered shrub and/or scrubby trees
 - 5a. With scattered 1st-story trees
 - 5b. Dense shrub and/or scrubby trees
 - 6a. With scattered 1st-story trees
 - 6b. With grain-bark cultivation
 - 7. Palms with or without grain-bark cultivation
 - 8. Steppe
 - 9. Steppe-savanna
 - 10. Grain-bark cultivation
 - 11. Marsh
 - 12. VEGETATION COMPLEXES
- Palms

Dist	Ground Cover %	Canopy Cover %
1. Barren	<1	1
2. Sparse shrub & grass	1-5	1
3. Scattered shrub & grass	5-25	0-5
4. Scattered shrub and/or scrubby trees	25-50	<50
With scattered 1st-story trees	50-90	<50
5. Dense shrub and/or scrubby trees	50-100	>50
a. With scattered 1st-story trees	50-100	>50
b. With grain-bark cultivation	50-100	>50
6. Palms with or without grain-bark cultivation	75-100	1
7. Steppe	50-100	1
8. Steppe-savanna	50-100	5-10
9. Grain-bark cultivation	50-100	1
10. Marsh	50-100	1

* Vegetation stories are distinguished on the basis of height 5 to 25 ft. 1st story, from 25 to 75 ft.

† Indicates factor is unimportant or not applicable within the

ANALOGS OF
MIDDLE
VEGETATION



VEGETATION

Areally predominant (70 percent or more) vegetation type mapped.

Code	Symbol	Description
1	[Pattern]	Barren
2	[Pattern]	Sparsely shrub & grass
3	[Pattern]	Scattered shrub & grass
4	[Pattern]	Scattered shrub and/or scrubby trees
4a	[Pattern]	a. With scattered 1st-story trees
5	[Pattern]	Dense shrub and/or scrubby trees
5a	[Pattern]	a. With scattered 1st-story trees
5b	[Pattern]	b. With grass-herb cultivation
6	[Pattern]	Palm with or without grass-herb cultivation
7	[Pattern]	Steppe
8	[Pattern]	Steppe-savanna
9	[Pattern]	Grass-herb cultivation
10	[Pattern]	Marsh
11	[Pattern]	VEGETATION COMPLEXES
	[Symbol]	Palm

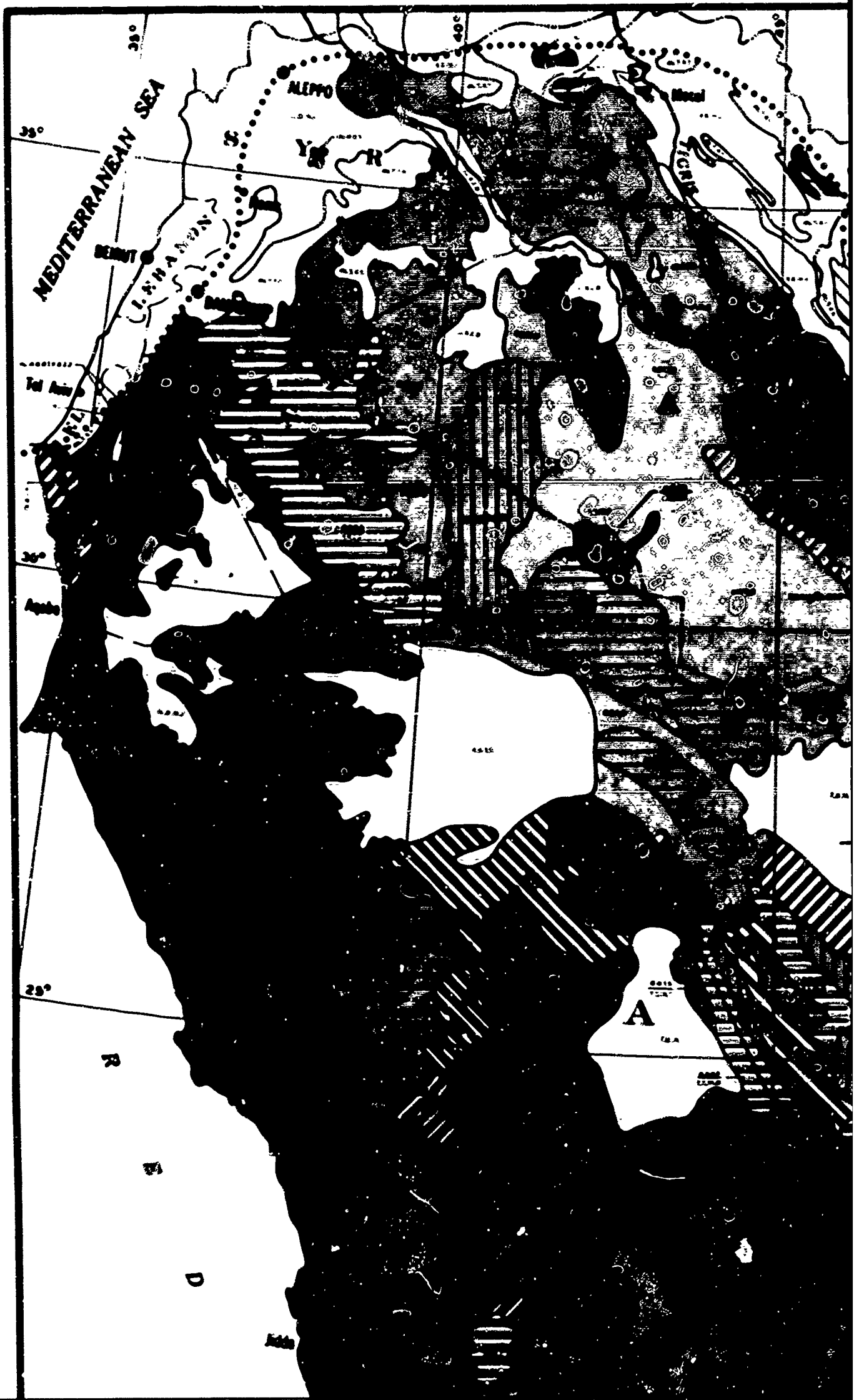
VEGETATION

Supplementary Data

Code	Ground Cover %	Canopy Cover %		Spacing		Height		Trunk Diam.		Crown Diam.	
		1st Story %	2nd Story %	1st Story ft.	2nd Story ft.	1st Story ft.	2nd Story ft.	1st Story in.	2nd Story in.	1st Story ft.	2nd Story ft.
1. Barren	<1	?	?	?	?	?	?	?	?	?	?
2. Sparsely shrub & grass	1-5	?	?	?	?	?	?	?	?	?	?
3. Scattered shrub & grass	5-25	5-5	?	much >12	?	6-10	?	2-5	?	5-10	?
4. Scattered shrub and/or scrubby trees	50-90	<50	?	>12	?	6-25	?	2-12	?	5-25	?
4a. With scattered 1st-story trees	50-90	<45	5-25	>12	>12	6-25	15-30	2-12	12-20	5-25	25-40
5. Dense shrub and/or scrubby trees	80-100	>50	?	<12	?	6-25	?	2-12	?	5-25	?
5a. With scattered 1st-story trees	80-100	>50	5-25	<12	>12	6-25	25-30	2-12	12-20	5-25	25-40
5b. With grass-herb cultivation	90-100	>50	?	>12	?	10-30	?	5-10	?	10-20	?
6. Palm with or without grass-herb cultivation	75-100	?	50-75	?	>12	?	65-80	?	12-20	?	25-30
7. Steppe	50-100	?	?	?	?	?	?	?	?	?	?
8. Steppe-savanna	80-100	5-10	?	much >12	?	15-25	?	2-12	?	15-25	?
9. Grass-herb cultivation	90-100	?	?	?	?	?	?	?	?	?	?
10. Marsh	80-100	?	?	?	?	?	?	?	?	?	?

a. Vegetation stories are distinguished on the basis of height: 1st-story vegetation ranges from 0 to 6 ft in height, 2nd story, from 6 to 25 ft; 3rd story, from 25 to 70 ft.
 ? Indicates factor is unimportant or not applicable within the vegetation unit.

ANALOGS OF YUMA TERRAIN IN THE MIDDLE EAST DESERT VEGETATION

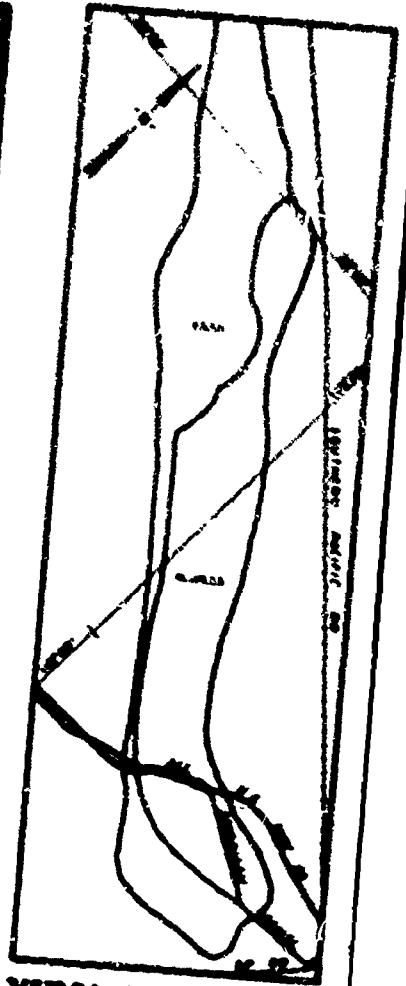


2

I R A N

P E R S I A N

G U L F



YUMA SAND HILLS

(GROSS LANDSCAPE: GL, 1, 3, 5)

Line of latitude

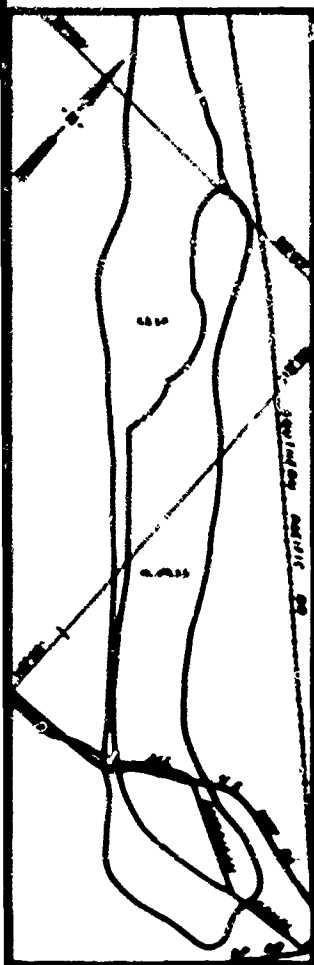
Shaded area

Shaded area

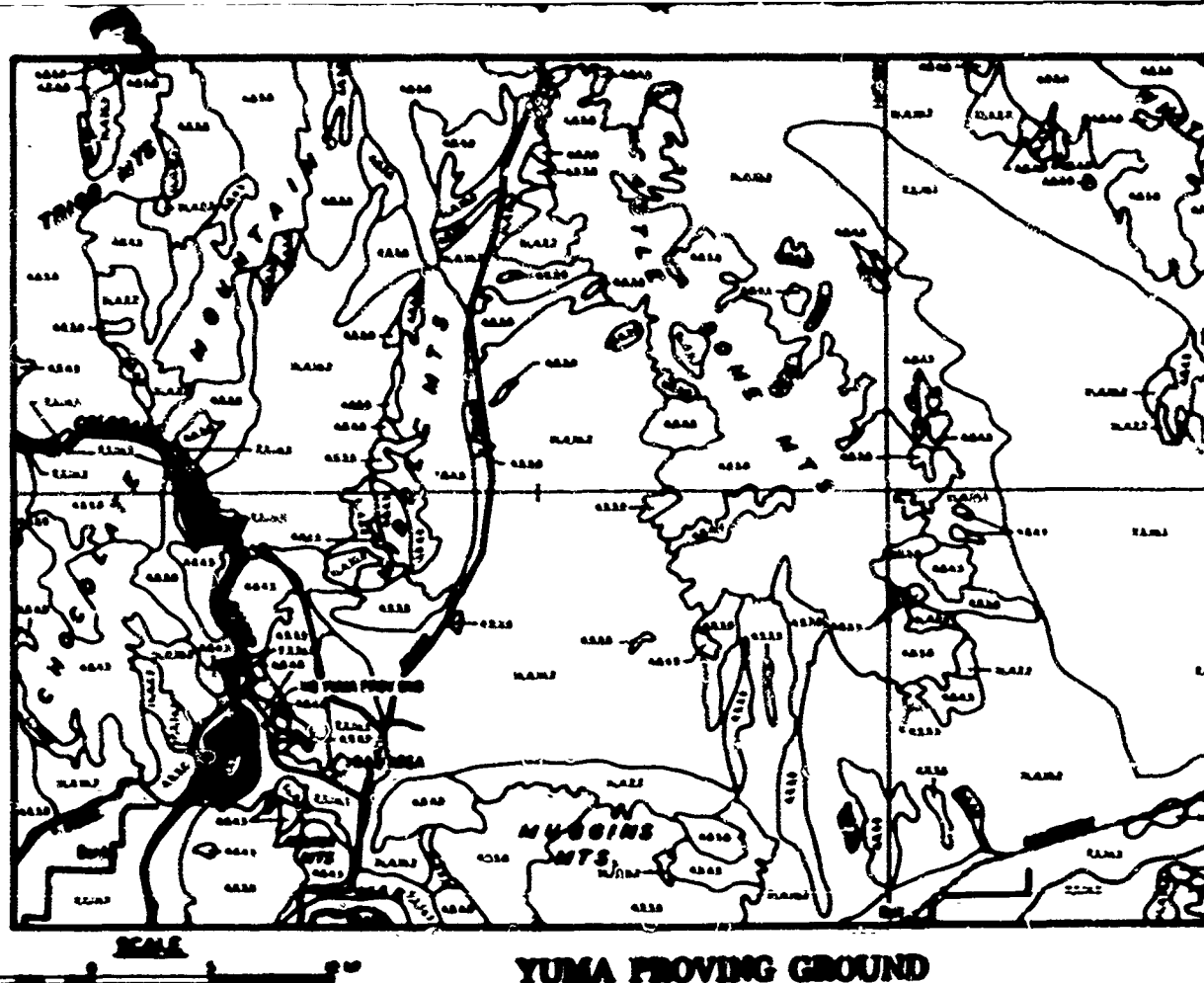
Shaded area

Shaded area

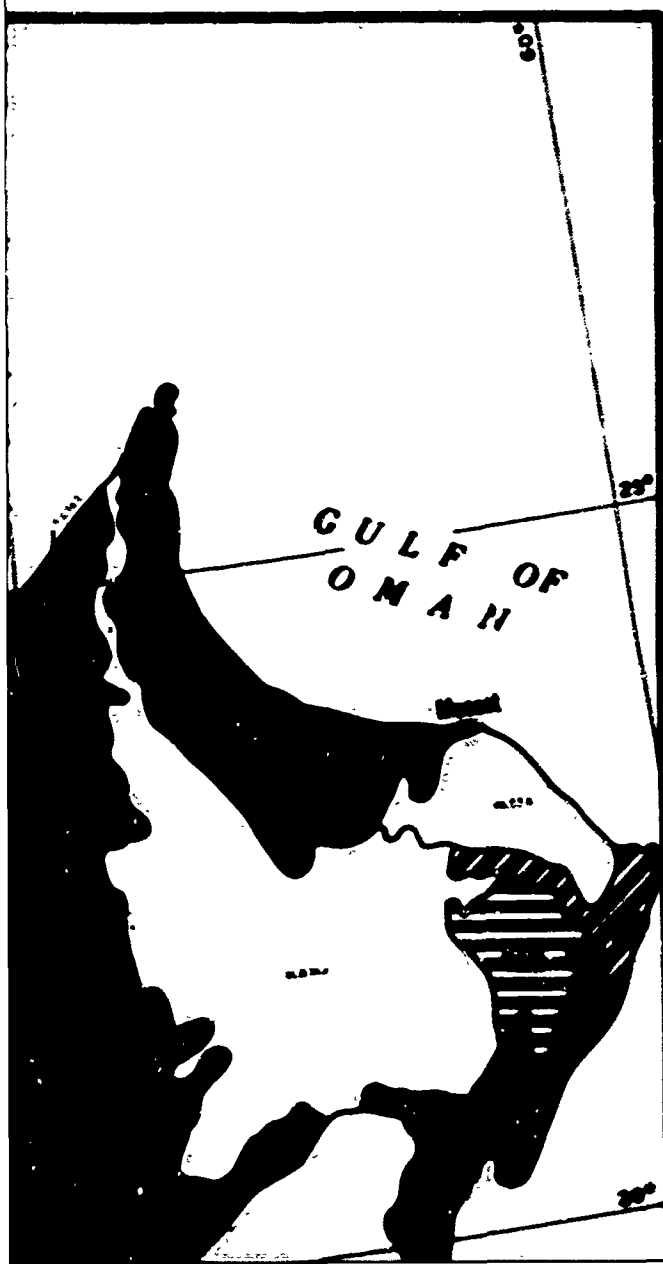
Shaded area



YUMA SAND HILLS
GROSS LANDSCAPE: (SL, 1, 3, 5)



YUMA PROVING GROUND
(GROSS LANDSCAPE: SL //, 1, 3, 5, 7)



GEOMETRY OR FORM ANALOGY

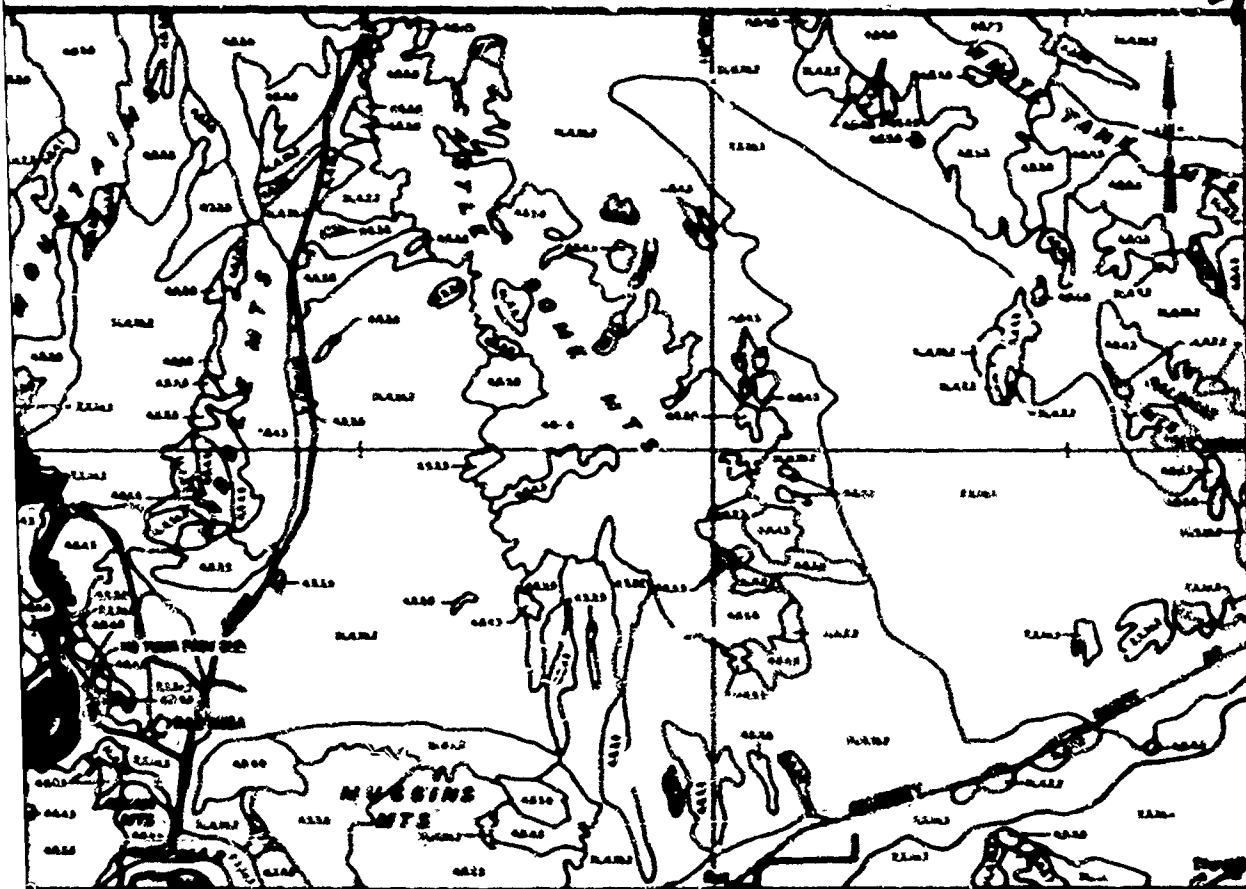
LEGEND

4	Highly Analogous	The structural landscape is found at Yuma.
3	Moderately Analogous	Three units of the array are found in an array occurring at Yuma.
1.5	Slightly Analogous	One or two units of the array are found in an array at Yuma.
0	Not Analogous	No unit of the array is found at Yuma.

LANDSCAPE COMPLEXES

Indicates the degree of analogy of the structurally predominant landscape type.

Indicates the degree of analogy of the structurally predominant landscape type.



YUMA PROVING GROUND

(GROSS LANDSCAPE: SL //, 1, 5, 7)

GEOMETRIC FORM ANALYSIS

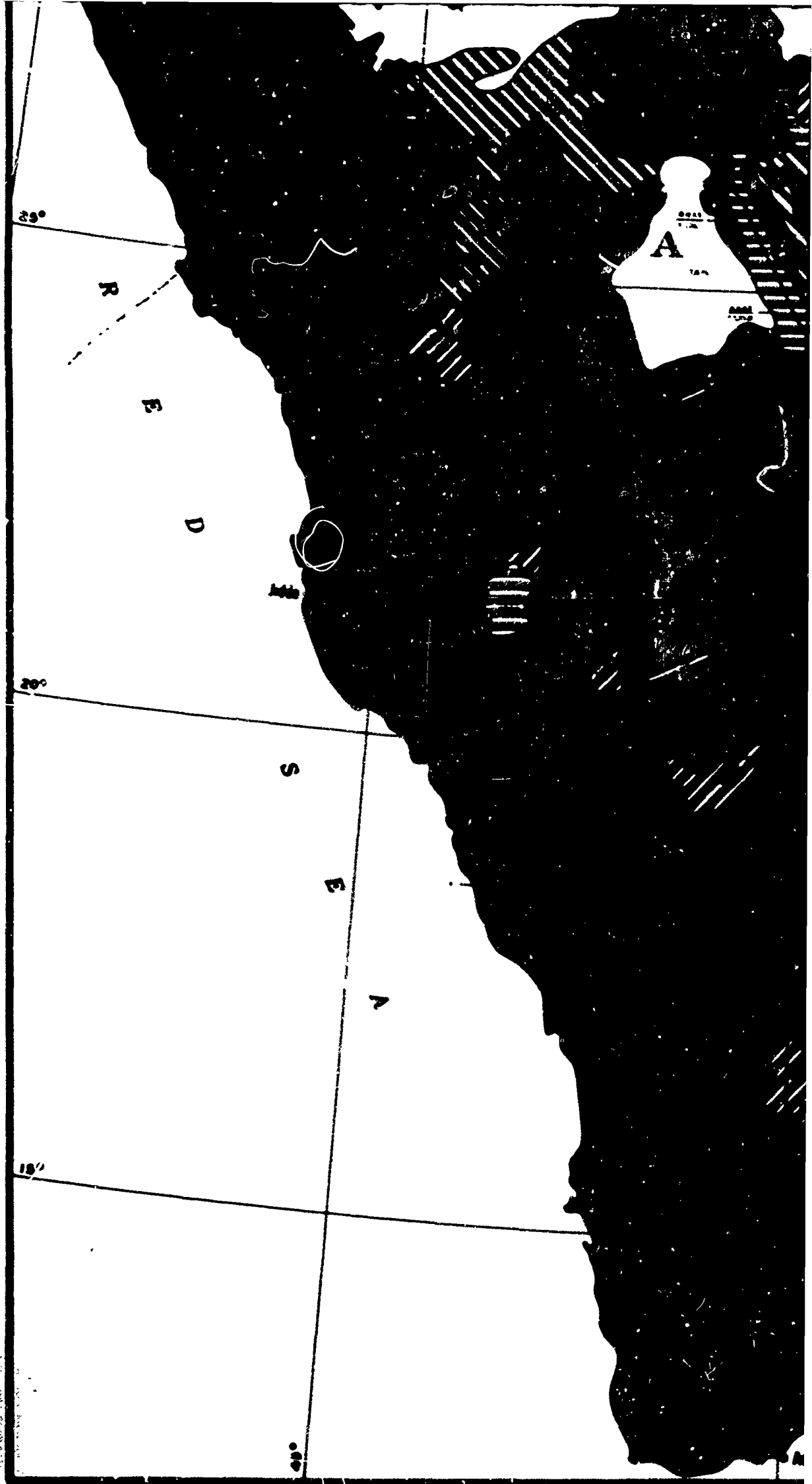
LEGEND

- 0120 Each landscape type is classified as a degree or an array of four symbols indicating mapping units of PLAN-PROFILE (1), SLOPE OCCURRENCE (2), SLOPE (3), and RELIEF (4). Mapping units of these four factors are always designated in this order.
- 0120 Landscapes in the Middle East are always compared with Yuma landscapes and not vice versa. The array of symbols in the Middle East is shown in light- and indicates type to indicate the maximum degree of analogy with Yuma, the analogy increasing as the number of light-side units increases. Units shown in boldface type are not found at Yuma in combination with the remaining units of the array. Units in lightface type indicate the maximum number of units found in the closest corresponding array on the Yuma map.
- 0120 Land Arid Complex. The aridly predominant landscape is the numerator of the complex, the subordinate the denominator.
- 0120 Land Grass-Complex Complex. The grass landscape is compared only with other grass landscapes.

1		Highly Analogous	The identical landscape is found at Yuma.
1		Moderately Analogous	Three units of the array are found in an array or setting at Yuma.
1.5		Slightly Analogous	One or two units of the array are found in an array at Yuma.
0		Not Analogous	No unit of the array is found at Yuma.

LANDSCAPE COMPLEXES

Indicates the degree of analogy of the possible combinations.



5





GEOMETRY OF FORM 3501

LEGEND

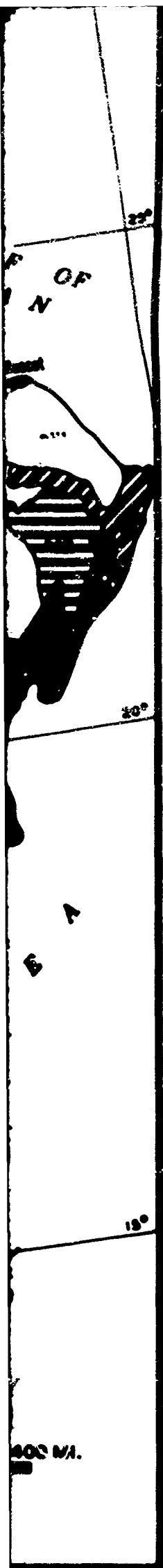
- 1000** Landmasses are shown by a series of contour mapping units of PLAN-FORM 1000. The units are defined in the Mapping Units section of this report.
- 1000** Landmasses in the Middle East are shown by a series of symbols in the 1000 series type to indicate the maximum degree of complexity as the number of lightness units and type are not found at Yuma or combinations with units in lightness type indicate the maximum in corresponding areas in the Yuma field.
- 1000** Aerial Complexes. The specific geographical features plus the subordinate the Administrative.
- 1000** Grass Landmass Complexes. The grass landmasses plus the subordinate the Administrative.
- 1000** Night Landmasses. The identical landmasses.
- 1000** Moderate Landmasses. Three units of the area, or less, accuracy at Yuma.
- 1000** Moderate Landmasses. One or two units of the area, or less, accuracy at Yuma.
- 1000** No Landmasses. No part of the area is shown.

LANDSCAPE COMPLEXES

- Indicates the degree of analogy of the small landscape type.
- Indicates the degree of analogy of the small landscape type.
- Indicates the degree of analogy of the grass landscape.
- Indicates the degree of analogy of the vegetation landscape of the vegetation type.

In a particular area it may be possible to choose different indicators to maximum degree of analogy. In such instances given to the areas. For example, the Middle East area: Yuma areas: a, rather than with Yuma: a. Complex resulted in the combination: a, a.

ANALOGS OF YUMA IN THE MIDDLE EAST DE GEOMETRY AN



GEOMETRY OR FORM ANALOGS

LEGEND

Each landscape type is identified by a series or an array of land symbols indicating mapping units of PLAN-PROFILE (1), SLOPE OCCURRENCE (2), SLOPE (3), and RELIEF (4). Mapping units of these four factors are always designated in this order.

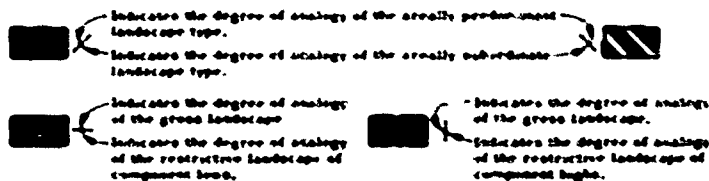
Landscape in the Middle East are always compared with Yuma landscapes and not vice versa. The array of symbols in the Middle East is shown in light- and boldface type to indicate the maximum degree of analogy with Yuma, the analogy increasing as the number of lightface units increases. Units shown in boldface type are not found at Yuma in combination with the remaining units of the array. Units in lightface type indicate the maximum number of units found in the closest corresponding array on the Yuma map.

Arreal Complexes. The arreally predominant landscape is the numerator of the complex, the subordinate the denominator.

Gross-Component Complexes. The gross landscape is compared only with other gross landscapes.

4		Highly Analogous	The structural landscape is found at Yuma.
3		Modestly Analogous	Three units of the array are found in an array existing at Yuma.
2		Slightly Analogous	One or two units of the array are found in an array at Yuma.
1		Not Analogous	No unit of the array is found at Yuma.

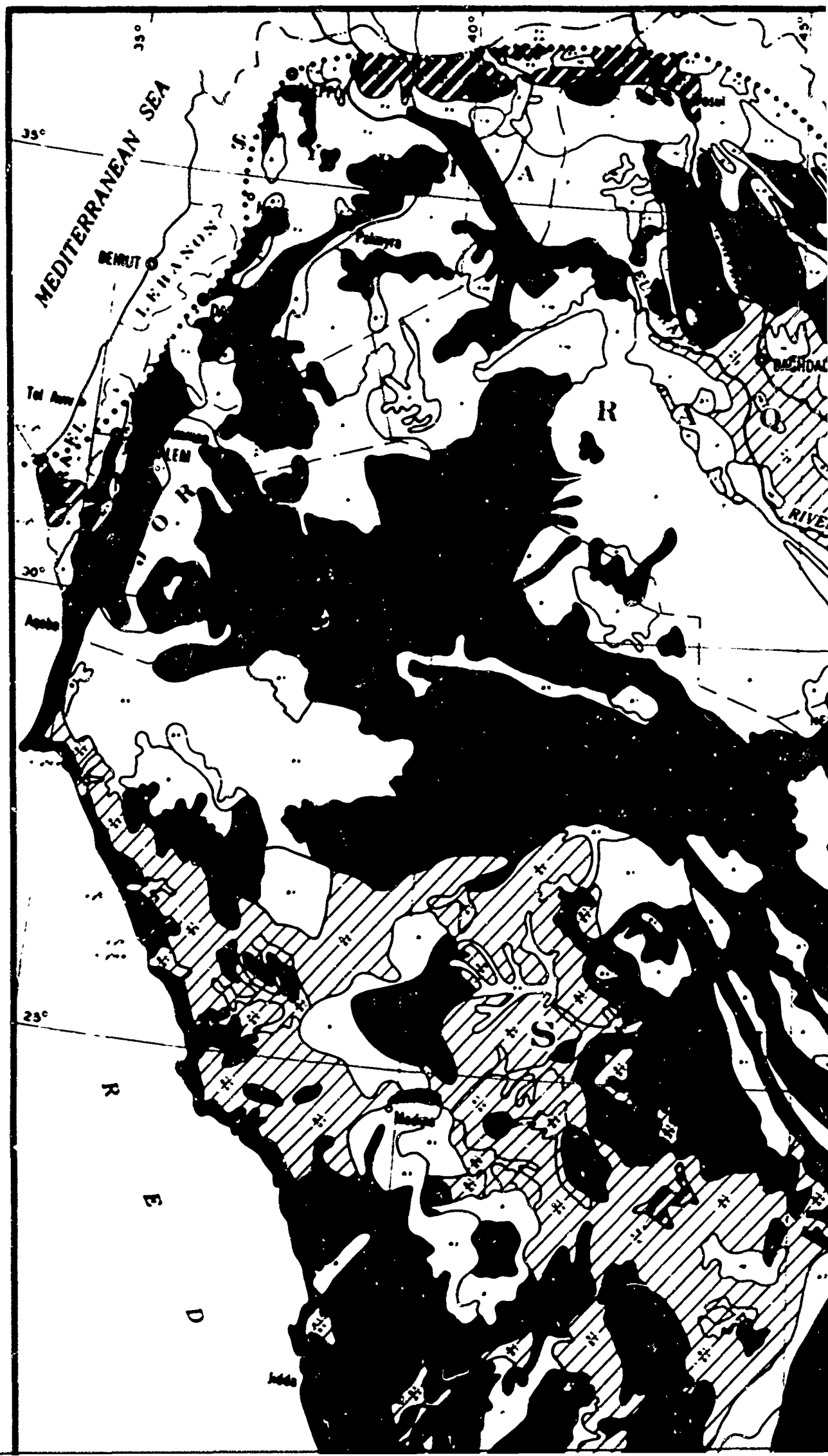
LANDSCAPE COMPLEXES

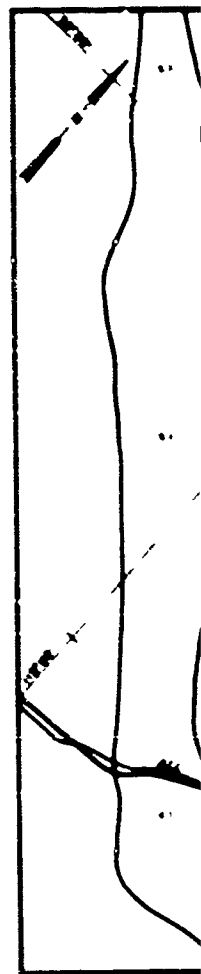


In a particular array it may be possible to change different sets of light- or boldface units to indicate the maximum degree of analogy. In such instances units are compared in the order given in the array. For example, the Middle East array was not compared with the Yuma array, rather than with Yuma, as comparison with the latter would have resulted in the symbolization.

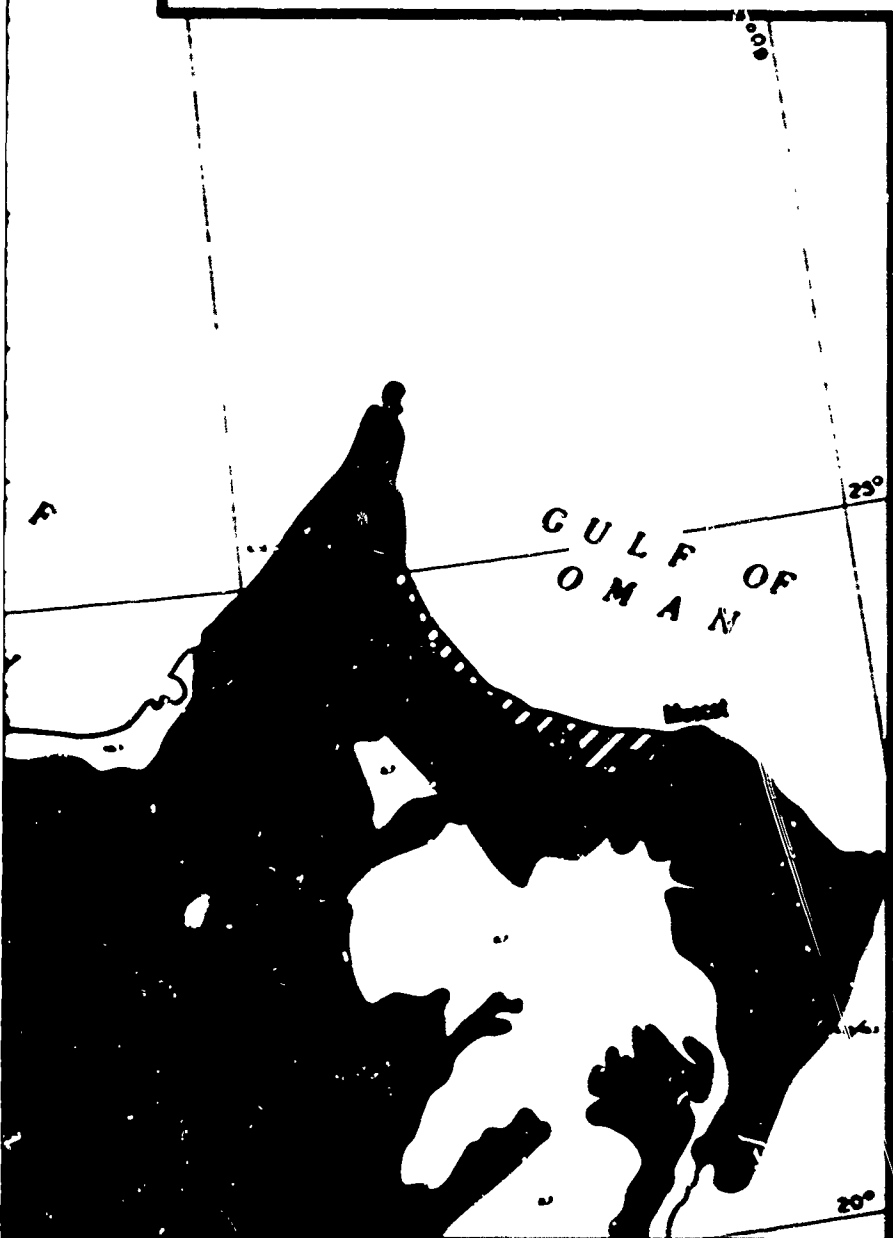
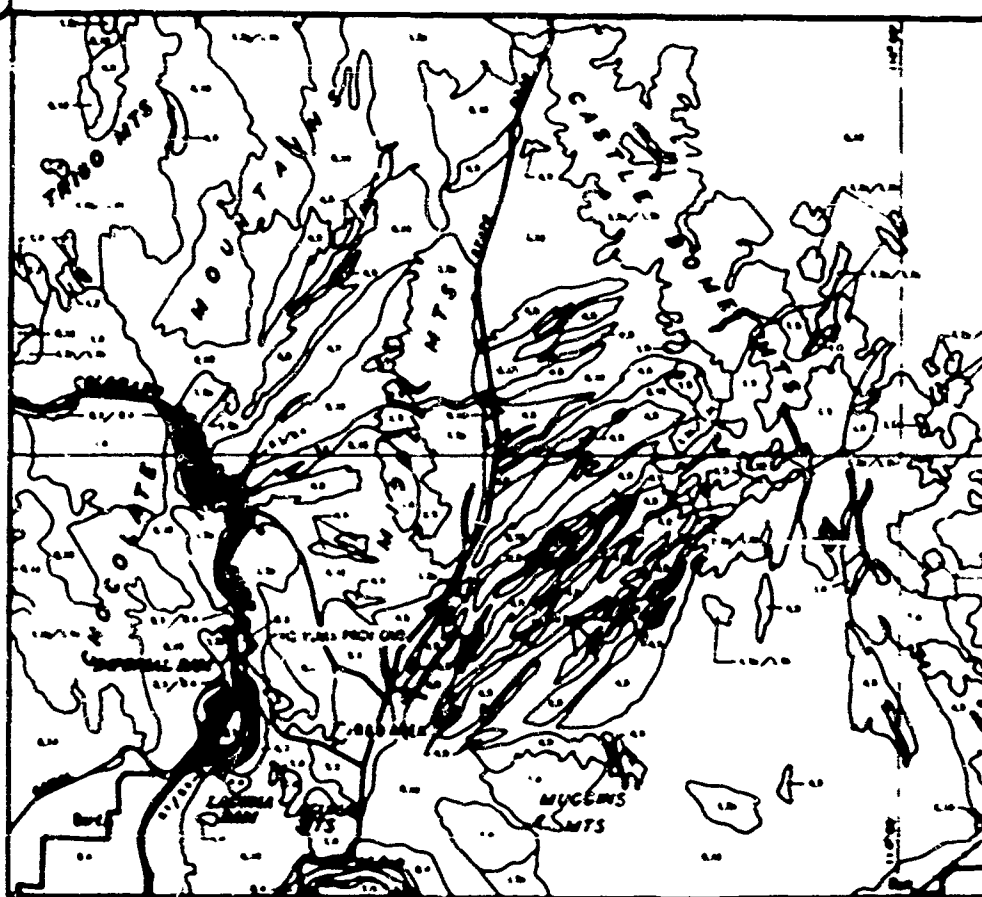
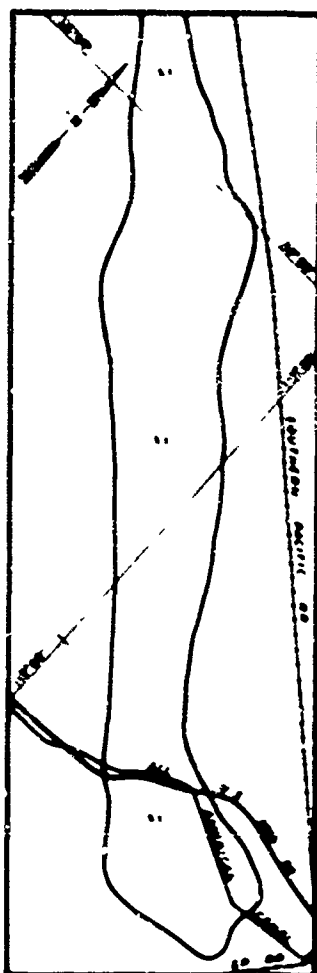
ANALOGS OF YUMA TERRAIN IN THE MIDDLE EAST DESERT GEOMETRY ANALOGS

8





YUMA SAN



GROUND ANALOGY

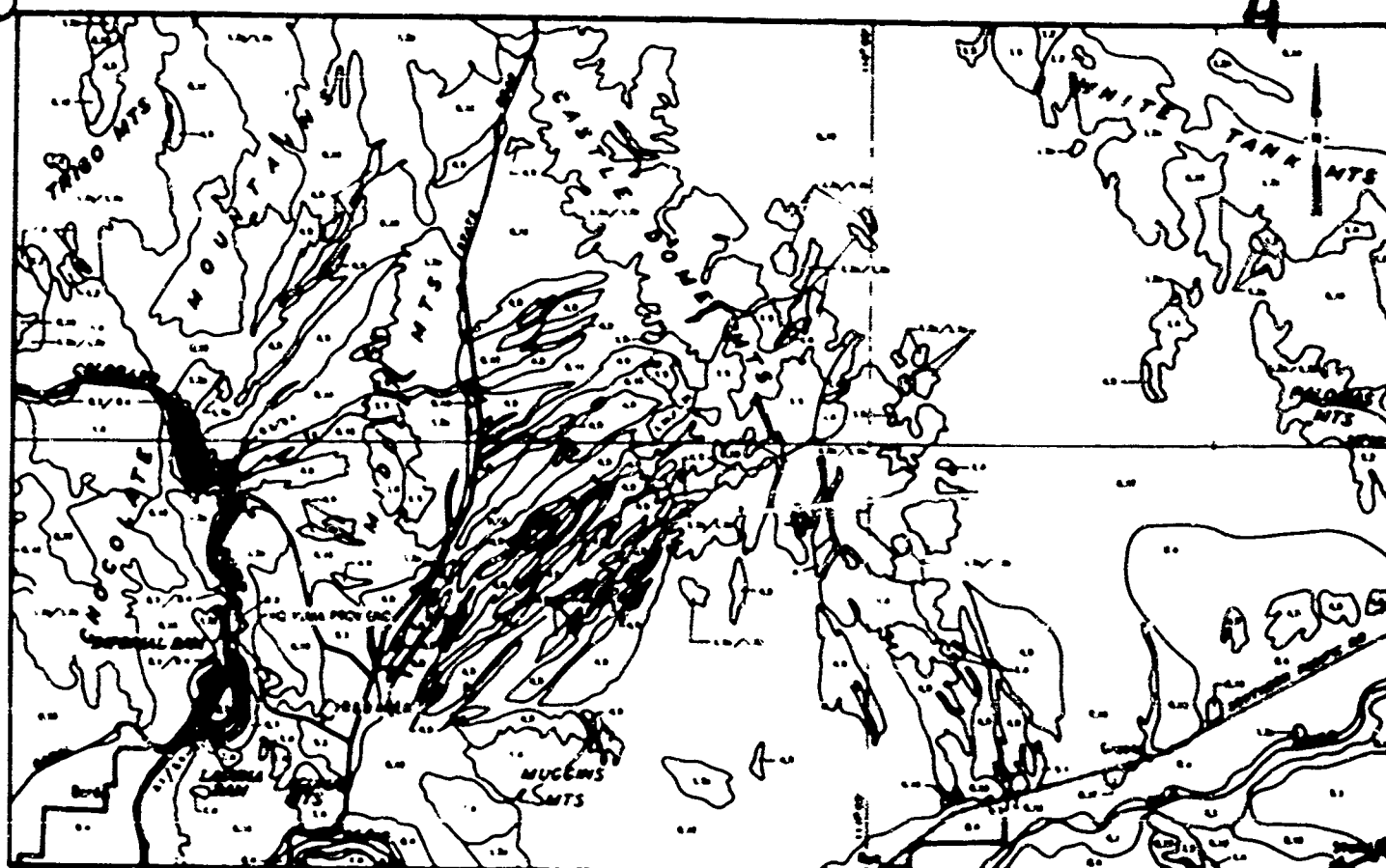
LEGEND

Numbers designate mapping units of soil type combinations respectively. If the soil type is the second digit designates a surface rock or first number is 6 or higher the second digit designates mapping unit. In the example given soil type the second surface rock.

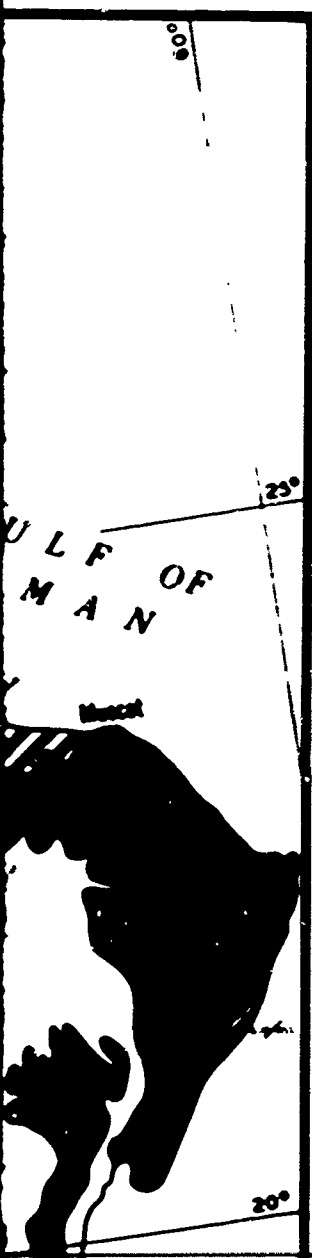
Ground features in the Middle East are shown. Ground features are not shown. If both are designated are listed in combination at Yuma other feature a combination exists at Yuma and if both digits are both are neither and.

Indicates area of ground features. Two digits of soil combinations combinations are present procedure derivation. The symbols indicate in the of the features.

- 2 [Solid Black Box] Highly Analogous combination found at
- 1 [White Box] Partially Analogous One of the two units
- 0 [Solid Black Box] Not Analogous None of the units at



YUMA PROVING GROUND

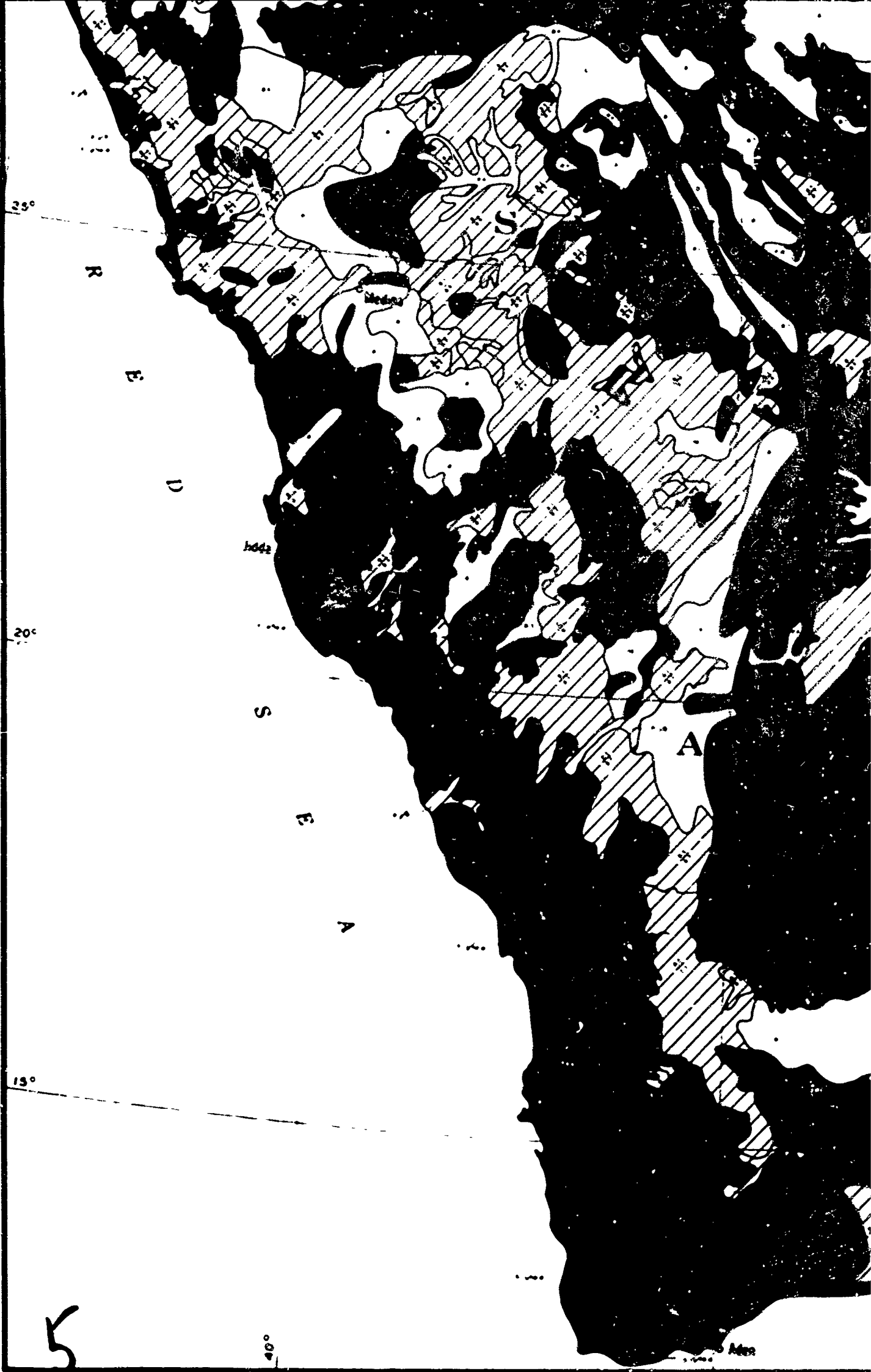


GROUND ANALYSIS

LEGEND

1. Numbers designate mapping units of soil type and surface rock or soil consistency, respectively. If the soil type (first number) is 1, 2, or 3, the second digit designates a surface-rock mapping unit; if the soil type (first number) is 4 or higher, the second number designates a soil consistency mapping unit. In the example given, e.g. 1 7, the first digit is soil type, the second, surface rock.
2. Ground features in the Middle East are always contained within Yuma ground features and not vice versa. If both digits are right-side, the units designated are found in combination at Yuma. If one is right-side and the other left-side, a combination exists at Yuma containing the right-side unit. If both digits are left-side, neither unit is found at Yuma.
3. Indicates area of ground complex. Two definite soil type-surface rock or soil consistency combinations are present, but the scale mapping procedure designation. The area is predominantly ground feature appears first in the complex.

1	Right Analogous	combination found at Yuma
2	Partially Analogous	One of the two units is found at Yuma
3	Not Analogous	None of the units are found at Yuma





287

[illegible]

— *Journal of the American Medical Association*, 1967, 201: 1001-1002.

1. The first step is to identify the problem or question that needs to be answered.

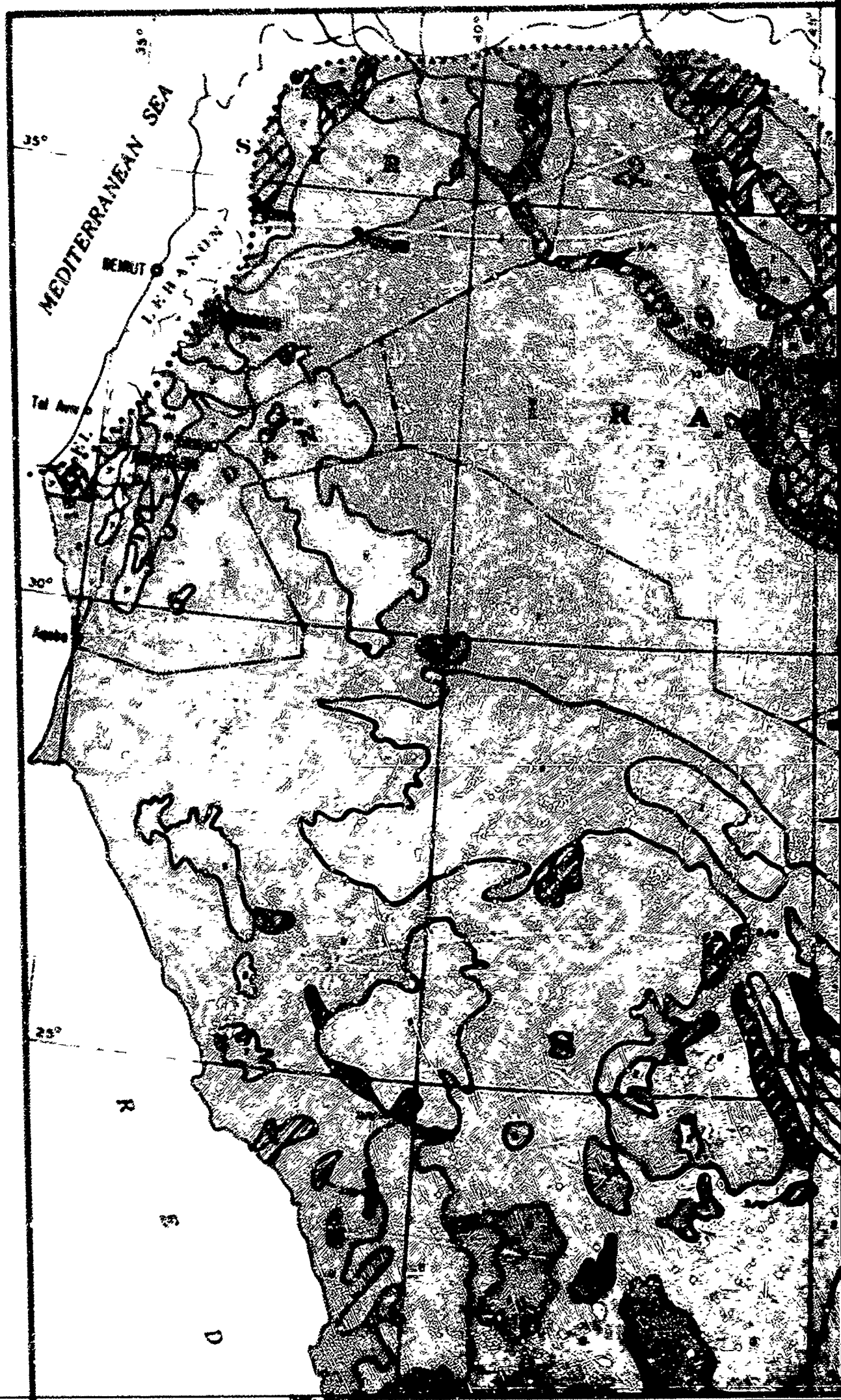
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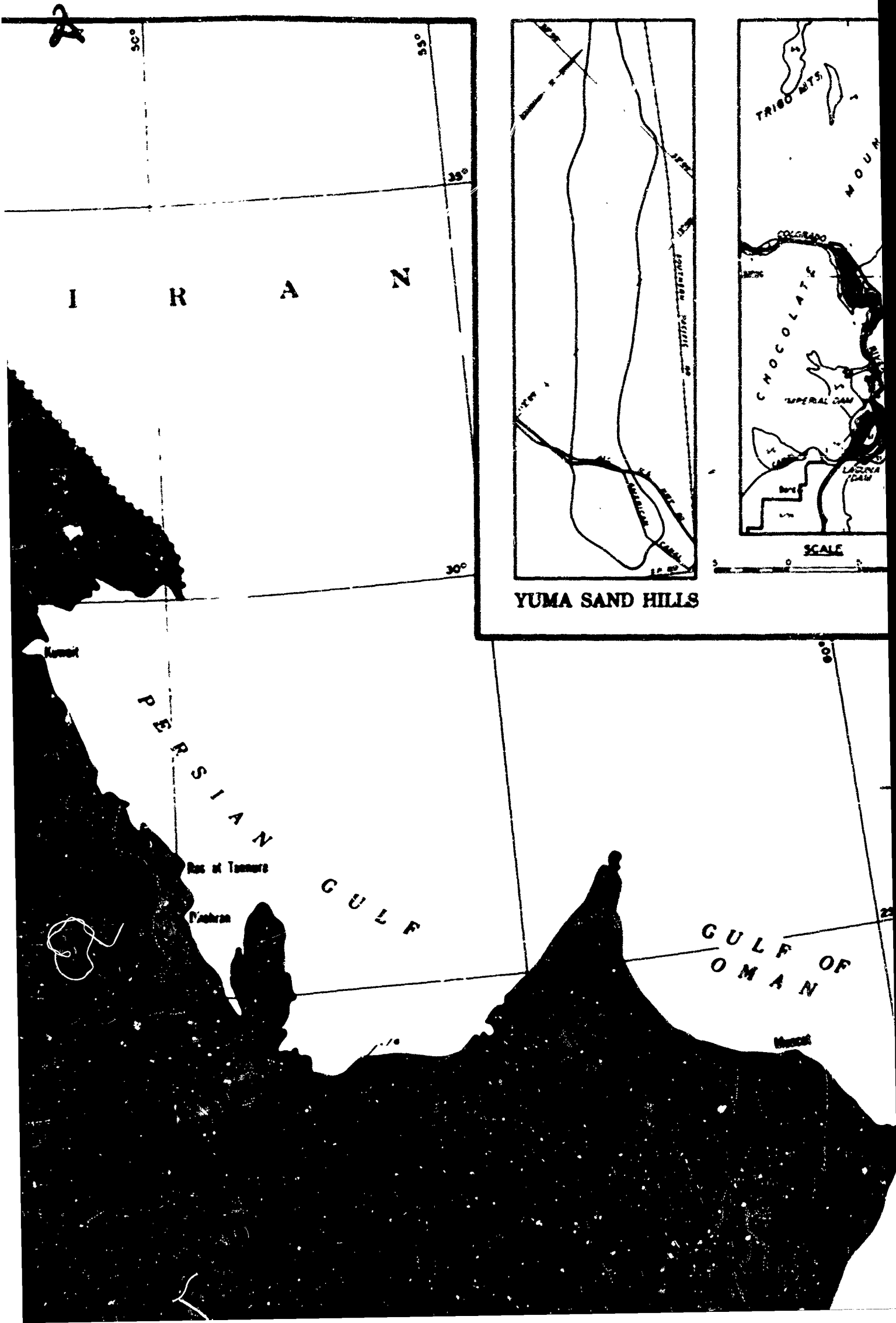
There are two types of the procedure - one for the first time and one for the second time.

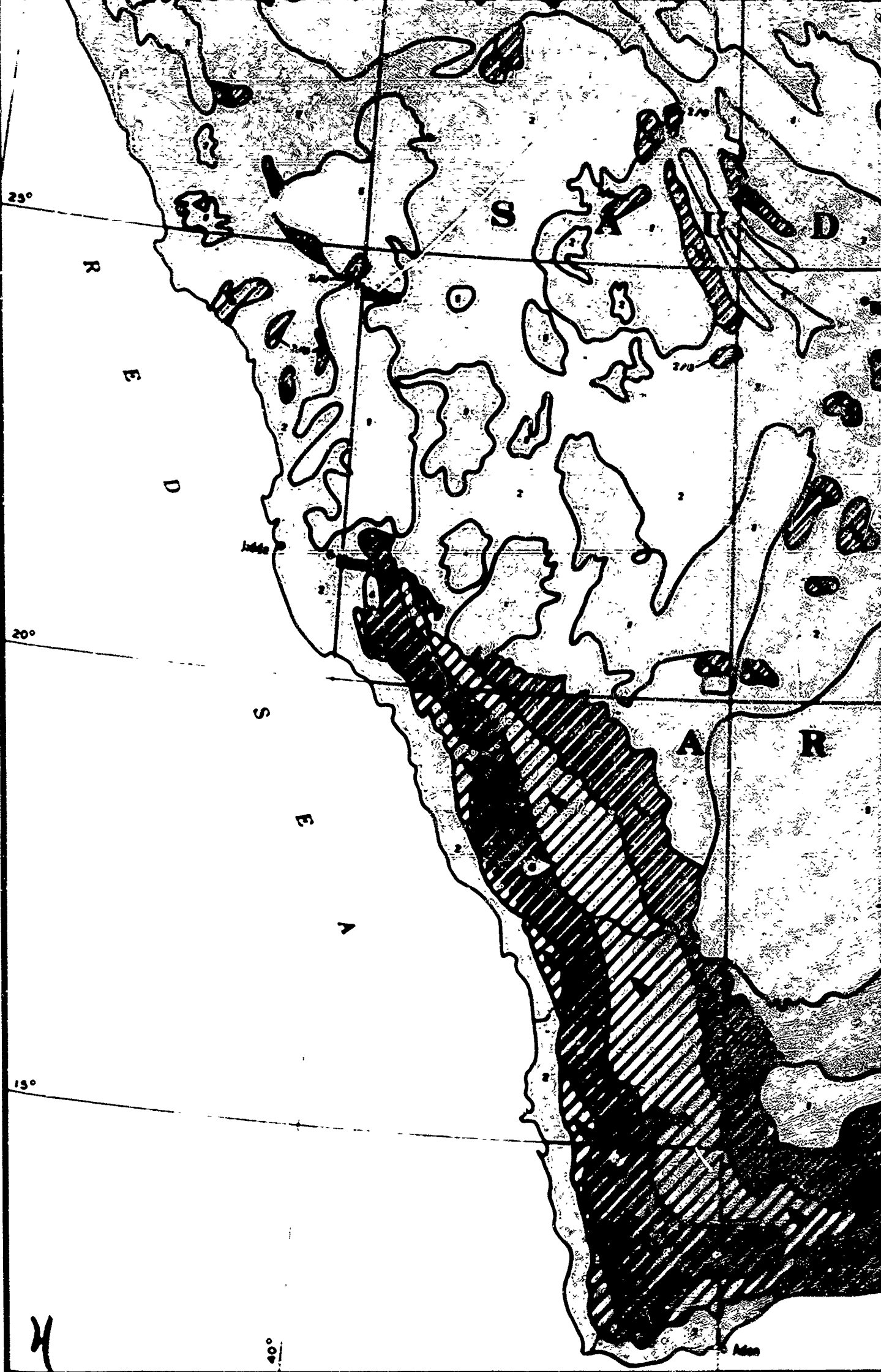
The first type is the "one-time" procedure. It is used when the person has never been convicted of a crime before. The second type is the "two-time" procedure. It is used when the person has been convicted of a crime before.

Q. I am confused as to what the "other" is that you are talking about. I am a little bit confused as to what the "other" is that you are talking about. I am a little bit confused as to what the "other" is that you are talking about.

PLATE II



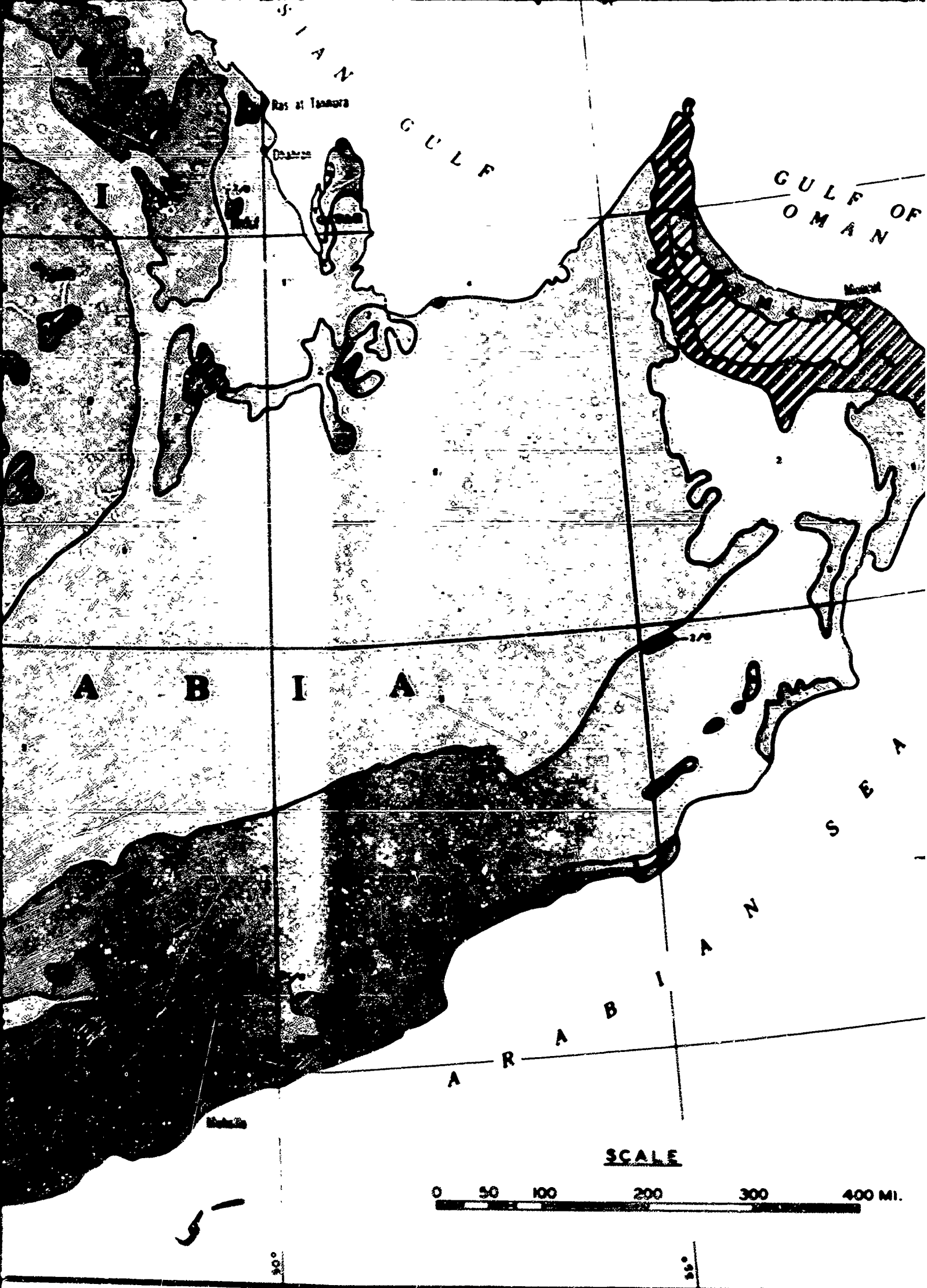


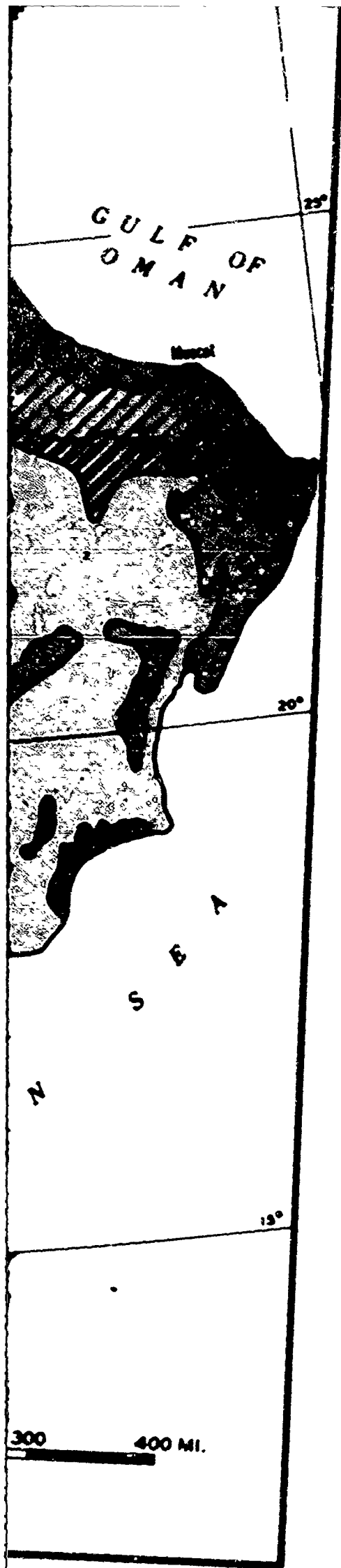


4

40°

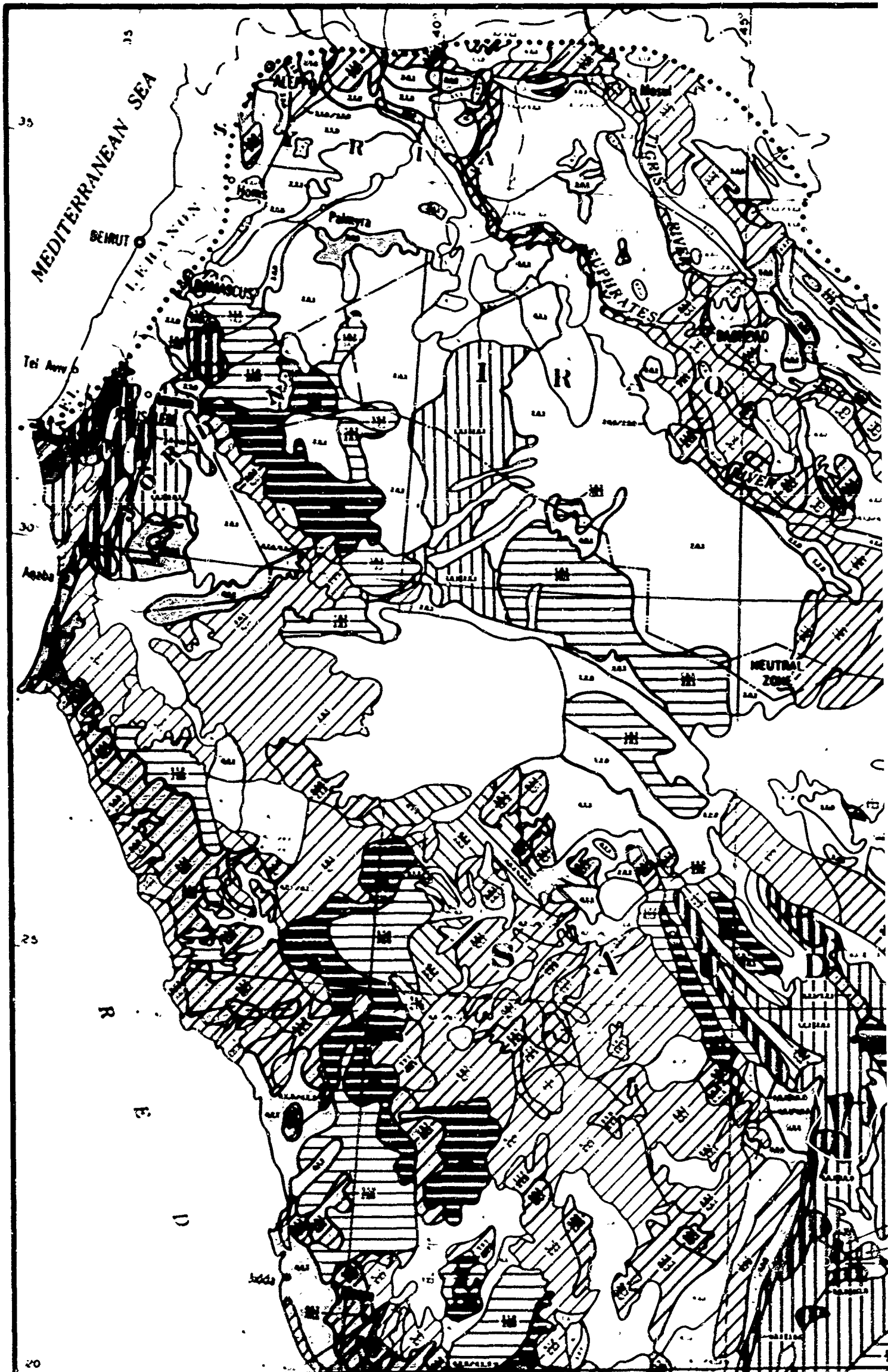
Adm





ANALOGS OF YUMA TERRAIN
IN THE
MIDDLE EAST DESERT

6 VEGETATION ANALOGS



2

50°

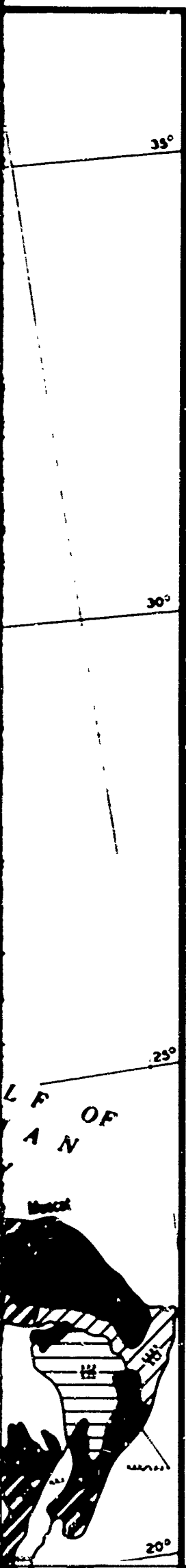
55°

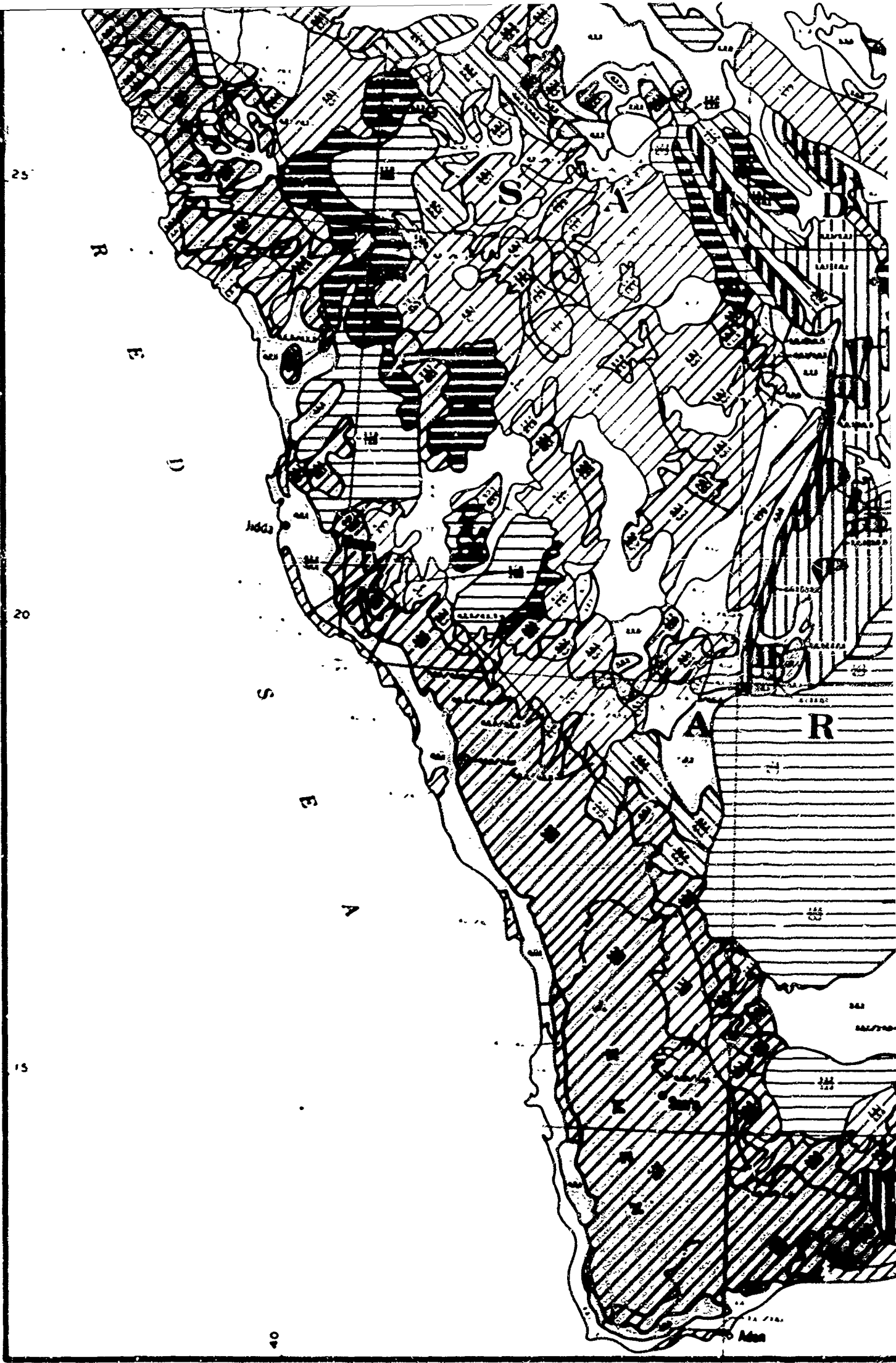
60°

I R A N



3





25

R

E

D

20

S

E

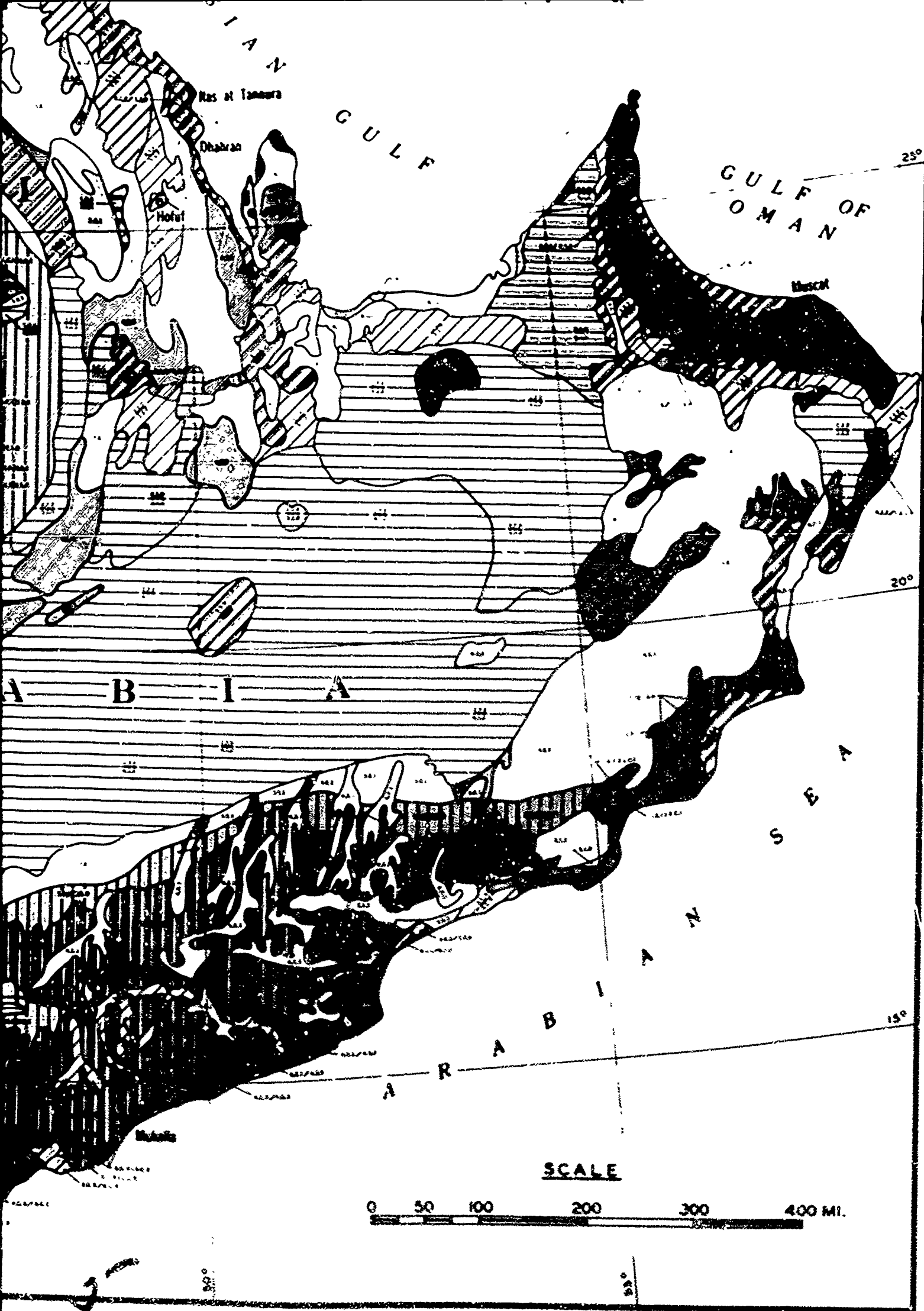
A

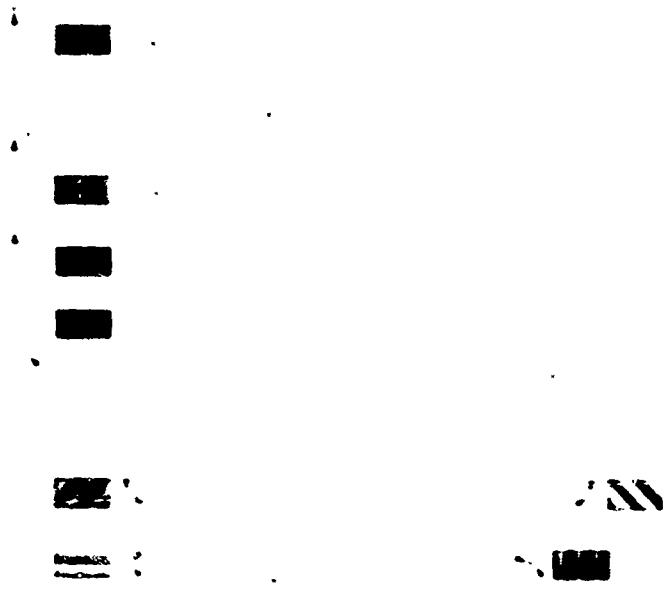
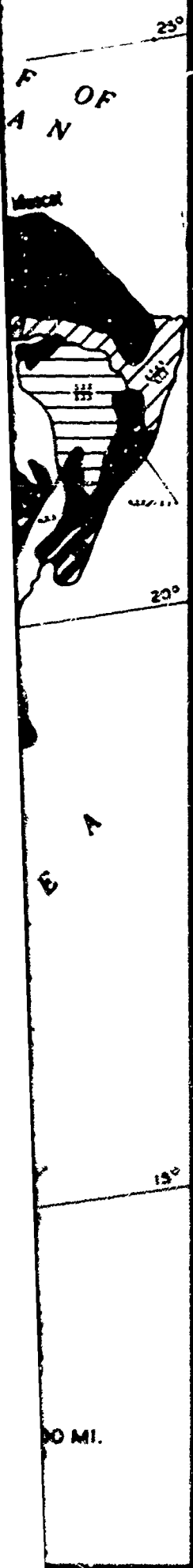
15

40

R

Aden





ANALOGS OF YUMA TERRAIN
IN THE
MIDDLE EAST DESERT
TERRAIN-TYPE ANALOGS

ANALOGS OF YUMA TERRAIN IN
SECTION II: SUPPLEMENTAL N

AIN IN THE MIDDLE EAST DESERT
AL MAPS AND TABULATIONS

256

P E R S I A N

C U L F

GULF OF
OMAN

CRUCIAL ON 11/11

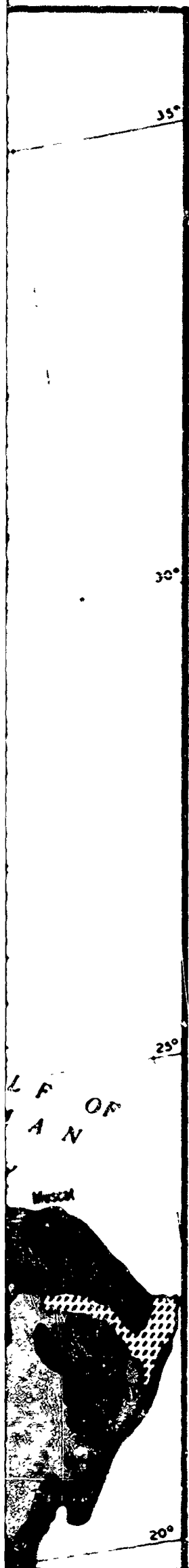
Bus at Tanagra

Don't miss

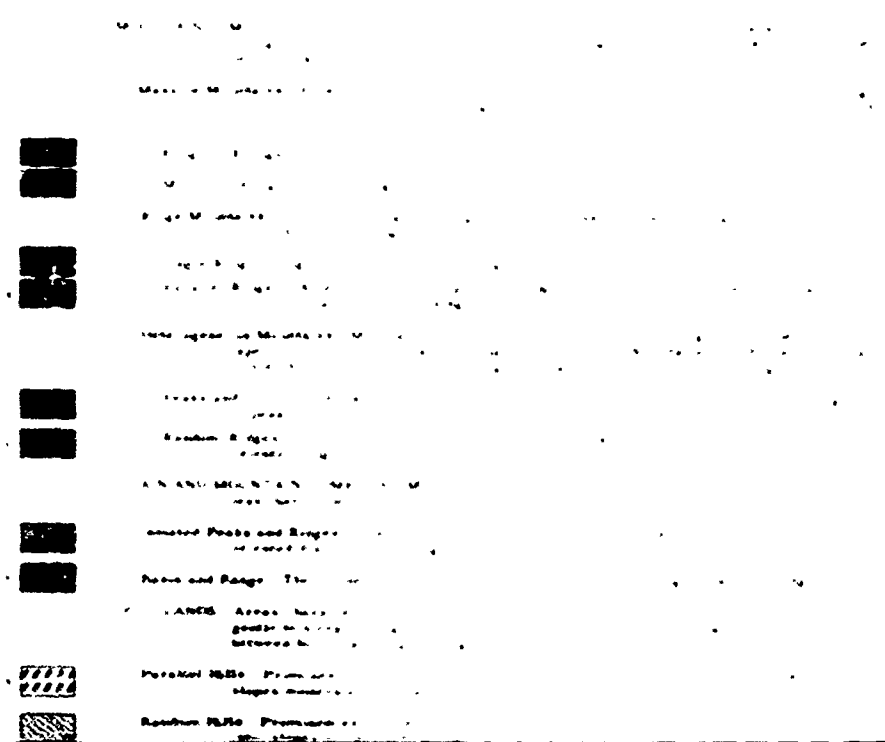
DATE

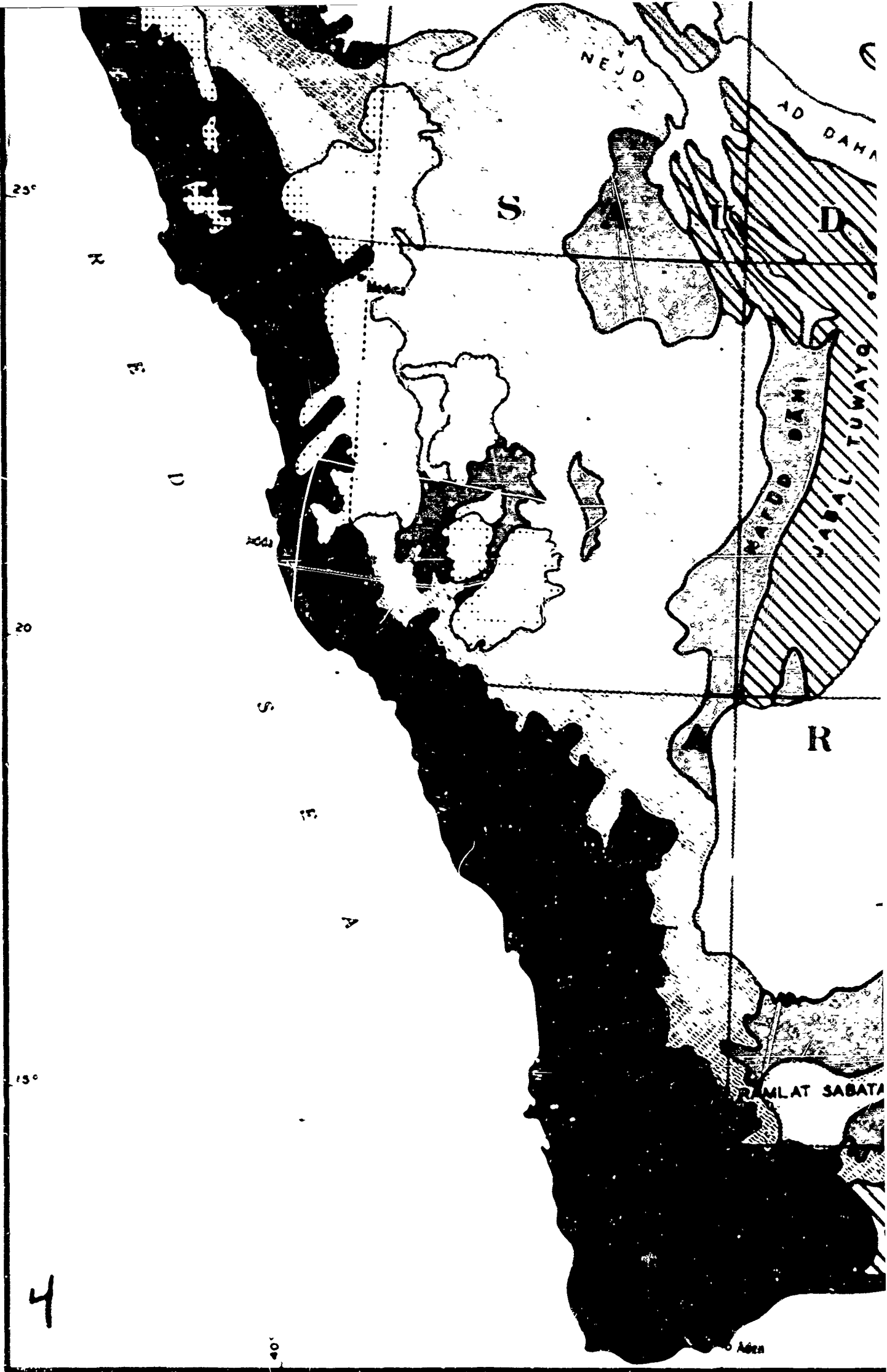
51

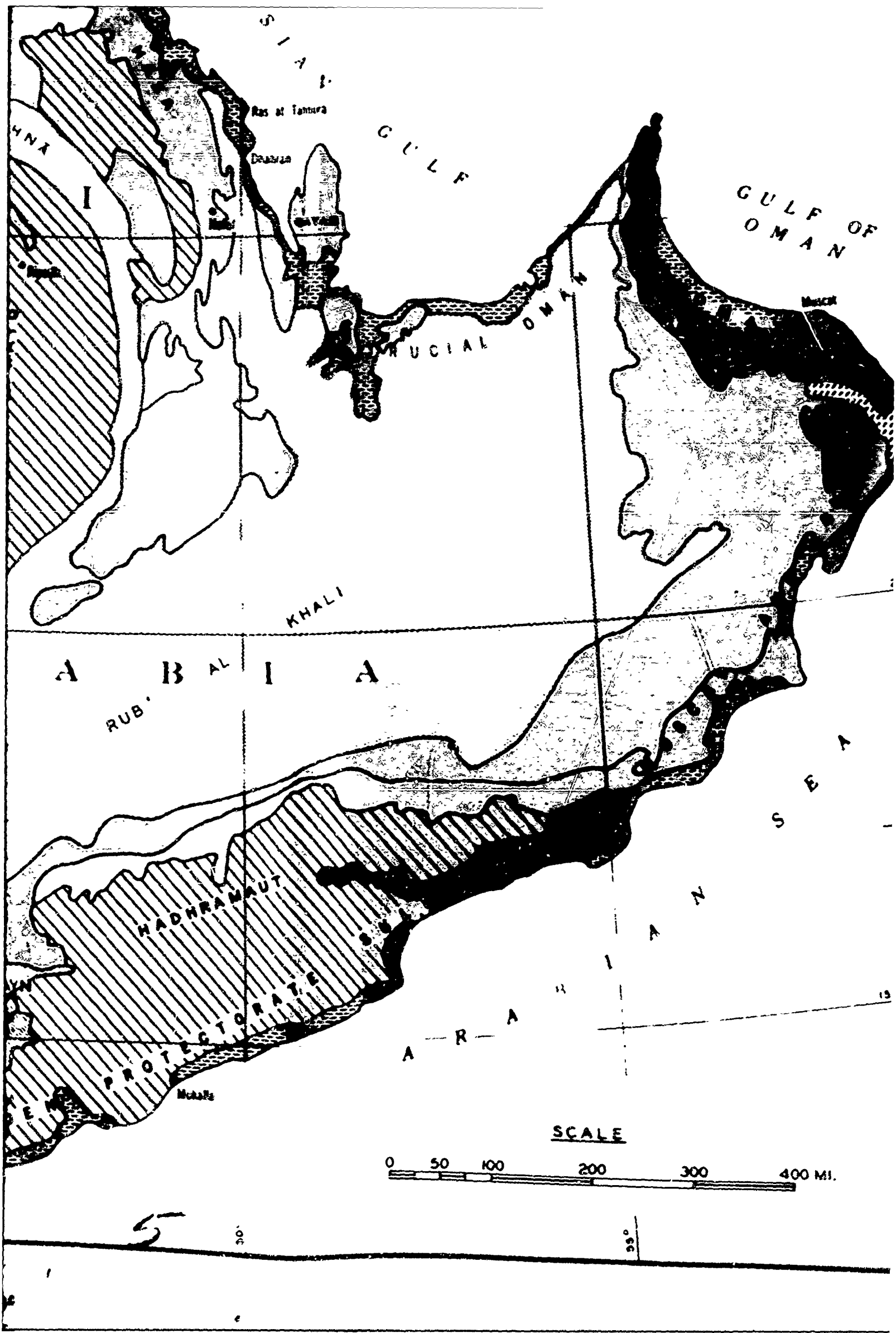
Abstract

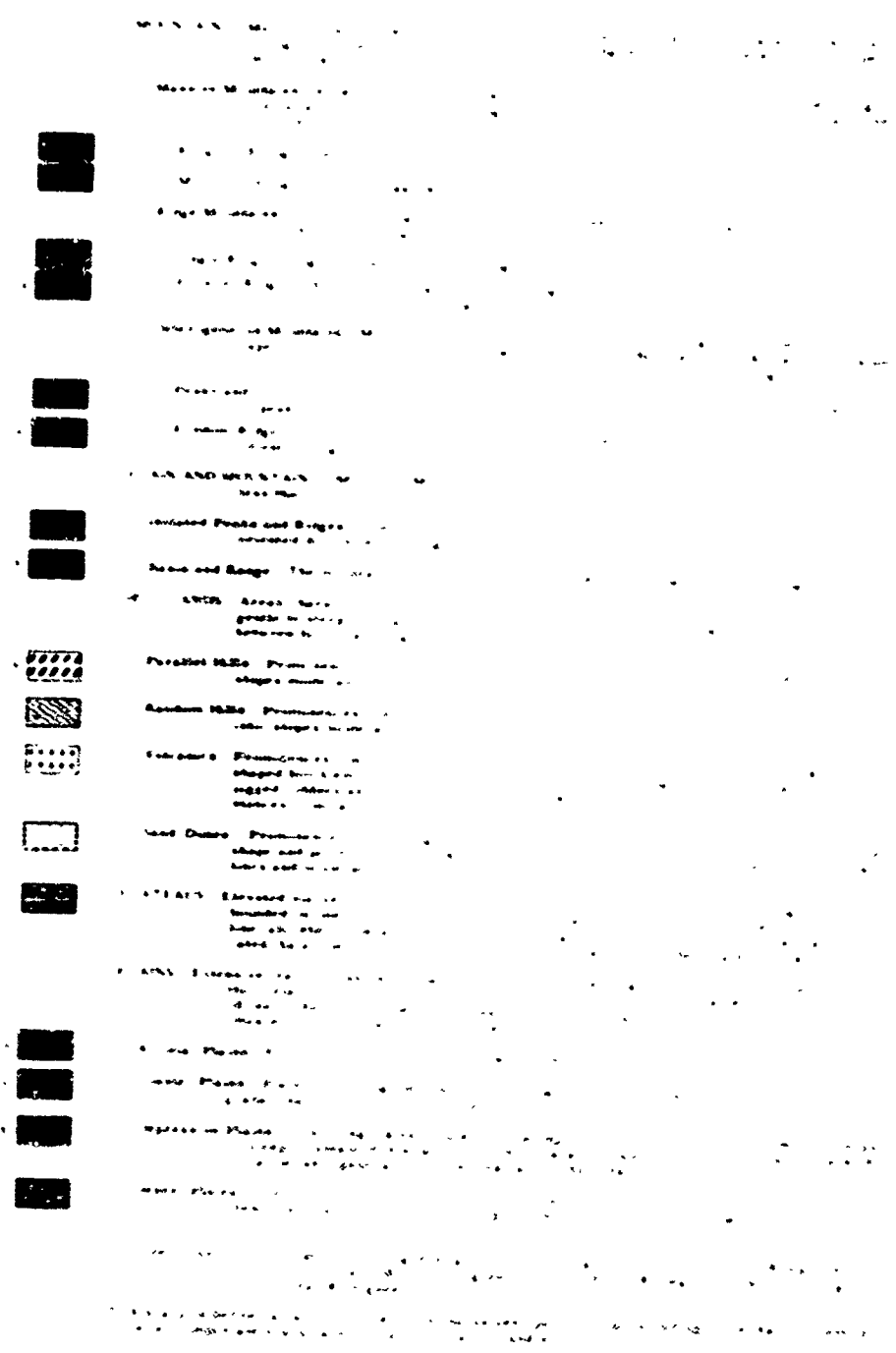
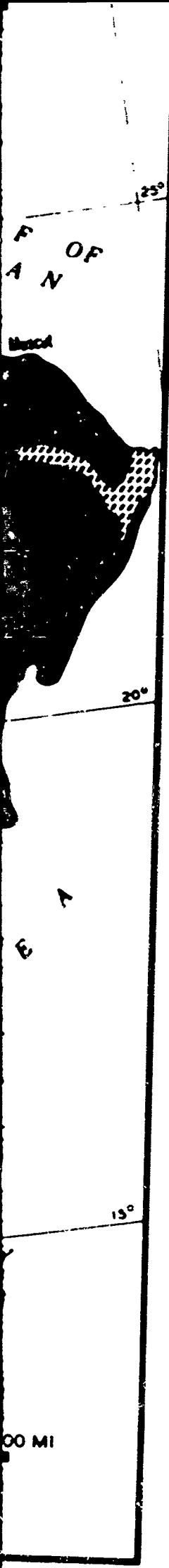


SOUTHWESTERN UNITED STATES









ANALOGS OF YUMA TERRAIN IN THE MIDDLE EAST DESERT PHYSIOGRAPHY

MOUNTAINS:

Mountains are masses of land compared to the basal dimensions and which rise above the surrounding terrain. Areas so mapped as massive, ridge, and heterogeneous mountain peaks in which the plains occupy more than half the area. The mountains of the Middle East are extremely rugged and relief ranging from 50 to 1000 feet. A vegetative type has been mapped within the area spotted with scattered woodlands and comprise approximately 13 percent of the area. The mountains form the entire western rim of the Arabian Peninsula from the port of Aden in the south to the port of Aqaba in the north. The mountains generally have crest elevations ranging from 5000 to 10000 feet. In the southern portion of the Arabian Peninsula the Qalamun Mountains extend



Reference 79

M-1. Northwest face of Jabal Jihaf from Al Muriah in the Wadi Tiban in the mountains of western Aden. At 13°45' N, 44°41' E.



Reference 79

M-4. Wadi Banih where it enters the coastal plain from the Hejaz Mountains in western Arabia. At 15°31' N, 42°30' E.



M-5. Jabal Sannin rising to 8422 ft in the Lebanon mountains of western Syria. Note terraced lower slopes. At 34°30' N, 35°45' E.

2 GEOGRAPHY: DESCRIPTIONS AND PHOTOGRAPHS

re summit areas that are small compared heights of more than 10,000 ft above may be entirely mountainous, such as or they may be plain-mountain components of the total area. The mountains with slopes ranging from moderate to steep. A wide variety of mountainous areas. Sparse, scrubby vegetation zones are typical. Mountains of the East desert. Ranges of massive Arabian Peninsula extending from north. These rugged crystalline mountains from 6000 to 9000 ft; however, some are known to exceed 11,000 ft. In northeast from Mount Hermon, on the

eastern side of the Rift Valley, as three roughly parallel ridges of sedimentary rock. In northeast Iraq roughly parallel, discontinuous ridges of sedimentary rock separated by extensive intermontane plains form a basin as a region which marks the transition from the western steppes to the high mountains of Kurdistan. In eastern Iraq the Zagros Mountains extend into Iran as a series of parallel ridge mountains. Genetically the Zagros are part of the same mountain mass as the Kurdish ranges to the north. In the extreme eastern portion of the Arabian Peninsula lies a crescentic band of massive mountains flanked by the great steppes and deserts to the south and west. These mountains of Oman, an extremely rugged range of igneous and sedimentary mountains trending some 400 miles to the northwest, paralleling the coast of Arabia. Along the southern shore of Arabia lies a thin strip of parallel ridge mountains. These are structurally part of the Hadramaut Plateaus, but the processes of erosion have created a series of sharp-crested, roughly parallel, sedimentary ridges several thousand feet in elevation.



M-2. View southward toward Ma'bar from the Naqil Isha pass, elevation 9600 ft. in the mountains of southern Yemen. At 14°46' N, 44°20' E.



M-6. Upper fold and nappe zone in the Basin and Range section of northwestern Iraq. At ap-



M-7. Mountains along the Iranian border looking southwest from Kish-i-Bazru

three roughly parallel ridges of folded sedimentary rocks of each. The intervening plains form a basin and range system from the western steppes to the high, rugged Zagros Mountains extend into the area states. Genetically the Zagros are part of the high ranges to the north. In the extreme south-west lies a crescentic band of massive mountain deserts to the south and west. These are the rugged ranges of igneous and sedimentary mountains, paralleling the coast of Oman. In this strip of parallel ridge mountains, the processes of erosion, but the processes of erosion created, roughly parallel, sedimentary ridges



Reference 70

elevation 9600 ft.



Reference 70

M-1. View from eastern edge of the top of Jabal Hajar, elevation 7700 ft. in the southwestern mountains of Arabia. At $13^{\circ}46'$ N, $44^{\circ}52'$ E.



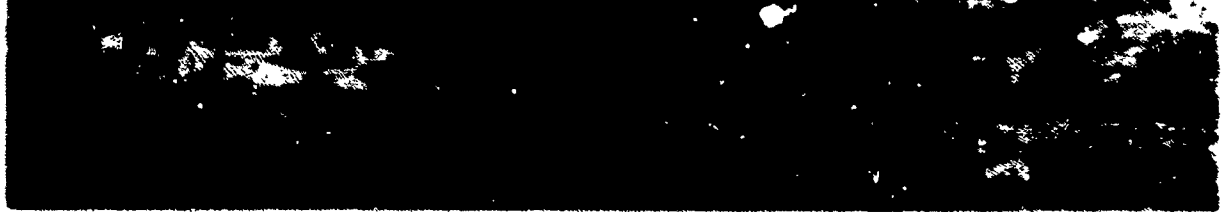
Dr. James H. McLaughlin

M-7. Mountains along the Iranian border.



Reference 70

M-8. Oman Mountains north of Rasatani. At approximately $22^{\circ}30'$ N.



Reference 10

M-1. Northwest face of Jabal Jihaf from Al Marikh in the Wadi Tibac in the mountains of western Aden. At $13^{\circ}45'$ N, $44^{\circ}41'$ E.



Reference 7

M-4. Wadi Baish where it enters the coastal plain from the Hejaz Mountains in western Arabia. At approximately $17^{\circ}23'$ N, $42^{\circ}30'$ E.



M-5. Jabal Sanain rising to 8622 ft in the Lebanon western Syria. Note terraced lower slopes. At approximately $34^{\circ}00'$ N, $35^{\circ}15'$ E.



Reference 27

M-9. Jabal Kaur in mountainous Oman as seen from the west. At approximately $22^{\circ}57'$ N, $56^{\circ}53'$ E.



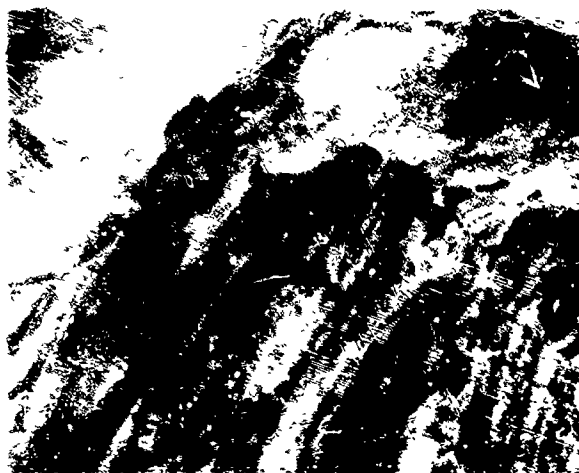
M-10. Drowned valley near Ras the northern tip of Oman. At approximately $26^{\circ}20'$ N, $56^{\circ}30'$ E.

4



Pl. 100000 10

M-2. View southward toward Ma'bar from the Naqra Plateau, elevation 5500 ft., in the mountains of southern Yemen. At 14°44' N, 44°20' E.



Pl. 100000 10

M-5. Upper fold and nappe zone in the Qasim and Hajar region of northeastern Iraq. At approximately 35°30' N, 45°20' E.



M-7. Mountains along the Iran-Iraq border looking southwest from Masak. At 33°20' N, 45°20' E.

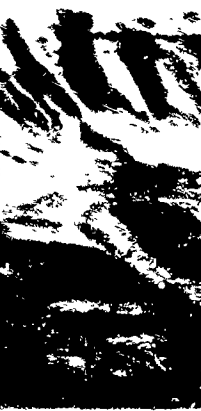


Pl. 100000 10

M-11. Dissected limestone country of Ruus al-Bal looking southwest from Khazab on the Masandam Peninsula. At 26°11' N, 94°15' E.



M-12. Foothills of the Qasim from the Wadi Jinn in the Masandam Peninsula. At approximately 26°25' N, 94°15' E.



Pl. 100000 10

M-3. Qasim range, at approximately 35°30' N, 45°20' E.



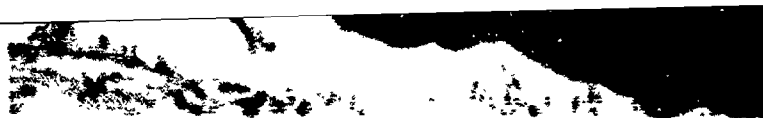
Pl. 100000 10

M-4. Ras Masandam on the Masandam Peninsula at approximately 26°11' N, 94°15' E.



Reference 70

p, elevation 9600 ft.



Reference 70

M-3. View from eastern edge of the top of Jebel Harir, elevation 7900 ft., in the southwestern mountains of Arabia. At 15°44' N, 44°32' E.



Reference 70

M-7. Mountains along the Iranian border, looking southwest from Kalak-i-Buzurg. At 33°30' N, 46°20' E.



Reference 70

M-8. Oman Mountains north of Suraimi. At approximately 22°30' N, 50°00' E.



Reference 70

M-12. Footills of the Oman Mountains as seen from the Wadi Jiss in the Batina coastal plain. At approximately 24°25' N, 54°39' E.



Reference 70

M-13. Western end of the Aden peninsula seen eastwards from the air.

ANALOGS OF YUMA TERRAIN

IN THE

MIDDLE EAST DESERT

PHYSIOGRAPHY

DESCRIPTIONS AND PHOTOGRAPHS

6

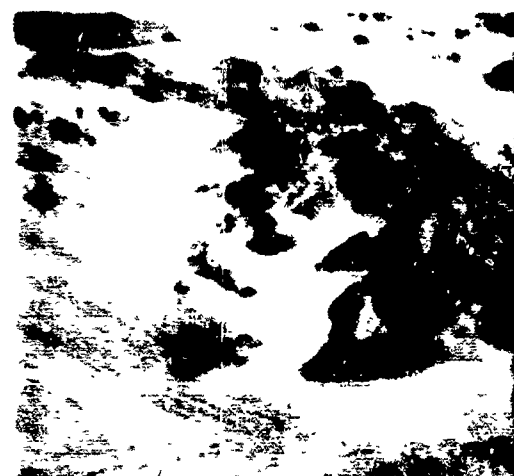
HILL LANDS:

Hill lands are areas characterized by prom-
that rise to heights of less than 1000 ft above the
mapped may consist of hill masses or of hills and
occupy as much as 75 percent of the total area.
position of hill lands vary widely. They may con-
composed of igneous, metamorphic, and sedimentary
materials: volcanic hills, composed of lava or ash
into a wide variety of types by the wind. Slopes are
to steep, and relief ranges from 10 to 700 ft. The
characteristically barren of vegetation, which tends to
support a sparse vegetative cover. Hill lands occur
the Middle East desert. Random hills of crystalline
the great central tableland of Arabia which flanks
and slopes gently toward the Persian Gulf to the east.
these hill lands are composed predominantly of



Reference 20

H-1. Craters and lava-flow north of Jabal Maki in western Arabia. At 19°17' N, 44°04' E.



Reference 20

H-2. Maturely dissected hill lands in western Transjordan near Aqaba. Gullies project from vast areas of sand. At 29°39' N, 35°25' E.



Reference 20

H-6. Crystalline hill in the Jabal Aja Range near Yousiyo in central Arabia. At 27°44' N, 41°36' E.



Reference 20

H-7. Weathered crystalline hill in north central Arabia. At 29°44' N, 37°36' E.



H-8. A typical approximate

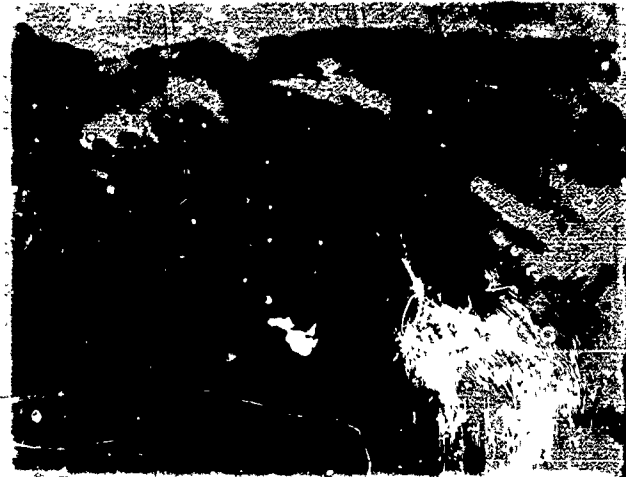
GRAPHY: DESCRIPTIONS AND PHOTOGRAPHS

generally, in small, isolated areas, surrounded by terrain. Areas so separated by plains -- which may be characterized by a series of parallel or sub-parallel hills of rock or even unconsolidated sand; or sand dunes, sculptured in hill lands range from gentle dunes and the volcanic hills are parallel and rounded hills may be approximately 1 percent of the rock form the western part of the great western mountain range. In their northern extremity, sedimentary rocks. However,

immediately adjacent to the western mountains they are interrupted by volcanic harra, i.e., vast fields of basaltic lava surmounted by groups of cinder cones. The harra extend in a broken line from the Aden Peninsula in the south to the Hauran district of southern Syria. Sand dunes occupy much of southern Arabia with the greatest concentration being in the Rub' al Khali, a sand dune area of 350,000 square miles and second only to the Sahara in size. From the northern part of this vast sea of longitudinal dunes, thin strips of sand desert, composed of low dunes, project in a northwesterly direction and terminate in the An Nafud -- the northern desert of Arabia. Smaller dune areas are found scattered throughout the peninsula, the most notable of which are the Nafud Dahl in central Arabia, the Ramlat Sabateyn in southern Arabia, and the Haza plain in eastern Arabia. Parallel hills have been mapped in two small areas, a small zone flanking the southeastern extremity of the Oman Mountains and a hilly area to the west of Jerusalem. The gross topography of both areas is the surface expression of folding in sedimentary rocks.



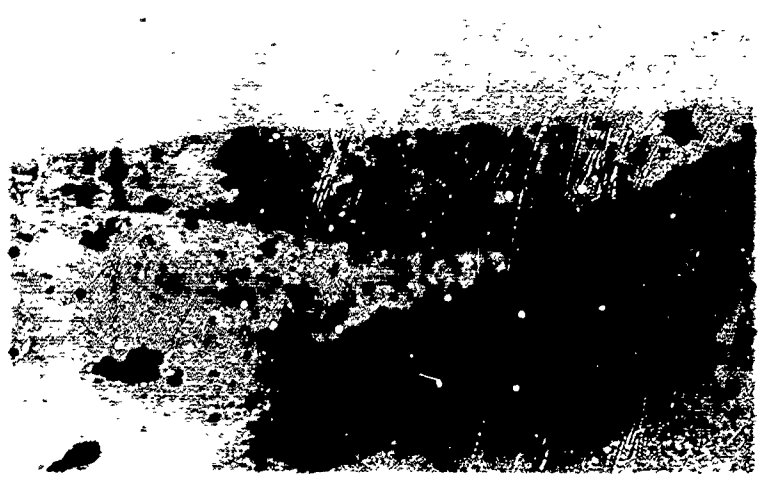
H-1. A granite base as seen from the Wadi Ta'iz in the hill lands of southwestern Arabia.



H-2. Interior of Harra volcanic crater in the hill lands of southwestern Arabia. At 14°25' N, 46°45' E.



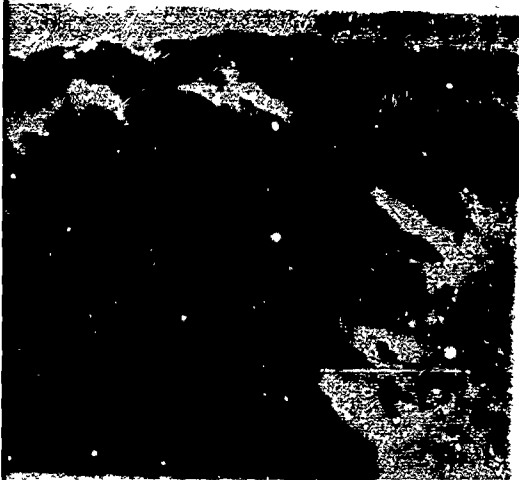
H-3. Longitudinal dune in the Rub al Khali. At 22°30' N, 52°30' E.



H-4. Dune mounds in southern Liwa in northeastern Rub al Khali. At approximately 23°00' N, 53°10' E.

PHS

mountains they are interrupted by volcanic
surmounted by groups of cinder cones.
the Aden Peninsula in the south to the
dunes occupy much of southern Arabia
the Rub' al Khali, a sand dune area of
the Sahara in size. From the northern
thin strips of sand desert, composed of
ction and terminate in the An Nafud --
the areas are found scattered throughout
re the Nafud Dali in central Arabia, the
the Hasa plain in eastern Arabia. Par-
areas, a small zone flanking the south-
and a hilly area to the west of Jerusalem.
surface expression of folding in sedi-



Reference 12

Interior of Karah volcanic crater in the
of southwestern Arabia. At $14^{\circ}26' N$,
E.



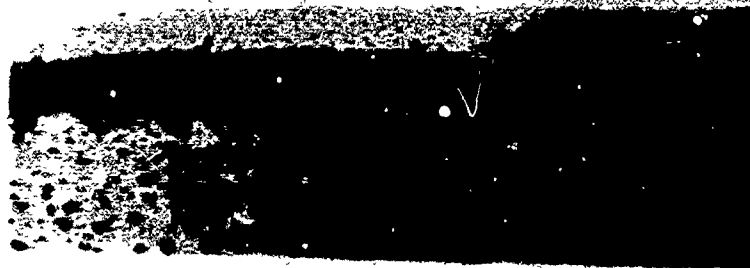
Reference 13

H-5. Badly weathered crystalline hill in the
Hima Valley in southwestern Arabia. At
 $16^{\circ}15' N$, $44^{\circ}30' E$.



Reference 14

Lima in northeastern Rub al
N, $33^{\circ}10' E$.



Reference 15

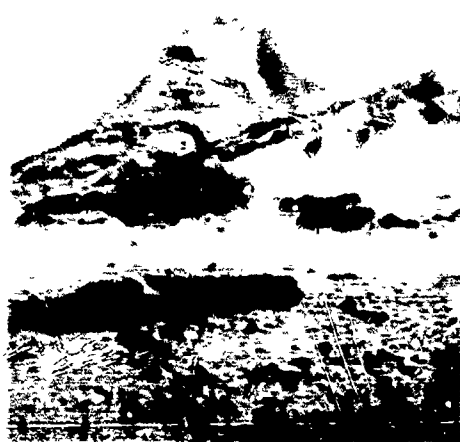
H-10. A deep horseshoe depression in the An Nafud in
northern Arabia. At approximately $28^{\circ}30' N$, $41^{\circ}30' E$.



H-1. Craters and lava-flows north of Jabal Kohl in western Arabia. At $15^{\circ}47' N, 44^{\circ}00' E$.



H-2. Maturely dissected hill lands in western Transjordan near Aqaba. masses projecting from vast areas of sand. At $29^{\circ}35' N, 35^{\circ}25' E$.



H-6. Crystalline hill in the Jabal Aja Range near Yuvaiya in central Arabia. At $27^{\circ}44' N, 41^{\circ}36' E$.



H-7. Weathered crystalline hill in north central Arabia. At $27^{\circ}44' N, 37^{\circ}36' E$.



H-8. A type of approximation.



H-11. Isolated barchan dunes between Dammam Dune and the northern Jafra desert in eastern Arabia. At approximately $26^{\circ}17' N, 50^{\circ}00' E$.



H-12. Gahum sand dune, typical of the Rub' al Khali. At approximately $19^{\circ}55' N, 54^{\circ}30' E$.

* Reference numbers refer to similarly numbered entries in the bibliography at the end of volume I of this

Platting East

South-
at rock
scree



Reference 11

H-3. A granite boss as seen from the Wadi
arib in the hill lands of southwestern Arabia.



Reference 11

H-4. Interior of Karsh volcanic crater in the
hill lands of southwestern Arabia. At $14^{\circ}35'$ N,
 $46^{\circ}45'$ E.



Reference 11

H-8. Longitudinal dune in the Rub al Khali. At
 $22^{\circ}30'$ N, $52^{\circ}30'$ E.



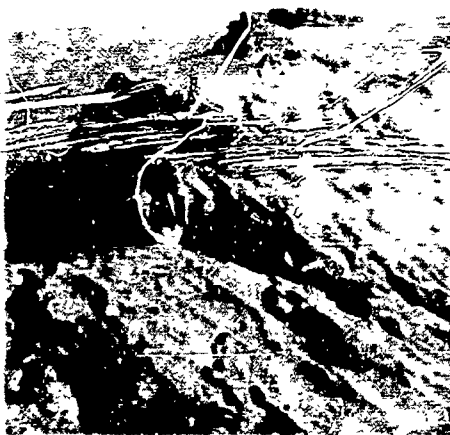
Reference 11

H-9. Dune massifs in southern Liwa in northeastern Rub al
Khali. At approximately $23^{\circ}00'$ N, $53^{\circ}10'$ E.



Reference 11

H-13. Wind-blown sand encroaching
on the date gardens of Qatif in
the Hasa. At $26^{\circ}32'$ N, $50^{\circ}00'$ E.



Reference 11

H-14. Fossil dune at Suraiyat in
the Hasa Plain of eastern Arabia.
At $26^{\circ}24'$ N, $50^{\circ}07'$ E.



11

H-15. Active dunes on a
plain in western Arabia.
 $43^{\circ}05'$ E.



H-4. Karah x 43

H-4. Rim of Karah volcanic crater in the southwestern Arabia. At $14^{\circ}35' N$, $43^{\circ}10' E$.



H-5. Karah x 43

H-5. Badly weathered crystalline hill in the Ijima Valley in southwestern Arabia. At $18^{\circ}15' N$, $44^{\circ}38' E$.



H-9. Karah x 43

H-9. Deep depression in the An Nafud in northeastern Rub al Khali. At $23^{\circ}10' N$, $43^{\circ}10' E$.



H-10. Karah x 43

H-10. A deep horseshoe depression in the An Nafud in northern Arabia. At approximately $25^{\circ}30' N$, $41^{\circ}30' E$.



H-15. Karah x 43

H-15. Active dunes on an old peneplain in western Arabia. At $21^{\circ}00' N$, $43^{\circ}05' E$.



H-16. Karah x 43

H-16. Dune patterns created by a variable wind regime on a peneplain in southern Rub al Khali. At $18^{\circ}45' N$, $52^{\circ}40' E$.

ANALOGS OF YUMA TERRAIN

IN THE

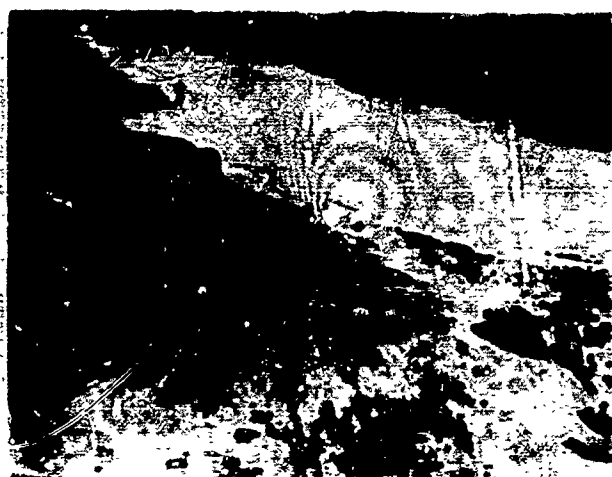
MIDDLE EAST DESERT

PHYSIOGRAPHY

DESCRIPTIONS AND PHOTOGRAPHS

PLATEAUS:

Plateaus are elevated masses of land characterized by flat-lying summit areas bounded on one or more sides by steep slopes. Dissected plateaus have been eroded so that only a small portion of the original surface remains. Approximately 80 percent of the world's land surface consists of plateaus, some 80 percent of which are dissected plateaus. The average slope of a plateau is less than 1 degree; however, some summits have steep slopes and exhibit slopes ranging up to 6 degrees. The average height of a plateau may range up to 10 ft, whereas the rolling plateau may range up to 50 ft. Depth of dissection along the major divides may exceed 1000 ft. The plateaus were formed in areas of sedimentary rock of which sandstone and limestone are the most common types. In general, plateau summits lie between the Southern Plateaus, (2) the Central Plateaus, and the northern section of the Hadramaut, as it is called. The most impressive plateau regions of the world. Deep, 1000 ft deep and several miles across, cut the



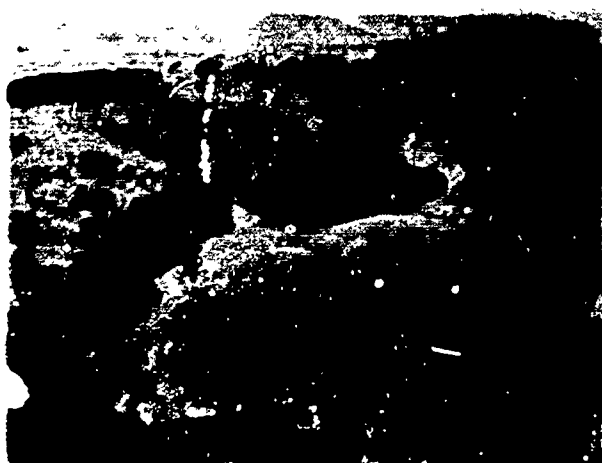
Reference 22

P-1. Wadi 'Amd at Hureidha in the Hadramaut, Southern Arabia.



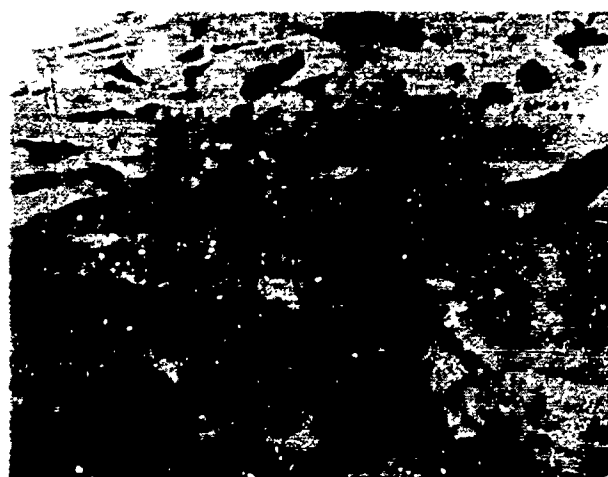
By courtesy of the British Ministry of Defense Navy Department

P-2. The Jordan Plateaus between Jerusalem and Jericho as seen from the air. Exact location unknown.



Reference 12

P-6. Plateau surface above Tarim in the Hadramaut. At approximately 16°05' N, 44°20' E.



Reference 17

P-7. Typical plateau surface south of the Wadi Hadramaut. At approximately 15°45' N, 44°20' E.

2 GRAPHY: DESCRIPTIONS AND PHOTOGRAPHS

characterized by extensive, more or less sides by steep, greater than mapped where less than 50 percent (21 percent of the Middle East which have been mapped as dis- summit is characteristically less es which are more undulating or Relief on the flat-lying summits e tops have relief ranging from sinageways may occasionally ex- of bedded horizontal-lying sedi- the most commonly occurring vations of 1000 and 600 ft. The iced into three or four: (1) the (3) the Northern Plateaus. The ed, is certainly one of the most finding wadis, often as much as ountry into great isolated blocks

of tableland. The Hadhranaut has a steep seaward-facing scarp and slopes gently to the north where it grades without a distinct break into the Rub' al Khali Desert. The central section consists of a series of roughly concentric bands of plateau separated by thin strips of sand desert. They reach their greatest elevations in the west and grade gently eastward until they dip beneath the plain bordering the Persian Gulf. The westernmost of these plateaus, Jabal Towayq, is intensely dis- sect, and travel through this area is restricted to the beds of a few deep wadis. To the east the plateaus occur as relatively undissected flat-lying areas of ben- rock often covered with a thin veneer of wind-polished gravel. The northern pla- teaus occupy much of the northwest portion of the study area. They are bounded to the north by the Qalamun Ranges and the Euphrates River and extend in a south- east direction until they merge with the central plateaus to the south. To the east the plateaus gradually grade into desert plains. In general, they have their great- est dissection in the west. The western component of this area is separated from the eastern by the large volcanic area that extends from Damascus to the south- east through Syria, Transjordan, and into northern Saudi Arabia. The Al Wadiy Plateau, immediately to the east of these lava fields, is dissected by innumerable shallow wadis.



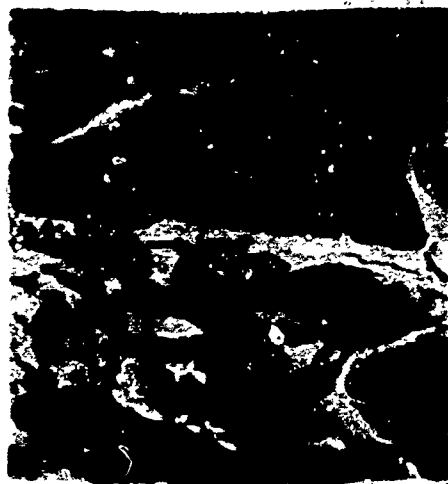
By courtesy of the British Ministry of Defense (Army Department)

P-3. View eastward from the Dair Plateau region in Jordan, near Petra. Exact location unknown.



By courtesy of the British Ministry of Defense (Army Department)

P-4. Crater of Jebel Seys, Jebel Druse volcanic plateau region, Syria. At 33°25'N, 36°50'E.



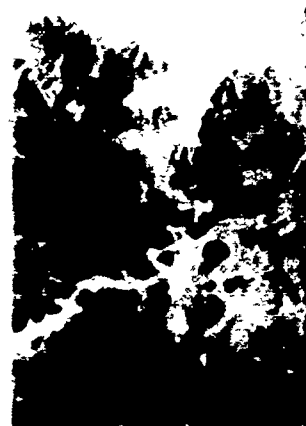
Reference 11

P-8. Aerial view of the dissected Hadhranaut plateaus showing the wadi network and the char-



By courtesy of the British Ministry of Defense

P-9. The Saja Pass in Jabal Towayq in central Arabia. At 26°30'N, 46°25'E.



P-10. Intensely dissected plateau bordering the southern Plateau.

up seaward-facing scarp and slopes gently
 distinct break into the Rub' al Khali Desert.
 of roughly concentric bands of plateau
 They reach their greatest elevations in
 they dip beneath the plain bordering the
 plateaus, Jabal Turayq, is intensely dis-
 tinguished by the beds of a few deep wadis,
 very un dissected flat-lying areas of bed-
 wind-polished gravel. The northern pla-
 teau of the study area. They are bounded on
 the Euphrates River and extend in a south-
 central plateaus to the south. To the east
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 component of this area is separated from
 that extends from Damascus to the north
 to northern Saudi Arabia. The Al Wadyan
 lava fields, is dissected by innumerable



by courtesy of the British Ministry of Defense (Iraqi Department)
 of Jebel Seys, Jebel Druze volcanic
 region, Syria. At 33°25'N, 36°50'E.



by courtesy of the British Ministry of Defense (Iraqi Department)
 P-5. Safi lava flood, Jebel Druze, Syria. At
 33°25'N, 36°50'E.



P-10. Intensely dissected edge of
 the plateau bordering the Wadi Araba
 in southern Palestine. At 30°09' N,
 34°00' E.



P-11. Looking up the Wadi Zarga
 in the Jordan Plateau north of
 the Dead Sea. At approximately



Reference 12

P-1. Wadi 'Amd at Hureidha in the Hadhramaut, Southern Arabia.



As measured by the Jewish Museum of Jerusalem, New Department

P-2. The Jordan Plateaus between Jerusalem and Jericho as seen from the air. Exact location unknown.



Reference 12

P-6. Plateau surface above Tarim in the Hadhramaut. At approximately $16^{\circ}05' N$, $48^{\circ}58' E$.



Reference 12

P-7. Typical plateau surface south of the Wadi Hadhramaut. At approximately $15^{\circ}45' N$, $49^{\circ}00' E$.



Arabian and Asia Personal, L.T.

P-12. Intensely dissected plateau region near Jabal Ram in southwestern Transjordan. At $29^{\circ}35' N$, $35^{\circ}25' E$.



Arabian and Asia Personal, L.T.

P-13. A line of rugged peaks rising sharply from the margins of the Wadi Araba south of the Dead Sea. At $29^{\circ}55' N$, $35^{\circ}05' E$.

4

• Reference numbers refer to similarly numbered entries in the bibliography at the end of volume I of this report.



P-3. View eastward from the Deir Plateau region in Jordan, near Petra. Exact location unknown.



P-4. Crater of Jebel Seyo, Jebel Druse volcanic plateau region, Syria. At $33^{\circ}25'N$, $36^{\circ}50'E$.



P-8. Aerial view of the dissected Hadhramaut plateaus showing the entrenched drainage and the characteristic denudation. At approximately $16^{\circ}15'N$, $49^{\circ}30'E$.



P-9. The Sogta Pass in Jabal Tuwaiq in central Arabia. At $24^{\circ}30'N$, $46^{\circ}25'E$.



P-10. Intensely dissected plateau borders in southern Palestine. At $35^{\circ}05'E$.



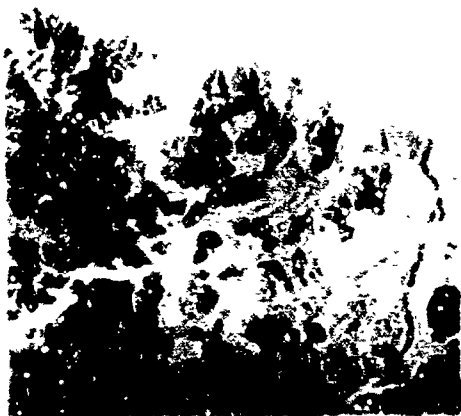
P-14. Remnants of old plateau surface in the Upper Wadyan Province, southwestern Iraq. The Wadi Hauran traverses the area shown in the photo, flowing from left to right. At approximately $33^{\circ}30'N$, $41^{\circ}40'E$.



P-15. Jointing in well-bedded Cretaceous limestone on the north side of Wadi Hauran in southwestern Iraq. At approximately $33^{\circ}40'N$, $42^{\circ}00'E$.

Craters of Jebel Syys, Jebel Druse volcanic region, Syria. At $33^{\circ}25'N$, $36^{\circ}50'E$.

P-5. Safa lava flood, Jebel Druse, Syria. At $33^{\circ}25'N$, $36^{\circ}50'E$.



P-10. Intensely dissected edge of the plateau bordering the Wadi Araba in southern Palestine. At $30^{\circ}00'N$, $35^{\circ}05'E$.



P-11. Looking up the Wadi Zerga in the Jordan Plateau north of the Dead Sea. At approximately $32^{\circ}10'N$, $35^{\circ}50'E$.



Mining in well-bedded Cretaceous on the north side of Wadi Houran in northern Iraq. At approximately $33^{\circ}40'N$,



P-16. Erosional remnants in the Gassra Depression, southwestern Iraq. At approximately $33^{\circ}30'N$, $40^{\circ}15'E$.

ANALOGS OF YUMA TERRAIN IN THE MIDDLE EAST DESERT PHYSIOGRAPHY DESCRIPTIONS AND PHOTOGRAPHS

PLAINS:

Plains are extensive tracts of land characterized by flat to gentle slopes. Hills may be found within plain regions but occupy less than 25 percent of the total area. Approximately 28 percent of the Middle East desert is occupied by plains. Plains may be subdivided on the basis of origin or physiographic relation. Flood-plains, deltas, and terraces of major rivers are termed alluvial plains; plains bordering the sea, coastal plains; low-lying plains bounded on two or more sides by scarps, depression plains; and interior plains not readily classifiable into the other types, desert plains. Undissected plains exhibit relief ranging from approximately 0 to 10 ft. Relief within dissected plains would characteristically be between 10 and 50 ft and occasionally up to 100 ft. The composition of the plains of the Middle East desert varies widely. In the interior, vast plains of sedimentary and crystalline rocks are found. However, the majority of the plains are composed of unconsolidated material of which sand, gravel, silt, and salt are the most common. Most of the plains lie between the elevations of 0 and 1000 ft. A narrow coastal plain fringes the entire Arabian Peninsula. The plain ranges from several miles to as much as 40 miles in width and is occasionally interrupted where the adjacent highlands extend to the sea. Where the coastal plains lie in close proximity to the mountains



Reference 22

PL-1. The town of Muhalla on the narrow coastal plain of southern Arabia. At $14^{\circ}33'$ N, $49^{\circ}07'$ E.

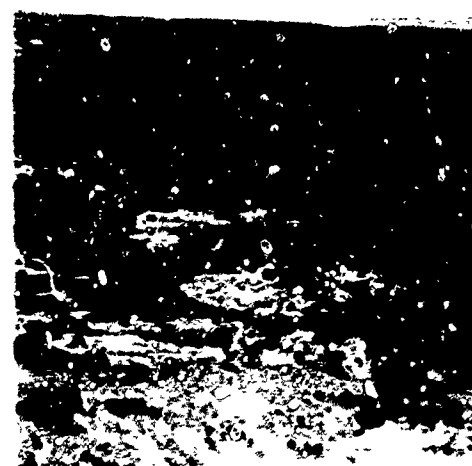


PL-2. Intermontane plain in the Hijaz mountains of western Arabia. Village and fields in the foreground are backed by volcanic cones. At $18^{\circ}03'$ N, $43^{\circ}01'$ E.



Reference 21

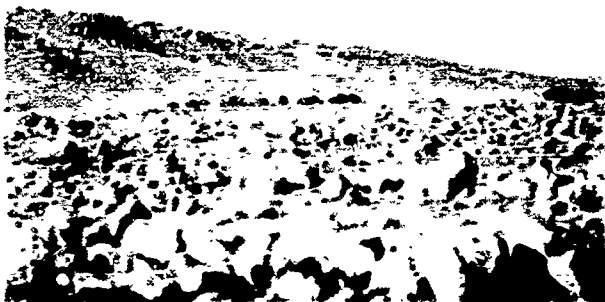
PL-4. Saudi Arabian Mining Syndicate road passing through high lava plateau strewn with broken lava. At approximately $22^{\circ}05'$ N, $40^{\circ}20'$ E.



PL-5. Outcrop of gypsum exposed on the face of the Al Jazireh, a vast desert between the Tigris and Euphrates Rivers. At approximately $30^{\circ}30'$ N, $41^{\circ}10'$ E.

and plateaus they are highly dissected. Along the Hasa plain in eastern Arabia and in the southeast part of the peninsula, relatively undissected plains grade into interior plains which extend inland for great distances. Two depression plains are found in the Middle East desert: (1) the Dead Sea Trough which marks the eastern boundary of Palestine, and (2) the Wadi Sirhan in northwestern Arabia. Of the two the Wadi Sirhan is the larger, being some 200 miles in length and averaging some 20 miles in width. The Dead Sea Trough is approximately half this size. Characteristics of the two plains, however, are strikingly similar. Both are bounded on either side by high, steep scarps flanked by numerous alluvial fans and talus slopes. The floors of the depressions are generally sandy with numerous salt playas and patches of gravel. Both contain large areas of salt marsh. The Dead Sea Trough north of the Dead Sea is crossed by the Jordan River and bears little resemblance to the portion of the depression lying south of the sea. Only one alluvial plain has been mapped in the Middle East desert, that of the Tigris and Euphrates Rivers. The plain extends from north of Baghdad to the head of the Persian Gulf. The eastern limit of the floodplain is the break with the mountains of Iran. To the west the plain gradually rises until it merges with the dunes of the bordering desert plains

or the escarpment of the Arabian Desert. A large number of intermittent rivers flow upon the level of the rivers. Alluvial origin characterize the plains with differences in elevation near the northern part of the study area. The Mediterranean mountains of Iraq and south along the Persian Gulf northwest to southeast: (1) the Al Jazira, the desert plain; (2) Al Hajara, the steppe plain; (3) the Dibdibba, a flat, relatively level plain; and northeastern Arabia, the Persian Gulf and the Arabian Desert. A number of large sand dunes in southern Arabia flanks the Persian Gulf marks the transition between the



Dr. James G. Balch

PL-3. North slope of the Faidhat Sa'atullah Depression south of Salum in southern Iraq. Possibly caused by solution. At $30^{\circ}25' N$, $44^{\circ}25' E$.



Dr. James G. Balch

PL-4. Jabal Madhira' ash Shamali, an isolated butte on the Damman Dome in eastern Arabia. Typical sabkha in the foreground. At $26^{\circ}11' N$, $50^{\circ}05' E$.



Dr. James G. Balch

PL-5. Sinkhole near Ain Wisa in the Lower Wasat Province of southern Iraq. At $33^{\circ}06' N$, $42^{\circ}00' E$.



Dr. James G. Balch

PL-6. Ain Aqis, an oasis in the Lower Wasat Province of southern Iraq. The trees surrounding the spring are date palms. At approximately $33^{\circ}06' N$, $42^{\circ}00' E$.

or the escarpment of the Arabian tableland. Most of the plain is swampland, with a large number of intermittent freshwater lakes which vary greatly in size. Depending upon the level of the rivers. Unconsolidated deposits of silt, sand, and clay of alluvial origin characterize the plain. The relief throughout the entire plain is very low with differences in elevation never exceeding a few feet. Desert plains occupy much of the northern part of the study area. Beginning with the Syrian Steppe, which borders the Mediterranean mountains to the west, the plains extend to the east across Iraq and south along the Persian Gulf in Arabia. The northern plains are, from northwest to southeast: (1) the Syrian Steppe, lying west of the Euphrates River, (2) the Al Jazira, the desert plain lying between the Tigris and the Euphrates Rivers, (3) Al Hajara, the stony plain of southern Iraq south of the Euphrates River, and (4) the Dibdibba, a flat, relatively undissected desert plain in southeastern Iraq, Kuwait, and northeastern Arabia. In east central Arabia the sandy Hasa plain parallels the Persian Gulf and merges with the central plateaus to the west. In central Arabia a number of large sand and gravel plains occur. A long, rolling desert plain in southern Arabia flanks the Hadhramaut Plateaus and the Oman Mountains and marks the transition between these highlands and the Rub ' al Khali Desert.



Reference 20

4. Jabal Madhira' ash Shamali, an isolated peak on the Damman Dome in eastern Arabia. Typical sabkha in the foreground. At $26^{\circ}18' N$, $50^{\circ}5' E$.



Dr. James G. McHarg

PL-5. Stony surface typical of the Al Hajara Plateau Province in southern Iraq. At $30^{\circ}40' N$, $43^{\circ}45' E$.



Dr. James G. McHarg

9. Ain Ajla, an oasis in the Lower Wadyan region of southern Iran. The trees are...



Dr. James G. McHarg

PL-10. The surface of the Al Hamed Plain in southwestern Iran. At approximately $33^{\circ}20' N$.



PL-1. The town of Makkah on the narrow coastal plain of southern Arabia. At $14^{\circ}33' \text{ N}$, $49^{\circ}07' \text{ E}$.



PL-2. Intermontane plain in western Arabia. Volcanic fields in the foreground are h of volcanic cones. At $18^{\circ}03' \text{ N}$, $42^{\circ}03' \text{ E}$.



PL-6. Saudi Arabian Mining Syndicate road passing through high lava plateau strewn with broken lava. At approximately $22^{\circ}05' \text{ N}$, $40^{\circ}20' \text{ E}$.



PL-7. Outcrop of gypsum on face of the Al Jezira, a vast island between the Tigris and Euphrates. At approximately $34^{\circ}30' \text{ N}$, $43^{\circ}00' \text{ E}$.



PL-11. Fortified town of Dara-Europus in the desert plains bordering the lower Euphrates in Iraq. Exact location unknown.



PL-12. The flat plains of southern Iraq as viewed from the Euphrates. At $30^{\circ}45' \text{ N}$, $47^{\circ}00' \text{ E}$.

Reference 78

the Hijaz Moun-
tains and cultivated
backed by a number
N, 43°12' E.



Dr. James C. McQuinn

PL-3. North slope of the Fai-shat Sa atullah
Depression south of Salum in southern Iraq.
Possibly caused by solution. At 30°25' N,
44°25' E.

PL-4. Jabal Madhra' ash Shamal;
butte on the Dammam Dome in Iraq.
Typical sabkha in the foreground.
50°35' E.



Dr. James C. McQuinn

exposed on the sur-
face of the desert plain lying
between the Tigris and
Euphrates Rivers. At
30° E.

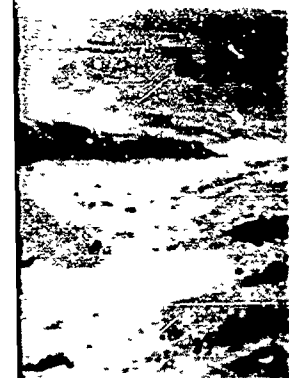


Dr. James C. McQuinn

PL-8. Sinkhole near Ain Wiza in the Lower
Wadyan Province of southern Iraq. At 33°06' N,
42°40' E.



PL-9. Ain Apis, an oasis in the La
Province of southern Iraq. The trees
surrounding the spring are date palms.
Approximately 33°20' N, 43°00' E.



Dr. James C. McQuinn

Ad Dibdibba in
from the top of Jabal
35° E.



Reference 52

PL-13. Al Umchaimin Depression
in southwestern Iraq; the crater is
approximately 2 miles in diameter
and is, supposedly, of meteoric ori-
gin. At 32°35' N, 39°25' E.

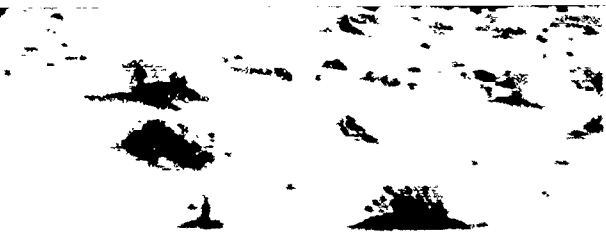


Dr. James C. McQuinn

PL-14. The vast flood plain of the Tigris
south of Baghdad. At approximately 33°
44°35' E.

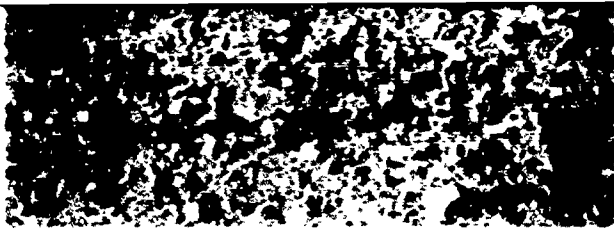
of this report

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Recherches 26

PL-4. Jabal Madhra' Ash Shamali, an isolated butte on the Damman Dome in eastern Arabia. Typical sabkha in the foreground. At $26^{\circ}18' N$, $50^{\circ}05' E$.



Dr. James G. McNeill

PL-5. Stony surface typical of the Al Hajara Plateau Province in southern Iraq. At $30^{\circ}40' N$, $43^{\circ}45' E$.



Dr. James G. McNeill

PL-9. Ain Apis, an oasis in the Lower Wadyan Province of southern Iraq. The trees surrounding the spring are date palms. At approximately $33^{\circ}20' N$, $43^{\circ}00' E$.



Dr. James G. McNeill

PL-10. The surface of the Al Hamad Plain in southwestern Iraq. At approximately $33^{\circ}30' N$, $40^{\circ}00' E$.



Dr. James G. McNeill

PL-14. The vast flood plain of the Tigris River south of Baghdad. At approximately $33^{\circ}10' N$, $35^{\circ} E$.



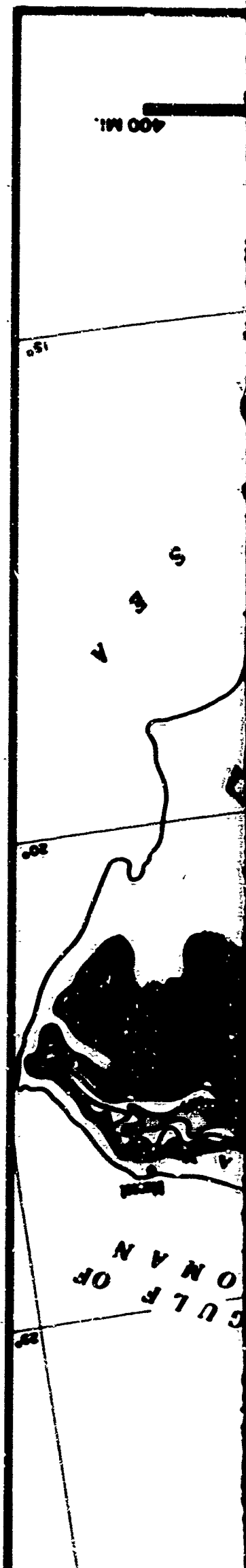
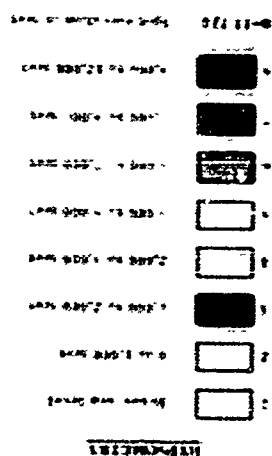
Dr. James G. McNeill

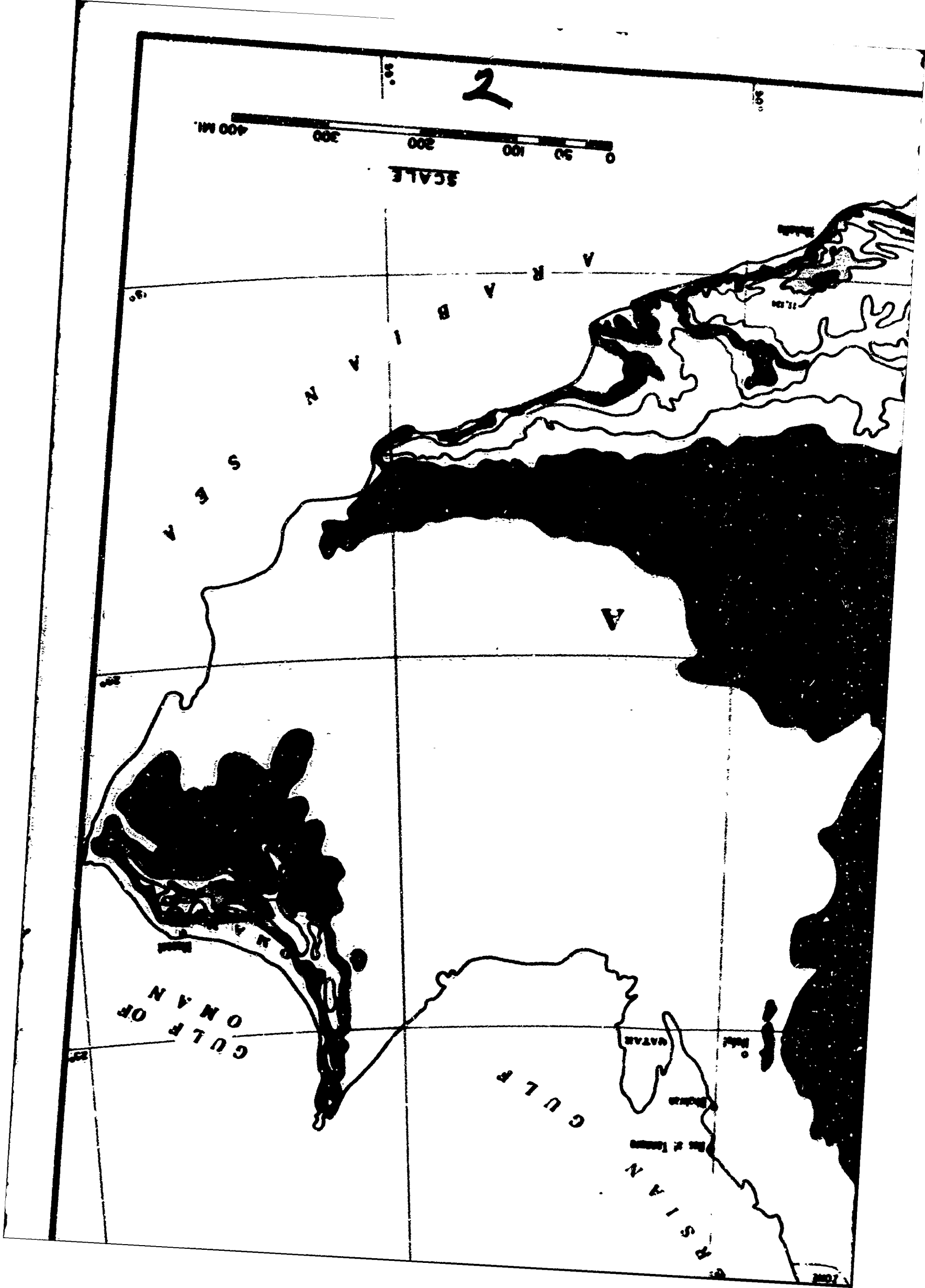
PL-15. Marsh in the southern part of the Tigris-Euphrates Delta Plain. At approximately $30^{\circ}50' N$, $47^{\circ}30' E$.

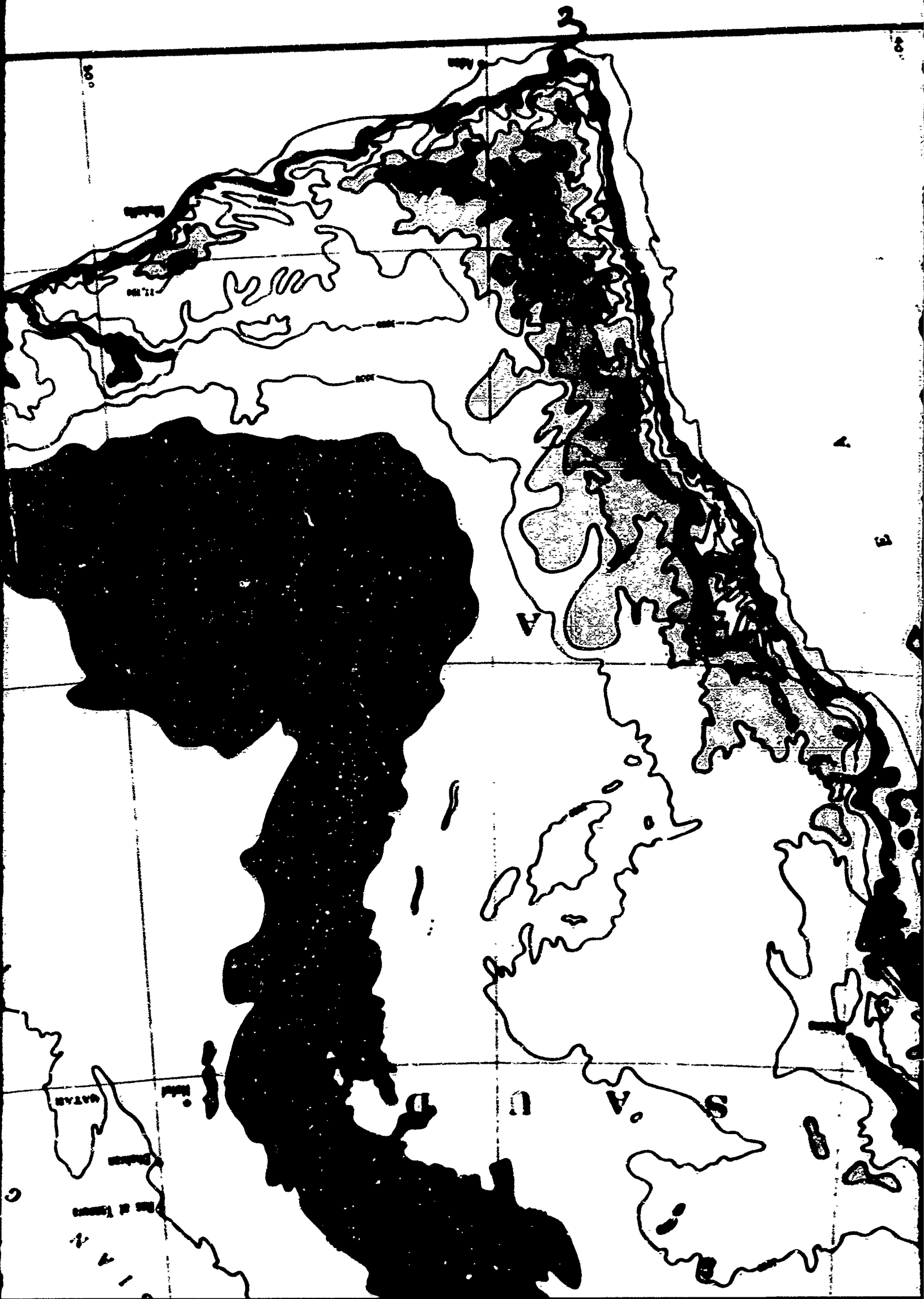
ANALOGS OF YUMA TERRAIN IN THE MIDDLE EAST DESERT

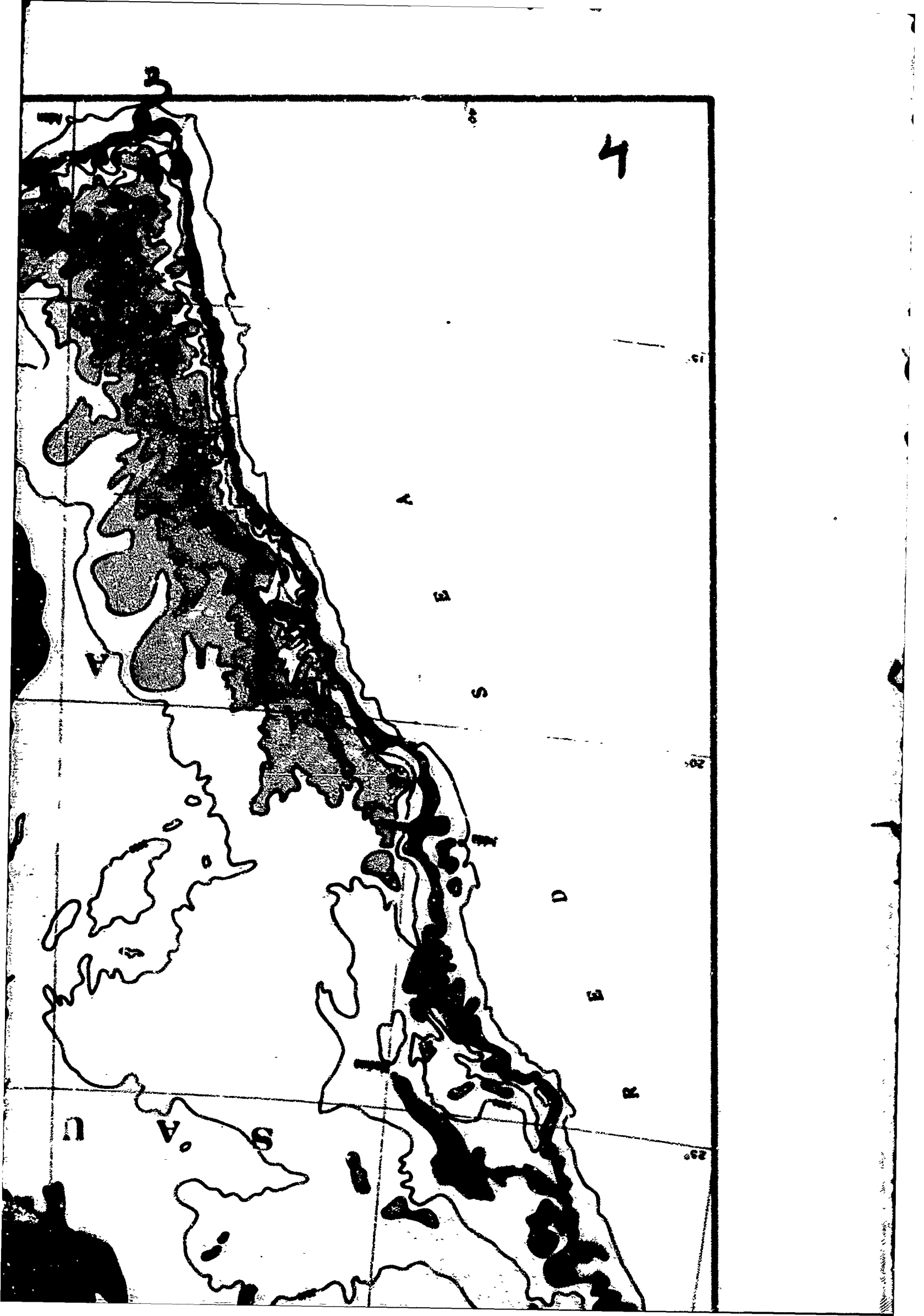
4 PHYSIOGRAPHY DESCRIPTIONS AND PHOTOGRAPHS

ANALOGS OF YUMA TERRAIN IN THE MIDDLE EAST DESERT HYPSOMETRY

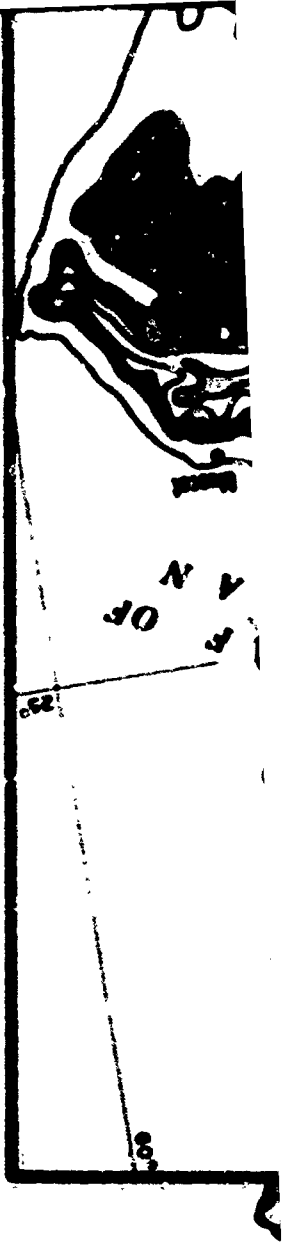






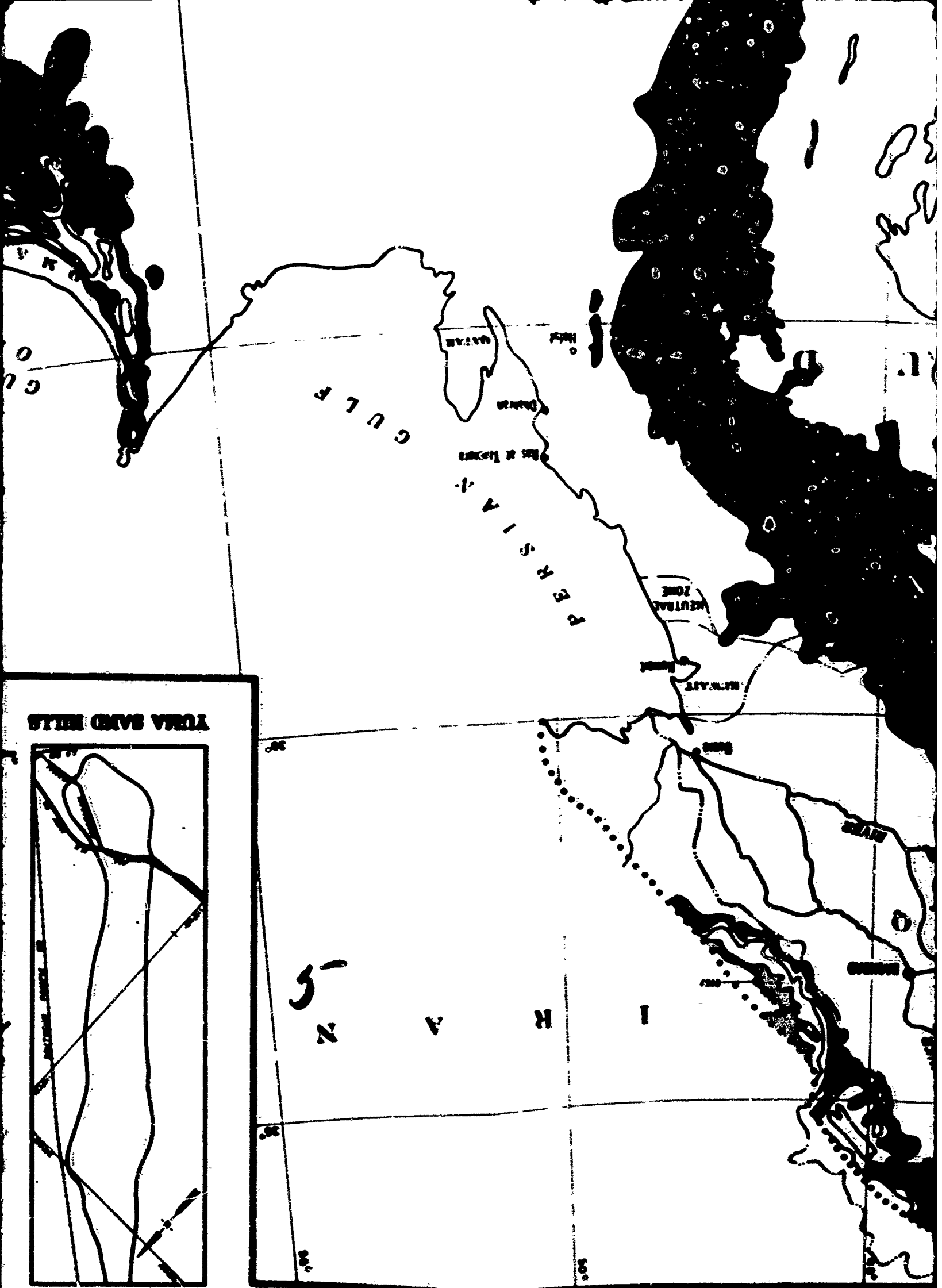


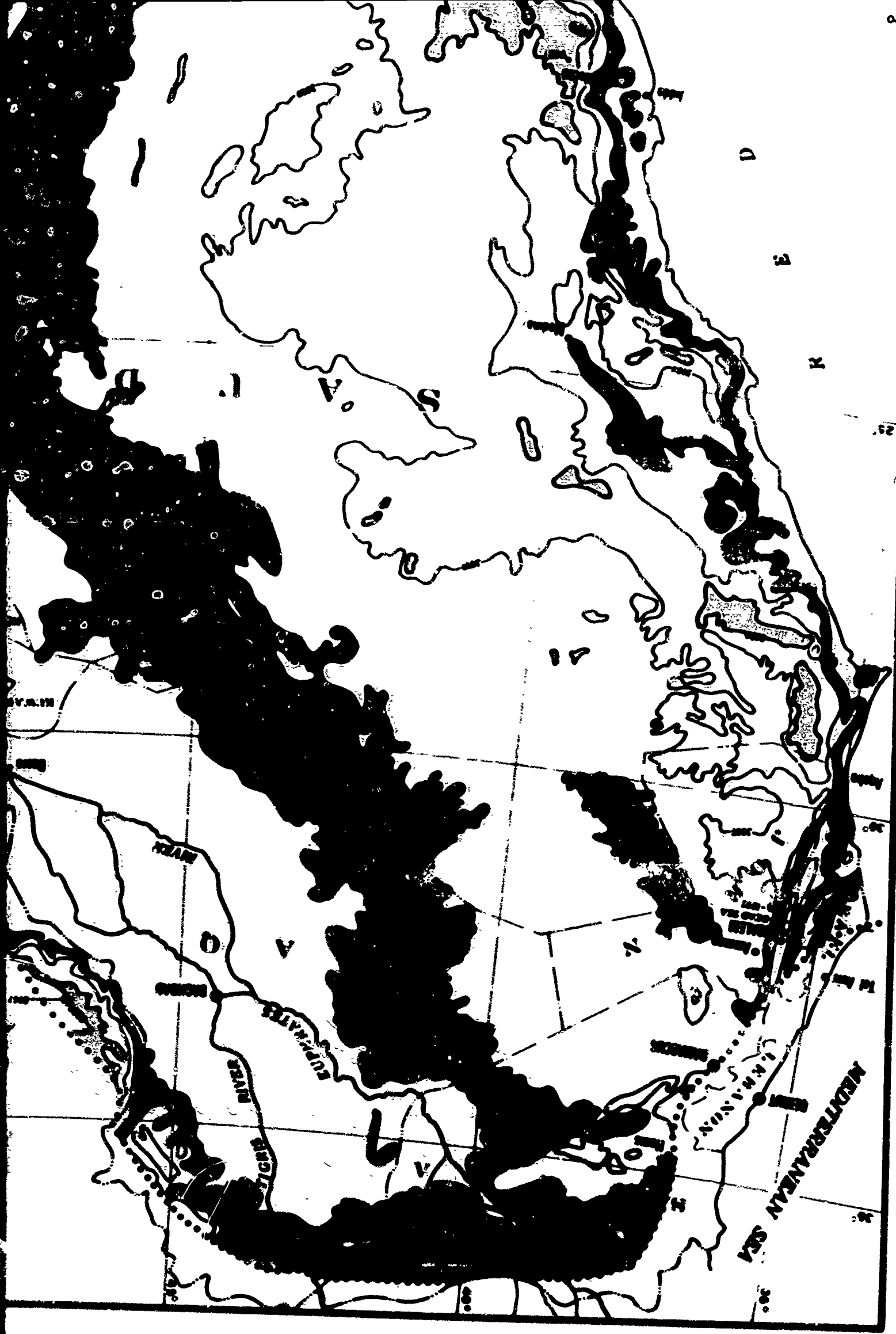
YUMA PROVING GROUND

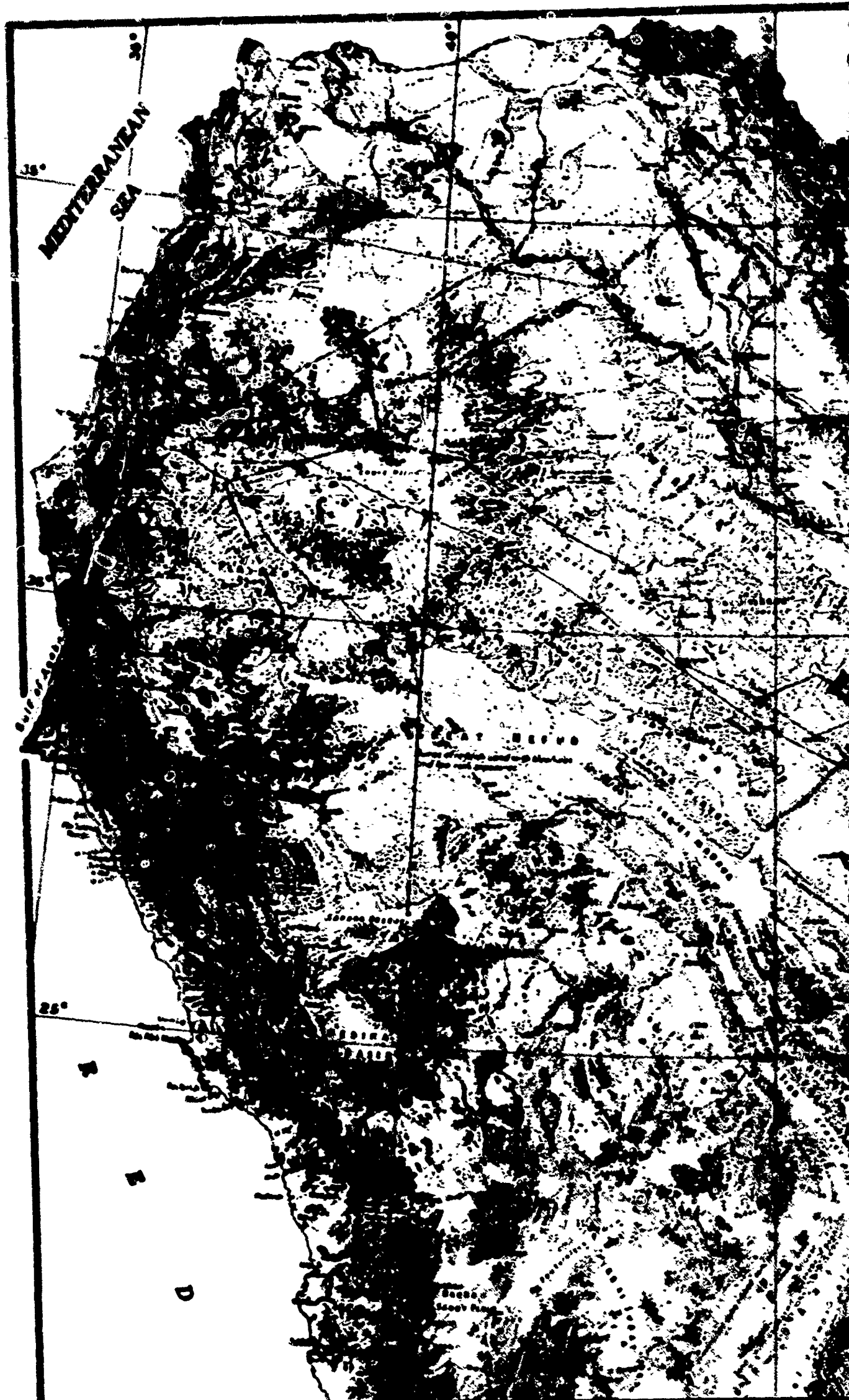


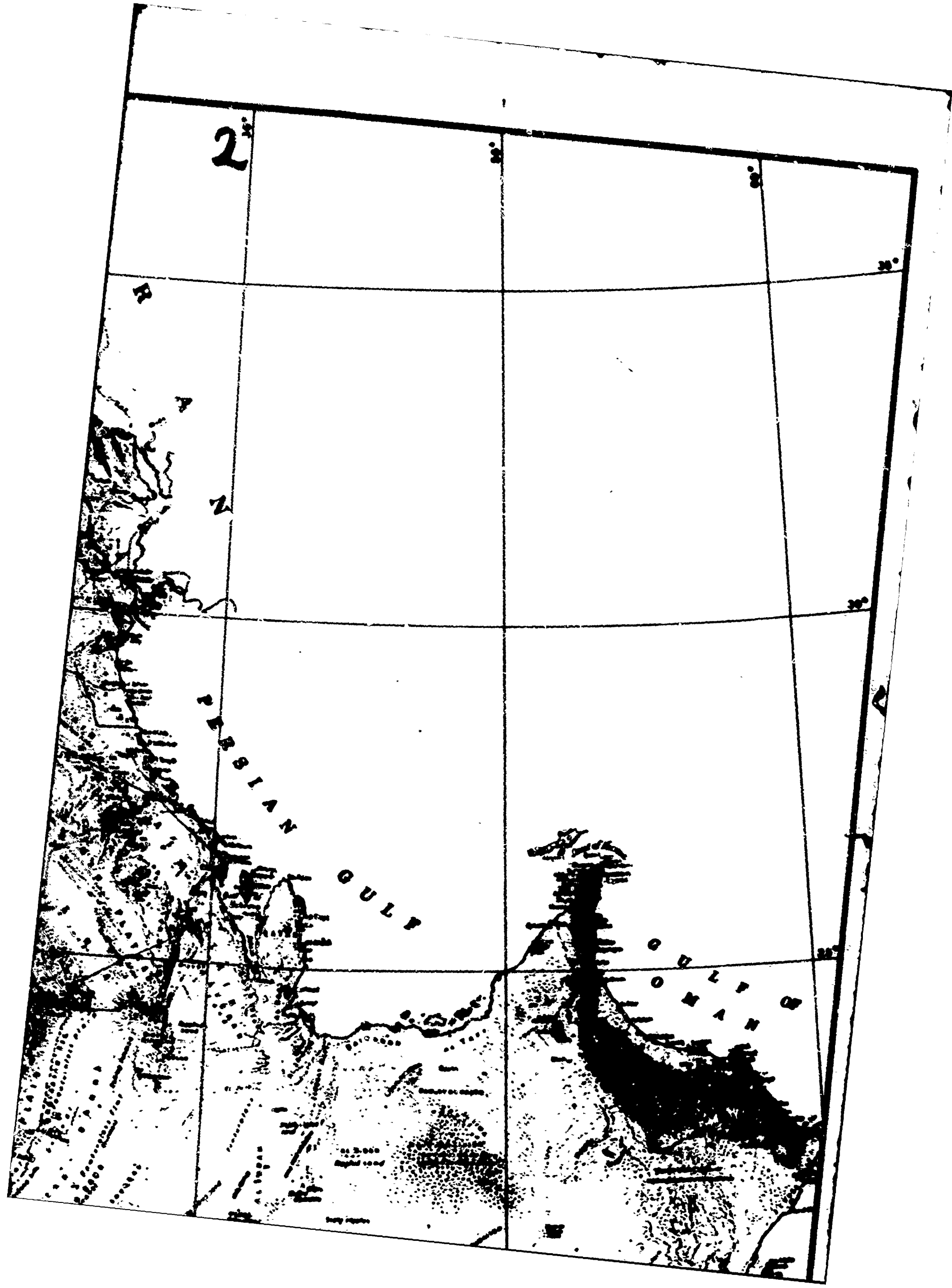
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100' x 100'





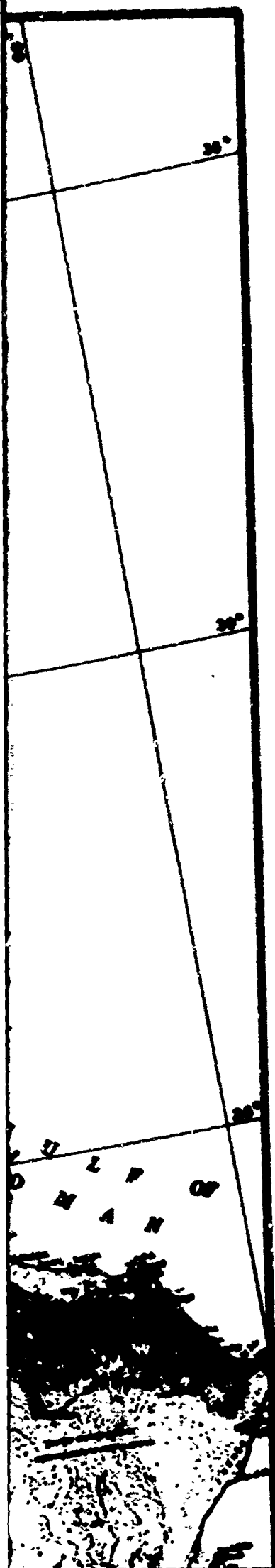


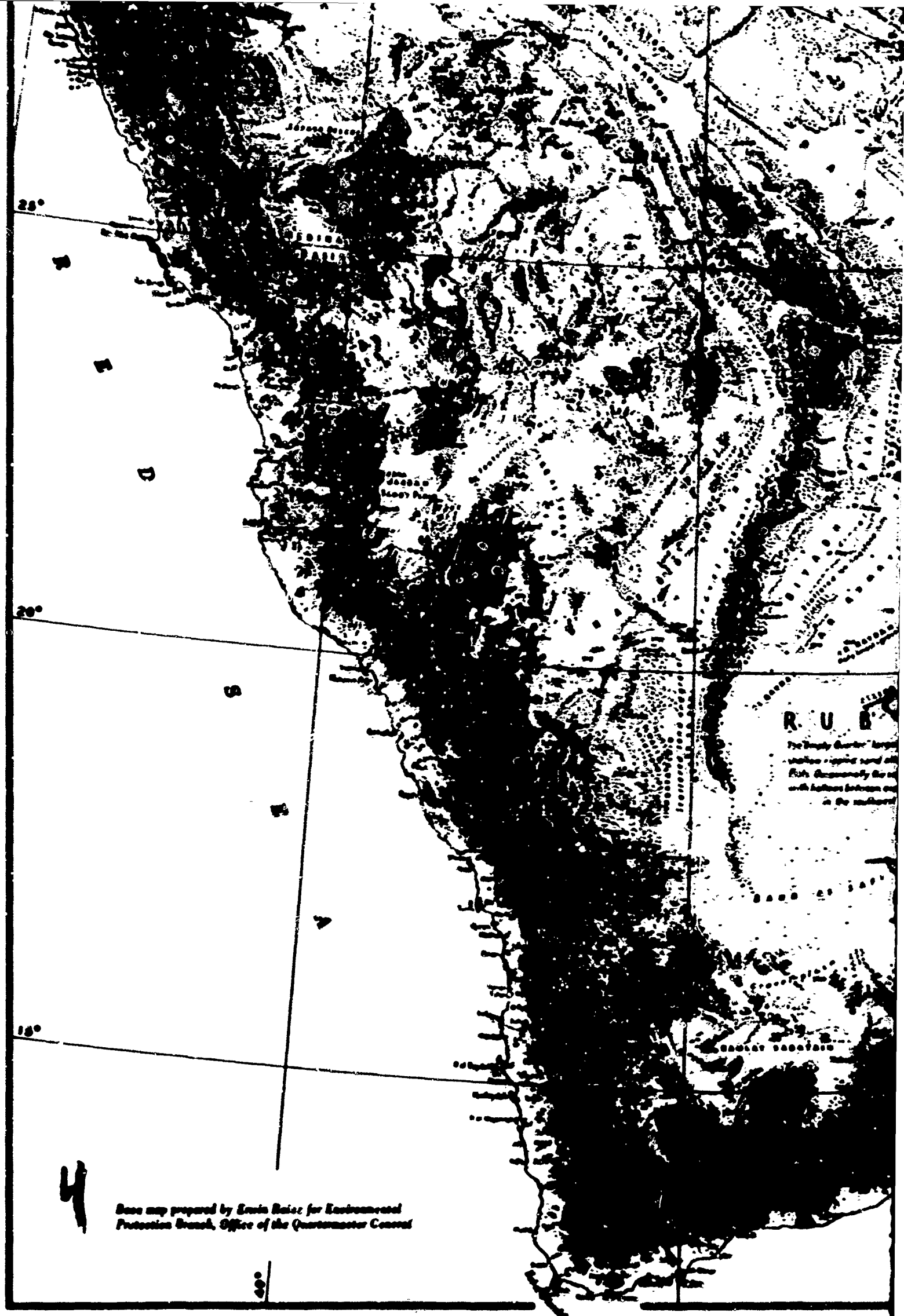




SOUTHWESTERN UNITED STATES

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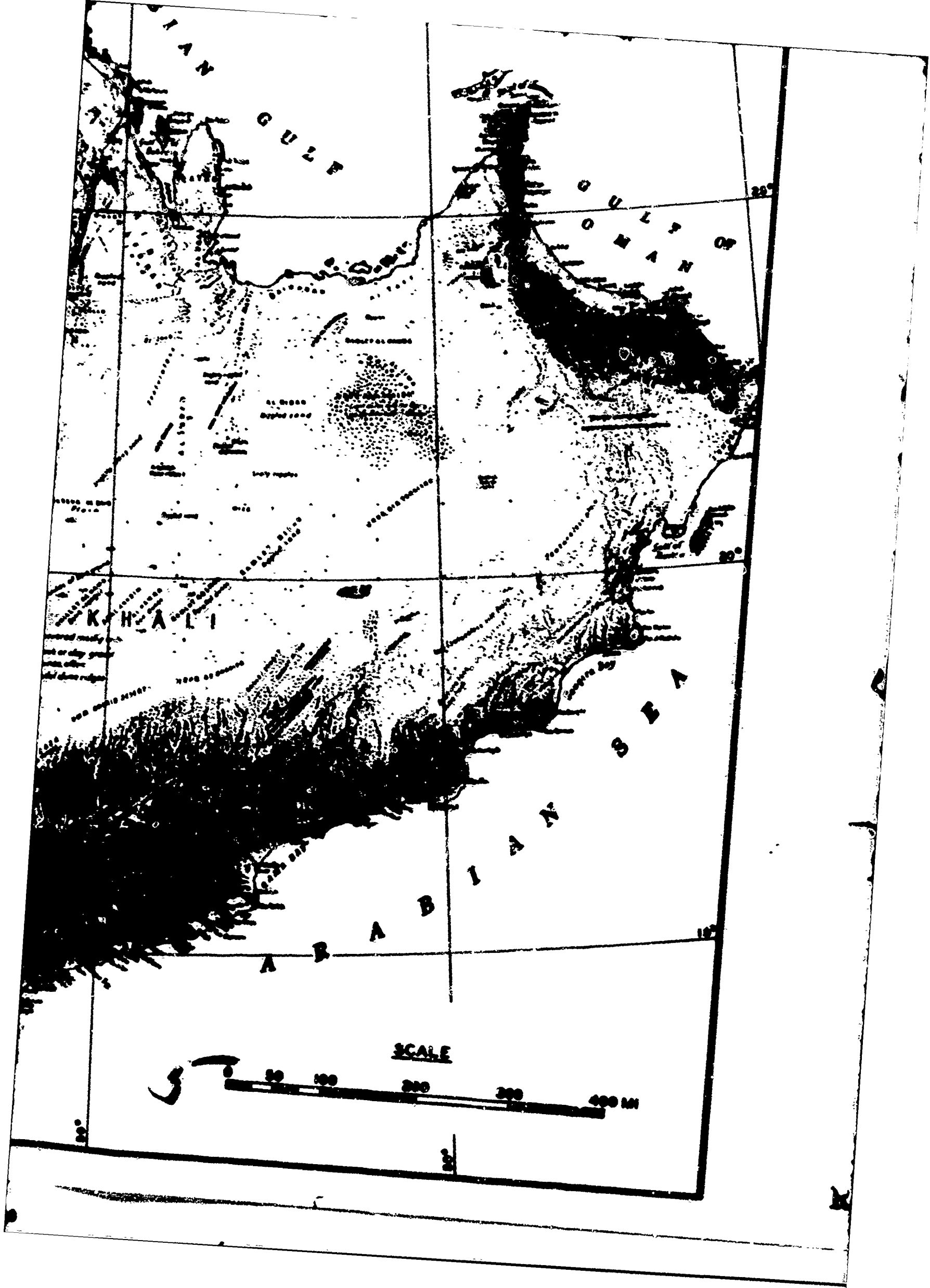


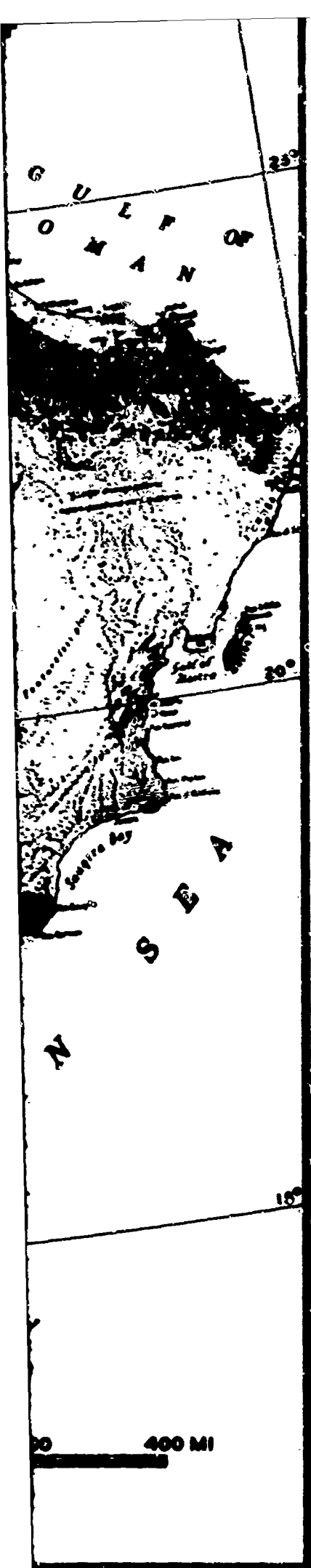


RUB
The "Rough Guide" to the Gulf of Mexico
shows the location of the Gulf of Mexico
and the surrounding landmasses.
It is a useful reference for anyone
interested in the Gulf of Mexico.

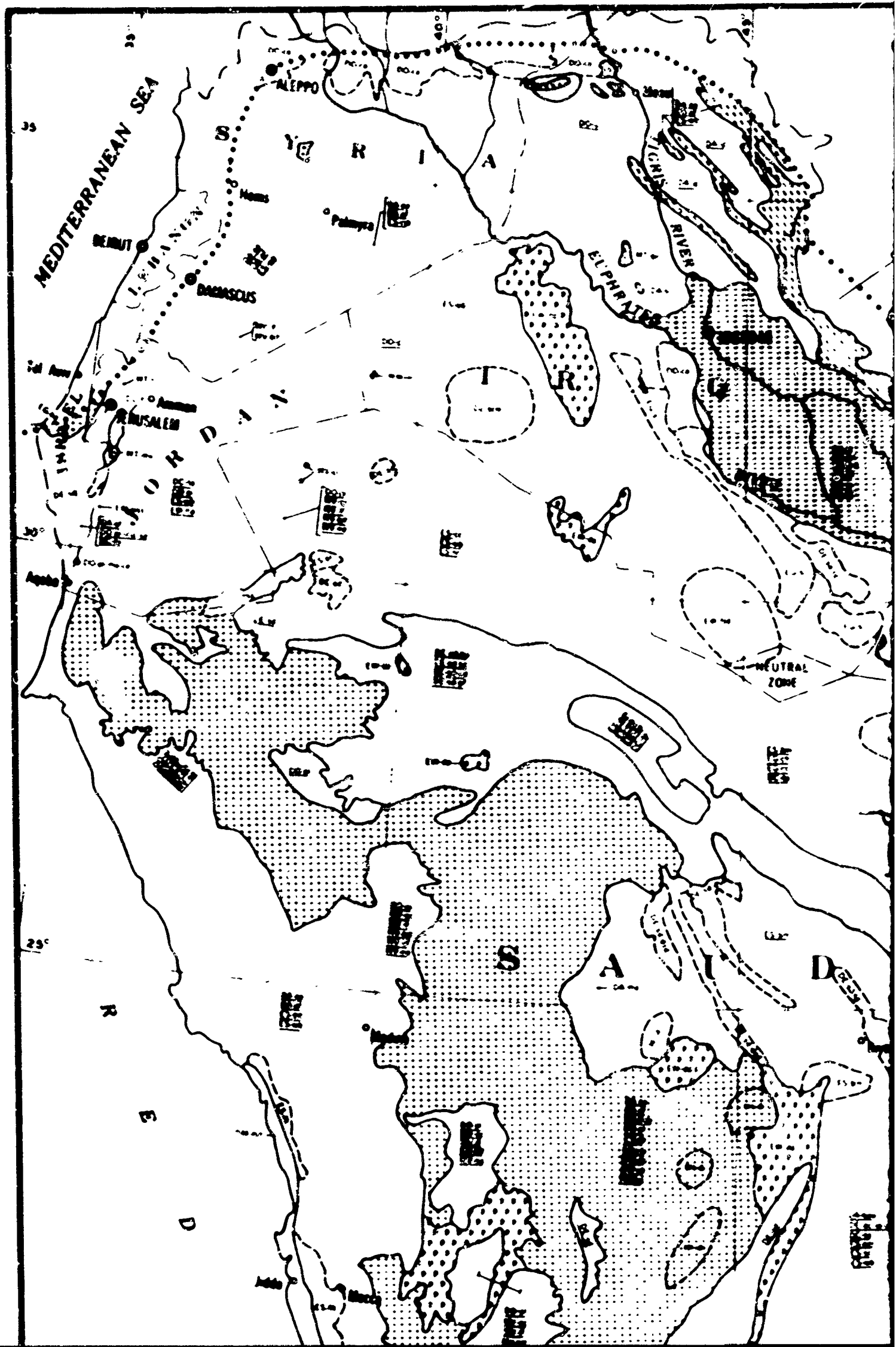
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Base map prepared by Edwin Raizer for Environmental
Protection Branch, Office of the Quartermaster General





**ANALOGS OF YUMA TERRAIN
IN THE
MIDDLE EAST DESERT
RAISZ'S LANDFORM MAP**



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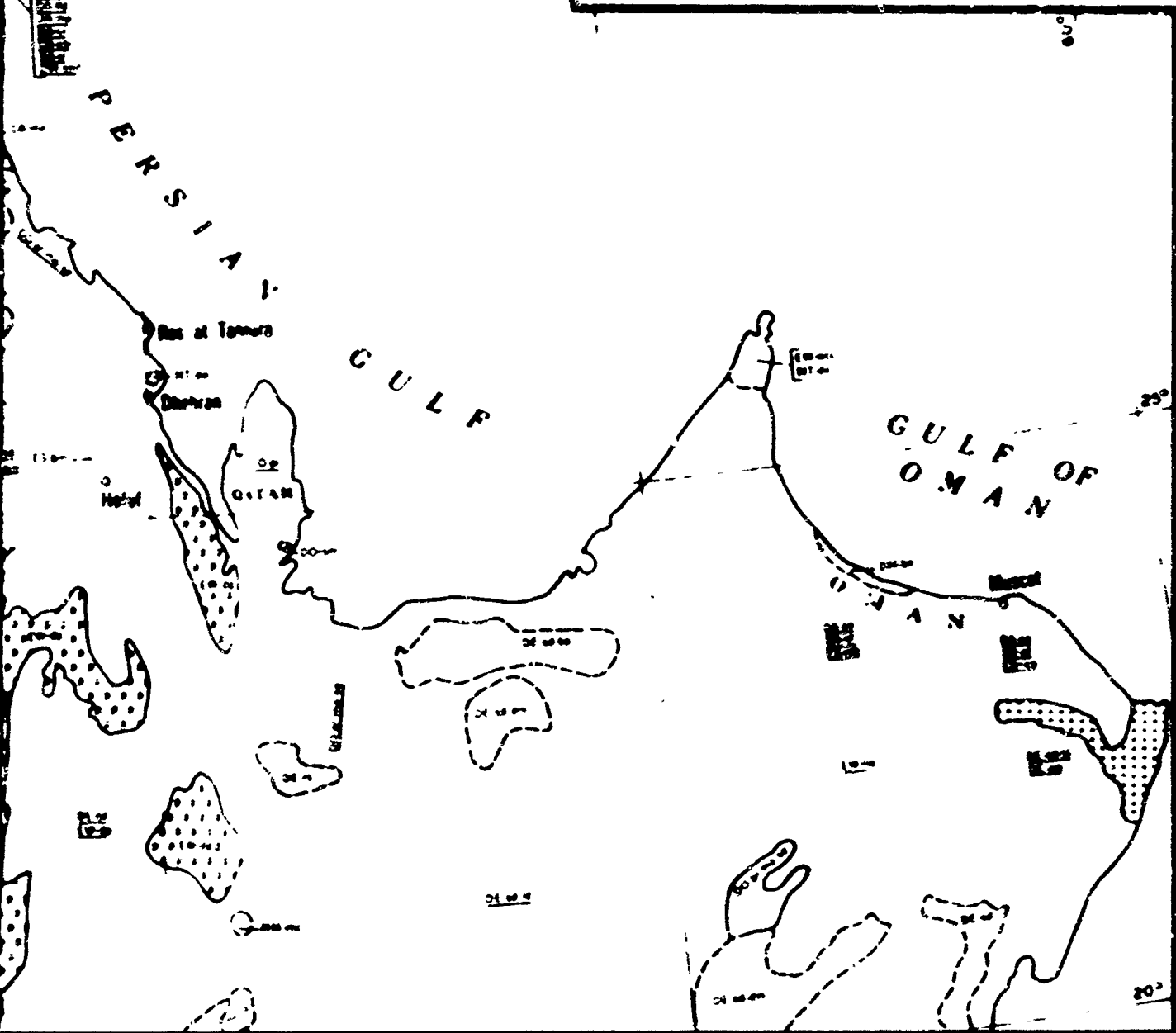


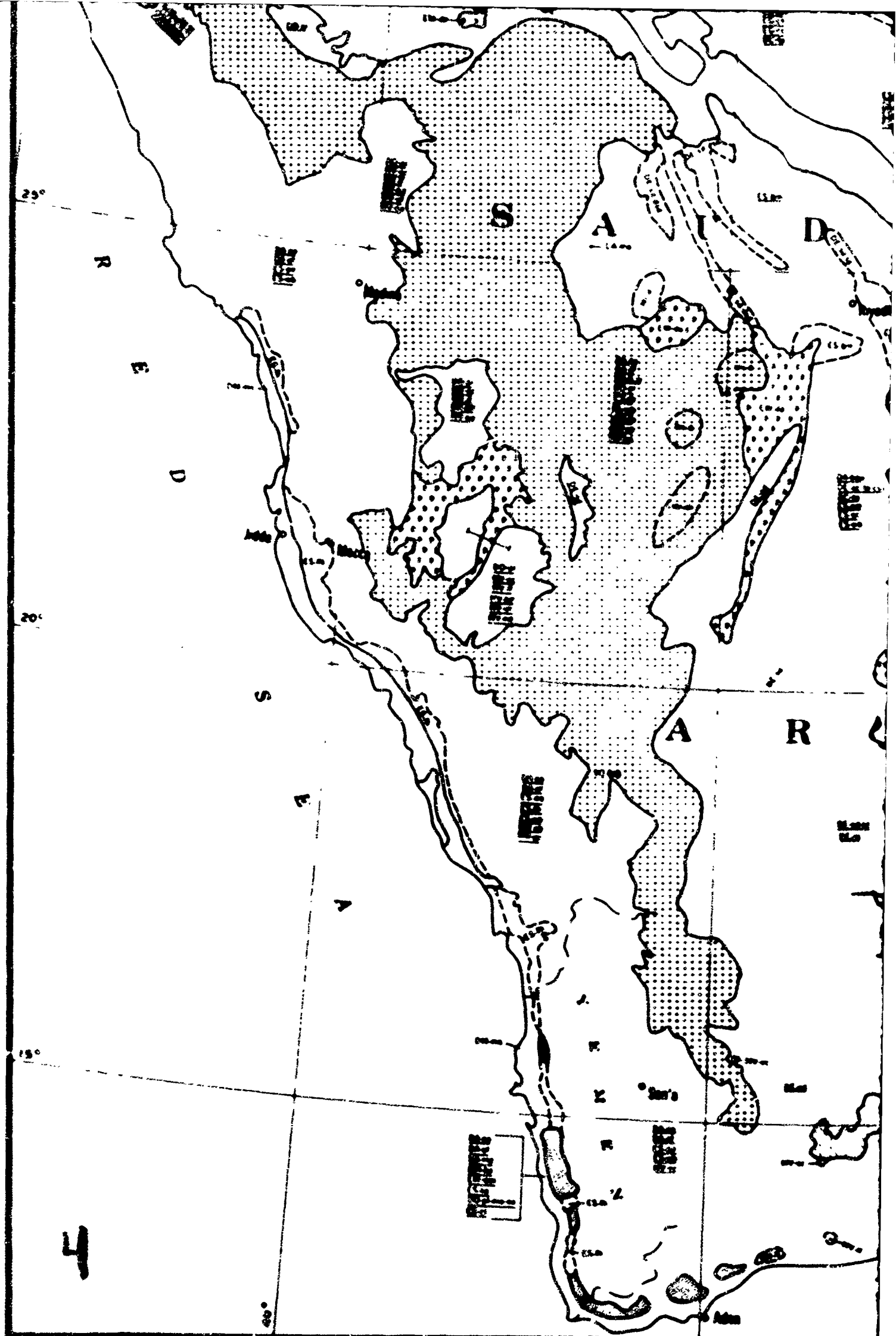
YUMA SAND HILLS

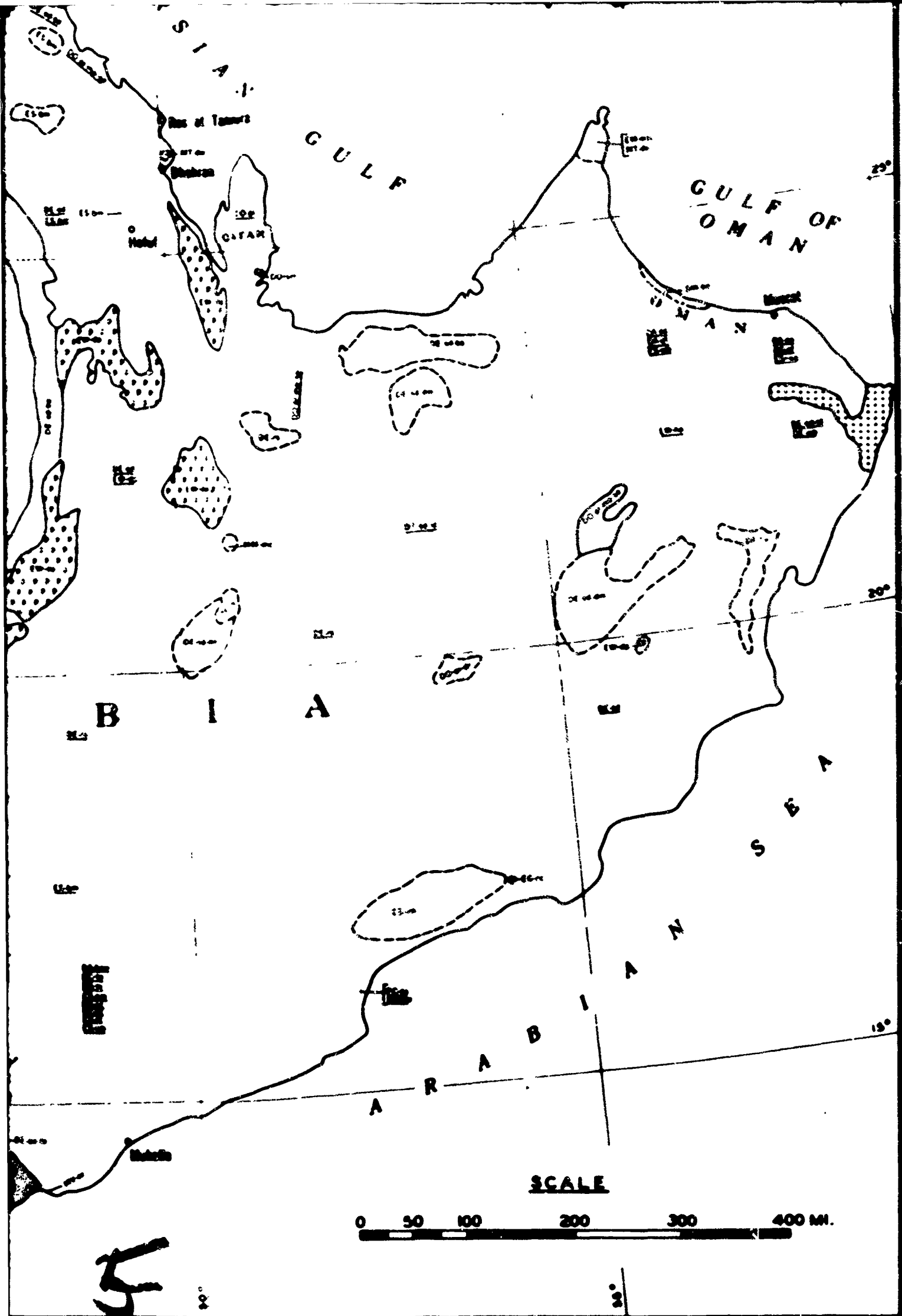


SCALE

0 10 20 30 40 50 60 70 80 90 100







LANDFORMS

Photo No.	CLASSIFICATION AND DESCRIPTION
	I. DEPOSITIONAL ALLUVIAL
1	Abandoned courses: Abandoned courses are lengthy segments of a river abandoned when the stream takes a new course across the floodplain.
2	Alluvial aprons: Alluvial aprons are created through coalescence of alluvial fans along the base of mountains or plateau escarpments. Several fans coalesce to form an alluvial apron.
3	Alluvial fans: Alluvial fans are cone-shaped features occurring at the base of mountains, hills, etc., where streams experience a sufficient reduction in gradient to deposit their loads. They are steepest near the mountains, slope gently outward with a continually decreasing gradient, and are characterized by braided stream channels which score their surfaces.
4	Bars and swales: Bars and swales are accretion deposits formed on the inside of river bends, wherever the channel migrates. Sandy bar deposits or "ridges" are laid down during high stage of the river and, as the water subsides, an accreted depression or "swale" often flanks the bar on the landward side. The swale is modified by subsequent high-stage flow and eventually is abandoned when the river continues to migrate. The depression is gradually filled with fine-grained material. A migrating series of sandy ridges and clayey swales results, conforming to the curvature of the meandering channel.
5	Boulder-choked wadies: Boulder-choked wadies are relatively narrow and deep, intermittent streams generally in mountainous or plateau regions, where boulders have been amassed in numbers sufficient to retard or prevent vehicular movement.
6	Deltas: Deltas are alluvial tracts of land, usually triangular in shape, formed at the mouth of a river. The boundaries of deltas often, but not invariably, coincide with the farthest upstream distributaries of a river.
7	Floodplains: Floodplains are relatively smooth, flat lands bordering a stream. They are built up of sediments deposited by the stream and inundated by floodwaters.
8	River terraces: River terraces are flat strips of land bordering river floodplains. They are characterized by a sharp descent toward the river and by more elevated land on the opposite side. An arrangement of several terraces often flanks larger floodplains.
9	Intermittent freshwater lakes: Intermittent freshwater lakes are standing bodies of inland fresh water which become dry during certain periods of the year.
10	Intermontane plains: Basins of interior drainage between mountain ranges composed of fine-grained sediments deposited by streams issuing from the adjacent mountains.
11	Levee-flank depressions: Levee-flank depressions are irregular to rectilinear low areas, usually containing ponds or lakes, paralleling and flanking natural levee ridges. They are best developed in alluvial regions.
12	Marsh: Marsh is a tract of low (in reference to surrounding terrain), wet ground, usually mucky soil, with rank grass and sedge vegetation and confined to freshwater areas.
13	Natural levees: Natural levees are long, relatively narrow alluvial ridges, higher near the river and usually sloping away from it, which are built up on either side of a stream by overbank flow. Drainage patterns range from minute drainageways to major crevasses, commonly found at right angles to the direction of levee elongation.
14	Ox-bow lakes: Ox-bow lakes are crescent-shaped lakes formed when rivers are shortened by the cutting off of migrating river bends at the upstream and downstream arms of meander loops.
	• Not applicable.

SURFACE CONDITIONS: DESCRIPTIONS AND PHOTOGRAPHS

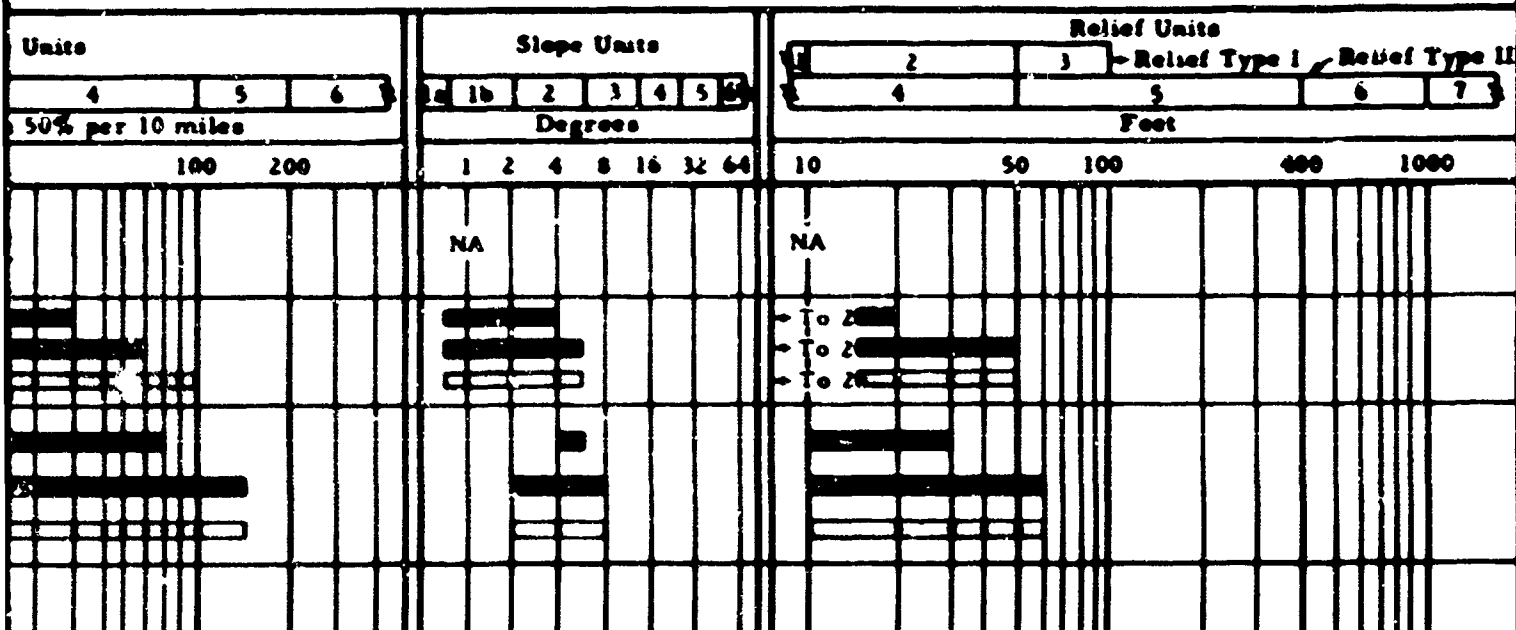
		TYPICAL GEOMETRY FACTOR					
		Range at Yuma			Range in Middle East Desert		
	Plan-Profile Units	Slope Occurrence Units					
		Number of slopes greater than 50% per 10 miles					
		1	2	3	4	5	6
		1	5	20	100	200	
Does	•NA	NA					NA
ains	1L, 7 1, 1L, 7 1, 1L, 7	→ To 0					
erms. fans. e	1L 1, 1L 1, 1L						
ges of on the as the an al- mi-	This phenomenon is classed as a surface condition and considered in terms of surface roughness or micro-rolling in nature, with the crest of the bars ranging from 2 to 10 feet above the adjacent swale.						
ds, ffi-	NA	NA					
inland s	7 7	Lacking Lacking					
ents	7 7 7, 1, 1L	Lacking → To 0 → To 0					
ized e	7 7, 1 7, 1	Lacking → To 0 → To 0					
	NA	NA					
gium	7, 1, 1L 7, 1, 1L	→ To 0 → To 0					
aising aic	NA	NA					
vered	This phenomenon is classed as a surface condition and considered in terms of surface roughness or micro-characteristically featureless.						
grad- urface ght	NA NA	NA NA					
escence	NA	NA					

PHOTOGRAPHS

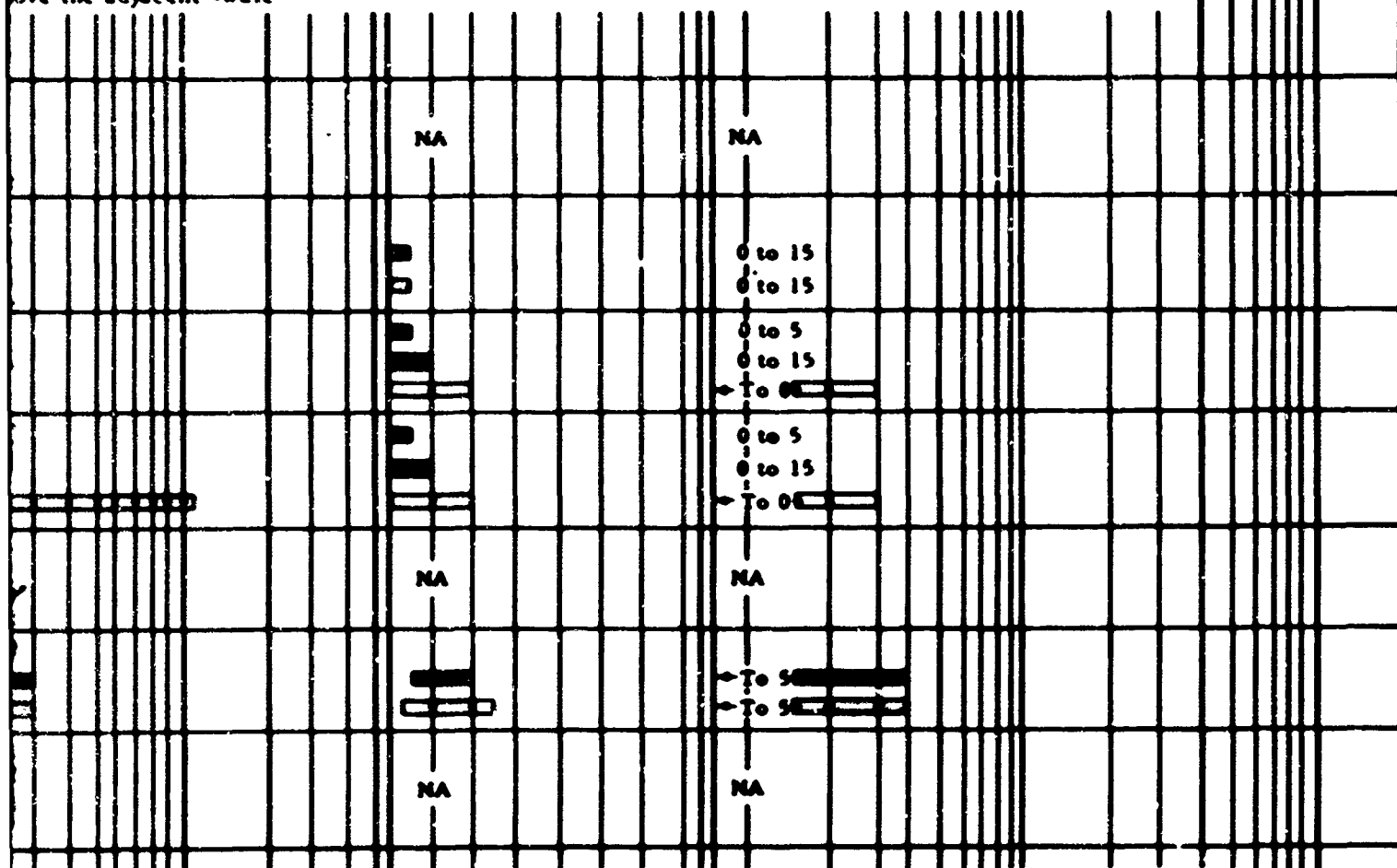
TYPICAL GEOMETRY FACTOR RANGES

 Range in Middle East Desert

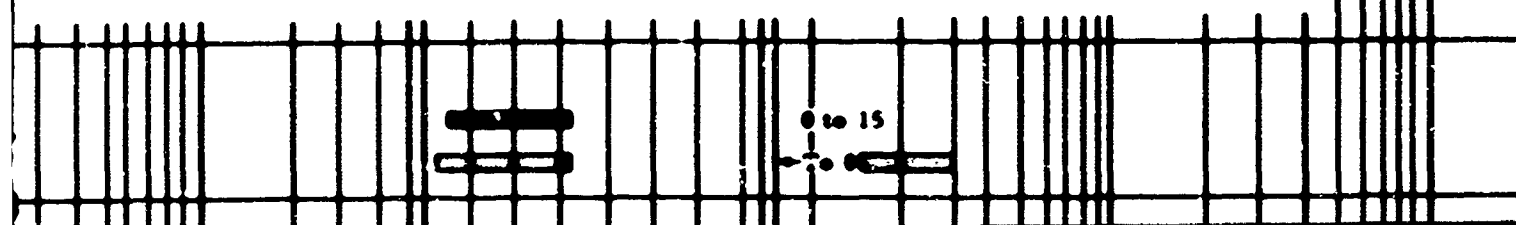
 World-wide Range



forms of surface roughness or microrelief rather than geometry factor ranges. These surfaces are above the adjacent swale



forms of surface roughness or microrelief rather than geometry factor ranges. Marshes are



7	deposited by the stream and inundated by floodwaters
8	River terraces. River terraces are flat strips of land bordering river floodplains by a sharp descent toward the river and by more elevated land on the opposite side. The arrangement of several terraces often flanks larger floodplains.
9	Intermittent freshwater lakes. Intermittent freshwater lakes are standing bodies of water which become dry during certain periods of the year.
10	Intermontane plains. Basins of interior drainage between mountain ranges composed of deposits deposited by streams issuing from the adjacent mountains.
11	Levee-flank depressions. Levee-flank depressions are irregular to rectilinear depressions, ponds or lakes, paralleling and flanking natural levee ridges. They are common in river valleys.
12	Marsh. Marsh is a tract of low (in reference to surrounding terrain), wet ground, with rank grass and sedge vegetation and confined to freshwater areas.
13	Natural levees. Natural levees are long, relatively narrow alluvial ridges, high on one side and usually sloping away from it, which are built up on either side of a stream. Drainage patterns range from minute drainageways to major crevasses, all at angles to the direction of levee elongation.
14	Ox-bow lakes. Ox-bow lakes are crescent-shaped lakes formed when rivers are in the process of migrating river bends at the upstream and downstream arms of meanders.

• Not applicable.

†† Raised numbers refer to similarly numbered entries in the bibliography at the end of the report.



1. A vertical photograph showing the new heavily vegetated meander of an abandoned course in the lower left quarter of the photograph.



2. An alluvial apron forming a narrow, continuous band between the background mountains and the basin in the lower half of the photograph.



3. A view of an alluvial fan.



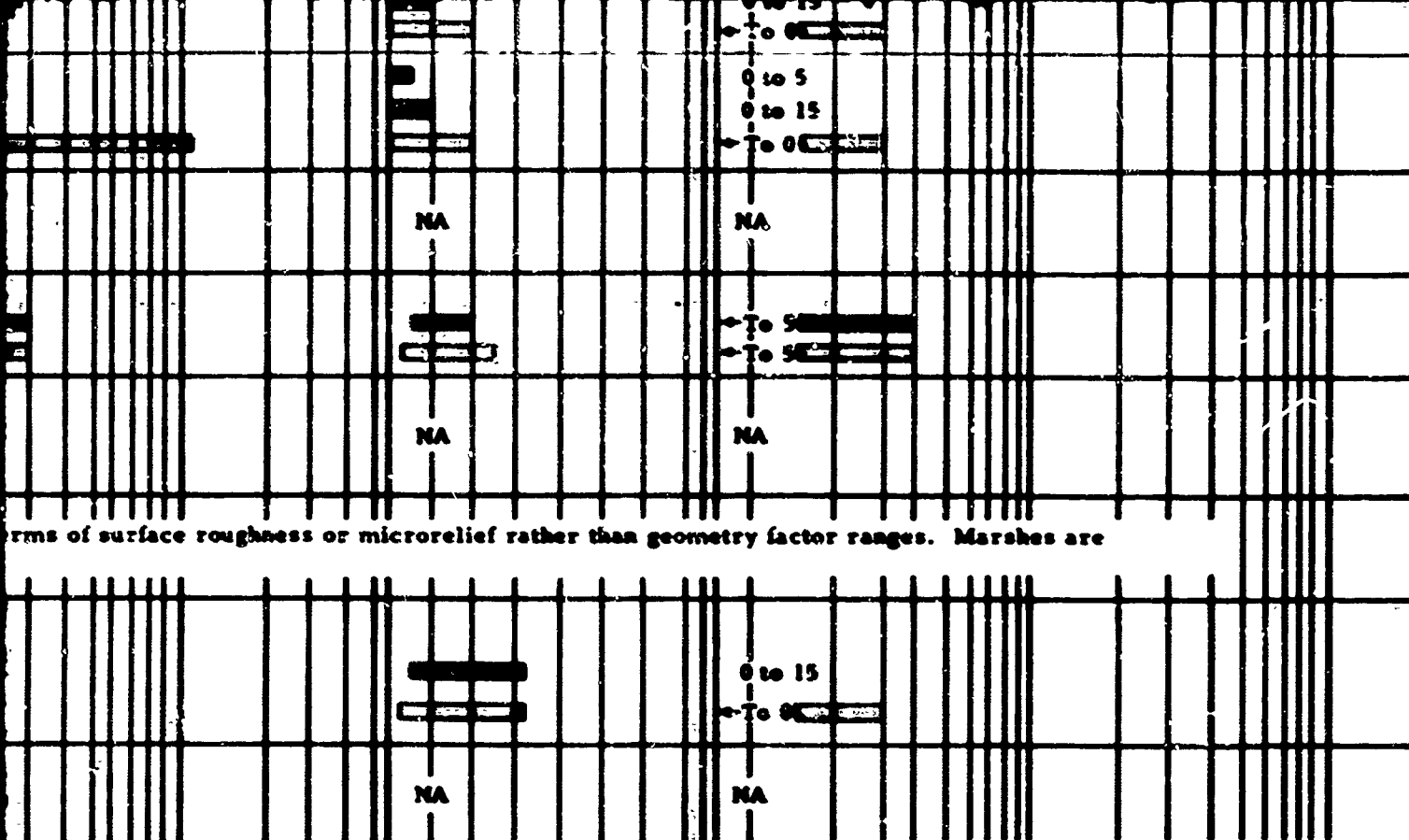
9. Intermittent freshwater lakes.



10. Intermontane plain as viewed from adjacent mountains.



11. Wet depression.



terms of surface roughness or microrelief rather than geometry factor ranges. Marshes are



U. S. Army Engineer District, New Orleans

Present distributary system of Mississippi River Delta



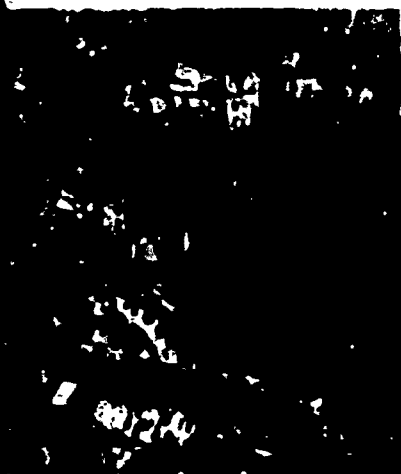
Reference 44

7. Floodplain of the Colorado River, looking southward from Laguna Dam, Arizona



H. E. Green, 1965

8. Valley of Sevier River near Hatch, Utah, showing meanders and terraces



U. S. Army Corps of Engineers

A vertical photograph of an oxbow lake -- Pecos River Cutoff, New Mexico

ANALOGS OF YUMA TERRAIN IN THE MIDDLE EAST DESERT LANDFORMS-SURFACE CONDITIONS DESCRIPTIONS AND PHOTOGRAPHS

Photo No.	CLASSIFICATION AND DESCRIPTION
	I. DEPOSITIONAL (CONT.)
	ALLUVIAL
15	Salt lakes Salt lakes are permanent or intermittent bodies of saline water, generally of surface evaporation of water exceeds inflow, thus creating saline conditions.
	COLLUVIAL
16	Talus. Talus is an unconsolidated, sloping heap of fairly large rock fragments or debris at an escarpment or steep slope through gravitational accumulation.
	EOLIAN
	Accumulations near barriers Large extensive obstacles
17	Climbing sand drifts: These are massive accumulations of windblown sand which form extensive obstacles such as plateau scarps, hills, and mountains.
18	Falling sand drifts: Falling sand drifts are massive accumulations of windblown sand windward of extensive obstacles such as plateau scarps, hills, and mountains.
19	Rippled surfaces: Washboard-like surfaces caused by the heaping of sand by wind action, found on the gentler slopes of dunes or in flat, sandy areas.
20	Sand-choked wadis Sand-choked wadis are intermittent streambeds generally within plain areas which have been almost completely or partially filled with windblown sand.
	Sand dunes: Mobile heaps of windblown sand independent of fixed objects or underlying topography.
21	Barchans: Barchans are dunes having a crescentic ground plan with the convex side facing the windward side extending leeward. The profile is asymmetric with the gentler slope on the windward side and the steeper slope on the concave or leeward face.
22	Complex dunes Complex dunes are irregular masses of sand not readily classifiable as any one of the other types.
23	Peak and fulji: These occur where the tips or horns of a fast-moving barchan join or merge with the side of another barchan, thus forming a circular or horseshoe-shaped hollow at the crest of the barchan slipface which flanks the fulji is referred to as the peak.
24	Transverse dunes: Transverse dunes are strongly asymmetric ridges extending transverse to the dominant sand-moving winds. The leeward slope is steep; the windward, comparatively gentle.
25	Dome-shaped dunes: Dome-shaped dunes, formed as a result of highly varying wind direction, are broad circular upwinds. Barchan dunes often constitute the secondary surface of dome-shaped dunes.
26	Dune massifs: Dune massifs are massive, roughly conical or pyramidal dunes characterized by small hollows and terraces often dimple their steep sides. The massifs are usually composed of longitudinal dunes, but are quite unmistakable as they rise far above the general surface.
27	Longitudinal dunes Longitudinal dunes usually consist of a single continuous ridge which at regular intervals to form a chain of summits connected by a continuous wavy surface. The profile is asymmetric with one side exhibiting a moderate slope, the other, a steep or nearly vertical slope. Longitudinal dunes are aligned parallel to dominant sand-moving winds.
28	Waves and billows Waves and billows are undulating to rolling areas of sand which present a surface unlike the waves of a rough sea.

		TYPICAL GEOMETRIC FORMS				
		Range at Yuma	Range in Middle			
	Plan-Profile Units	Slope Occurrence Units				
		1	2	3	4	5
		Number of slopes greater than 50% per 10 miles				
		1	5	20	100	200
considerable size	NA	NA				
formed at the base of	NA	NA				
	NA	NA				
form to the windward of	7	Lacking				
	7	Lacking				
and which form to the lee-	7	Lacking				
	7	Lacking				
They are normally	This phenomenon is classed as a surface condition and considered in terms of surface roughness height from 1 or 2 inches to 3 feet and are spaced at intervals of several inches to 4 or 5 feet.					
ain or plateau	NA	NA				
nd.						
topography.						
e facing the wind and horns	1					
convex side and the	5, 6					
	5, 6					
	4					
into types.	4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100					
er intersect the windward	4					
ow known as a fulji. The	4					
sh.	4					
	4L					
verse to the direction of	4L, 4L, 5L, 5L					
mparatively gentle.	4L, 4L, 5L, 5L, 6L, 6L					
direction, are shaped like	4, 4, 5, 5, 6, 6					
face expression on broad	4, 4, 5, 5, 6, 6					
acterized by curved slopes.	4					
re usually associated with	4					
eneral crest level.						
which swells and rises	5L, 6L					
heavy crest. The profiles	4, 4L, 5L, 5L, 6L, 6L					
o or slipface. Longitudi-						
forms a surface not						

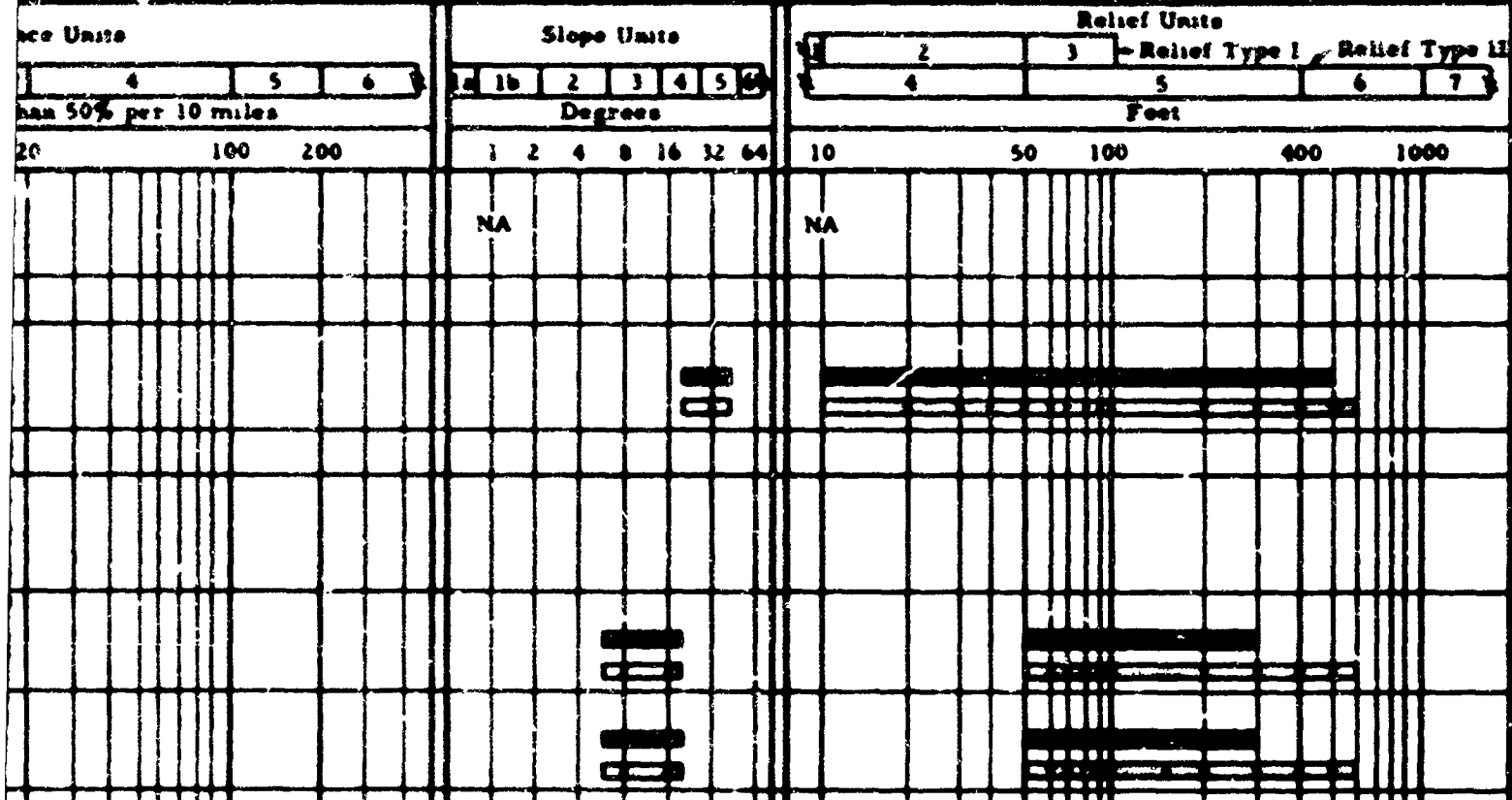
PHOTOGRAPHS

3

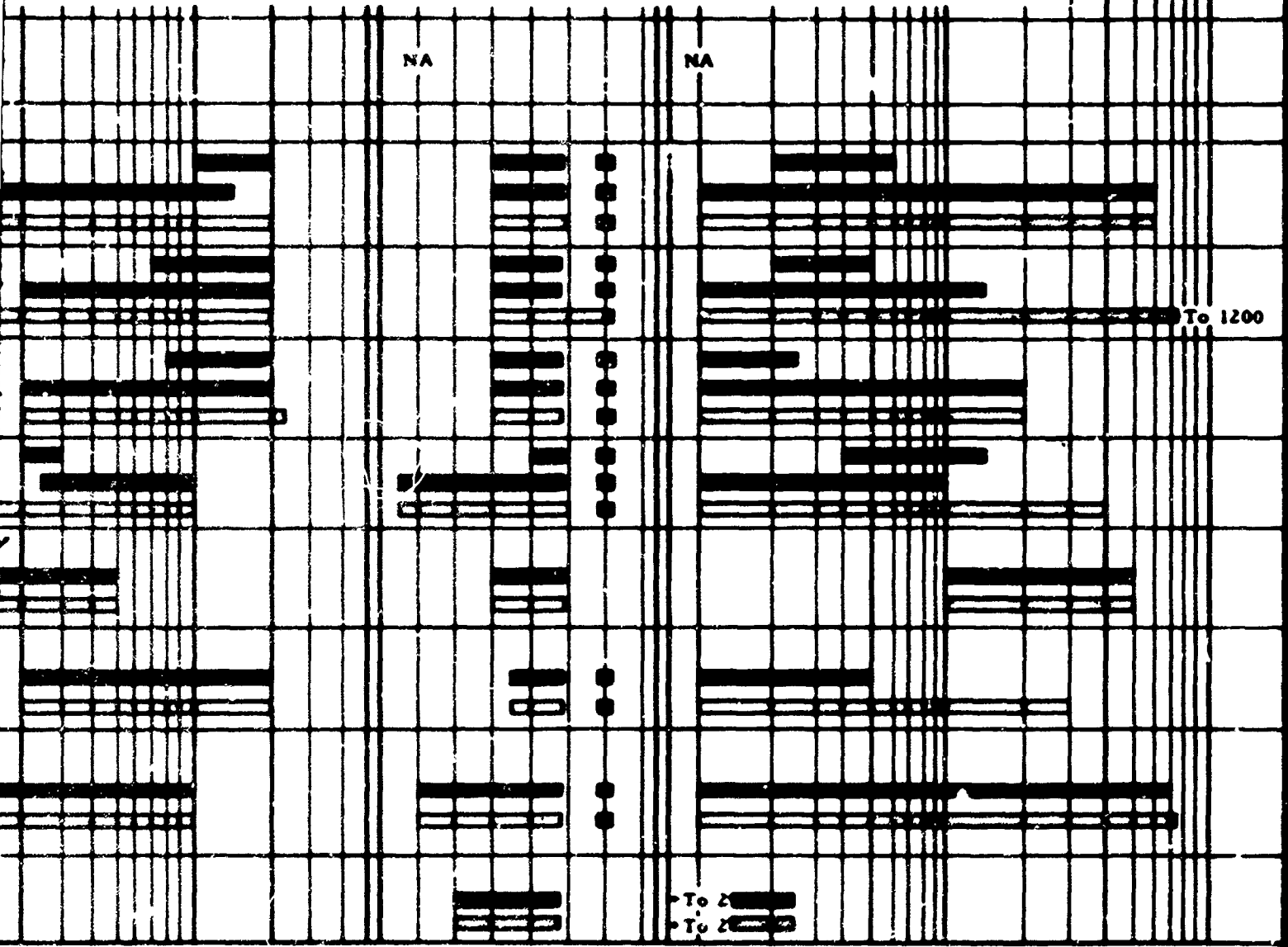
TYPICAL GEOMETRY FACTOR RANGES

Range in Middle East Desert

World-wide Range



in terms of surface roughness or microrelief rather than geometry factor ranges. Ripples range in vertical inches to 4 or 5 feet.



21	Barchans. Barchans are dunes having a crescentric ground plan with the convex side extending leeward. The profile is asymmetric with the gentler slope on the steeper slope on the concave or leeward face.
22	Complex dunes Complex dunes are irregular masses of sand not readily classified.
23	Peak and fulji: These occur where the tips or horns of a fast-moving barchan join or side of another barchan, thus forming a circular or horseshoe-shaped hollow. The crest of the barchan slipface which flanks the fulji is referred to as the peak.
24	Transverse dunes: Transverse dunes are strongly asymmetric ridges extending transverse to dominant sand-moving winds. The leeward slope is steep; the windward, comparatively gentle.
25	Dome-shaped dunes: Dome-shaped dunes, formed as a result of highly varying wind directions. Barchan dunes often constitute the secondary surface of dome-shaped dunes.
26	Dune massifs. Dune massifs are massive, roughly conical or pyramidal dunes characterized by small hollows and terraces often dimple their steep sides. The massifs are longitudinal dunes, but are quite unmistakable as they rise far above the general level of the surrounding dunes.
27	Longitudinal dunes. Longitudinal dunes usually consist of a single continuous ridge with summits at regular intervals to form a chain of summits connected by a continuous windward slope. The profile is asymmetric with one side exhibiting a moderate slope, the other, a steep slope. Longitudinal dunes are aligned parallel to dominant sand-moving winds.
28	Waves and billows Waves and billows are undulating to rolling areas of sand which present a surface unlike the waves of a rough sea.

Not applicable
Circled plan-profile designations indicate gross landscapes

* Underlined plan
** Raised numbers



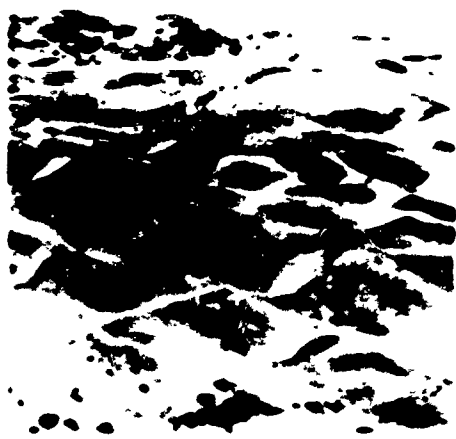
15. A salt lake fringed by white, crystalline salt.



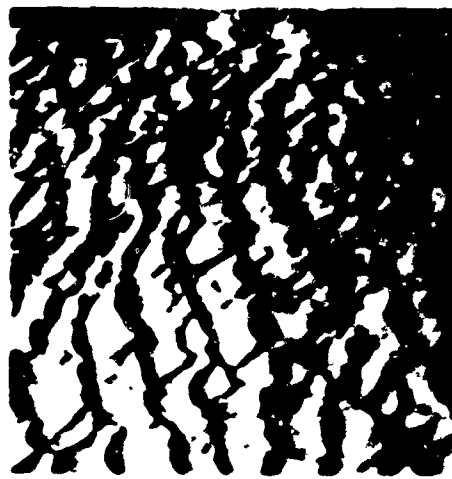
16. Steeply sloping talus cone flanking a plateau escarpment.



17. A large climbing dune encroaching on a meadow.



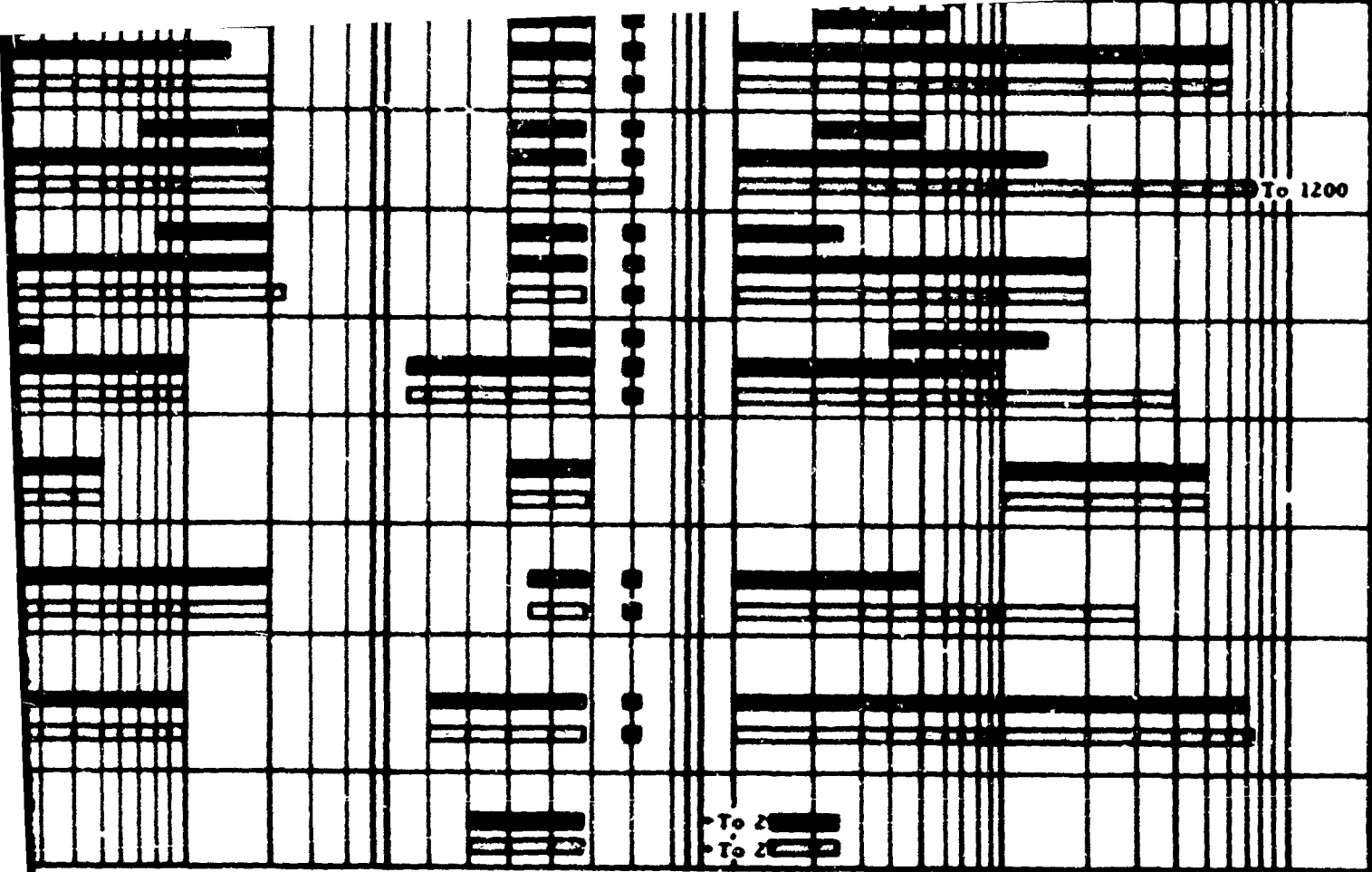
23. Peak and fulji topography in the Yuma Sand Hills, Arizona.



24. Transverse dunes in the vicinity of Delta, Utah.



25. A vertical profile of a dome-shaped dune, light, roughly circular.



20. A photograph of a plateau showing wadis which carve through the dissected plateau



21. A field of barchan dunes north of Magdalena Bay, Mexico



22. A vertical photograph of a complex dune field in Algeria



23. A photograph of a sandy plain showing waves and billows rising from it

ANALOGS OF YUMA TERRAIN
IN THE
MIDDLE EAST DESERT
LANDFORMS-SURFACE CONDITIONS
DESCRIPTIONS AND PHOTOGRAPHS

Photo No.	CLASSIFICATION AND DESCRIPTION
	I. DEPOSITIONAL (CONT.) LACUSTRINE
29	Lacustrine terraces: Terraces which mark the shore lines of ancient lakes, or earlier high-water standing lakes. They have nearly horizontal surfaces with relatively steep slopes facing the portion of the lake.
	MARINE
30	Beaches: Beaches are gently sloping strips of land bordering the sea, usually recognized as that part lies between high- and low-water marks and formed by the action of the sea.
31	Mangrove swamps: Salt or brackish swamps along the coast where there are abundant mangrove trees.
32	Tidal mud flats: Marshy or muddy lands covered and uncovered by the rise and fall of the tide.
	ORGANIC-CHEMICAL
33	Caliche: Caliche is a calcareous deposit occurring at or near the surface which has accumulated from calcium charged groundwater moving upward and evaporating.
	Playas: Playas are nearly flat areas of salt or salty fine-grained soils occupying basins where water and evaporates after moderate or torrential rains.
34	Dry: Dry playas are characterized by very hard, smooth, flat surfaces of fine-grained soil.
	Moist: Moist playas are characterized by irregular, puffy surfaces with a thin friable surface crust is underlain by soft, spongy ground.
35	Clay-encrusted: Clay-encrusted playas are moist playas with a surface crust of clay.
36	Salt-encrusted: Salt-encrusted playas are moist playas with a surface crust of salt.
37	Salt marsh: Salt marshes are flat, poorly drained parts of a coastal region whose surfaces are so near level of the mean high tide that they are covered by the majority of high tides.
	II. EROSIONAL GROUNDWATER
38	Caves and caverns: Caves or caverns are natural cavities or chambers beneath the surface. In limestone areas they are often connected by underground solution channels formed by subterranean water.
39	Chimneys: Chimneys are vertical shafts, with a variety of plan shapes, connecting underground caves with the surface. They are typically formed by solution in limestone areas.
40	Karst topography: Karst topography is developed in limestone regions by the solution action of ground surface waters. In advanced stages, the topography is irregular and characterized by numerous sinkholes and depressions of all sizes interspersed with abrupt ridges and irregular protuberant rocks.
41	Sinks: Sinks are circular or elongate depressions of varying size formed by solution and collapse in limestone or evaporite rock.

* Not applicable

† Raised numbers refer to similarly numbered entries in the bibliography at the end of volume 1 of this report.

FORMS — SURFACE CONDITIONS: DESCRIPTIONS AND PHOTOGRAPHS

2		TYPICAL GEOMORPHIC			
		Range at Yuma	Range in Miles		
	Plan-Profile Units	Slope Occurrence Units			
		1	2	3	4
		Number of slopes greater than 50% per 10 miles			
		1	5	20	100
er high-water stages of slopes facing the central	7 7, 3	→ To 5 → To 0			
ized as that part which	7 7	Lacking Lacking			
at mangrove trees.	This phenomenon is classed as a surface condition and considered in terms of surface roughness. At low tide, are impenetrable tangles of roots and knees, surmounted by high mangrove trees.				
of the tide.	This phenomenon is classed as a surface condition and considered in terms of surface roughness. Relatively smooth surfaces of low bearing capacity and are indented by numerous shallow				
accumulated from	This phenomenon is classed as a surface condition and considered in terms of surface roughness. Most desert areas within plains of gentle slope. It may occur as deposits of calcium carbonate diameters up to several inches.				
ains where water collects					
ained soil.	This phenomenon is classed as a surface condition and considered in terms of surface roughness. Playas are characterized by desiccation polygons whose edges may warp upward from a				
able surface crust which					
d clay.	This phenomenon is classed as a surface condition and considered in terms of surface roughness. Characterized by slightly rolling and spongy surfaces.				
salt.	This phenomenon is classed as a surface condition and considered in terms of surface roughness. Playas are characterized by soft, puffy mounds or pinnacles of salt a few inches to 5 or 6				
riaces are so near the s.	NA	NA			
surface. In limestone subterranean water.	NA	NA			
underground caves with the	NA	NA			
action of ground and erized by numerous sticks protuberant rocks.	1 1				
and collapse in areas of	NA NA	NA NA			

35	Clay-encrusted: Clay-encrusted playas are moist playas with a surface crust of clay.
36	Salt-encrusted: Salt-encrusted playas are moist playas with a surface crust of salt.
37	Salt marsh: Salt marshes are flat, poorly drained parts of a coastal region whose surfaces are level of the mean high tide that they are covered by the majority of high tides.
	II. EROSIONAL GROUNDWATER
38	Caves and caverns: Caves or caverns are natural cavities or chambers beneath the surface. In areas they are often connected by underground solution channels formed by subterranean water.
39	Chimneys: Chimneys are vertical shafts, with a variety of plan shapes, connecting underground chambers with the surface. They are typically formed by solution in limestone areas.
40	Karst topography: Karst topography is developed in limestone regions by the solution action of surface waters. In advanced stages, the topography is irregular and characterized by steep slopes and depressions of all sizes interspersed with abrupt ridges and irregular protuberances.
41	Sinks: Sinks are circular or elongate depressions of varying size formed by solution and collapse of limestone or evaporite rock.

Not applicable

†† Raised numbers refer to similarly numbered entries in the bibliography at the end of volume 1 of this series.



29. Several flat-topped, steep-fronted lacustrine terraces flanking a mountain range in Utah



30. A narrow beach bounded by the vegetated coastal plain and the sea



31. Mangrove swamps bordering the Gulf of Siam in southern Thailand



37. Salt marsh



38. Entrance to Carlsbad Caverns in southeastern New Mexico

NO
PHOTOGRAPH
AVAILABLE

39. Chimneys

characterized by slightly rolling and spongy surfaces.

This phenomenon is classed as a surface condition and considered in terms of surface roughness or microrelief. Playas are characterized by soft, puffy mounds or pinnacles of salt a few inches to 5 or 10 feet in height.

	NA	NA																NA
	NA	NA																NA
he	NA	NA																NA
kr	1																	
	NA	NA																
	NA	NA																



32. Tidal mud flat at the mouth of the Chao Phraya River, coastal Thailand



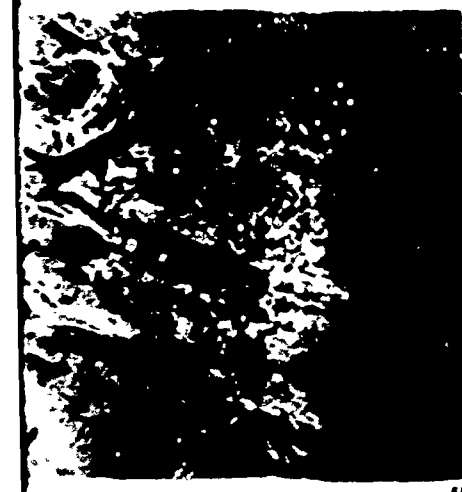
33. The light-colored caliche is overlain by a dark sandy clay layer



34. Desiccation cracks on the surface of a dry playa



35. clay-



40. A vertical photograph of Karst topography in a limestone plateau area

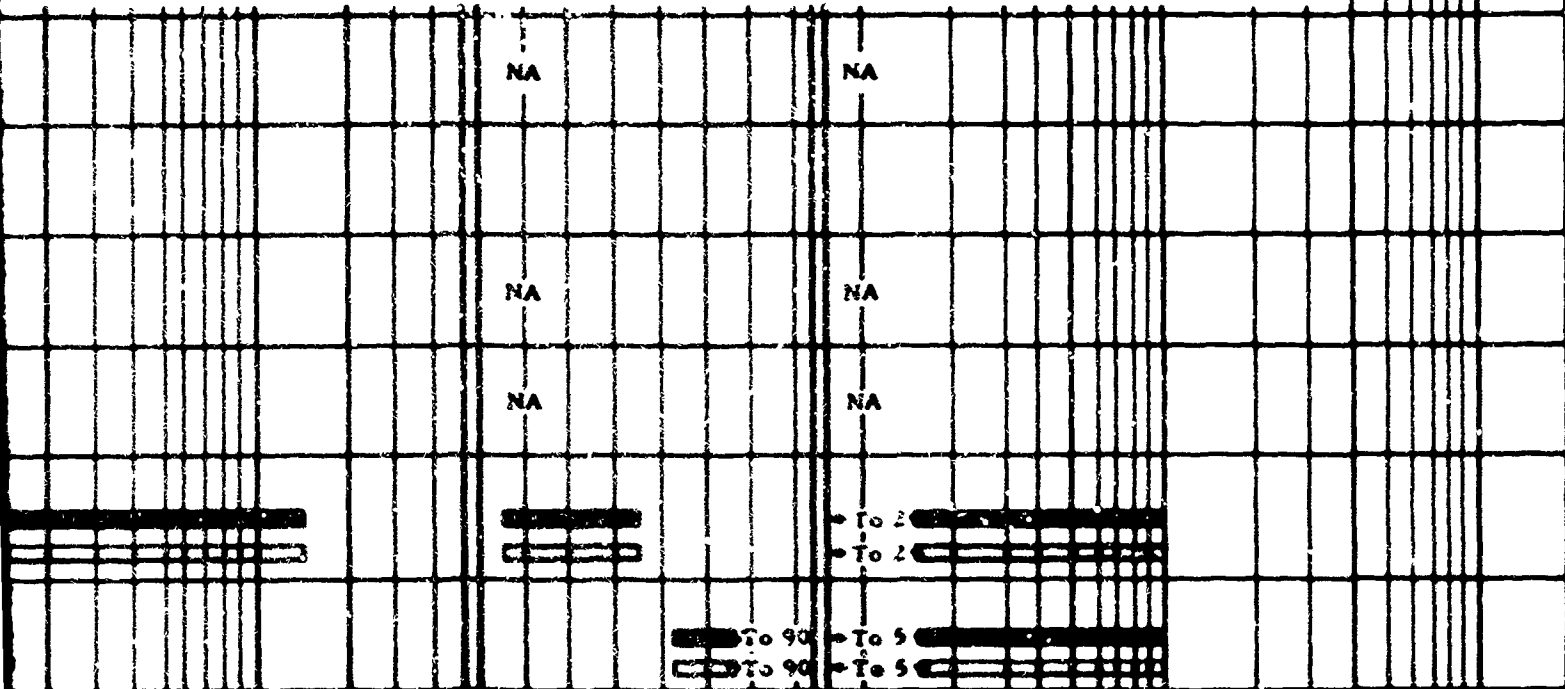


41. A sink as viewed from the rim

LA

in terms of surface roughness or microrelief rather than geometry factor ranges. These playas are

in terms of surface roughness or microrelief rather than geometry factor ranges. Surfaces of these
a few inches to 5 or 10 feet in height.



34. Desiccation cracks on the surface of a dry playa



35. Soft and spongy surface of a clay-encrusted playa



36. Rough surface of a salt-encrusted playa

ANALOGS OF YUMA TERRAIN

IN THE

MIDDLE EAST DESERT

LANDFORMS-SURFACE CONDITIONS

DESCRIPTIONS AND PHOTOGRAPHS

Photo No.	CLASSIFICATION AND DESCRIPTION
	II. EROSIONAL (CONT.) MARINE
42	Wave-cut cliffs: Steep cliffs of bare rock, or occasionally unindurated materials, marking the seaward limit of the coast.
43	Wave-cut terraces: Steplike, narrow strips of land adjacent to or near the sea where the waves and current. Each terrace records a landward advance of littoral.
	SURFACE WATER
44	Amphitheatres: Amphitheatres are semicircular erosion bays, formed at the head of often scallop plateau scarps in arid regions.
45	Aqabas: Aqabas are gaps in asymmetrical ridges which connect basins of different levels between the ridges.
46	Badlands: Regions nearly devoid of vegetation where erosion, instead of carving high ridges, has cut the land into an intricate maze of narrow ravines, sharp peaks, and small flat tops.
47	Buttes and mesas: Isolated residual prominences with very steep or precipitous slopes; remnants of a plateau area. Mesas have distinctively flat tops; buttes have small flat tops or peaks remain.
48	Canyon country: Canyon country refers to a plateau dissected by a branching network of valleys.
49	Flatirons: Triangular remnants of an eroded hogback ridge often occurring in series on a mountain.
50	Foothills: Foothills are lower subsidiary hills at the foot of mountains or higher plateaus; zones between the highlands and the adjacent lower land.
51	Hogbacks: Hogbacks are sharp-crested ridges produced by unequal erosion in steeply tilted strata.
52	Incised meanders: Incised meanders are deep, sinuous valleys cut by rejuvenated streams whose former course having been acquired in a former cycle.
53	Knife-edged spurs: Sharp-crested rock ridges forming interstream divides which are remnants of former plateau masses.
54	Outliers: Isolated remnants of rock detached from the main mass.
55	Pediments: Pediments are relatively smooth rock plains gently inclined away from the base of the mountains. They are sometimes partly covered by a thin veneer of alluvium.
* Not applicable ** Circled plan-profile designations indicate gross landscapes † Underlined plan-profile designations indicate that they occur in both gross and restrictive landscapes †† Raised numbers refer to similarly numbered entries in the bibliography at the end of volume I of this report	

SURFACE CONDITIONS: DESCRIPTIONS AND PHOTOGRAPHS

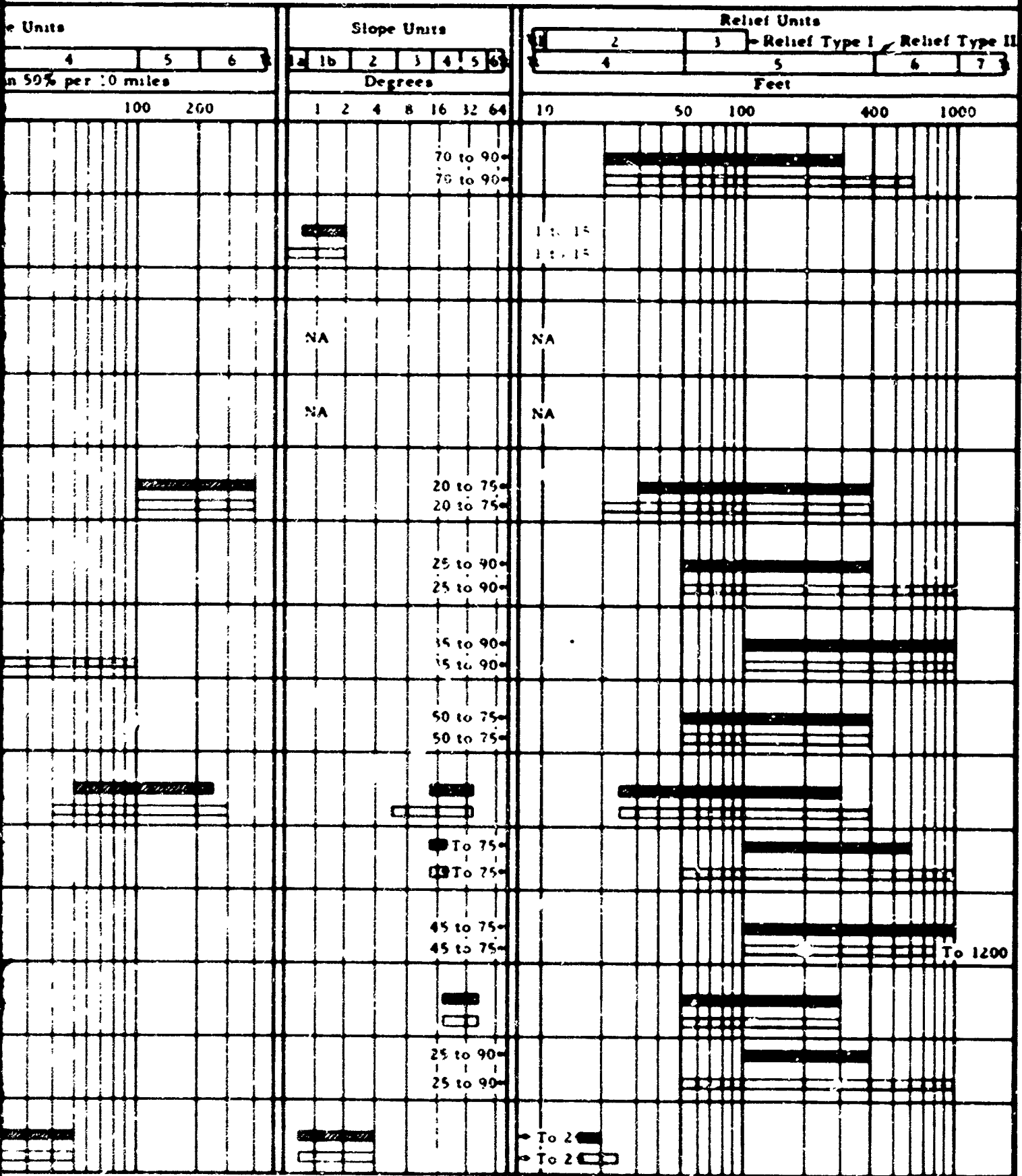
2	TYPICAL GEOMETRY FACTOR RA											
			Range at Yuma					Range in Middle East Desert				
			Slope Occurrence Units									
			Number of slopes greater than 50% per 10 miles									
		</										

PHOTOGRAPHS

TYPICAL GEOMETRY FACTOR RANGES

 Range in Middle East Desert

 World-wide Range



49	Flatirons Triangular remnants of an eroded hogback ridge often occurring in series on the flank of a mountain.
50	Foothills Foothills are lower subsidiary hills at the foot of mountains or higher hills. They form transition zones between the highlands and the adjacent lower land.
51	Hogbacks Hogbacks are sharp-crested ridges produced by unequal erosion in steeply inclined rock.
52	Incised meanders Incised meanders are deep, sinuous valleys cut by rejuvenated streams, the meander course having been acquired in a former cycle.
53	Knife-edged spurs Sharp-crested rock ridges forming interstream divides which extend outward from main masses.
54	Outliers Isolated remnants of rock detached from the main mass.
55	Pediments Pediments are relatively smooth rock plains gently inclined away from hill or mountain top. They are sometimes partly covered by a thin veneer of alluvium.

Not applicable

Circled plan-profile designations indicate gross landscapes

* Underlined plan-profile designations indicate that they occur in both gross and restrictive landscapes

** Raised numbers refer to similarly numbered entries in the bibliography at the end of volume I of this report



42. Wave-cut cliffs



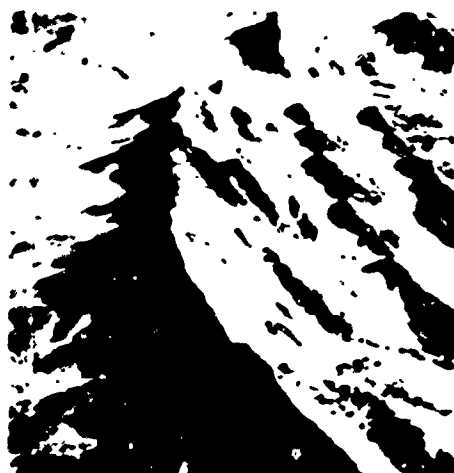
43. A wave-cut terrace surmounted by several stacks



44. Two well-developed amphitheatres in the face of an escarpment



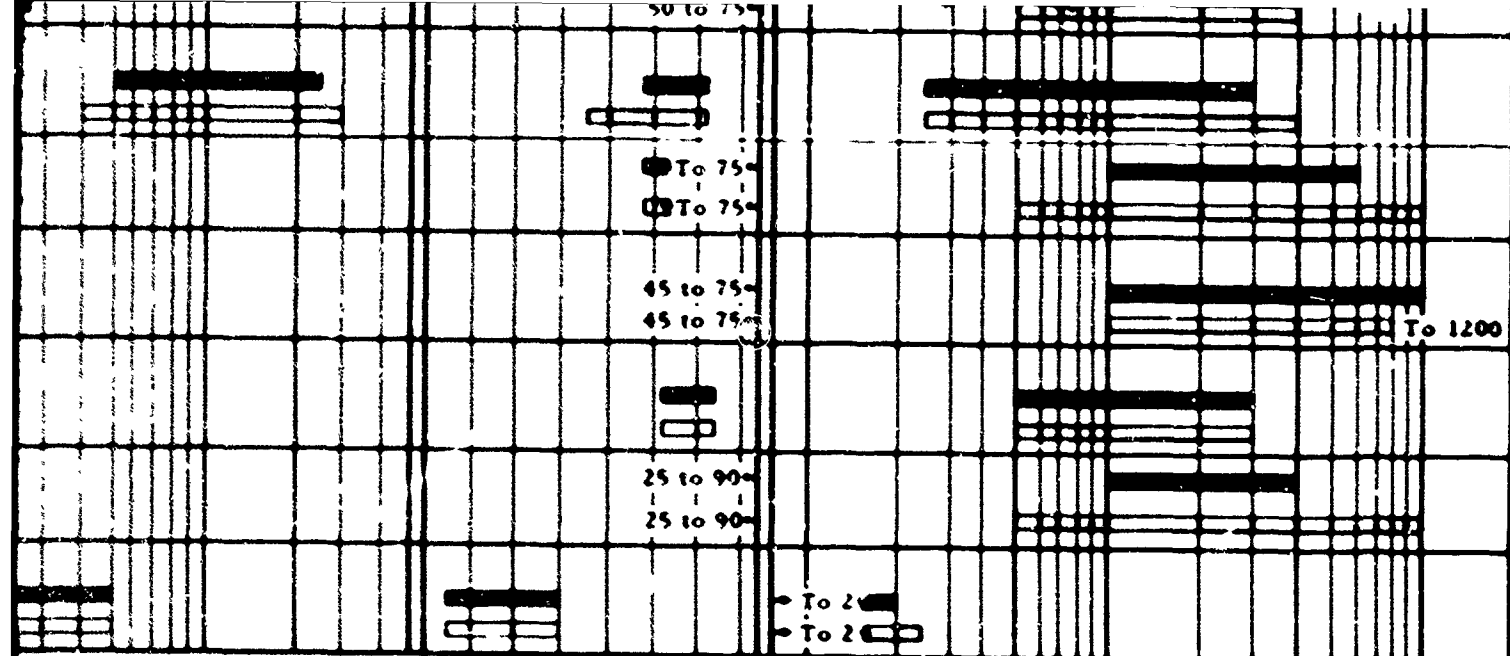
50. Foothills



51. Hogbacks



52. The valley of the San Juan River, Utah, incised to a depth of 1200 ft into the plateau



47. Buttes and mesas



48. Canyon country



49. Flatirons



A gently sloping pediment flanking the Grand Atlas Mountain in northern Morocco

**ANALOGS OF YUMA TERRAIN
IN THE
MIDDLE EAST DESERT
LANDFORMS-SURFACE CONDITIONS
DESCRIPTIONS AND PHOTOGRAPHS**

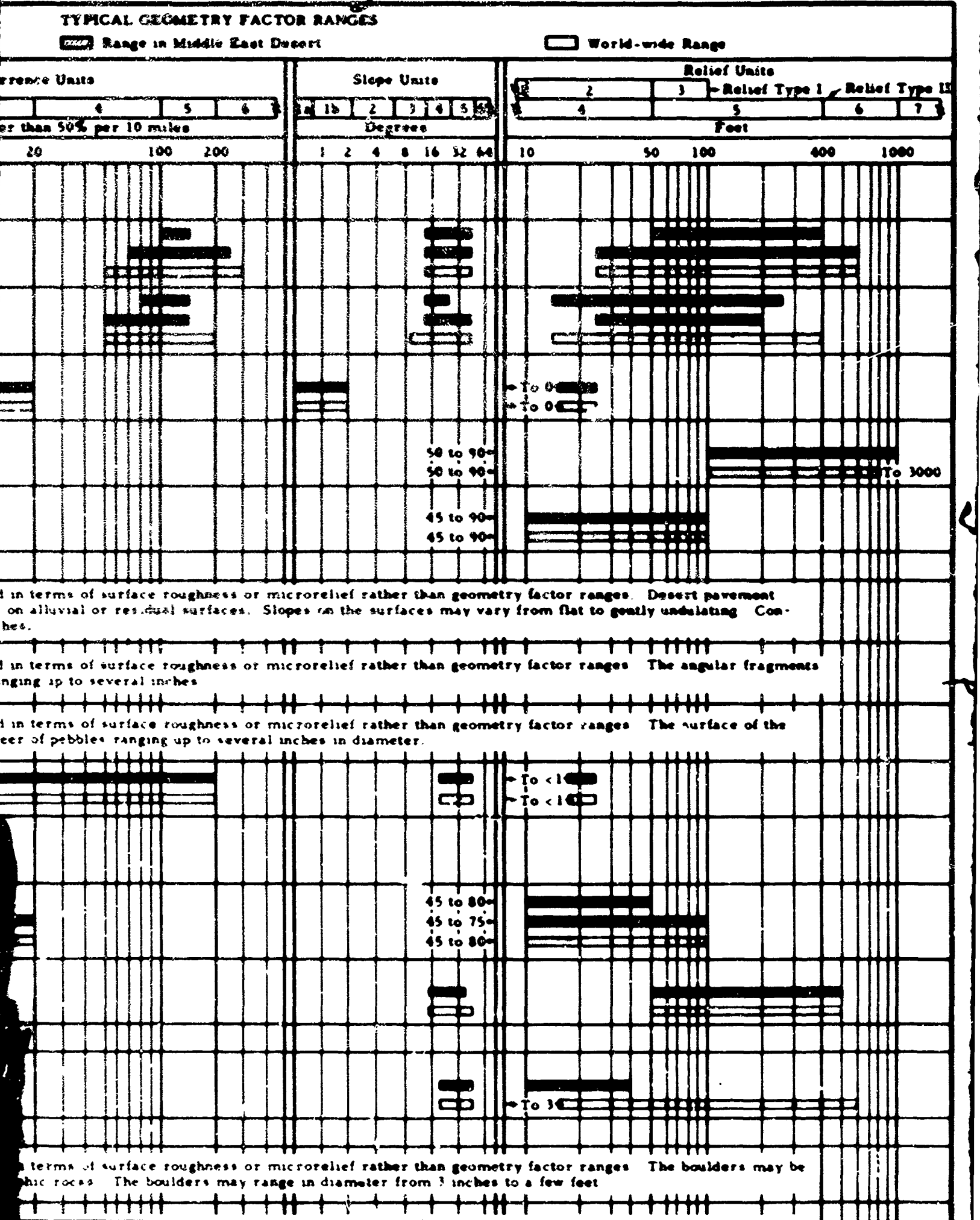
Photo No.	CLASSIFICATION AND DESCRIPTION
	II. EROSIONAL (CONT.) SURFACE WATER
	Random hills. Randomly oriented masses rising less than 1,000 feet above the level of the surrounding country.
56	Consolidated random hills: Consist of masses of sedimentary, igneous, or metamorphic rock.
57	Unconsolidated random hills. Consist of unconsolidated material such as clay, silt, sand, or gravel.
58	Rock terraces. Rock terraces are relatively narrow benches left when a stream cuts a new valley below level of the erosional plain which is cut into the bedrock.
59	Scarps. Scarps are more or less continuous, precipitous slopes exhibiting more than 100 feet of relief.
60	Steep wadi banks. Steep wadi banks are mapped where a conspicuous number of wadies bordered by precipitous banks occur. Wherever banks are higher than 100 feet they are considered scarps.
	WIND
61	Desert pavement. Desert pavement is a mosaic of closely packed pebbles and broken rock fragments coated with a stain or crust of manganese or iron oxide.
62	Flint-stream plains. Flint-stream plains are flat to undulating surfaces developed on weathered limestone or chalk. They are characterized by scattered pebbles and sharp-edged chips of flint weathered from parent rock.
63	Hamadas. Hamadas are extensive, flat to undulating surfaces of bedrock or bedrock covered by a thin layer of pebbles or rock fragments.
64	Wind-scored sandstone surfaces. Knobby, knotty surfaces of horizontal sandstone created by the abrasion action of sand-laden wind.
	III. MISCELLANEOUS INTRUSIVE
65	Dikes. Wall-like intrusions of igneous rock which cut across the bedding or other layered structure of country rock. On eroding they commonly form narrow, sharp-crested ridges which may run miles across country.
66	Knobs. Knobs are rounded, isolated hills or small mountains. They usually constitute the surface of weathered plutonic intrusions.
	METEORIC
67	Meteorite craters. Steep-walled, saucer-shaped depressions produced by the impact and accompanying explosion of an object of extraterrestrial origin.
	RESIDUAL
68	Exfoliated boulders. A term applied to boulders whose surfaces have broken or peeled off as scale or concentric sheets.
69	Grus. The accumulation of countless discrete particles on the surface sometimes extending to depths greater than 10 feet formed from weathering of the various minerals composing the rock.
	• Not applicable.

INDEX FORMS - SURFACE CONDITIONS: DESCRIPTIONS AND PHOTO

1		Range at Yuma		TYPICAL	
				Slope Occurrence Units	
		Plan-Profile Units		Number of slopes greater than 50% per	
				1 5 20	
level of the surrounding					
metamorphic rock.	4 4. 4L 4. 4L				
clay, silt, sand, or gravel.	4 4. 4L 4. 4L				
can cut a new valley below the	7. 1 7. 1	To 0			
more than 100 feet of relief.	NA NA	NA NA			
of wadies bordered by high they are considered scarps.	NA NA	NA NA			
broken rock fragments usually	This phenomenon is classed as a surface condition and considered in terms of surface relief. It occurs as a thin veneer of closely fitted gravel or rock fragments on alluvial or residual deposits. Constituent particles may exhibit maximum diameters of several inches.				
developed on weathered limestone or chips of flint weathered from the	This phenomenon is classed as a surface condition and considered in terms of surface relief. It occurs as a thin veneer of closely fitted gravel or rock fragments on alluvial or residual deposits. Constituent particles may exhibit maximum diameters of several inches.				
bedrock covered by a thin veneer	This phenomenon is classed as a surface condition and considered in terms of surface relief. It occurs as a thin veneer of closely fitted gravel or rock fragments on alluvial or residual deposits. Constituent particles may exhibit maximum diameters of several inches.				
limestone created by the abrasive	4. 5. 7 4. 5. 7	Lacking			
		Lacking			
other layered structure of the bed ridges which may run for	4L 4L 5L 6L 4L 5L 6L				
constitute the surface expression	4. 5. 6 4. 5. 6				
the impact and accompanying ex-	NA NA	NA NA			
or peeled off as scales, lamellae,	This phenomenon is classed as a surface condition and considered in terms of surface relief. It occurs as a thin veneer of closely fitted gravel or rock fragments on alluvial or residual deposits. Constituent particles may exhibit maximum diameters of several inches.				
times extending to depths comprising the rock	This phenomenon is classed as a surface condition and considered in terms of surface relief. It occurs as a thin veneer of closely fitted gravel or rock fragments on alluvial or residual deposits. Constituent particles may exhibit maximum diameters of several inches.				

ND PHOTOGRAPHS

3



63	Hamadas: Hamadas are extensive, flat to undulating surfaces of bedrock or bedrock of pebbles or rock fragments.
64	Wind-scored sandstone surfaces: Knobby, knotty surfaces of horizontal sandstone action of sand-laden wind.
III. MISCELLANEOUS	
INTRUSIVE	
65	Dikes: Wall-like intrusions of igneous rock which cut across the bedding or other country rock. On eroding they commonly form narrow, sharp-crested ridges miles across country.
66	Knobs: Knobs are rounded, isolated hills or small mountains. They usually consist of weathered plutonic intrusions.
METEORIC	
67	Meteorite craters: Steep-walled, saucer-shaped depressions produced by the implosion of an object of extraterrestrial origin.
RESIDUAL	
68	Exfoliated boulders: A term applied to boulders whose surfaces have broken or peeled in concentric sheets.
69	Grus: The accumulation of countless discrete particles on the surface sometimes greater than 10 feet formed from weathering of the various mineral components.

• Not applicable.

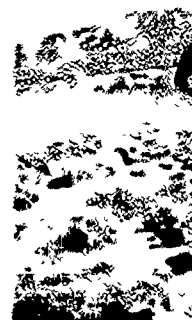
†† Raised numbers refer to similarly numbered entries



56. Rugged, crystalline hills rising above a desert plain



57. Unconsolidated hills near Yuma, Arizona



58. Rock-cut south of Wenatchee, Washington

NO
PHOTOGRAPH
AVAILABLE

64. Wind-scored sandstone surfaces



65. View along a ridge cut by dikes

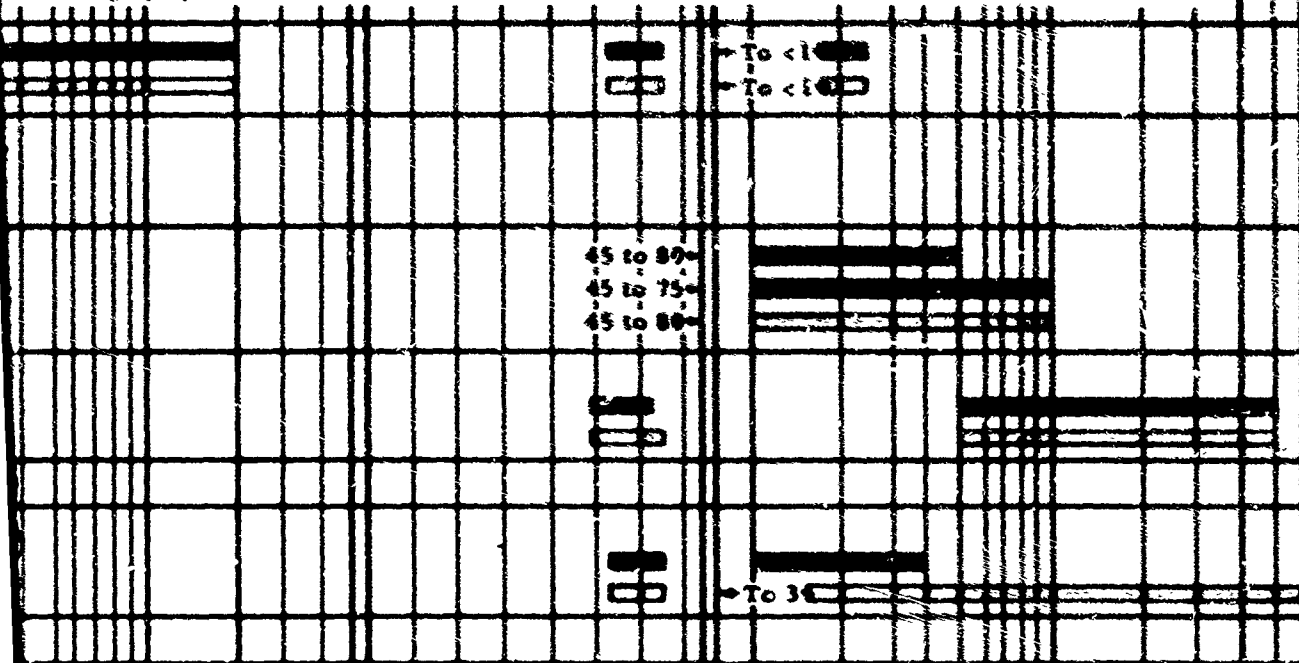


66. A granite knob above a desert plain

H

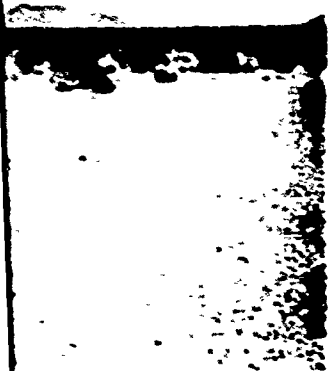
of surface roughness or microrelief rather than geometry factor ranges. The angular fragments to several inches.

of surface roughness or microrelief rather than geometry factor ranges. The surface of the boulders ranging up to several inches in diameter.



of surface roughness or microrelief rather than geometry factor ranges. The boulders may be s. The boulders may range in diameter from 3 inches to a few feet.

of surface roughness or microrelief rather than geometry factor ranges. Gravel consists of pebbles of several feet.



1. Smooth (100%)

Smooth surface of desert. The tire tracks have exposed the underlying silt.



62. Flint-strewn plains

62. Flint-strewn plains



63. The rocky surface of a hamada

63. The rocky surface of a hamada



64. Deposit resulting from

deposit resulting from
of igneous rock

6

DESCRIPTIONS AND PHOTOGRAPHS

ANALOGS OF YUMA TERRAIN

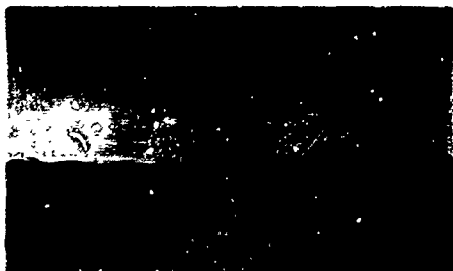
IN THE

MIDDLE EAST DESERT

LANDFORMS-SURFACE CONDITIONS

Photo No.	CLASSIFICATION AND DESCRIPTION
	III. MISCELLANEOUS (CONT.) TECTONIC
70	Basin ranges: Ranges of hills or mountains formed by faulted and tilted blocks of strata (separated by normal faults).
71	Domal warps: Domal warps are roughly circular upwarps with beds dipping away from a central point. The surface expression is often that of centrally facing, concentric series of erosional scarps.
72	Drowned valleys: Drowned valleys are erosional troughs of a dissected land surface inundated by the result of land-margin submergence.
73	Elongate domes: Elongate domes are elliptical upfolds, the beds dipping away from centrally located points.
74	Intramontane valleys: Intramontane valleys are narrow valleys or troughs with exterior drainage by rivers or streams.
75	Scarps: Scarps are more or less continuous, precipitous slopes exhibiting more than 100 feet of relief.
	VOLCANIC
76	Broken lava flows: Flat to undulating lava areas characterized by sharp-edged rocks and boulders.
77	Cinder cones: Cinder cones are conical hills formed by the accumulation of volcanic ash or clinkers around a vent.
78	Cinder fields: Cinder fields are flat to undulating areas, often miles in extent, composed of volcanic ash or clinkers that has mantled the pre-existing landscape.
79	Craters and Calderas: Bowl- or funnel-shaped depressions of volcanic origin which are more or less circular in plan and rimmed by an infacing scarp. Craters are commonly less than a mile in diameter; calderas have diameters several times larger.
80	Lava flows: Lava flows are solidified stationary masses of igneous rock which issued from a volcanic fissure.
81	Mud volcanoes: Small cone-shaped mounds built of clay and ordinarily formed by the eruption of sulfurous mud from a central vent or orifice.
82	Necks and plugs: Necks and plugs are lava-filled conduits of an extinct volcano exposed by erosion.

- † Not applicable
- ** Circled plan-profile designations indicate gross landscapes
- † Underlined plan-profile designations indicate that they occur in both gross and restrictive landscapes
- †† Raised numbers refer to similarly numbered entries in the bibliography at the end of volume I of this report



CE CONDITIONS: DESCRIPTIONS AND PHOTOGRAPHS

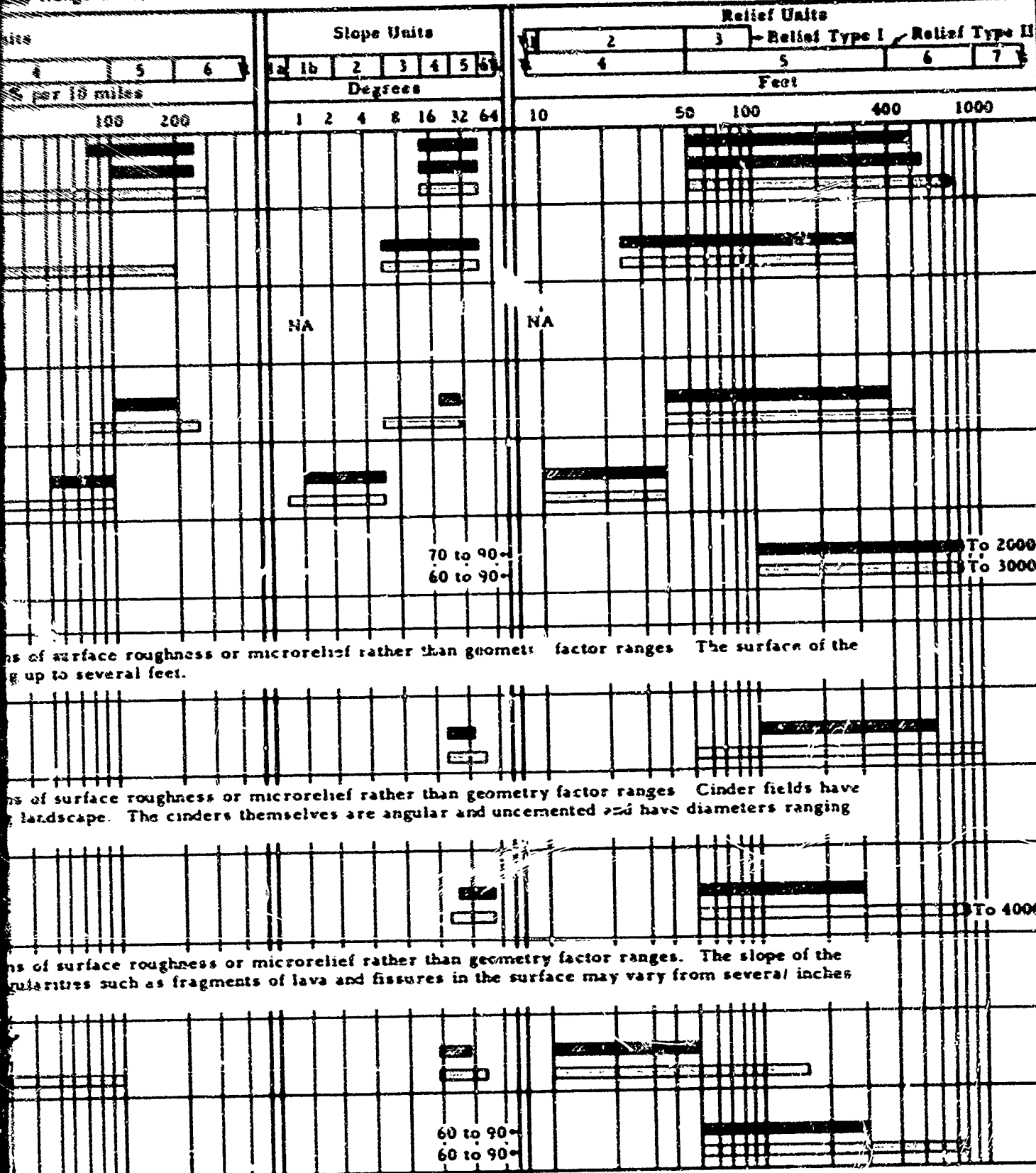
2		TYPICAL GEOMETRY FACTOR RANGES														
		Range at Yuma					Range in Middle East Desert									
Plan-Profile Units		Slope Occurrence Units										Slope				
		Number of slopes greater than 50% per 10 miles										Degree				
		1	2	3	4	5	6	7	8	9	10	1	2	4		
4 4, 4L (5L, 5L//, 6L, 6L//) **)																
6 4, 4L																
NA	NA															
4, 4L 4, 4L																
1, 1L 1, 1L																
NA NA	NA NA															
This phenomenon is classed as a surface condition and considered in terms of surface roughness or microrelief rather than flow is composed of large, angular blocks of lava having diameters ranging up to several feet.																
4, 4//, (5, 5//, 6, 6//) 4, 4//, (5, 5//, 6, 6//)																
This phenomenon is classed as a surface condition and considered in terms of surface roughness or microrelief rather than slopes which are determined to some extent by the underlying, preexisting landscape. The cinders themselves are an between 4 and 32 mm.																
NA NA	NA NA															
This phenomenon is classed as a surface condition and considered in terms of surface roughness or microrelief rather than surface of these flows varies from flat to gently undulating. Surface irregularities such as fragments of lava and fiss to 10 feet.																
4, 4// 4, 4//, (5, 5//, 6, 6//)																
4 4, 4//																



TYPICAL GEOMETRY FACTOR RANGES

Range in Middle East Desert

World-wide Range



76	Basin ranges: Basin ranges are undulating lava areas characterized by sharp-edged rocks and b
77	Cinder cones: Cinder cones are conical hills formed by the accumulation of volcanic ash o rial around a vent.
78	Cinder fields: Cinder fields are flat to undulating areas, often miles in extent, composed o that has mantled the pre-existing landscape.
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restrictive landscapes
- Referenced numbers refer to similar, numbered entries in the bibliography at the
end of volume I of this report



Reference 56

70. Basin ranges in the center and background of the photograph separated by alluvial aprons



E. S. Army Map Service

71. An eroded domal warp forming a topographic basin



72. Drowned volcanic vent



R. G. Sauer

78. Cinder field at the northern



[343]

79. Mt. Edgecomb, Kruzof Island,



E. S. Army Map Service, 11

80. Lava flow

dition and considered in terms of surface roughness or microrelief rather than geometry factor ranges. Cinder fields have by the underlying, preexisting landscape. The cinders themselves are angular and uncemented and have diameters ranging

dition and considered in terms of surface roughness or microrelief rather than geometry factor ranges. The slope of the only undulating. Surface irregularities such as fragments of lava and fissures in the surface may vary from several inches

60 to 90°
60 to 90°



74. Fault scarp

montane valley



75. Aerial view of Black Mountain

fault scarp furrowed by gorges south of Mormon, California



76. A broken structure partially

buried by sand



77. Cinder cone

ANALOGS OF YUMA TERRAIN IN THE MIDDLE EAST DESERT

LANDFORMS-SURFACE CONDITIONS DESCRIPTIONS AND PHOTOGRAPHS

END

DATE
FILMED

11 - 68