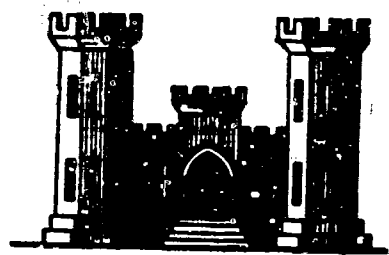


ANALOGS OF YUMA TERRACE IN THE SOUTH CENTRAL ASIAN DESERT

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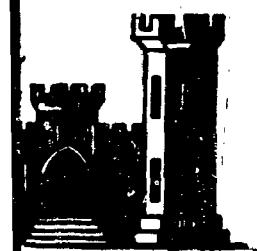
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PREPARED BY THE
GEOLOGY BRANCH-SOILS DIVISION
U.S. ARMY ENGINEER WATERWAYS EXPERIMENT
CORPS OF ENGINEERS

VICKSBURG, MISSISSIPPI

YUMA TERRAIN THE AL ASIAN DESERT.



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other than black and white are available until
stock is exhausted. Reproductions will be
made in black and white only.

**ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT**

**SECTION I: BASIC TERRAIN FACTOR
AND ANALOG MAPS**

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Scope of Study

This folio is a revision of the third in a series comparing the terrain of the U. S. Army Test Station at Yuma, Arizona, with other world desert areas. The area being compared with the Yuma Test Station in this folio is the South Central Asian Desert. Included within this area are Iran, Pakistan, western Afghanistan, and northwestern India. The location and limits of the area and geographic subdivisions are shown in fig. 1 and plate 15. Desert boundaries were determined from homoclimatic maps compiled by Dr. Peveril Meigs (Review of Research on Arid Zone Hydrology, published by UNESCO, 1952). However modifications were made on the basis of geomorphic, soil, and vegetation data collected in the present study. Meigs' classification is oriented toward agricultural potentialities, with temperature and rainfall being the most important factors considered.

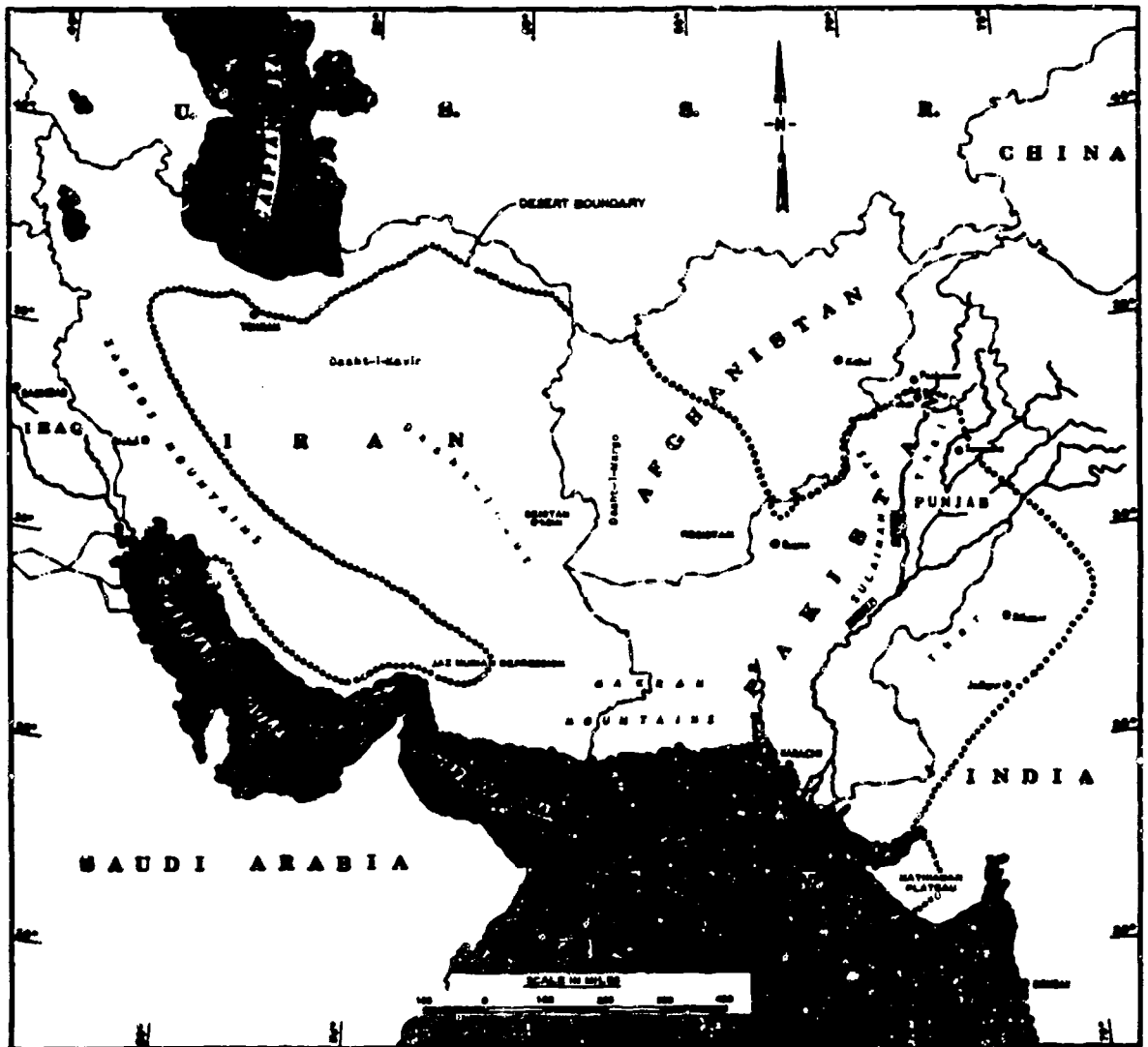


Fig. 1. South Central Asian Desert

The folio consists of a series of plates, each containing a map of the Yuma Test Station in the upper right-hand corner to enable easy comparison. Detailed explanations of the mapping procedures used in the preparation of the plates are found in the text entitled Handbook, A Technique for Preparing Desert Terrain Analogs, published by the Waterways Experiment Station in May 1959 (Technical Report No. 3-506).

The method of analog development depends on comparison of geometry factors (plan-profile, slope occurrence, characteristic slope, and characteristic relief), ground factors (soil type, soil consistency, and surface rock), and vegetation of the South Central Asian Desert with the same terrain types found at Yuma.

The terrain of the South Central Asian Desert was generally found to be moderately analogous to that found at the Yuma Test Station. Approximately 55 percent of the area is moderately analogous, 35 percent highly analogous, 7 percent slightly analogous, and 3 percent inappreciably analogous. None of the area was considered as nonanalogous.

Most of the areas mapped as highly analogous in South Central Asia were mountainous. Among these were the Makran Mountains in southern Iran, portions of the Zagros Mountains in western Iran, the Sulaiman Mountains of Pakistan, and the basin ranges in the interior of Iran. Other highly analogous areas include nonirrigated portions of the Indus floodplains and certain coastal plains of southern Iran.

Desert plains and sand dune areas are the main physiographic types mapped as moderately analogous. The coastal plains bordering Sulaiman and Makran Mountains on the south, irrigated portions of the Indus floodplain, and the large alluvial tract lying between the Indus and the Sulaiman Mountains were also mapped as moderately analogous.

Slightly analogous areas include vegetated dunes in the Registan and bordering the Jaz Murian Depression, the large desert plains east of Kohat and in the vicinity of Jodhpur, and the dune tract southwest of Bikaner.

The only area mapped as inappreciably analogous was the Kathiawar Plateau in southern Pakistan.

Although physiographic types and associated landforms are not used in determining the degree of analogy, the low degree of analogy between similar physiographic types is interesting. Some areas that are physiographically or landformwise similar to Yuma are mapped as slightly analogous. This is true of some of the desert plains in the area which are less dissected and have different soil and vegetative types than their Yuma counterparts. Other such areas include vegetated sand dune areas having different geometry and vegetation factor types and portions of the Indus floodplain where soil and vegetation types differ from their Yuma counterparts. Worthy of mention are areas in the South Central Asian Desert which are physiographically or landformwise dissimilar to Yuma, yet mapped as highly or moderately analogous. Highly analogous areas in this category are the Seistan Basin in eastern Iran, certain southern coastal plains, massive mountain ranges in northern Iran and southern Afghanistan, and parallel-ridge mountains in southern Pakistan. Moderately analogous areas dissimilar to Yuma are the great salt playas in the interior basin of Iran, coastal marsh areas, the Jaz Murian Depression, and longitudinal dune areas in the Thar Desert.

Sources of Information

Written physiographic and landform descriptions of the South Central Asian Desert are scarce. In many areas only brief travelers' accounts are

available to supplement the small-scale map coverage. These accounts were helpful in delineating boundaries between major physiographic types and in describing their associated landforms. Data were more abundant in some areas than in others. The Seistan Basin, Jaz Murian Depression, southern part of the Dashr-i-Lut, Punjab, the Sulaiman Mountains in the vicinity of Quetta, the Makran Mountains, and coastal areas in southern Iran were regions in which good descriptive accounts were available. Some of the regions in which written data were scarce or lacking were large portions of the Thal, Thar, and Registan Deserts, the great interior basin of Iran, the mountains of northern Iran and southern Afghanistan, and the southern Sulaiman Mountains of Pakistan.

Large-scale map coverage was available on Iran in the vicinity of Dizful and Tehran and on Pakistan in the vicinity of Karachi, Quetta, Sargodha, and Peshawar. These were helpful locally in preparing the geometry and vegetation maps. Full coverage of the area was provided by several sets of small-scale maps. Coverage of the entire area at a scale of 1:1,000,000 was provided by USAF World Aeronautical Charts and Geographical Section, General Staff maps. These were used in the preparation of the physiography, landforms-surface conditions, and geometry-factor maps. Complete coverage of U. S. Department of Agriculture World Soil Maps by the Bureau of Plant Industry at a scale of 1:1,000,000, together with definitions and symbols, was useful in the determination of the soil, soil consistency, and often of the rock types. These maps were also of some limited use in determining the vegetative types. Data for the hypsometric maps of Yuma were taken from U. S. Strategic Maps at a scale of 1:500,000; for the South Central Asian Desert these data were obtained principally from Air Force Aeronautical Planning Charts at a scale of 1:5,000,000.

The principal sources of information for the Yuma Test Station were the following: A report, Terrain Study of the Yuma Test Station Area, Arizona, prepared for the U. S. Army Engineer Waterways Experiment Station by Purdue University in March 1955; Handbook of Yuma Environment, published by Office, Quartermaster General, in February 1953 (Report No. 300); and A Study of Desert Surface Conditions by Thomas Clements and others, published by Quartermaster Research and Development Command in April 1957 (Technical Report EP-53).

Authorization and Acknowledgments

This study is a part of Research and Development project No. 8S70-09-001, entitled "Military Evaluation of Geographic Areas," which has been assigned to the U. S. Army Engineer Waterways Experiment Station by the Office, Chief of Engineers, and is being performed for Office, Chief of Research and Development, Department of the Army. The project is directed by the Area Evaluation Section of the Soils Division, Waterways Experiment Station.

This folio is a revision of an earlier report (Analog of Yuma Terrain in the South Central Asian Desert, dated March 1959), which was prepared without the assistance of any fieldwork. The survey of the available literature and actual mapping was done by Mr. William K. Dornbusch, Jr., Geology Branch, WES, under the immediate supervision of Dr. Charles R. Kolb, Chief

of the Geology Branch. Technical assistance was rendered by Mr. Harry K. Woods, Mr. Jerald D. Broughton, and Mr. P. R. Mabrey, all of the Geology Branch, and Mr. Warren E. Grabau, Chief, Area Evaluation Section. The project was under the general supervision of Mr. W. J. Turnbull and Mr. W. G. Shockley, Chief and Assistant Chief, respectively, Soils Division.

Directors of the Waterways Experiment Station during this study were Col. Edmund H. Lang, CE, and Col. Alex G. Sutton, Jr., CE. Technical Director was Mr. J. B. Tiffany.

ASSOCIATED REPORTS

<u>Date</u>	<u>Title</u>
Feb. 1958	Analogs of Yuma Terrain in the Northeast African Desert (revised June 1962)
Feb. 1958	Analogs of Yuma Terrain in the Northwest African Desert (under revision)
Mar. 1959	Analogs of Yuma Terrain in the South Central Asian Desert (revised June 1962)
Apr. 1959	Analogs of Yuma Terrain in the Mexican Desert
May 1960	Analogs of Yuma Terrain in the Middle Eastern Desert

- LIST OF PLATES -

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- Plate 2. Occurrence of Slopes Greater than 50 Percent
- Plate 3. Characteristic Slope
- Plate 4. Characteristic Relief
- Plate 5. Generalized Landscape
- Plate 6. Soil Type
- Plate 7. Soil Consistency
- Plate 8. Surface Rock
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- Plate 14. Hypsometry
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- Plate 16. Physiography: Descriptions and Photographs
- Plate 17. Selected Landforms and Surface Conditions
- Plate 18. Selected Landforms and Surface Conditions: Descriptions and Photographs

**ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT**

**ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT**

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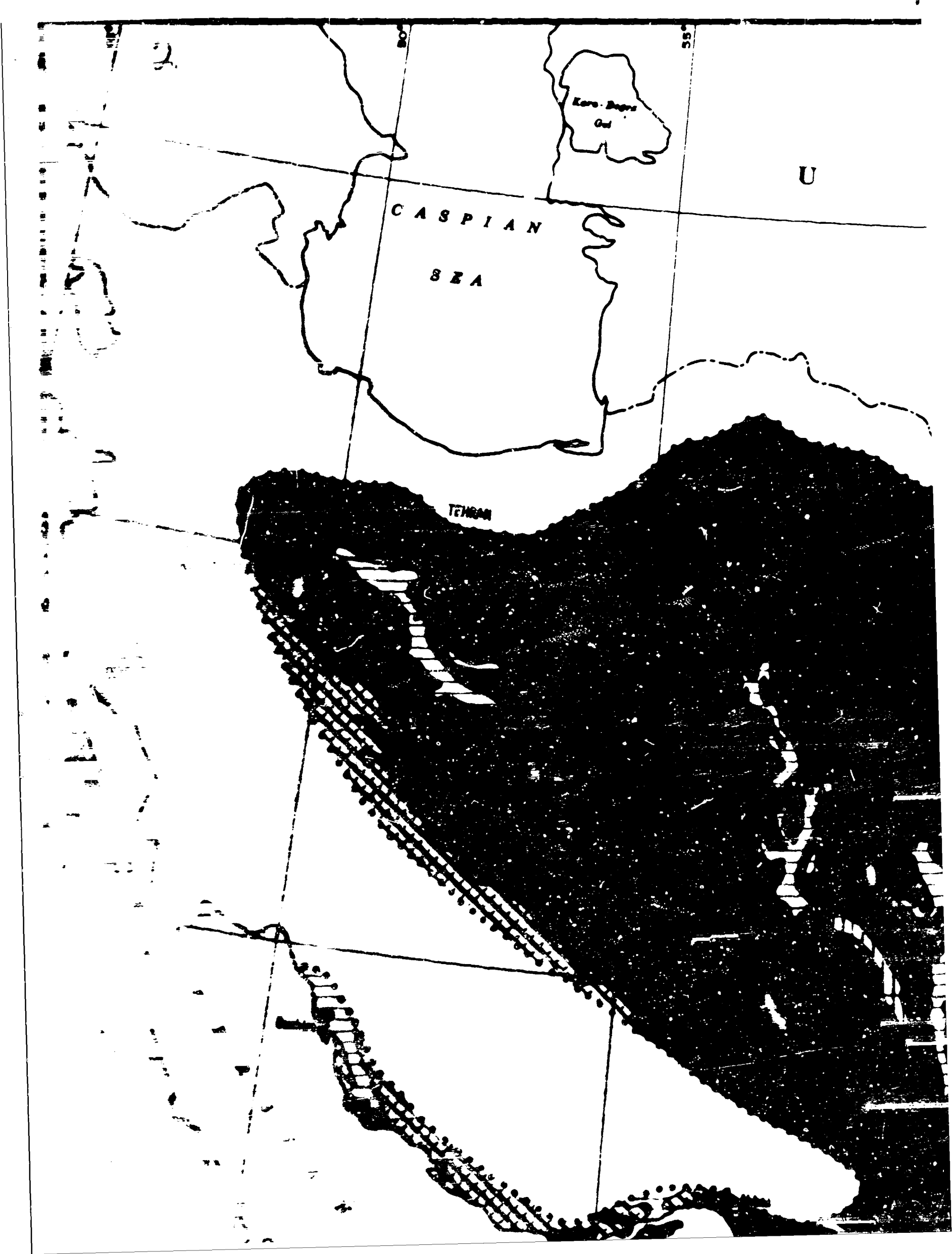
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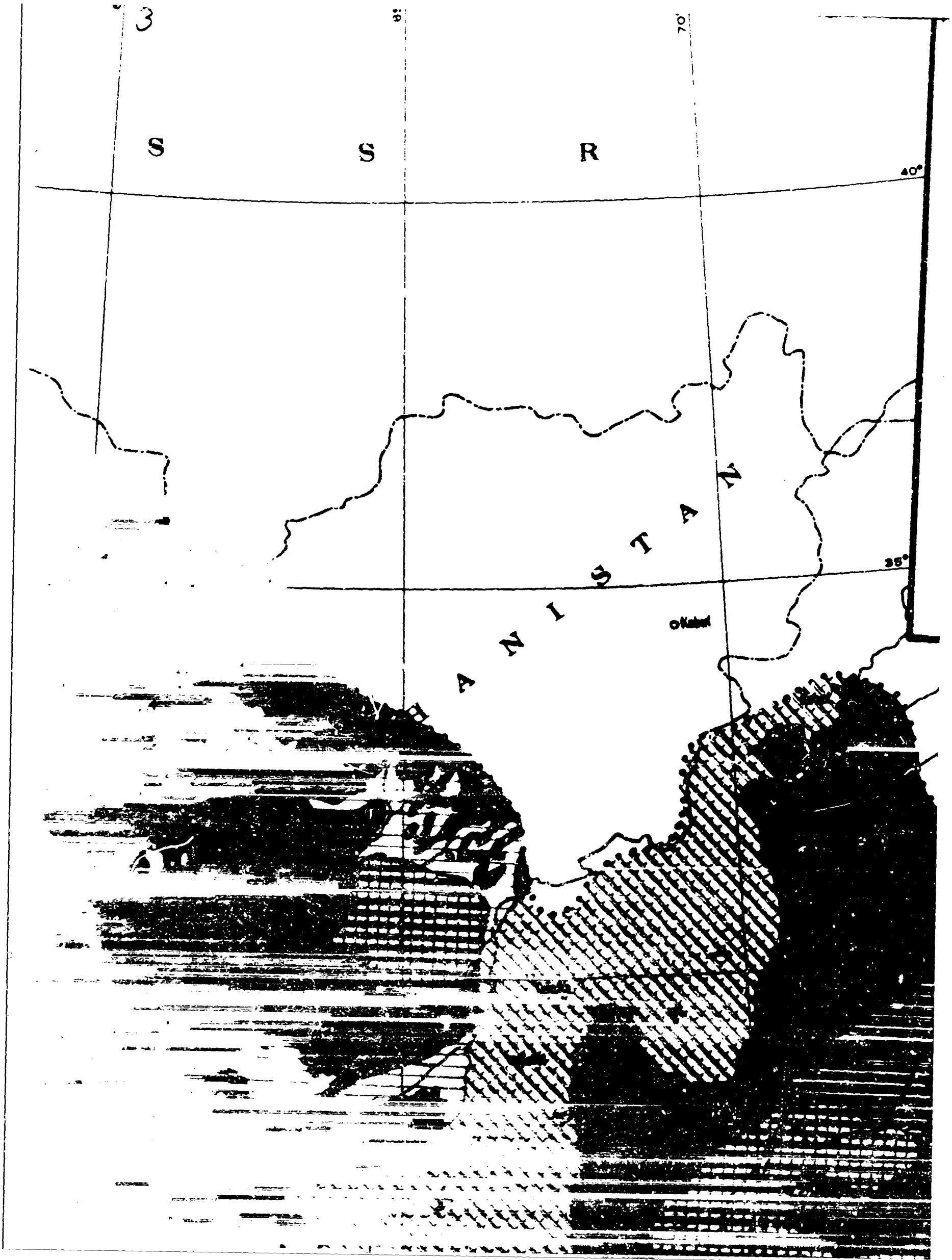
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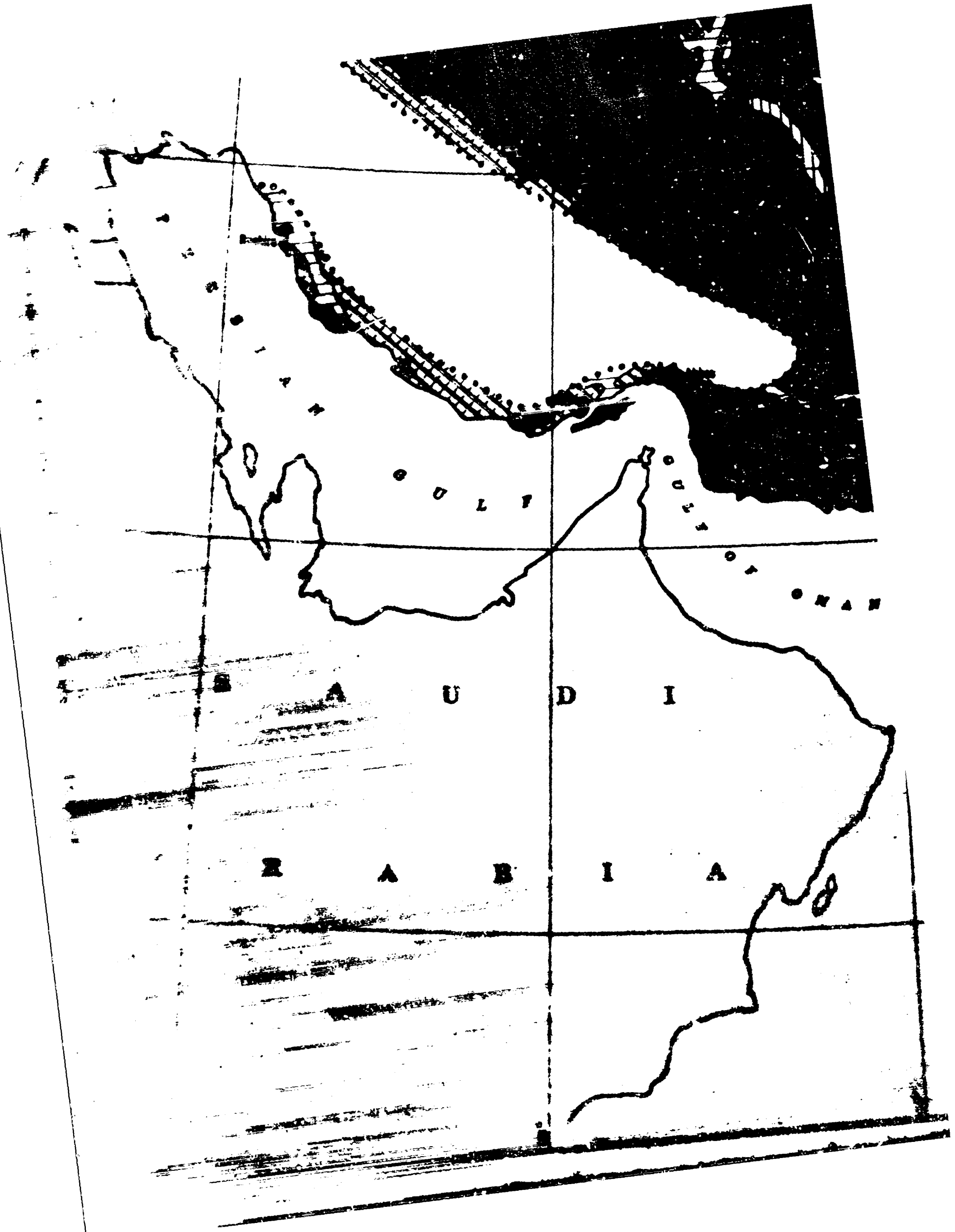
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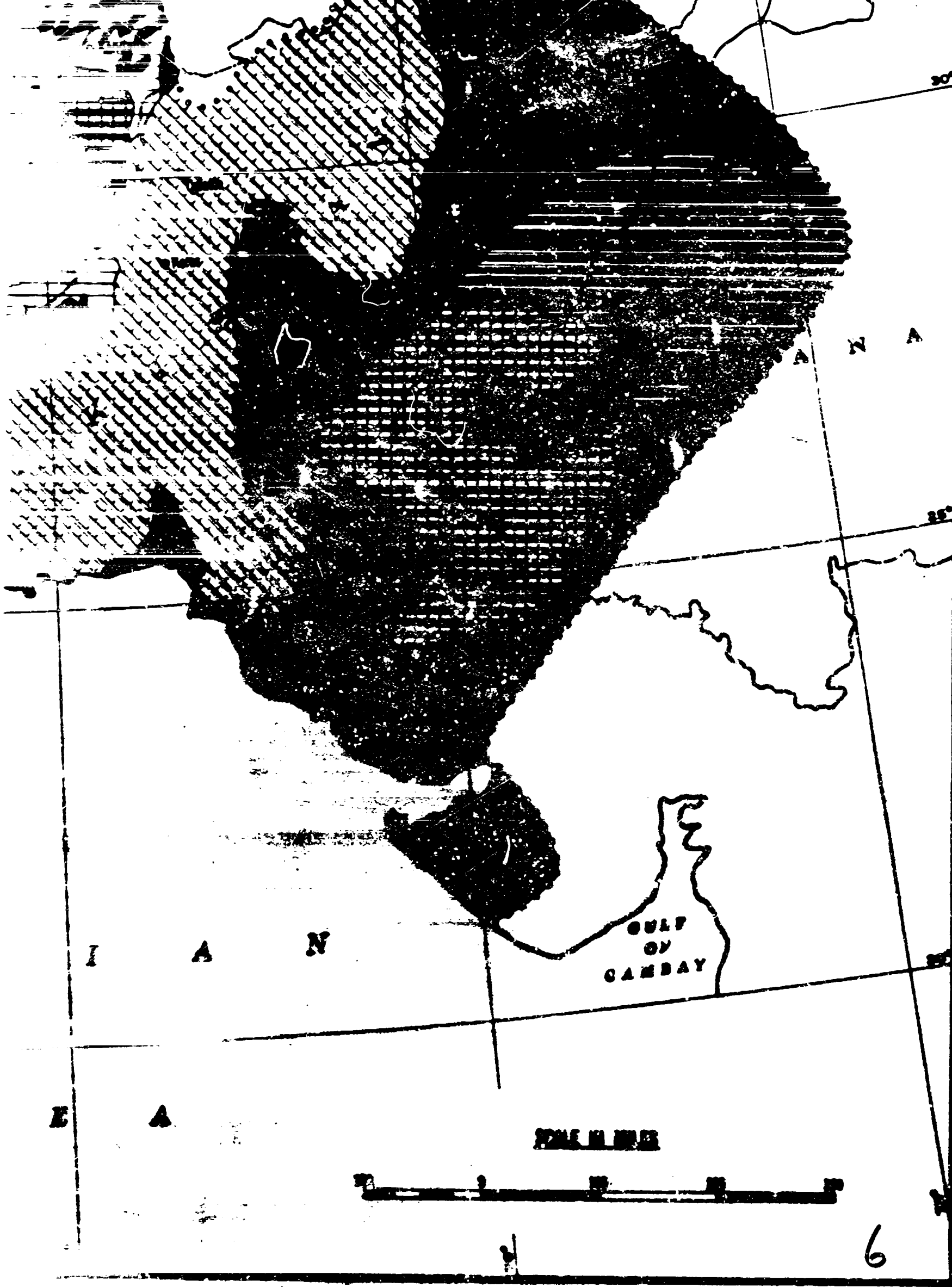
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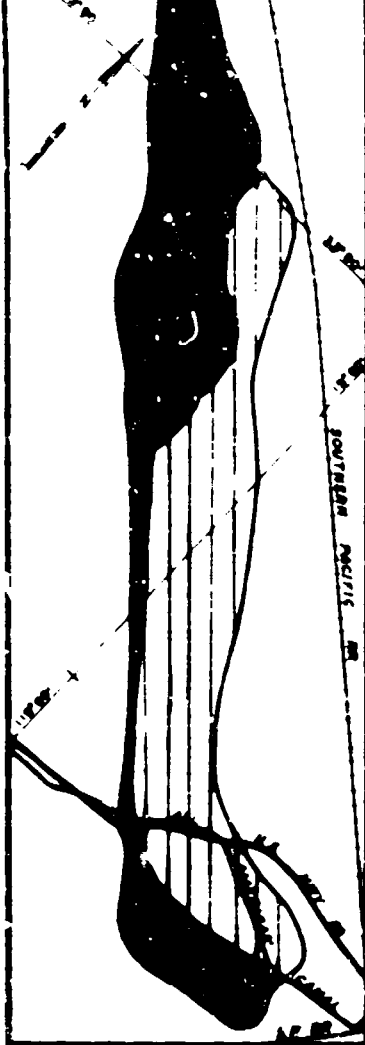






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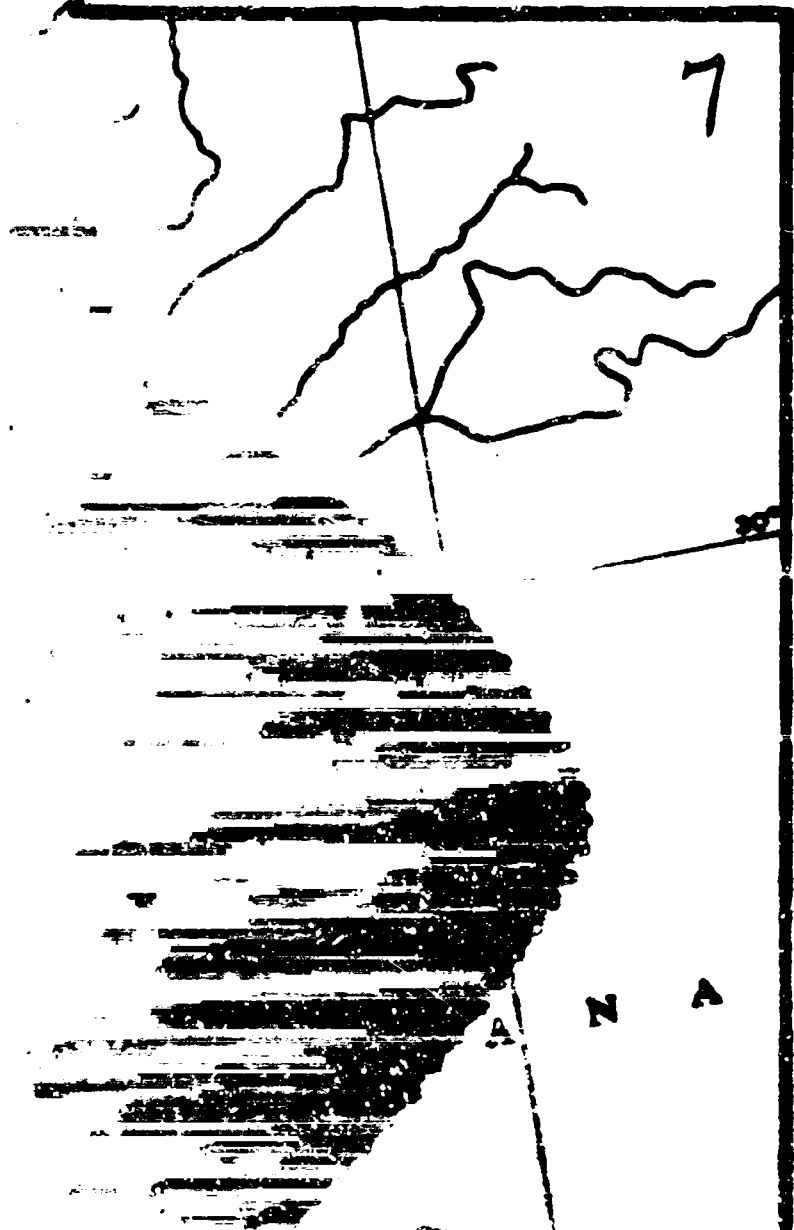


YUMA SAND HILLS
(GROSS PLAN-PROFILE: SL)



YUMA TEST STATION
(GROSS PLAN-PROFILE: SL)

SCALE



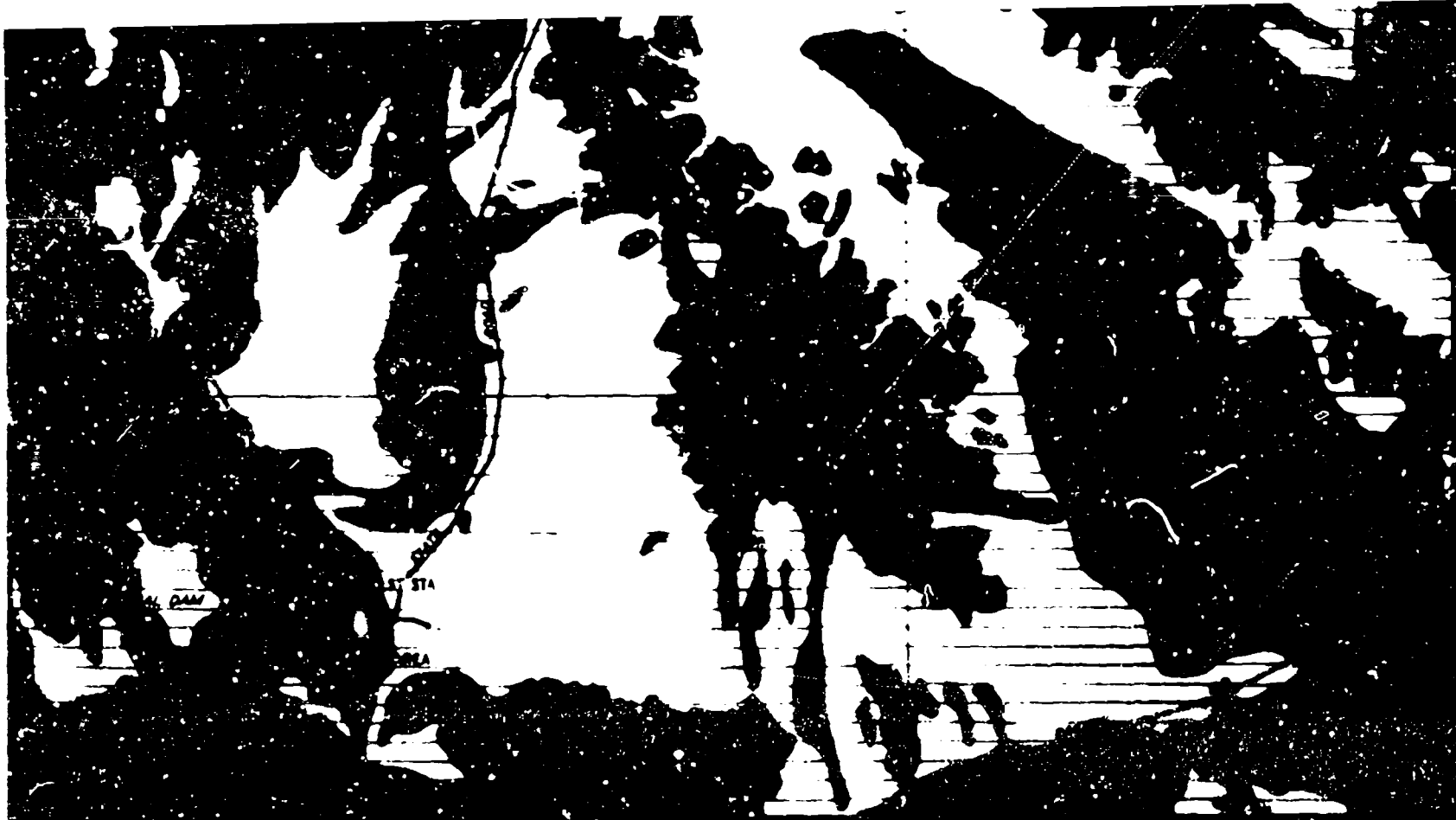
CHARACTERISTIC PLAN-PROFILE

The characteristic plan-profile is the most commonly found plan-profile. It may be either restrictive or gross. The restrictive plan-profile is based on 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 35 miles in diameter. Local relief of less than 10 ft is not considered. The predominance in each a plan-profile are termed intervening landscape component lines.

LEGEND				
Higher Occupancy	Flights are	Random and Random	Linear and Random	Random and Random
	Schematic Plan Schematic Profile			
>60% of area				
40-60% of area				
<40% of area				
>60% of area				
40-60% of area				
<40% of area				
No pronounced flight or lane				

PLAN-PROFILE COMPLEXES

Local Complexes: Confined to areas where two major, locally restrictive, both of the restrictive type, are mapped.



SCALE 0 10 MI

YUMA TEST STATION (GROSS PLAN-PROFILE: SL/H)

8

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 35 miles in diameter. Relief of less than 100 ft is not considered. The prominences in such a plan-profile are termed component highs, the intervening lowlands component lows.

LEGEND					
Highs Occur:	Highs are —>	Schematic Plan	Schematic Profile	Nonlinear and Random	Linear and Random
				Nonlinear and Parallel	Linear and Parallel
100% of area				1	1L
40-60% of area				2	2L
100% of area				3	3L
100% of area				4	4L
40-60% of area				5	5L
100% of area				6	6L
No pronounced highs or lows				7	

PLAN-PROFILE COMPLEXES

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

Plan-profile of the area



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 35 miles in diameter. Relief of less than 100 ft is not considered. The prominences in such a plan-profile are termed component highs, the intervening lowlands component lows.

		LEGEND			
Highs* Occur	Highs are —>	Schematic Plan	Nonlinear and Random	Linear and Random	Nonlinear and Parallel
		Schematic Profile			
>60% of area	Flat-topped				
>60% of area	Crested or Peaked				
No pronounced highs or lows					

PLAN-PROFILE COMPLEXES

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

- Plan-profile of the areally predominant lows.
Plan-profile of the areally subordinate highs.
- Plan-profile of the areally predominant highs.
Plan-profile of the areally subordinate lows.

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

- Gross plan-profile.
Restrictive plan-profile of component lows.
- Gross plan-profile.
Restrictive plan-profile of component highs.

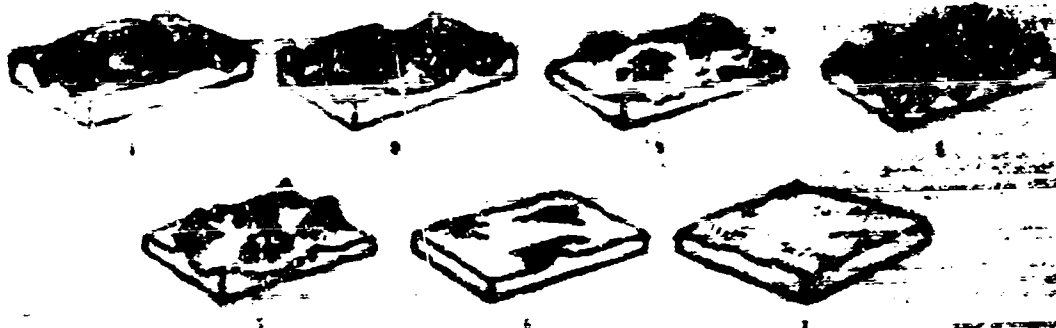
* Highs are considered to be (1) peaked or crested prominences which exhibit elevations some slopes greater than 5 degrees or (2) flatly flat-topped prominences or high-level areas bounded by slopes in excess of 10 degrees.

** L. H. Babbie's definition of high. A high is considered to be linear when its length is greater than 5 times its width.

*** // 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
SOUTH CENTRAL ASIAN DESERT
OCCURRENCE OF SLOPES
GREATER THAN 50 PER CENT**

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YUMA SAND HI
(GROSS OCCURRENCE)



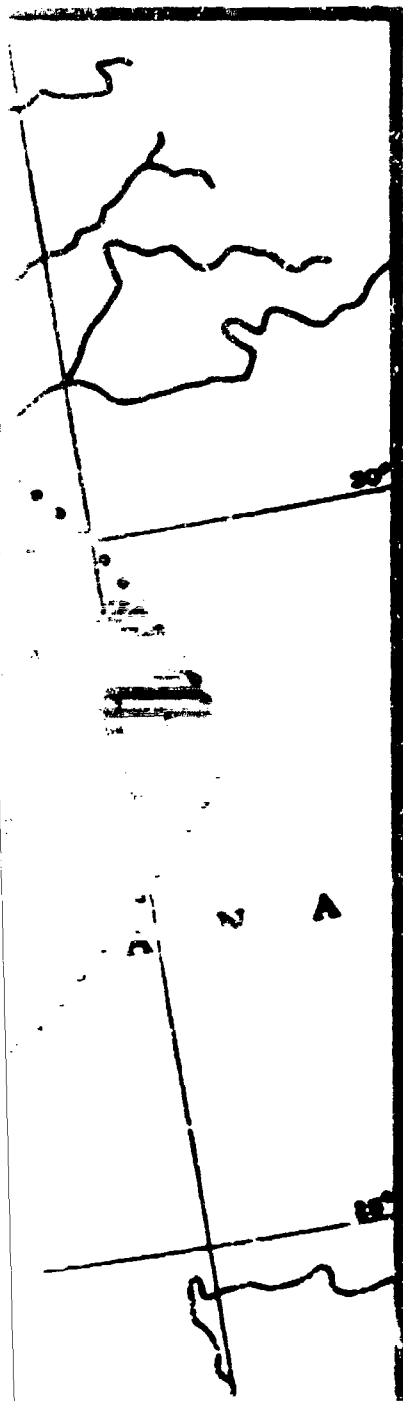
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YUMA TEST STATION

(GROSS OCCURRENCE OF COMPONENT MHHHS: 1)

3 HILLS
(REFERENCE: 1)



OCCURRENCE OF SLOPES GREATER THAN 10 PER CENT

Occurrences may be either restrictive or gross. A restrictive occurrence class indicates a small range of slopes greater than 10 per cent found along traverses containing the maximum number of such slopes. Slopes of less than 10 per cent are not considered. A gross occurrence indicates the total distance between component highs or component lows. Slopes of less than 10 per cent are not considered.

1. The number of slopes steeper than 10 per cent is less than 1 per 10 miles or in areas, less than 10 miles, in mountainous terrain, where such slopes are lacking.
2. The number of slopes steeper than 10 per cent ranges from 1 to 5 per 10 miles.
3. The number of slopes steeper than 10 per cent ranges from 6 to 20 per 10 miles.
4. The number of slopes steeper than 10 per cent ranges from 25 to 100 per 10 miles.
5. The number of slopes steeper than 10 per cent ranges from 100 to 200 per 10 miles.
6. The number of slopes steeper than 10 per cent exceeds 200 per 10 miles.

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

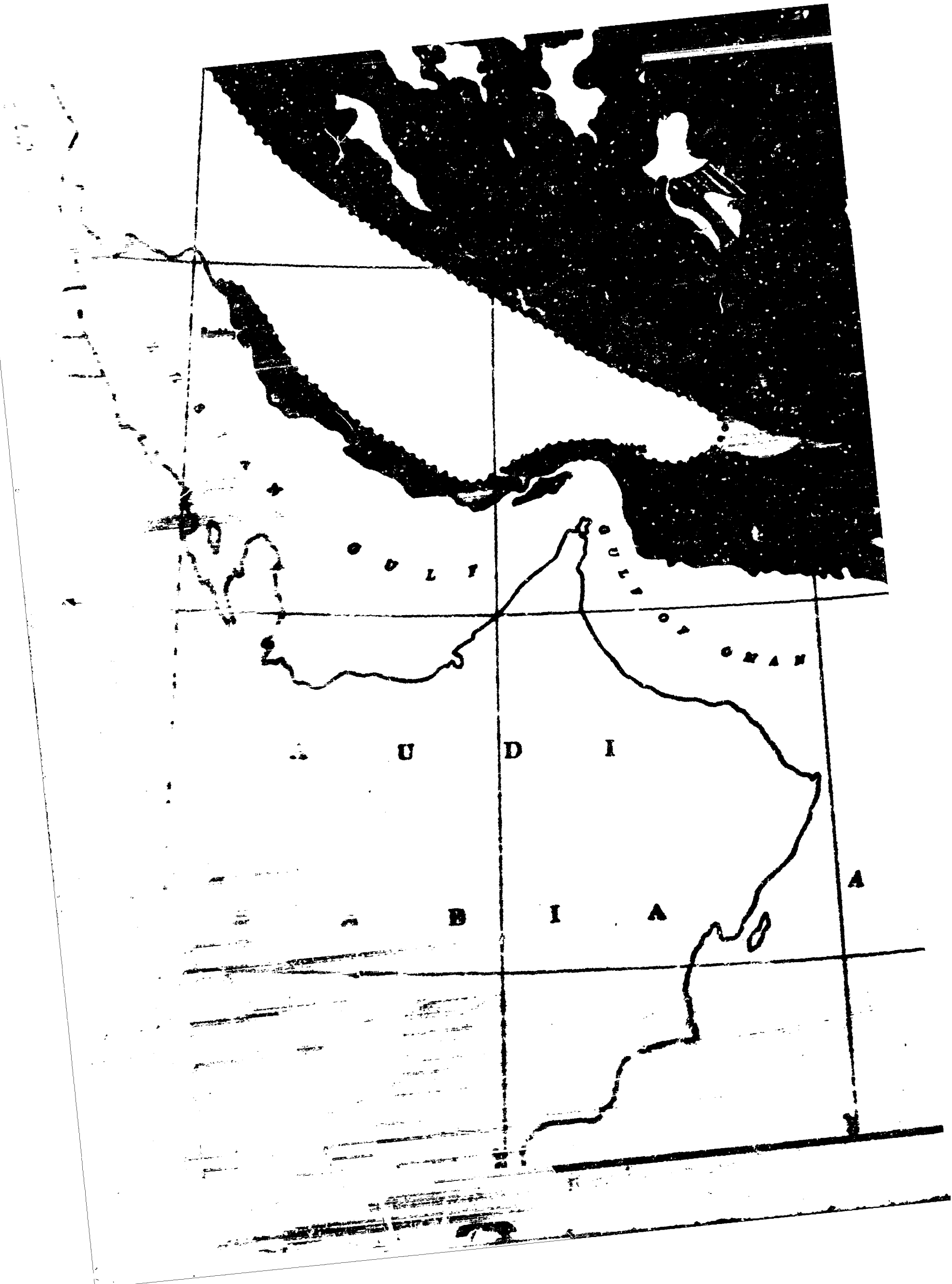
Areal Complexes: Confined to areas where two major, usually restrictive occurrence units, both of the restrictive type, are mapped.

- ✓ [Symbol] Slopes or areas of locally predominant, low slope occurrence of locally subordinate high.
- ✓ [Symbol] Slopes occurrence of locally predominant high.
- ✓ [Symbol] Slopes occurrence of locally subordinate low.

Gross-component Complexes: Mapped only where gross-component plan-profile complexes are mapped.

- ✓ [Symbol] Gross occurrence of component high.
- ✓ [Symbol] Restrictive occurrence within component high.
- ✓ [Symbol] Gross occurrence of component low.
- ✓ [Symbol] Restrictive occurrence within component low.







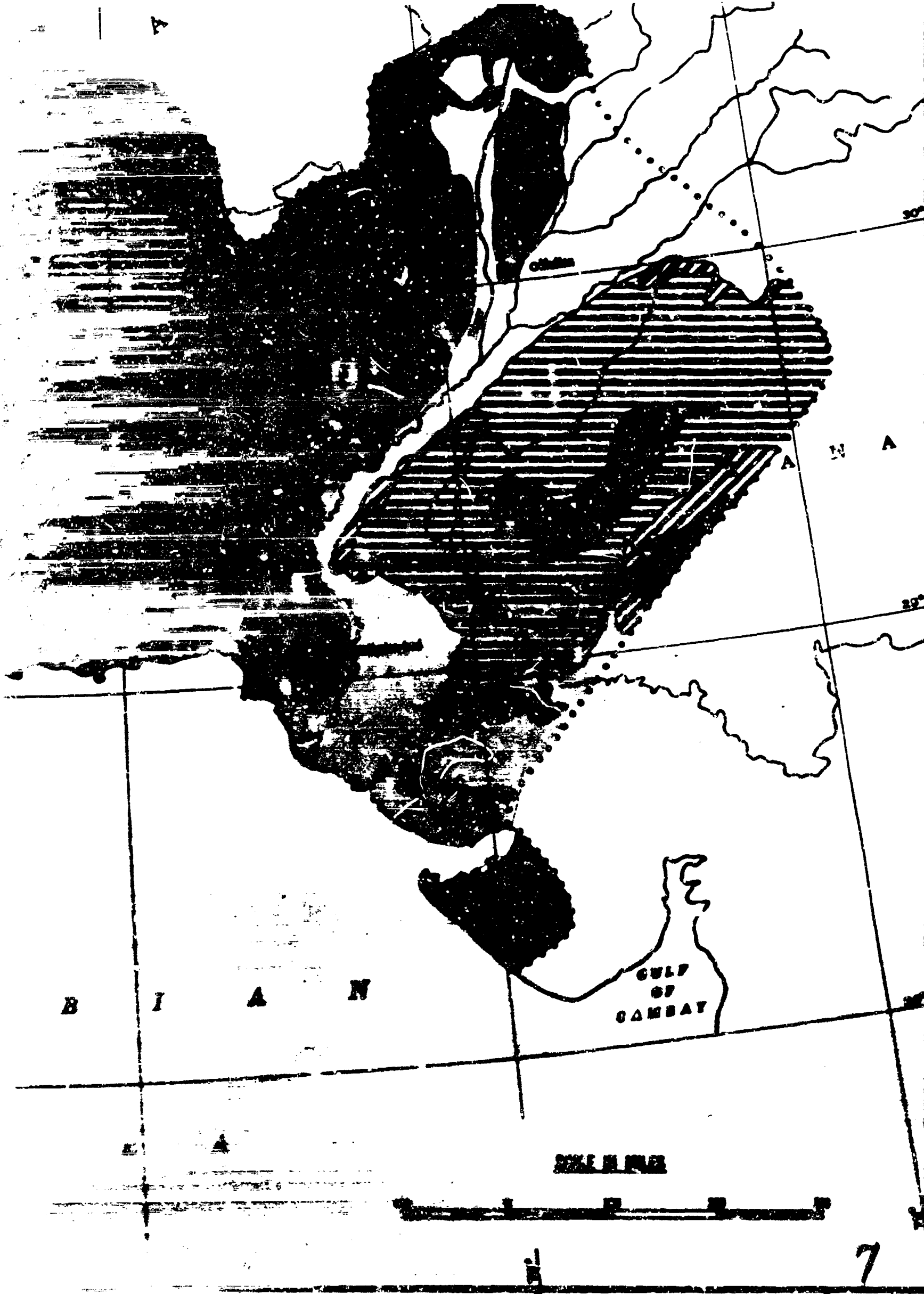
R A B I A N

S E A S

GULF
OF
CAMBAY

SCALE IN MILES





INDIA

GULF OF CAMBAY

SCALE BAR

SCALE

YUMA TEST STATION (GHOS# OCCURRENCE OF COMPONENT HILLS-1)

EXPLANATION OF ABBREVIATIONS USED IN THE MAP

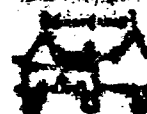
Contours map to show topographic features. A contour line connects points of equal elevation. Contours are drawn at 10 foot intervals. Contours are labeled with their elevation. Contours are drawn at 10 foot intervals. Contours are labeled with their elevation. Contours are drawn at 10 foot intervals. Contours are labeled with their elevation.

1. The number of slopes steeper than 50 per cent which are less than 10 miles in extent. (Slopes are measured from the base of the hill to the top.)
2. The number of slopes steeper than 50 per cent which are less than 10 miles in extent. (Slopes are measured from the base of the hill to the top.)
3. The number of slopes steeper than 50 per cent which are less than 10 miles in extent. (Slopes are measured from the base of the hill to the top.)
4. The number of slopes steeper than 50 per cent which are less than 10 miles in extent. (Slopes are measured from the base of the hill to the top.)
5. The number of slopes steeper than 50 per cent which are less than 10 miles in extent. (Slopes are measured from the base of the hill to the top.)
6. The number of slopes steeper than 50 per cent which are less than 10 miles in extent. (Slopes are measured from the base of the hill to the top.)

GHOS# OCCURRENCE OF COMPONENT HILLS-1. Shaded only where present. (See map.)

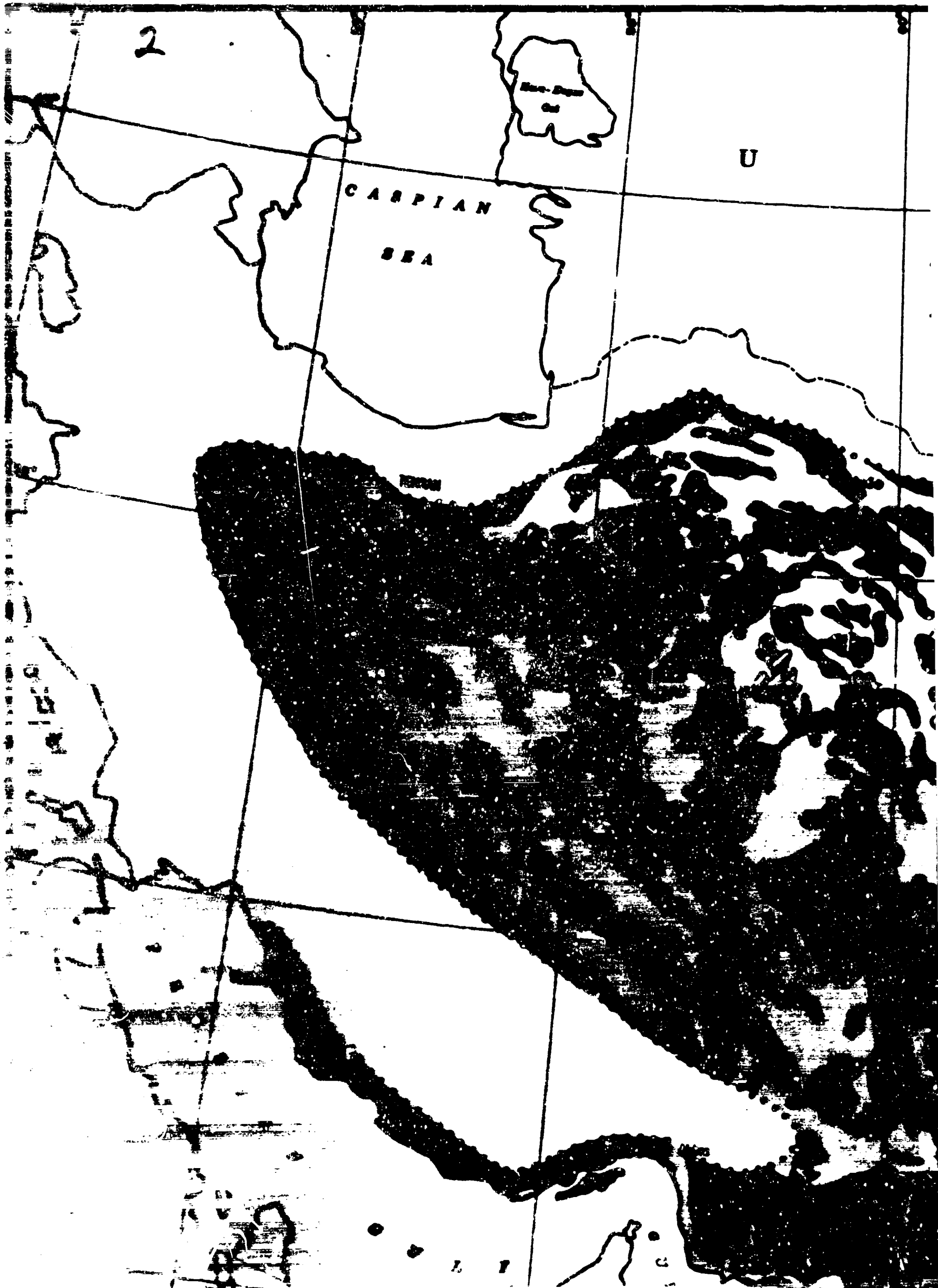
GHOS# OCCURRENCE OF COMPONENT HILLS-1. Shaded only where present. (See map.)

1. GHOS# OCCURRENCE OF COMPONENT HILLS-1. Shaded only where present. (See map.)
2. GHOS# OCCURRENCE OF COMPONENT HILLS-1. Shaded only where present. (See map.)
3. GHOS# OCCURRENCE OF COMPONENT HILLS-1. Shaded only where present. (See map.)
4. GHOS# OCCURRENCE OF COMPONENT HILLS-1. Shaded only where present. (See map.)
5. GHOS# OCCURRENCE OF COMPONENT HILLS-1. Shaded only where present. (See map.)
6. GHOS# OCCURRENCE OF COMPONENT HILLS-1. Shaded only where present. (See map.)



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ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ARIZONIAN DESERT
CHARACTERISTIC OF



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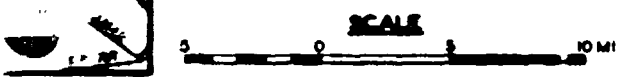
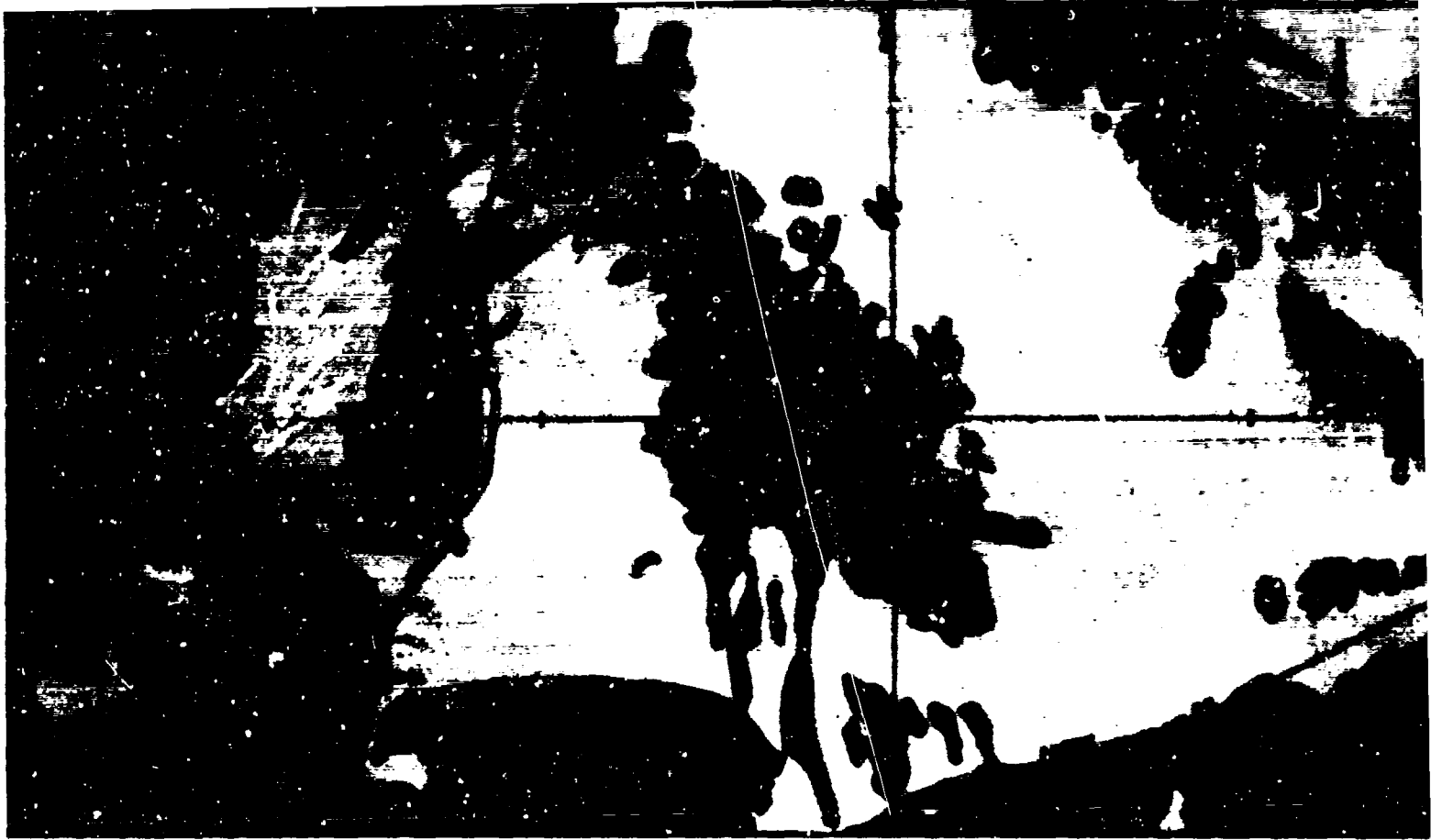
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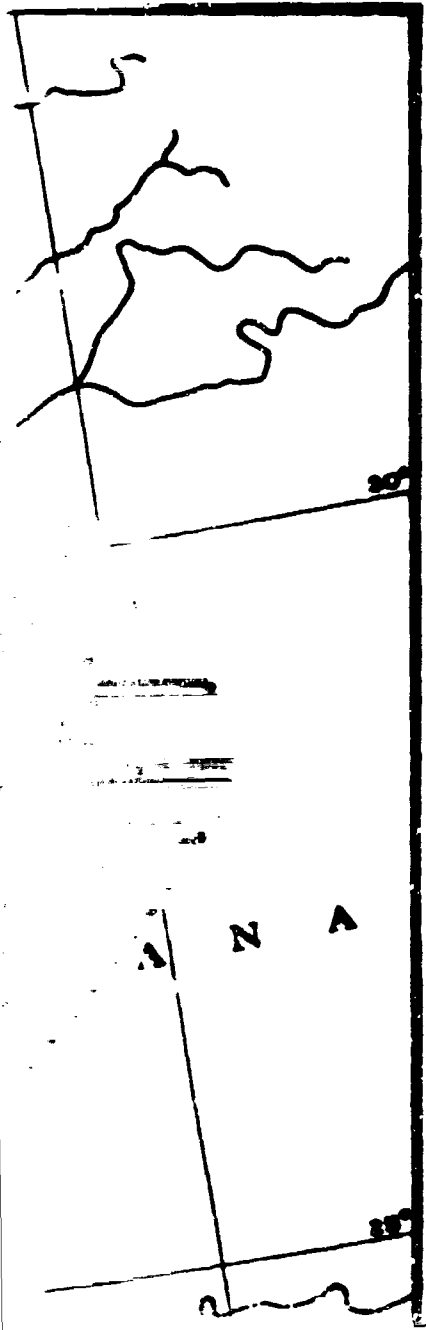




JO HILLS
(IC SLOPE: 3)

YUMA TEST STATION

(CHARACTERISTIC SLOPE WITHIN COMPONENT HIGHS: 5) **4**



CHARACTERISTIC SLOPE

Slope is defined as a surface identified or designated in terms of the 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 10-ft contour interval.

Flat: Characteristic slope between 0 and 1/2 degree (approx. 0 - 0.9%).

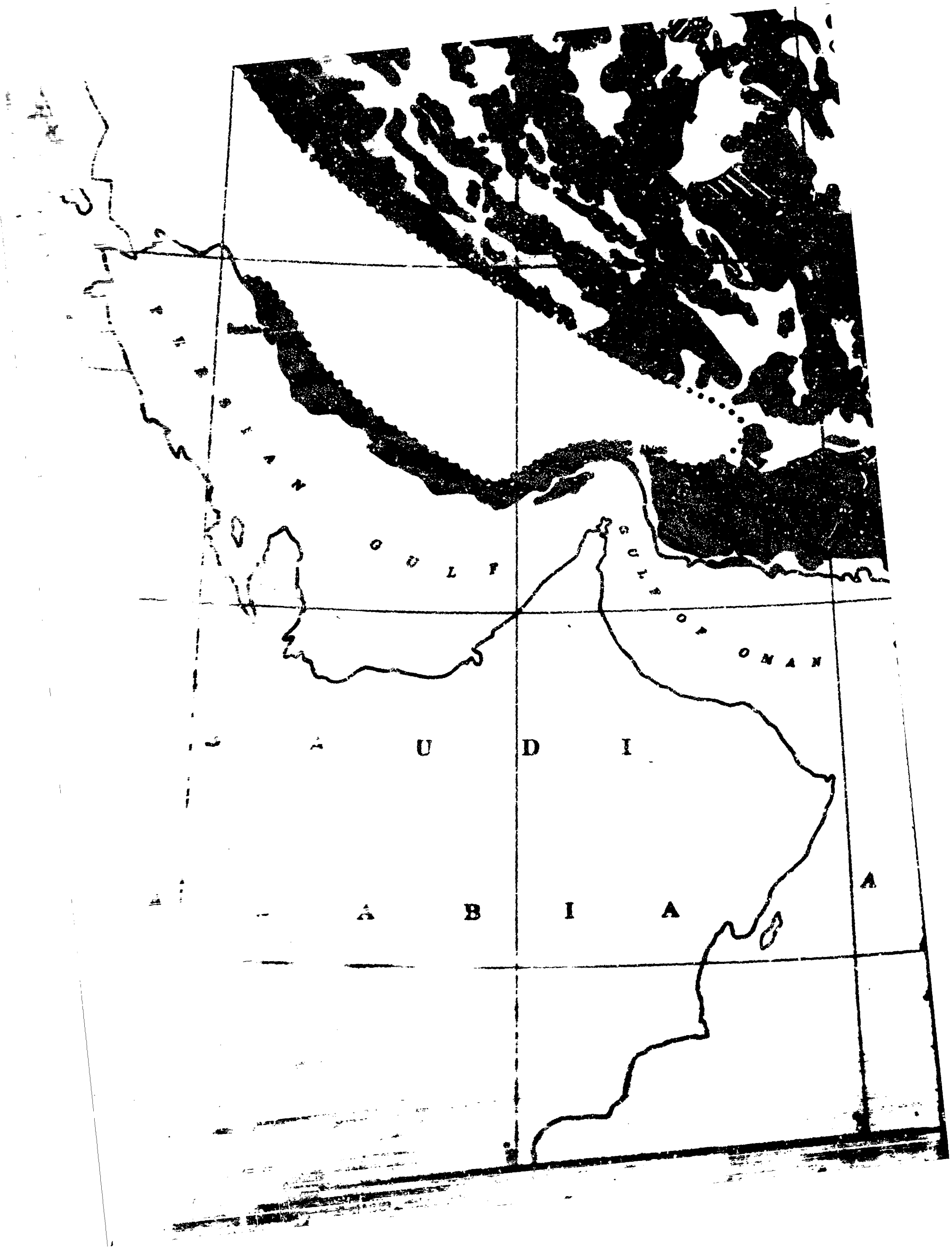
- 1a Between 0 and 1/2 degree (approx. 0 - 1%).
- 1b Between 1/2 and 1 degree (approx. 1 - 1.8%).
- 2 Gentle: Characteristic slope between 1 and 5 degrees (approx. 1.8 - 10%).
- 3 Moderate: Characteristic slope between 5 and 10 degrees (approx. 10 - 20%).
- 4 Steep: Characteristic slope between 10 and 25.5 degrees (approx. 20 - 50%).
- 5 Very Steep: Characteristic slope between 25.5 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)
Area Complexes: Confined to areas where two major, usually related slope types are mapped.

- 1a Characteristic slope of locally predominant low. Characteristic slope of locally subordinate high.
- 1b Characteristic slope of locally predominant high. Characteristic slope of locally subordinate low.

Green-component Complexes: Mapped only where green-component plan-profile complexes are mapped. The symbols in the complex are arranged vertically or horizontally depending on the plan-profile.

- 1c Characteristic slope within component high. Characteristic slope within component low.





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A R A B I A N

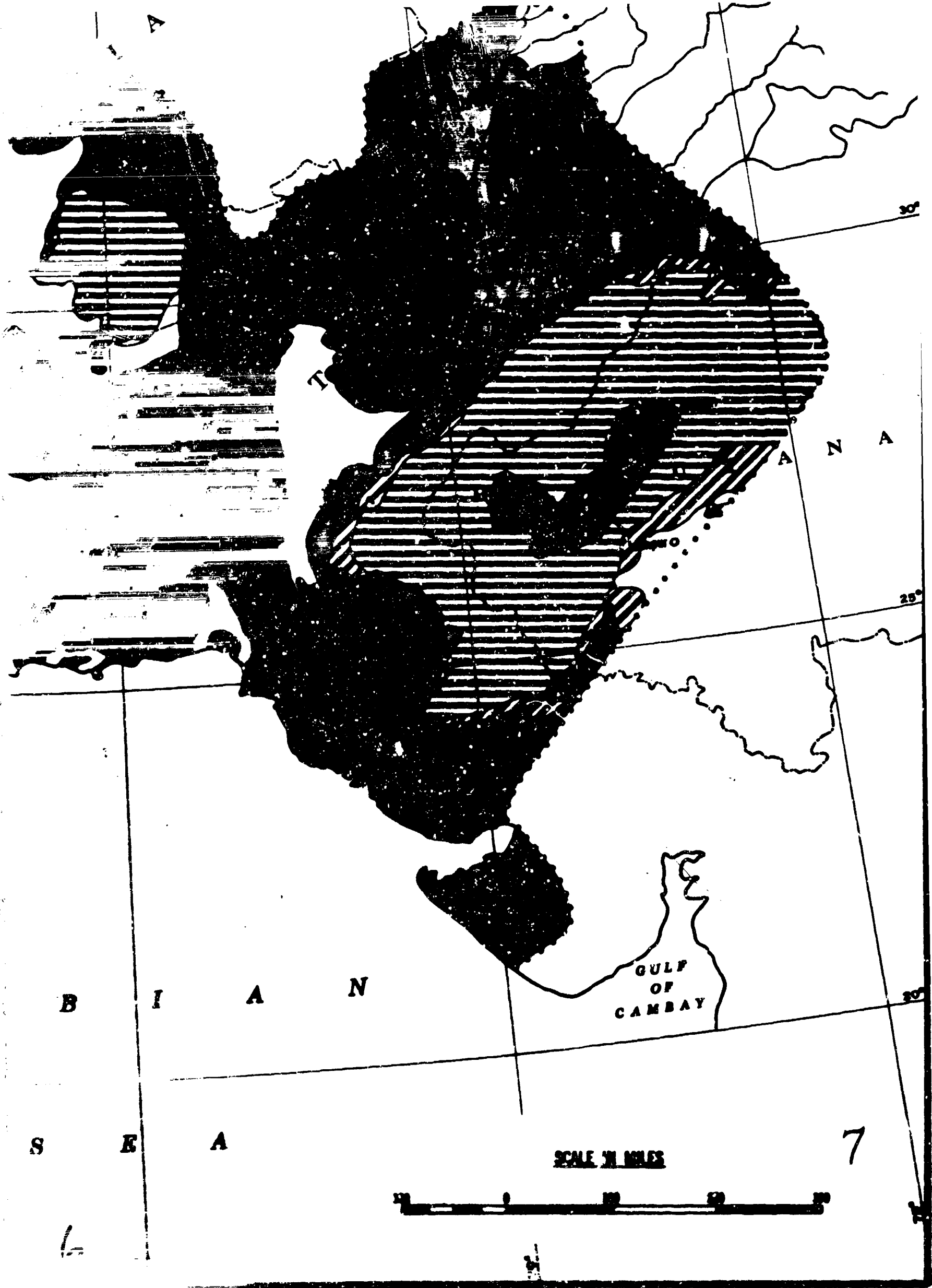
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GULF OF CAMBAY

SCALE IN MILES



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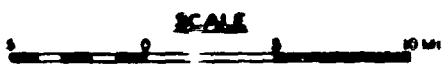
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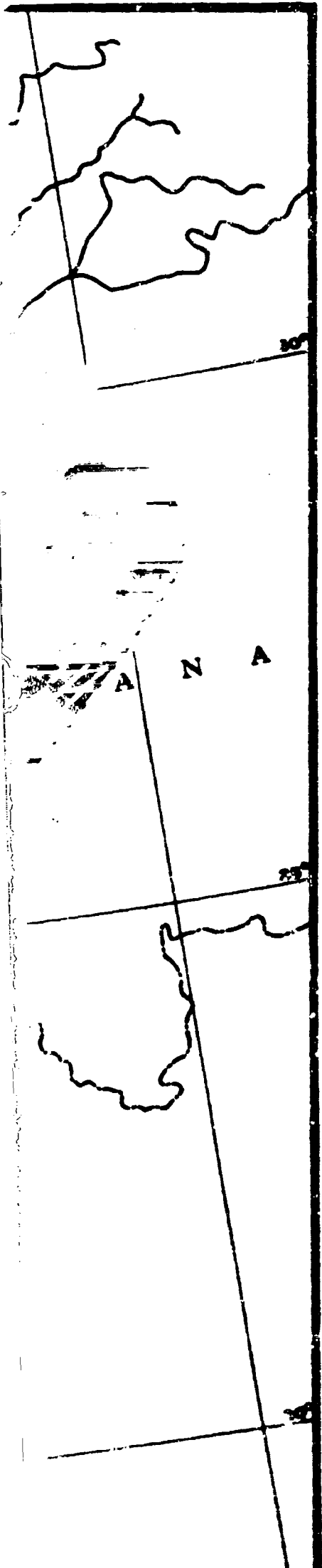
ND HILLS
TIC SLOPE: 9)



YUMA TEST STATION

(CHARACTERISTIC SLOPE WITHIN COMPONENT HIGHS: 5)

4



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 10-foot contour interval.

Flat: Characteristic slope between 0 and 2 degrees (approx. 0 - 3.9%).

- 1a Between 0 and 1/2 degree (approx. 0 - 1%).
- 1b Between 1/2 and 2 degrees (approx. 1 - 3.9%).
- 2 Gentle: Characteristic slope between 2 and 6 degrees (approx. 3.5 - 10%).
- 3 Moderate: Characteristic slope between 6 and 14 degrees (approx. 10 - 25%).
- 4 Declivitous: Characteristic slope between 14 and 26.5 degrees (approx. 25 - 50%).
- 5 Steep: Characteristic slope between 26.5 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. Aerial Contour: Confined to areas where two major, aerially restricted slope types are mapped.

- 1/2 Characteristic slope of aerially predominant low. Characteristic slope of aerially subordinate high.
- 1/3 Characteristic slope of aerially predominant high. Characteristic slope of aerially subordinate low.

Gross-component Complexes: Mapped only where gross-component plan-profile complexes are mapped. The symbols in the complex are arranged vertically or horizontally depending on the plan-profile.

- 1/4 Characteristic slope within component high.* Characteristic slope within component low.*
- 1/5 Characteristic slope within component low.* Characteristic slope within component high.*

Important Scarps: An important scarp is defined as a more or less continuous precipitation slope exhibiting more than 500 feet of relief. Only the better known scarps which extend for considerable distances have been mapped. Scarp height is indicated where known.

* In cases where the gross plan-profile is not mapped or has been limited the characteristic slope is considered to be the aerial slope of the bounding levels.

8

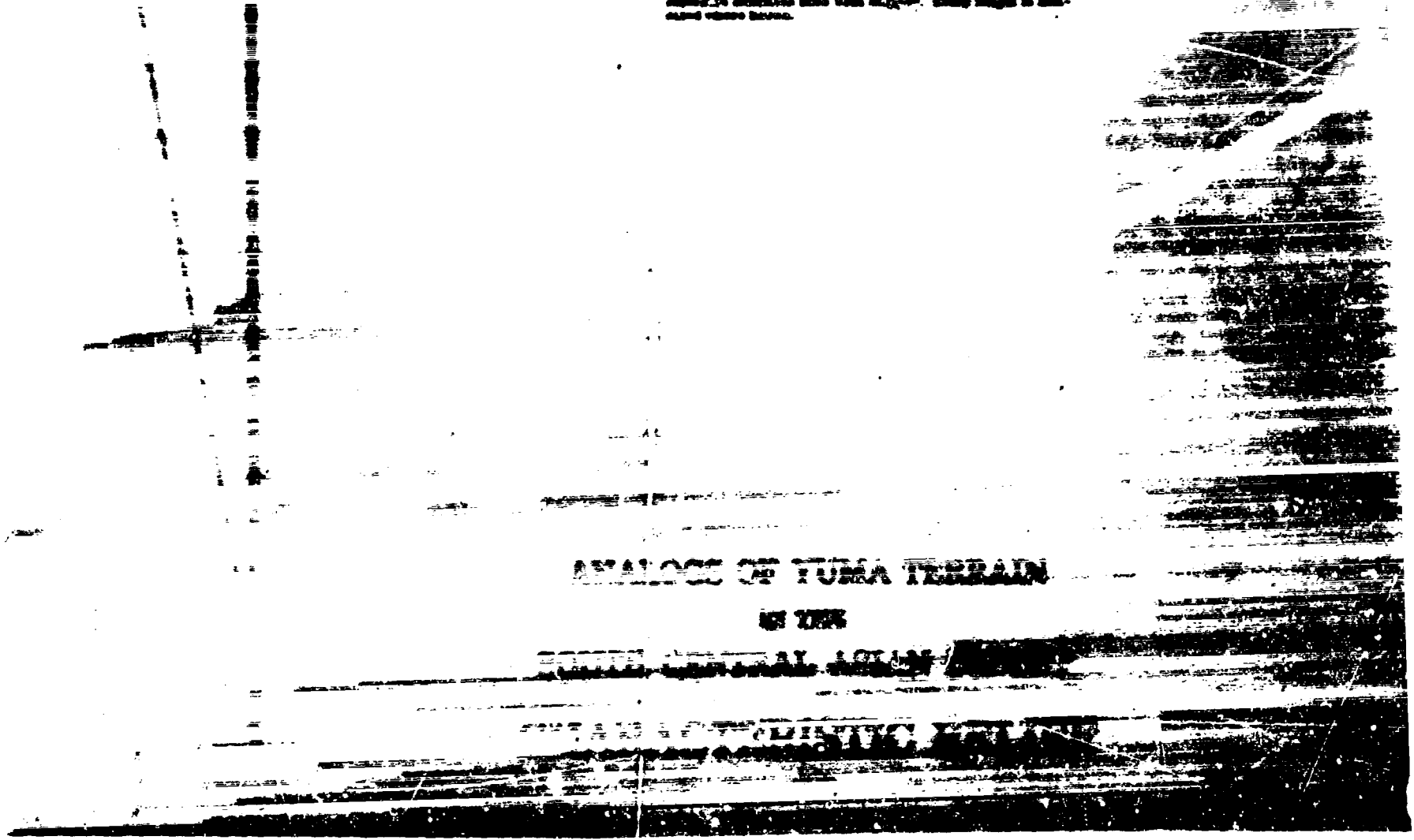
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... the ... have been height ...
... the ...

ANALOGUE OF TUMBA TERRAIN

IN THE

... ...

... ...



2

Kare-Bagan
Cul

U

CASPIAN
SEA

YENSON

3

S

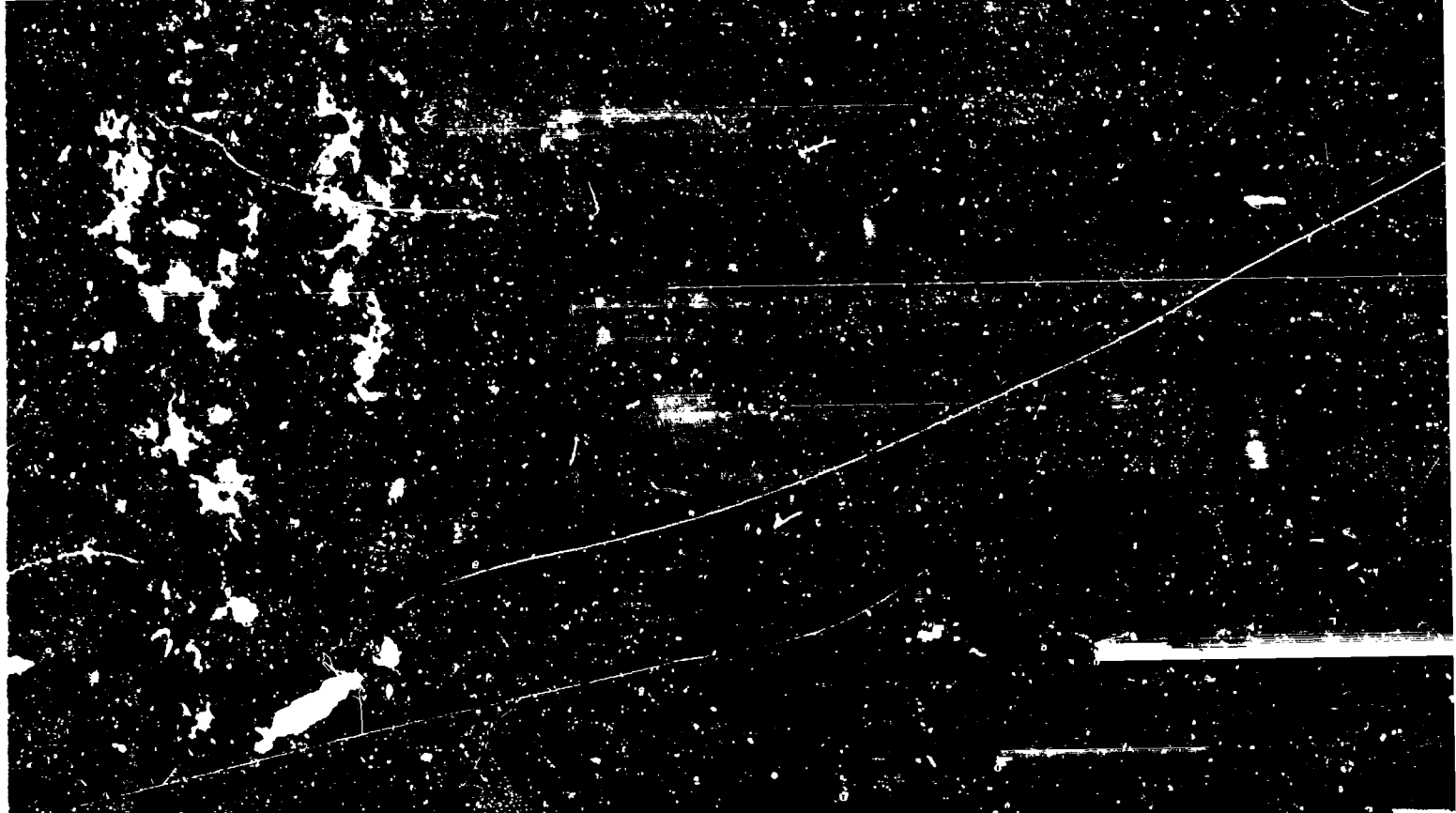
E

R

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I
S
T
A
N

YUMA SAND
(CROSS REL)

4



YUMA TEST STATION (GROSS RELIEF OF COMPONENT HILLS: 7)

0 HILLS
- 100 ft.



CHARACTERISTIC RELIEF

Characteristic relief may be either restorative or gross. Restorative relief is based on medial classes of stream length, elevation differential per unit area, or prominence height. This is further defined under type I and type II relief, below. Gross relief indicates the medial height of component hills as the medial depth of component low.

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

Relief is defined as the medial vertical distance from interflow areas to the immediately adjacent flow line, or in areas where drainage lines are poorly developed a "looking" from contour to adjacent flow.

- 1. Characteristic relief between 0 and 25 feet.
- 2. Characteristic relief between 25 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 medial maximum difference in elevation per square mile, or in areas where drainage lines are poorly developed a "looking" from contour to adjacent flow.

• Usually restricted to areas of 25 square miles or less of elevation differential.

- 4. Characteristic relief between 0 and 250 feet.
- 5. Characteristic relief between 250 and 500 feet.
- 6. Characteristic relief between 500 and 1,000 feet.
- 7. Characteristic relief greater than 1,000 feet.

RELIEF CLASSIFICATION (Applied only to the above classification)

Long drainage - defined as a drainage line which is continuous over a distance of 10 miles or more.

- 1. Relief of small, isolated hills.
- 2. Relief of small, isolated hills.
- 3. Relief of small, isolated hills.

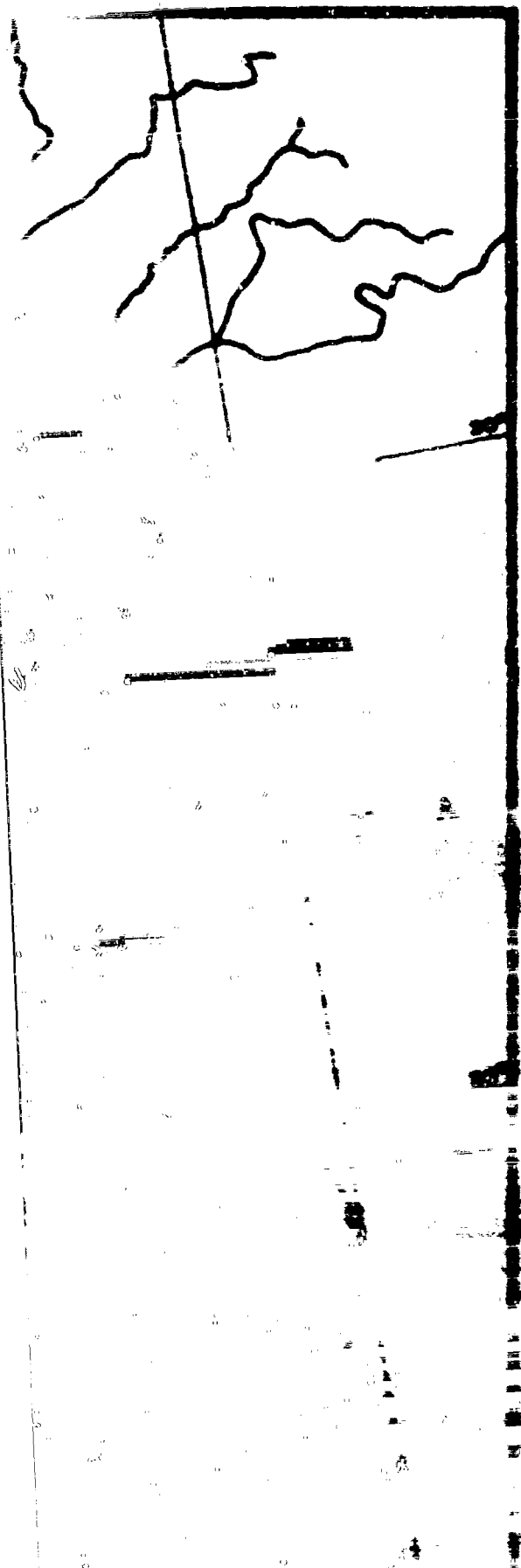






YUMA SAND HILLS
(GROSS RELIEF: 5)

YUMA TEST STATION
(GROSS RELIEF OF COMPONENT HILLS: 7)



CHARACTERISTIC RELIEF

Characteristic relief may be either restrictive or grade. Restrictive relief is based on model elevation of stream depth, elevation of threshold per unit area, or geomorphologic height. This is further defined under type I and type II relief. Grade relief indicates the model height of component hills or the model depth of component lines.

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

Relief is defined as the model vertical distance from threshold crest to the immediately adjacent flow line, or in areas where drainage lines are poorly developed or lacking, from summit to adjacent line.

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

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

Relief is defined as the model maximum difference in elevation per square mile, or in areas where drainage lines are poorly developed or lacking, from summit to adjacent line.

- Usually restricted to model area maximum height of dunes in areas where known.

- 4. Characteristic relief between 0 and 100 feet.
- 5. Characteristic relief between 100 and 400 feet.
- 6. Characteristic relief between 400 and 1,000 feet.
- 7. Characteristic relief greater than 1,000 feet.

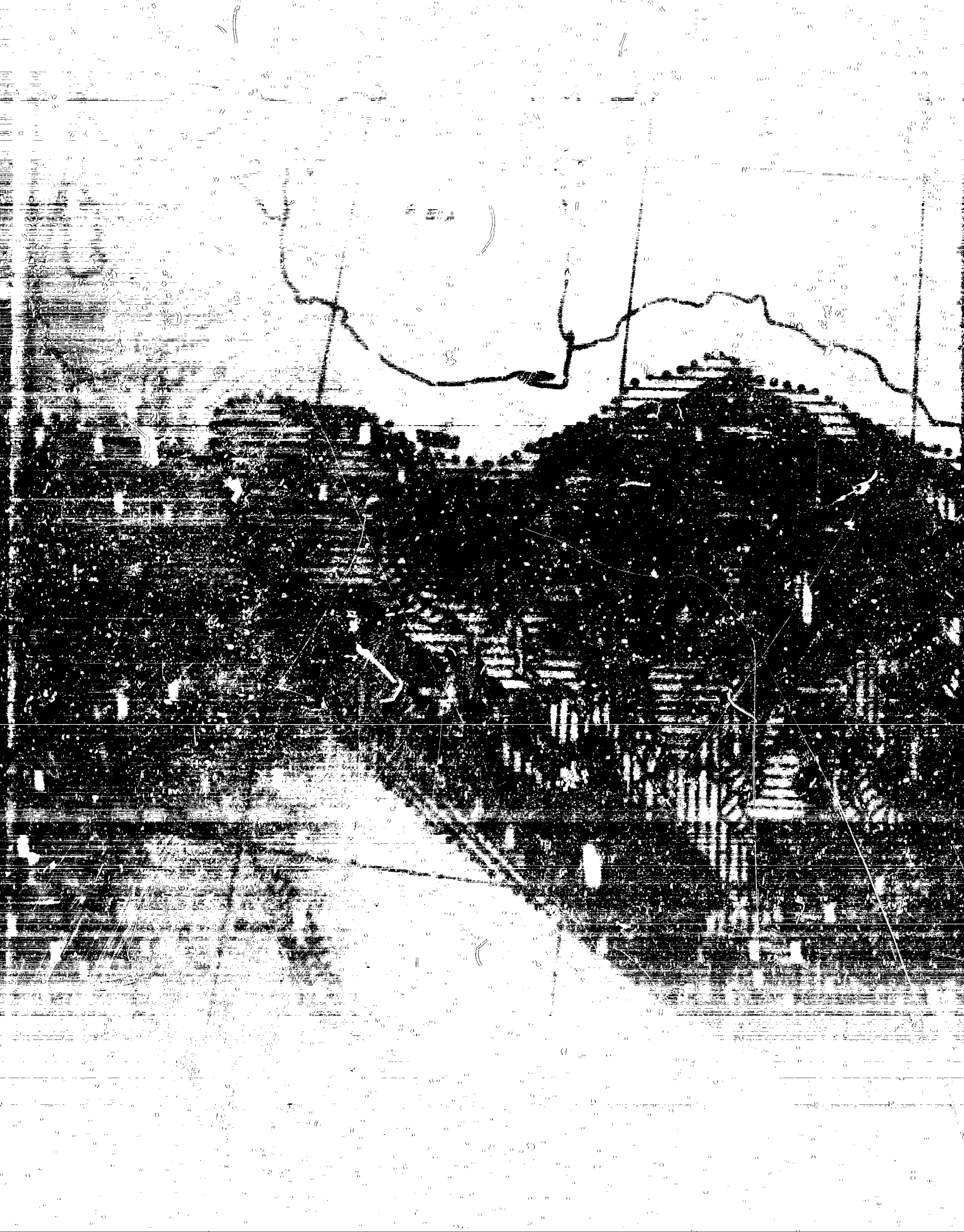
RELATIVE COMPLEXITY - Indicated only where plan-profile complexity is high. Complexity is defined as areas where topographic, geologic, and hydrologic features are all of the maximum type and extent.

- 1. Relief of mostly gradeless hills.
- 2. Relief of mostly gradeless hills.
- 3. Relief of mostly gradeless hills.
- 4. Relief of mostly gradeless hills.

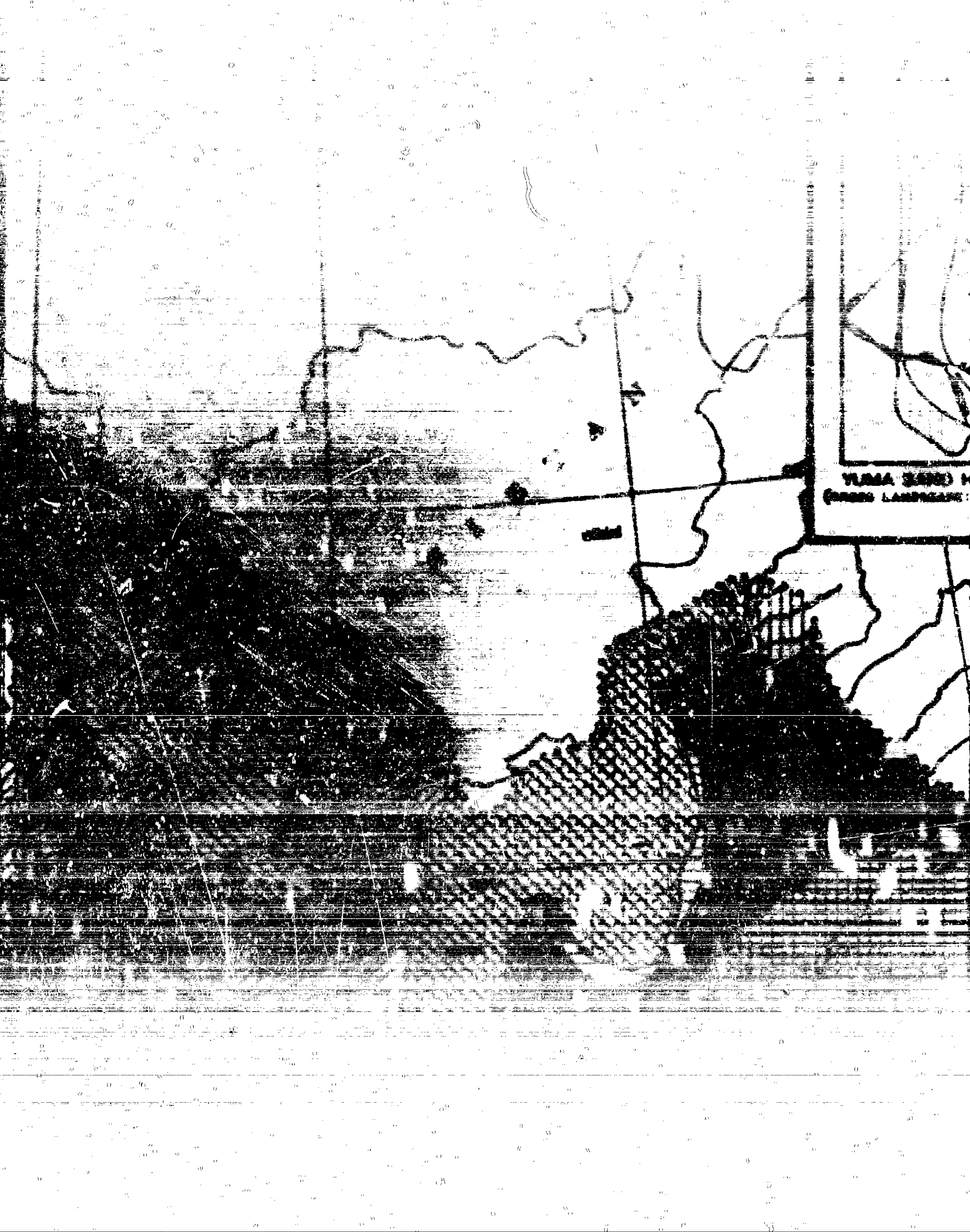
Grade-complexity - Indicated only where plan-profile complexity is high. Complexity is defined as areas where topographic, geologic, and hydrologic features are all of the maximum type and extent.

- 5. Grade relief of component hills.
- 6. Grade relief of component hills.
- 7. Grade relief of component hills.
- 8. Grade relief of component hills.

Stream Relief - A stream is defined as a line of water flow. Stream relief is defined as the model vertical distance from the stream bed to the immediately adjacent flow line, or in areas where drainage lines are poorly developed or lacking, from the stream bed to the immediately adjacent flow line.



YUMA 1950 M
(BIRD LAMPREY)





YUMA TEST STATION
(ORIGIN LANDSCAPE: B.L. 1, 2, 3)

SAND HILLS
(ORIGIN: B.L. 1, 2, 3)



GENERALIZED LANDSCAPE

WEST CENTRAL AREA

YUMA

SOUTH CENTRAL AREA

YUMA

PP	SS	CS	CL
1	2	3	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

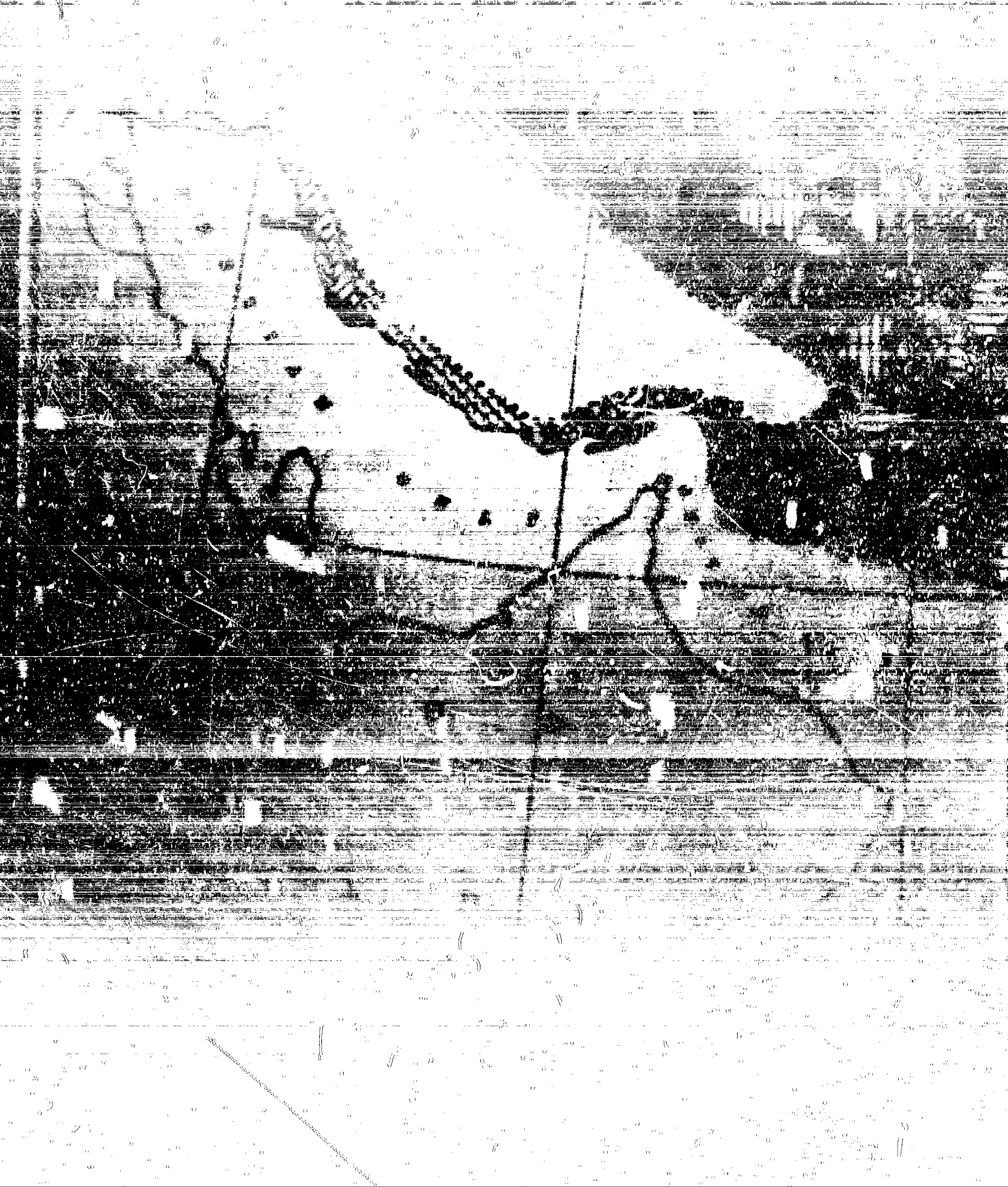
PP	SS	CS	CL
1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24
25	26	27	28
29	30	31	32
33	34	35	36
37	38	39	40
41	42	43	44
45	46	47	48
49	50	51	52
53	54	55	56
57	58	59	60
61	62	63	64
65	66	67	68
69	70	71	72
73	74	75	76
77	78	79	80
81	82	83	84
85	86	87	88
89	90	91	92
93	94	95	96
97	98	99	100

Typical
Landscape
West, central
or central Yuma

PP	SS	CS	CL
1	2	3	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

PP	SS	CS	CL
1	2	3	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

Typical
Landscape
West, central
or central Yuma







[illegible]





1954 SUMMARY

NEW YORK AREA

1. NEW YORK CITY
The New York City area is the largest and most important of the New York State areas. It includes the five boroughs of New York City and the surrounding areas.

2. NEW YORK STATE
The New York State area is the second largest and most important of the New York State areas. It includes the entire state of New York.

3. NEW YORK COUNTY
The New York County area is the third largest and most important of the New York State areas. It includes the entire county of New York.

4. NEW YORK TOWNSHIP
The New York Township area is the fourth largest and most important of the New York State areas. It includes the entire township of New York.

5. NEW YORK VILLAGE
The New York Village area is the fifth largest and most important of the New York State areas. It includes the entire village of New York.

6. NEW YORK CITY
The New York City area is the sixth largest and most important of the New York State areas. It includes the five boroughs of New York City and the surrounding areas.

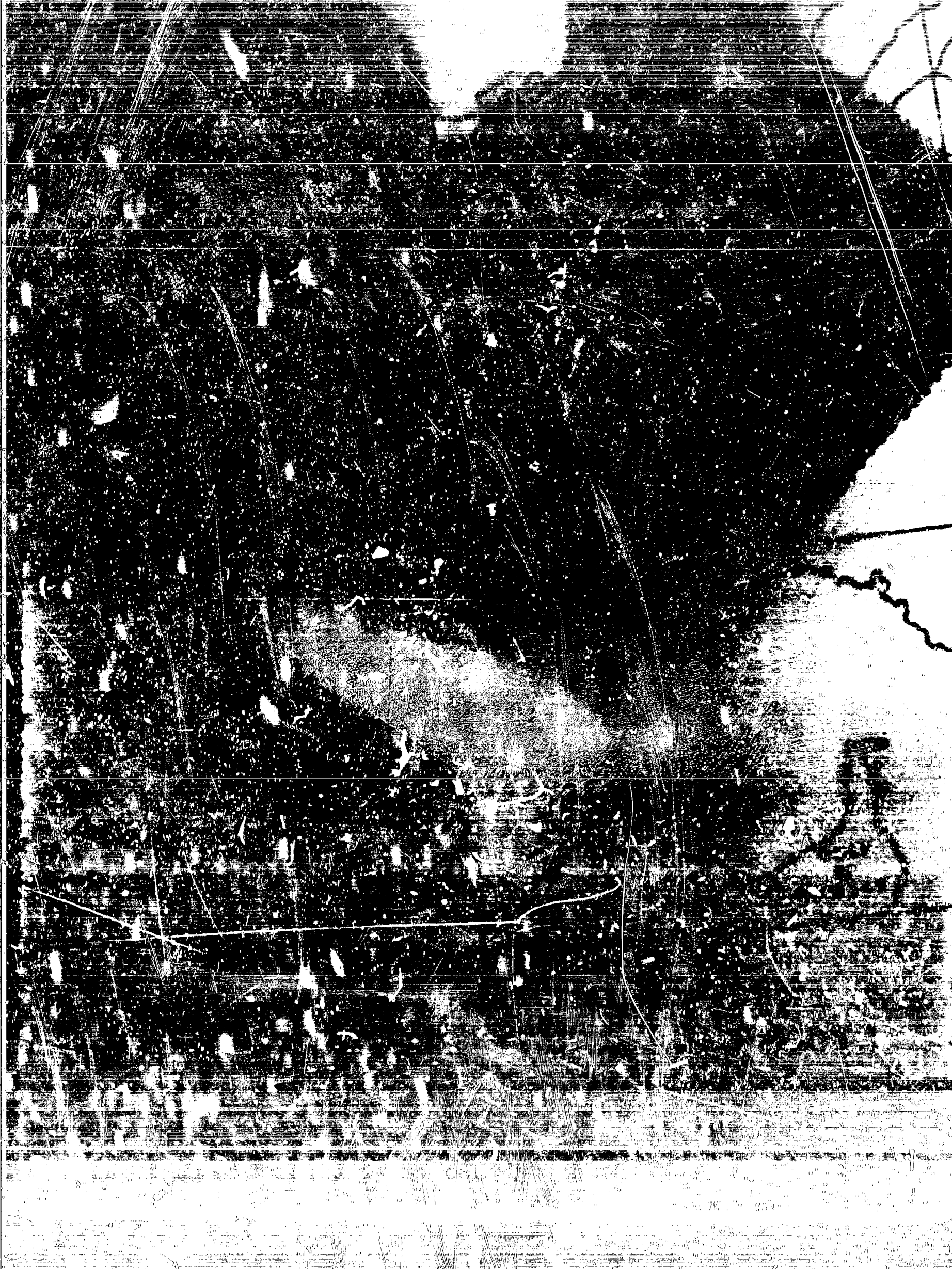
7. NEW YORK STATE
The New York State area is the seventh largest and most important of the New York State areas. It includes the entire state of New York.

8. NEW YORK COUNTY
The New York County area is the eighth largest and most important of the New York State areas. It includes the entire county of New York.

9. NEW YORK TOWNSHIP
The New York Township area is the ninth largest and most important of the New York State areas. It includes the entire township of New York.

10. NEW YORK VILLAGE
The New York Village area is the tenth largest and most important of the New York State areas. It includes the entire village of New York.









LEGEND

1. SOIL-ROCK ASSOCIATIONS

- ☒ Areas characterized by a mixture of bare rock and clay with a few scattered patches of coarse and fine-grained soils. Bare rock and clay soils cover more than 50 per cent of the area mapped.
 - ☒ Areas characterized by a mixture of bare rock and clay with numerous patches of coarse and fine-grained soils. Bare rock and clay soils cover from 30 to 50 per cent of the area mapped.
 - ☒ Areas characterized by a mixture of bare rock and fine-grained soils with numerous patches of coarse and clay soils. Bare rock and clay soils cover from 20 to 30 per cent of the area mapped.
 - ☐ Areas where patches of soil consist of unconsolidated deposits of volcanic ash or sand.
- Clay soils: More than 75 per cent of a typical sample consists of material coarser than gravel. Fine-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.

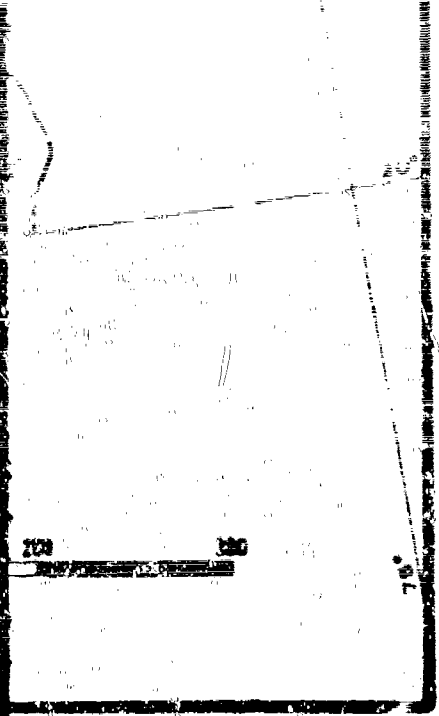
2. SOIL ASSOCIATIONS

Areas predominantly (75 per cent or more) soil and clay. Areas mapped cover include some 50 per cent bare rock and clay soils.

- COARSE:** ☒ More than 75 per cent of a typical sample consists of gravel.
- MEDIUM:** ☒ More than 50 per cent of a typical sample consists of sand.
- FINE:** ☒ Sand and gravel not so with major amounts of clay material. More than 50 per cent of a typical sample consists of sand and/or gravel.
- CLAY:** ☒ Soil and clay with major amounts of coarse material. More than 50 per cent of a typical sample consists of silt and/or clay.
- PEAT:** ☒ More than 75 per cent of a typical sample consists of peat.
- WATER:** ☒ More than 50 per cent of a typical sample consists of water.
- ICE:** ☒ More than 50 per cent of a typical sample consists of ice.
- ROCK:** ☒ Bare rock and clay with a small amount of soil. More than 50 per cent of a typical sample consists of bare rock and clay.

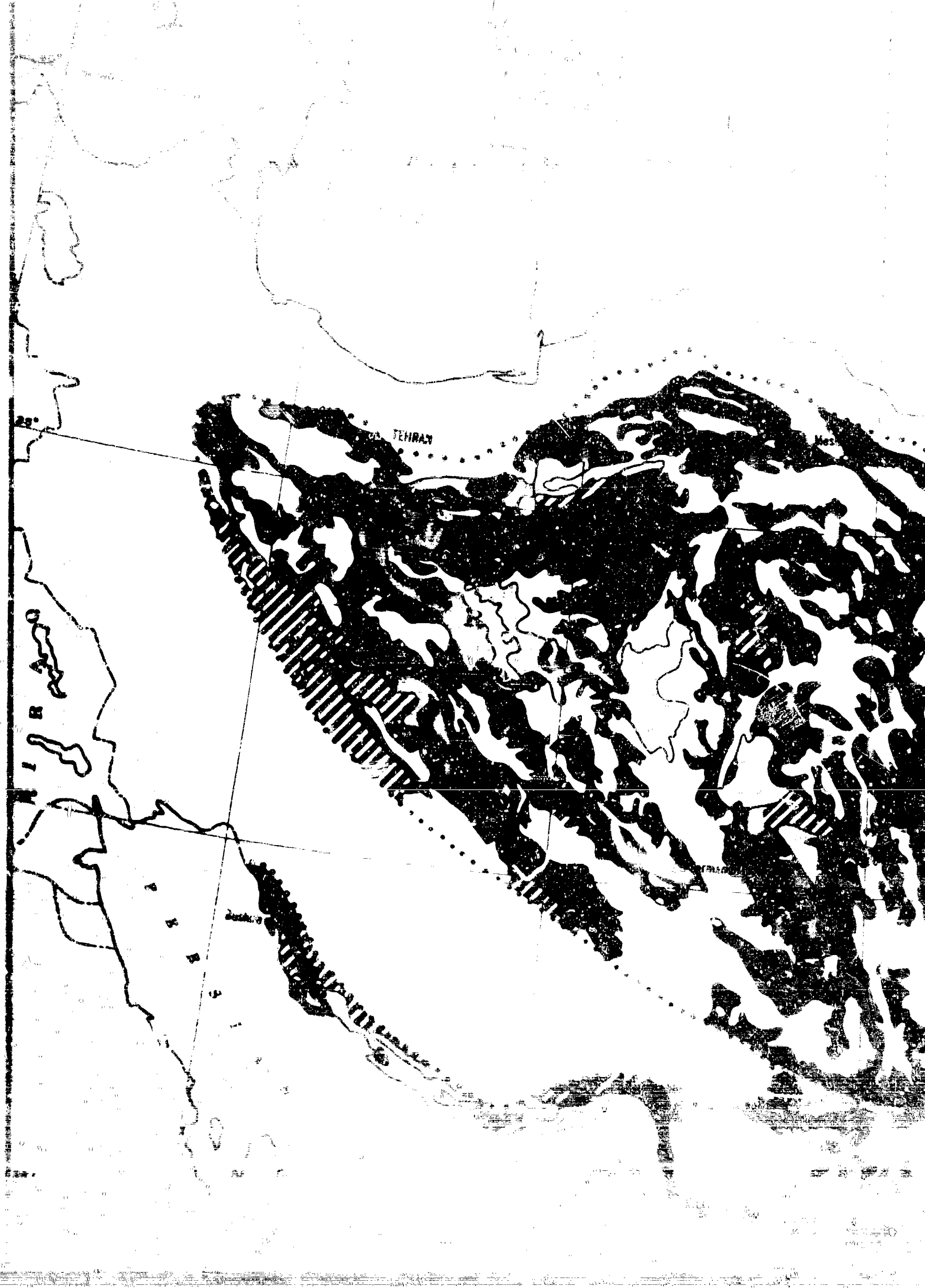
Areas where the soil is covered by a thin layer of vegetation. More than 50 per cent of a typical sample consists of soil and/or clay. Areas where the soil is covered by a thin layer of vegetation. More than 50 per cent of a typical sample consists of soil and/or clay. Areas where the soil is covered by a thin layer of vegetation. More than 50 per cent of a typical sample consists of soil and/or clay.

8



ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT
SOIL CONSISTENCY

PLATE 7



S

S

R

3

7

40°

25°

YUMA SAND HILL

Herat

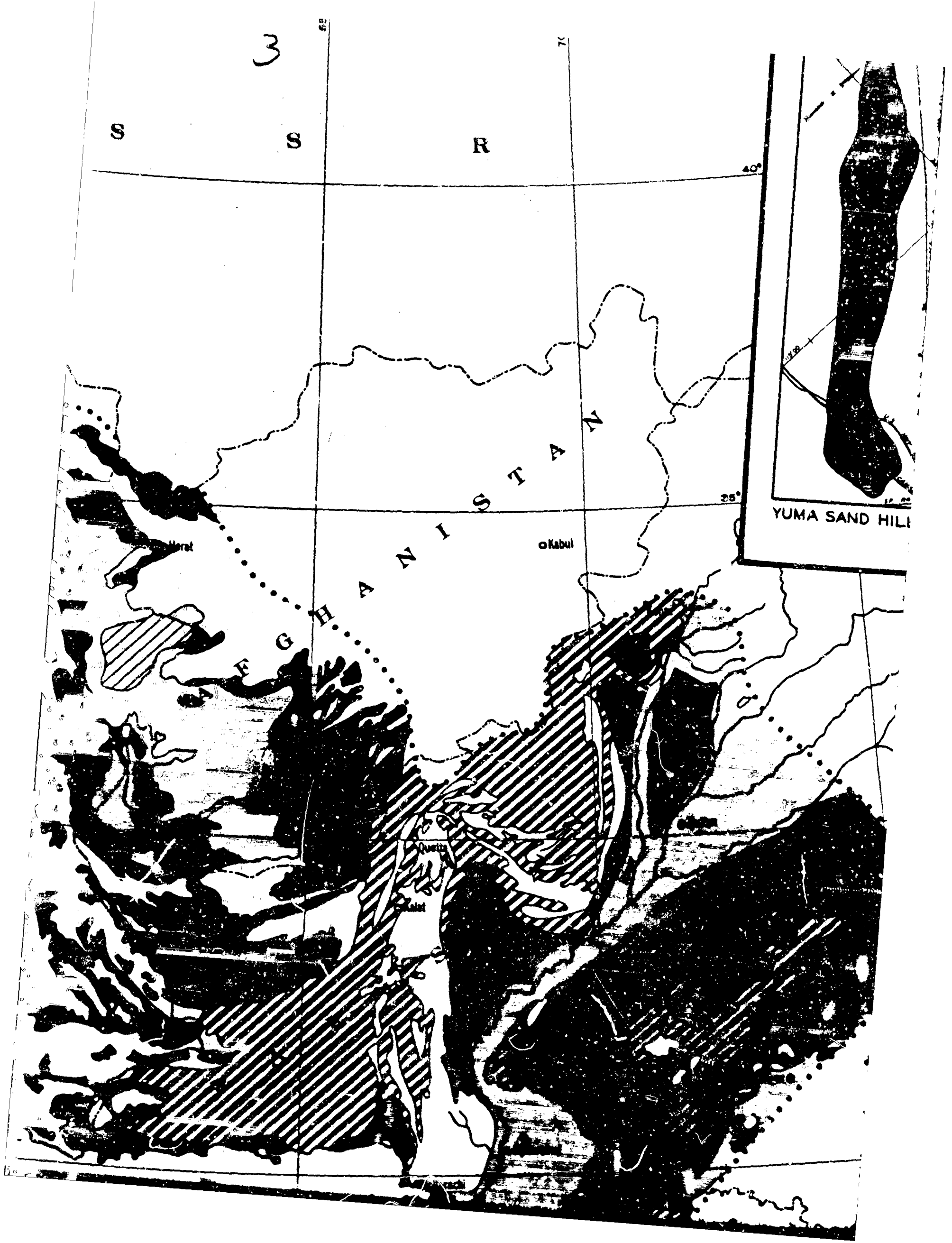
Kabul

A F G H A N I S T A N

Quetta

Kashgar

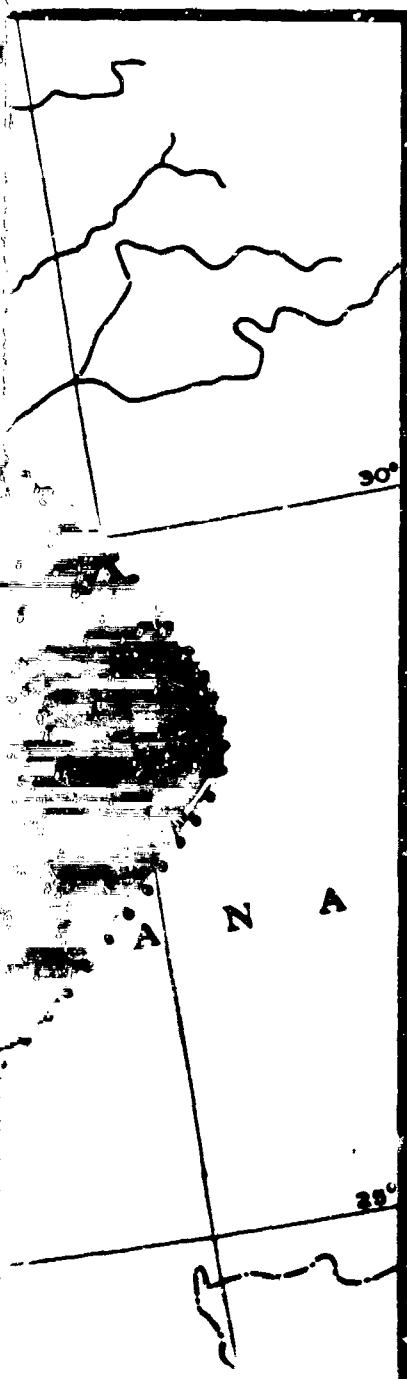
Yechi





YUMA TEST STATION

D HILLS



SOIL CONSISTENCY

Soil consistencies are mapped only where soil associations occur. Areally predominant (70 per cent or more) soil consistency mapped.

I. HOMOGENEOUS CONSISTENCIES. Soils of essentially un- changed 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 mutual attraction of the particles themselves, or because of the presence of a cementing material.

3. Soft: (usually) permanently wet. Little or no bearing capacity.

4. Firm: Moderate bearing capacity.

5. Hard: High bearing capacity.

II. LAYERED CONSISTENCIES. 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.

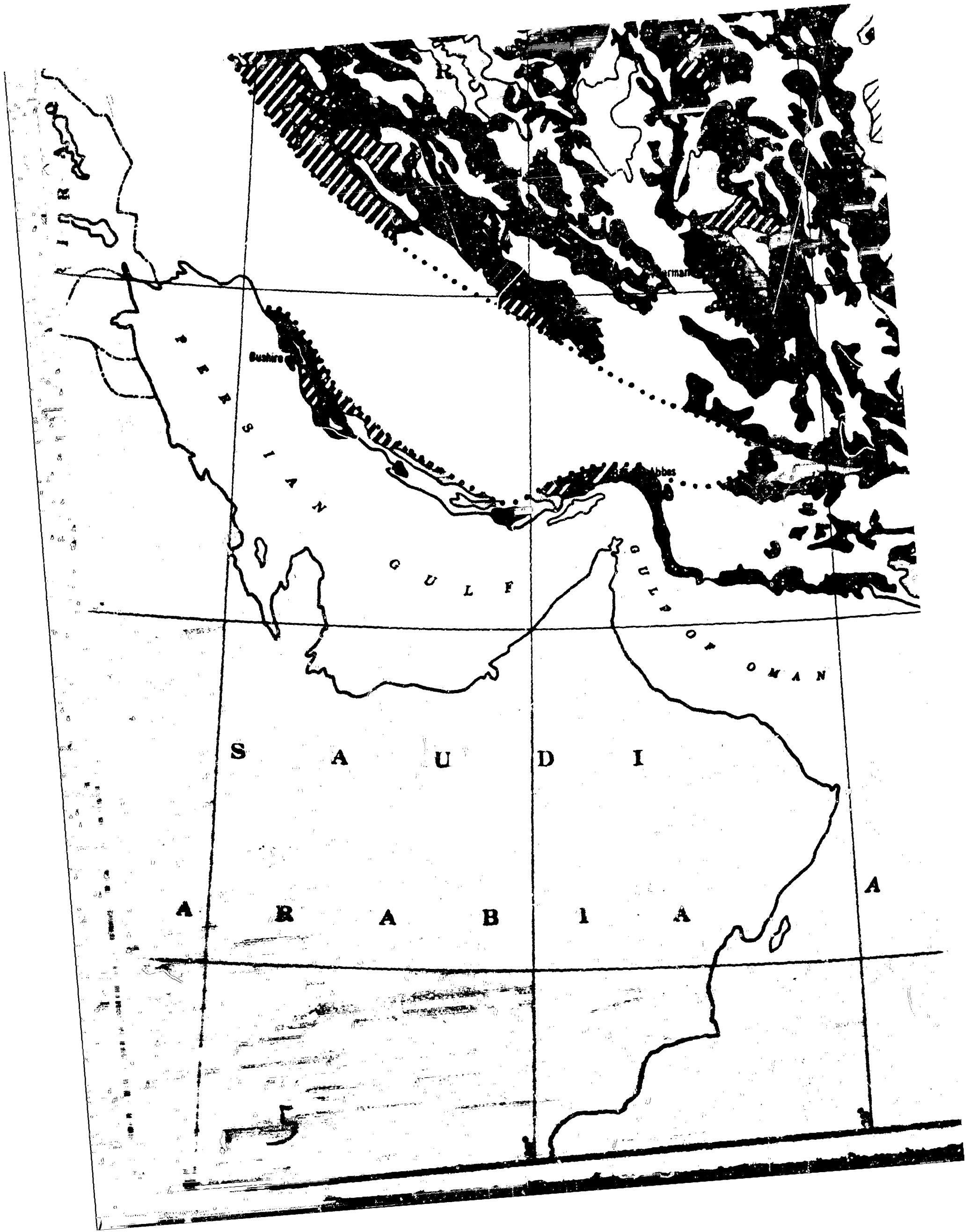
6. Hard than crust (commonly of cemented materials)
overlying soft materials (commonly silt, sand, or
saturated silt).

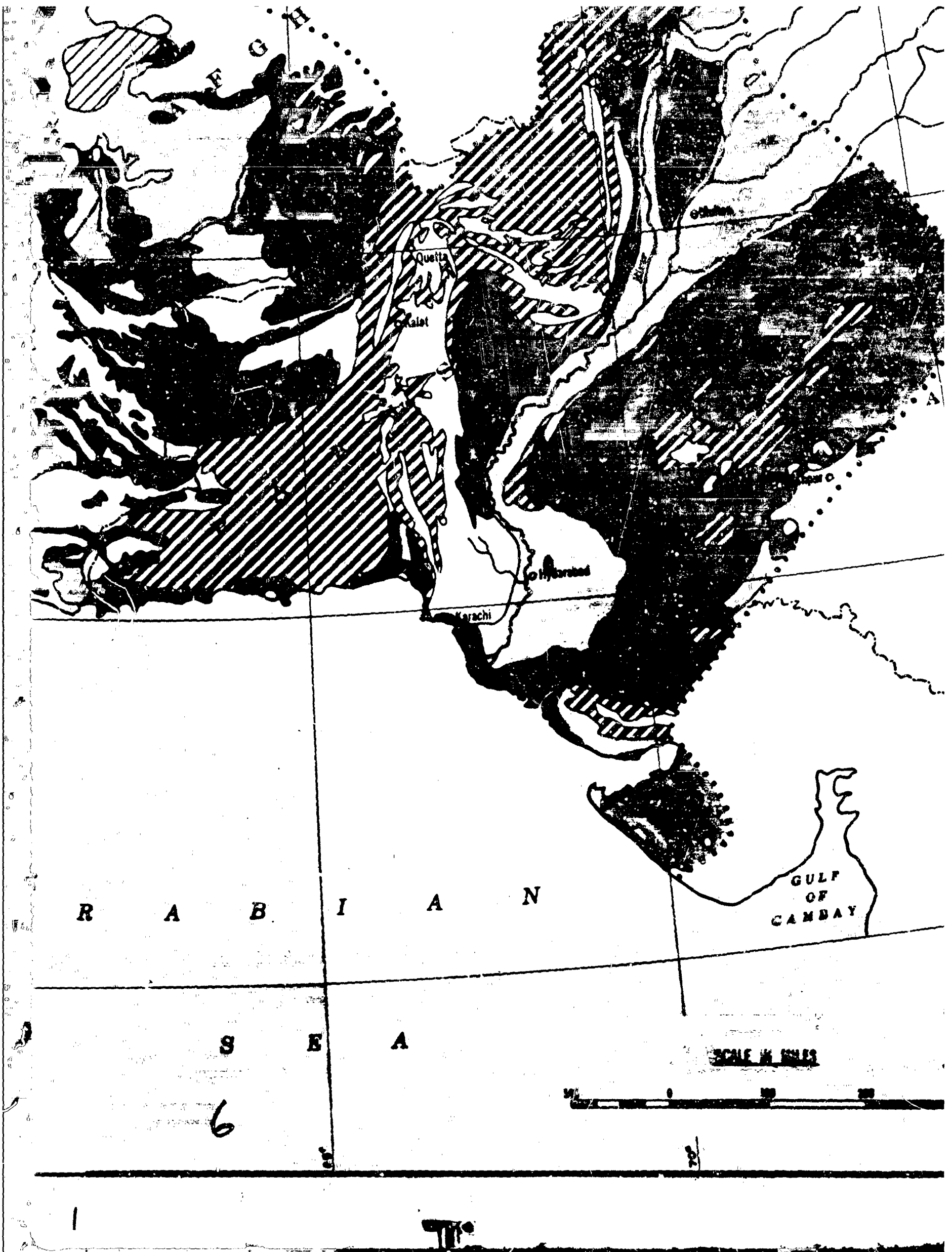
7. Hard crust (commonly of cemented materials) over-
lying noncohesive material (commonly sand or
silt).

8. Thin zone of firm materials over noncohesive mate-
rials. (Most common development in areas of fixed
dunes, with more or less continuous vegetation
cover.)

9. Surface of closely-fitted noncohesive pebbles or
gravel overlying noncohesive materials (commonly
sand or silt). (Such "desert pavements" also occur
over bedrock or materials of firm consistency, but
this is less common.)

B. Noncohesive surface layer less than 12 inches thick.





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GULF
OF
CAMBAY

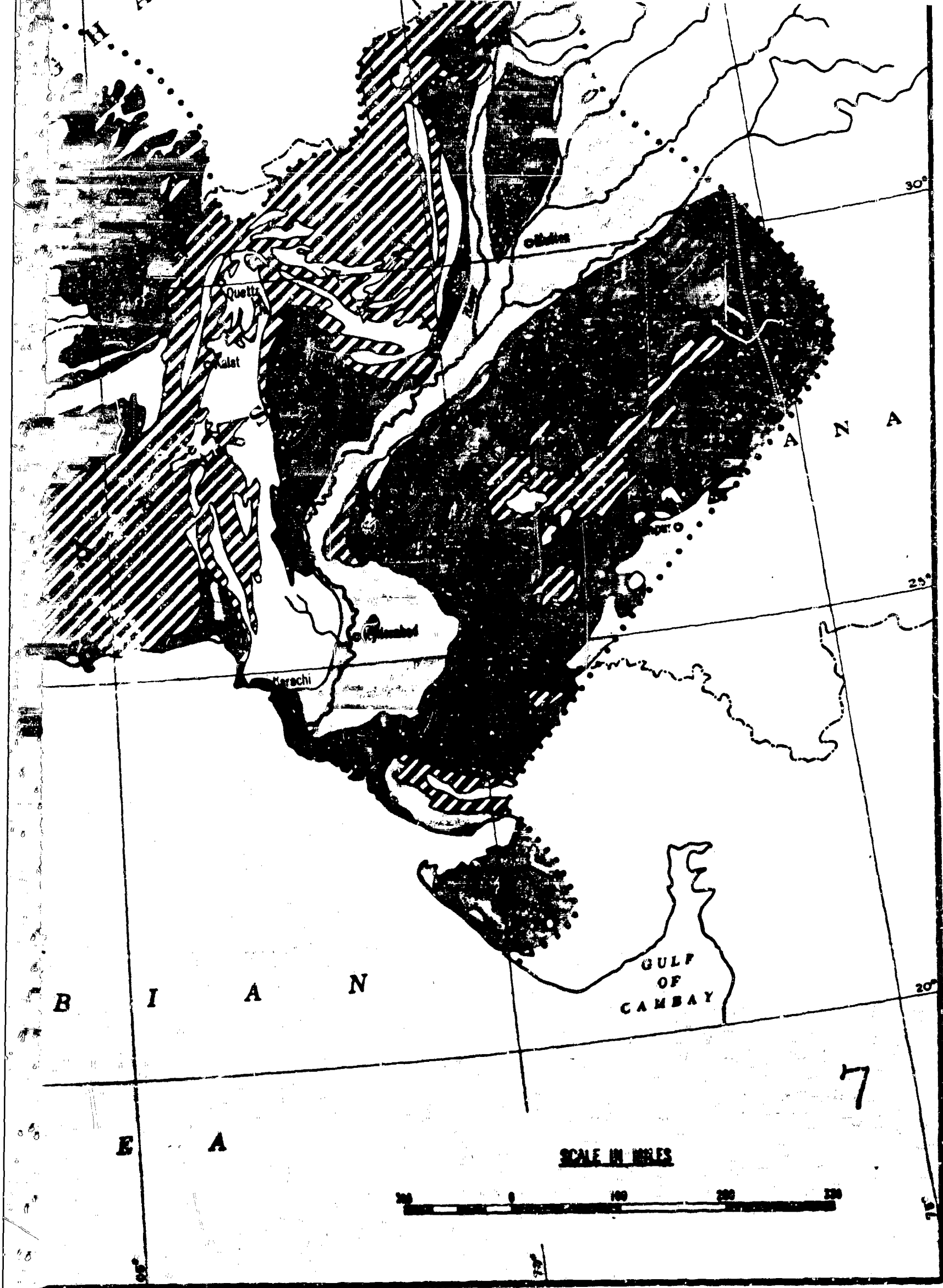
SCALE IN MILES



6

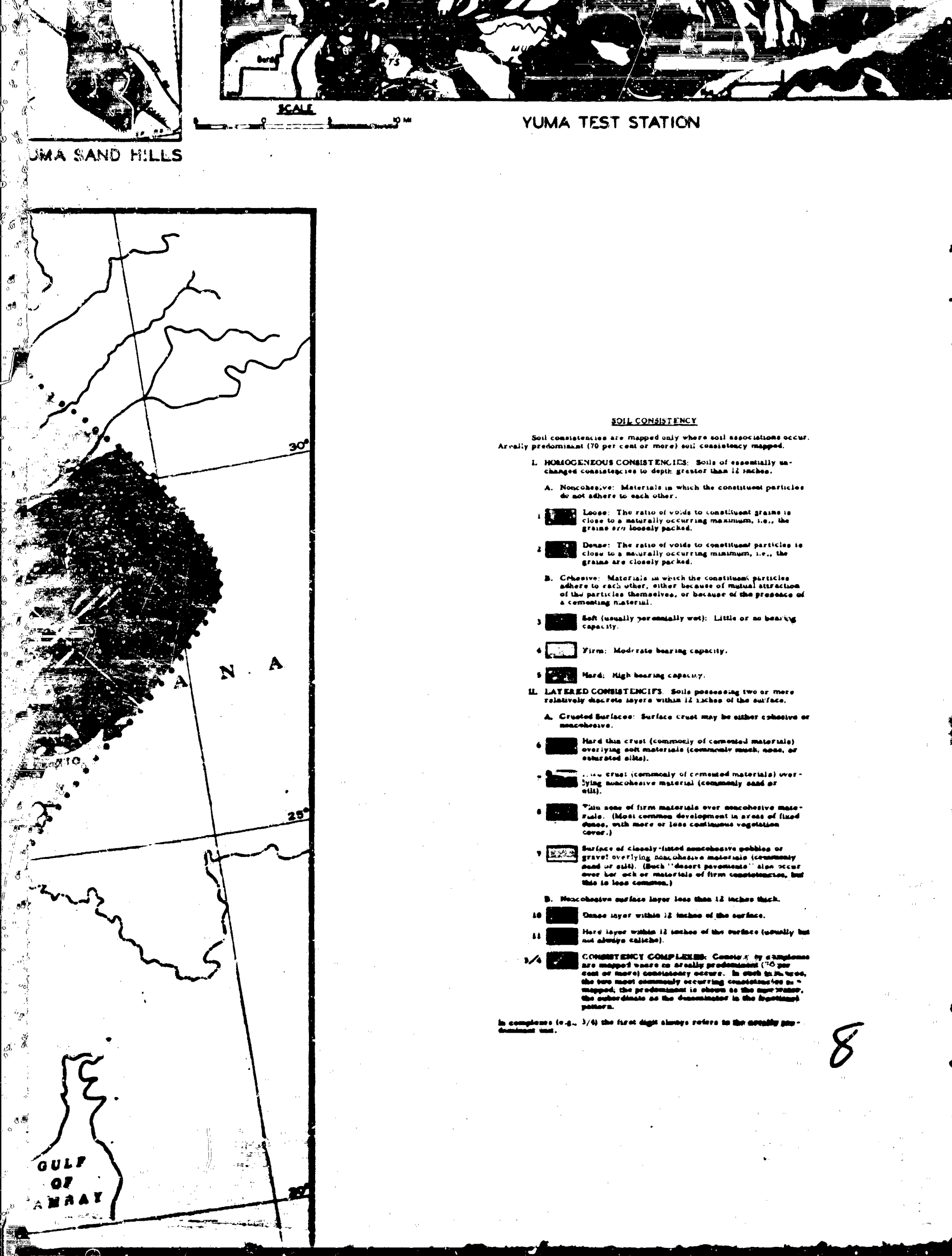
1

T



SCALE IN MILES





YUMA SAND HILLS

YUMA TEST STATION

SOIL CONSISTENCY

Soil consistencies are mapped only where soil associations occur. Areally predominant (70 per cent or more) soil consistency mapped.

I. HOMOGENEOUS CONSISTENCIES: 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 mutual attraction of the particles themselves, or because of the presence of a cementing material.

3.  Soft (usually permanently wet): Little or no bearing capacity.

4.  Firm: Moderate bearing capacity.

5.  Hard: High bearing capacity.

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

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

6.  Hard thin crust (commonly of cemented materials) overlying soft materials (commonly sand, silt, or saturated silt).

7.  Thin crust (commonly of cemented materials) overlying noncohesive material (commonly sand or silt).

8.  Thin zone of firm materials over noncohesive mass. (Most common development in areas of fixed dunes, with more or less continuous vegetation cover.)

9.  Surface of closely-fitted noncohesive pebbles or gravel overlying noncohesive materials (commonly sand or silt). (Such "desert pavements" also occur over bed rock or materials of firm consistencies, but this is less common.)

B. Noncohesive 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 (usually but not always caliche).

12.  CONSISTENCY COMPLEXES: Consistencies by themselves are mapped where an areally predominant (70 per cent or more) consistency occurs. In such instances, the two most commonly occurring consistencies are mapped; the predominant is shown as the background, the subordinate as the dominant in the foreground pattern.

In complexes (e.g., 3/4) the first digit always refers to the areally predominant unit.

8

Rock Type	Abrasion-Resistance					Permeability					Strength in Comp. - Wetted Core					Load Strength in Tunnels					Loading Capacity					Compressive Subgrade					Dimension Stone					Road Metal					Substructure Aggregate					Concrete Aggregate					Pile																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX		AY	AZ																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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Abrasion (as it affects excavation tools and equipment).

- A. Severe
- B. Severe
- C. Moderate
- D. Slight
- E. Minimal

Toile and proceeds, as required in concrete rock.

- a. Spalls and shovels
- b. Pick and shovel
- c. Pick, crowbar, and wedge
- d. Expanded drilling and blasting
- e. Almost continuous drilling and blasting

All other properties.

- 1. Excellent
- 2. Good
- 3. Adequate a. for
- 4. Poor or usable only in emergency
- 5. Undesirable, unsuitable, or absent

Adapted from Van Buren, Burd, and others, 1950.

ANALOGS OF YUMA TERRAIN IN THE SOUTH CENTRAL ASIAN DESERT SURFACE ROCK

PLATE 1

2

Kara-Bogaz
Gol

U

S

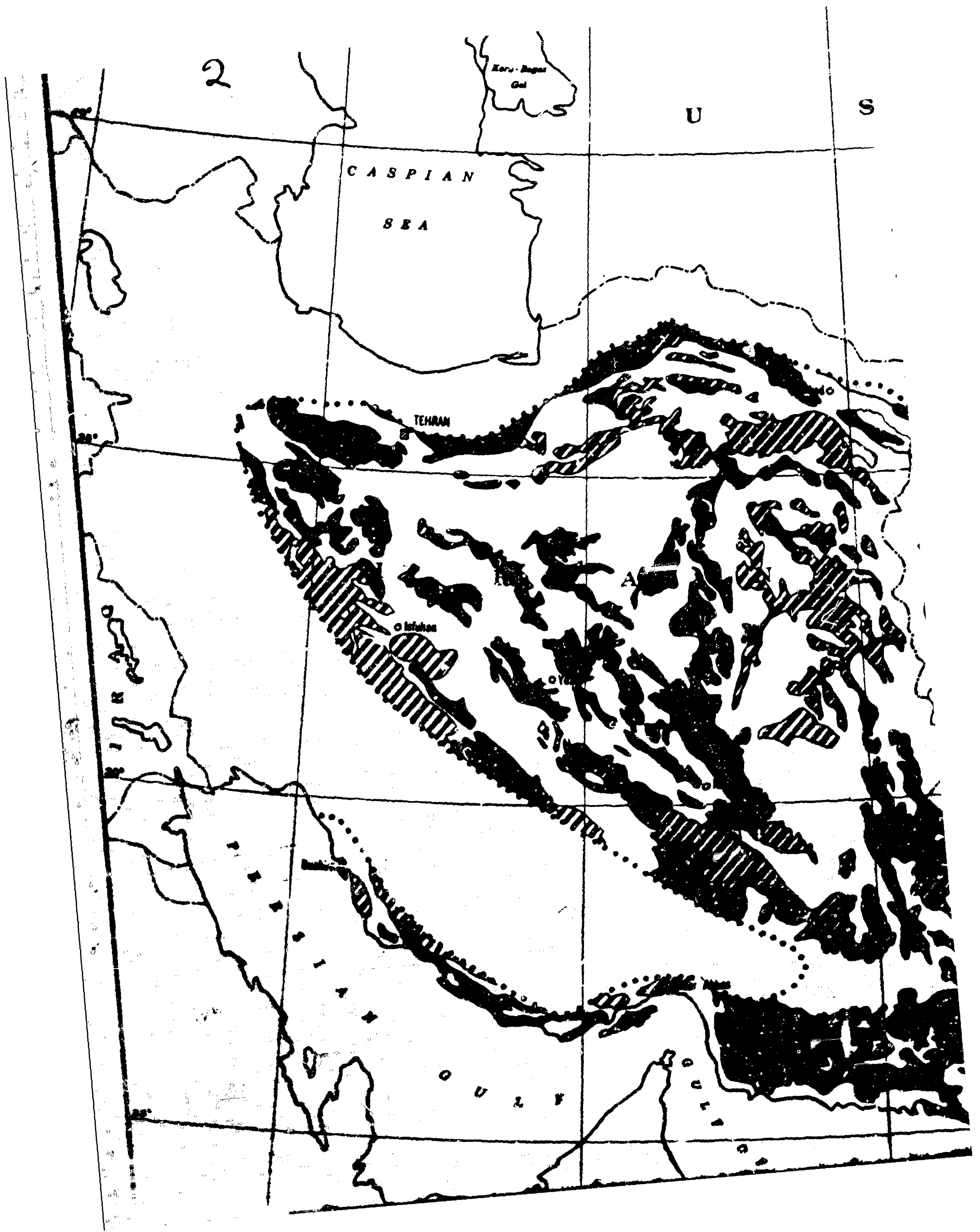
CASPIAN
SEA

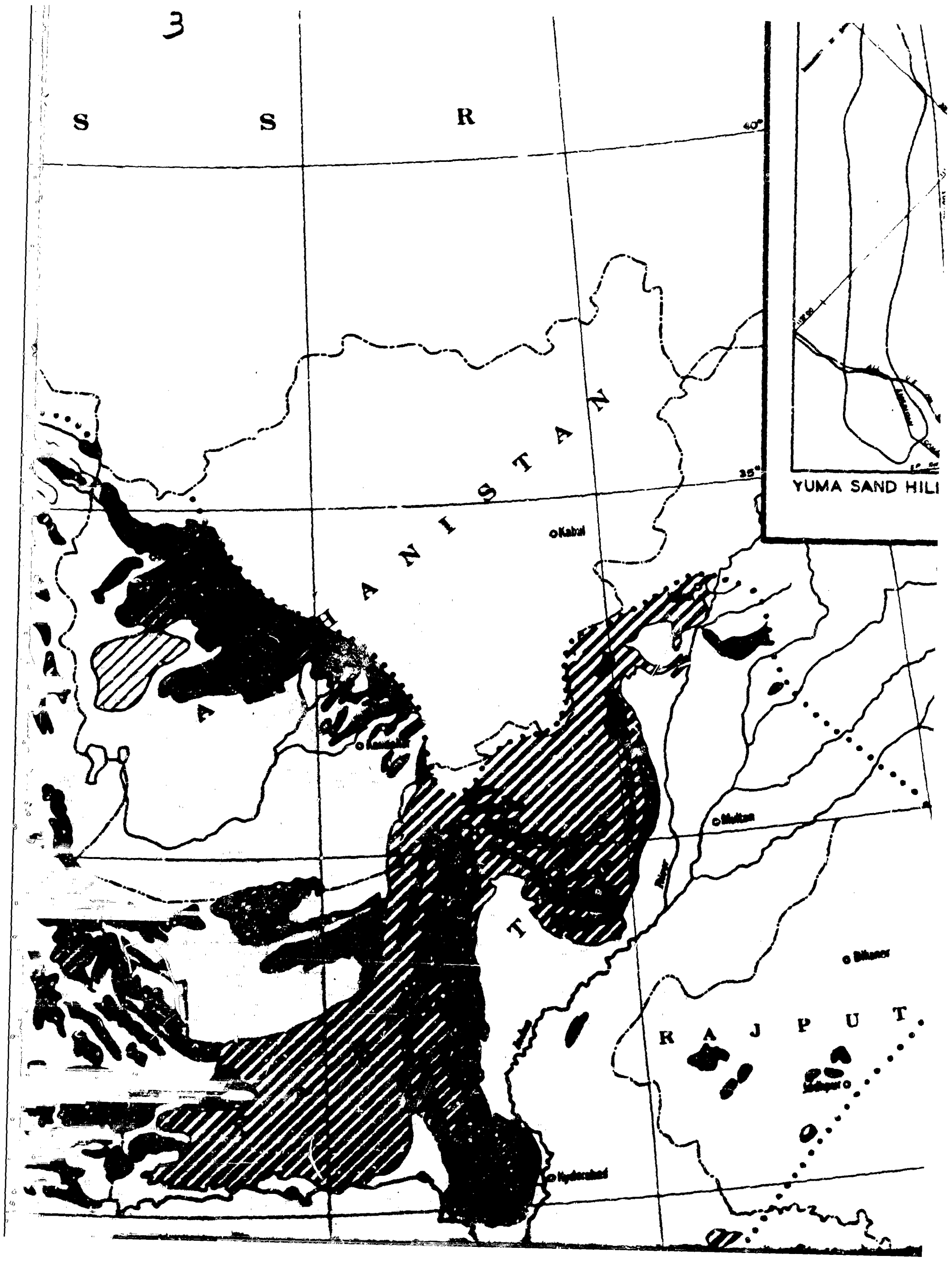
TEHRAN

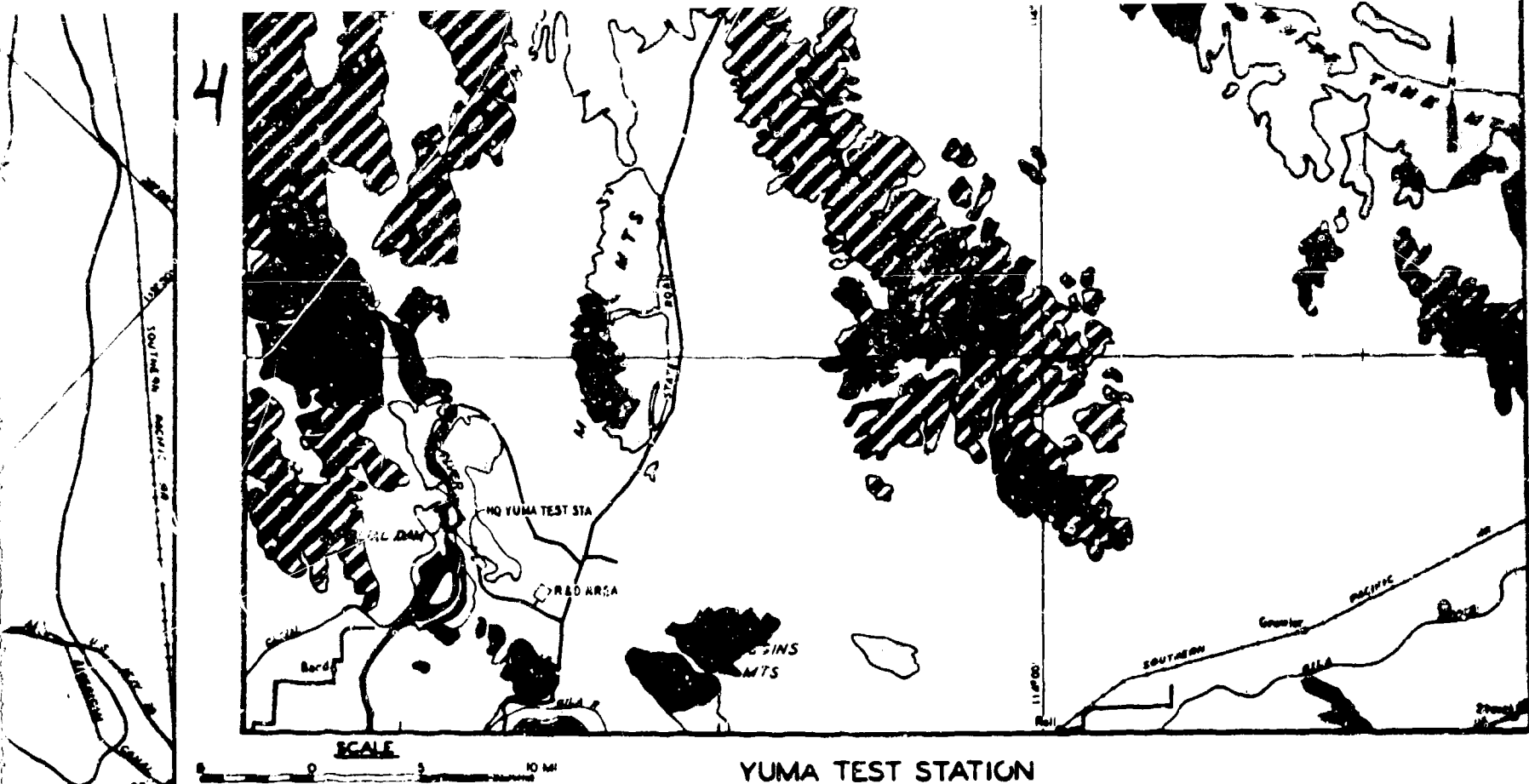
Isfahan

U
Z
B

A
F
G







YUMA TEST STATION

SURFACE ROCK

Mapped in regions where rock is exposed and at shallow depths (i.e., 0-10 feet) throughout the remainder of the area. In effect this procedure restricts the mapping of surface rock to areas mapped as 1, 2, or 3 under Soil Type.

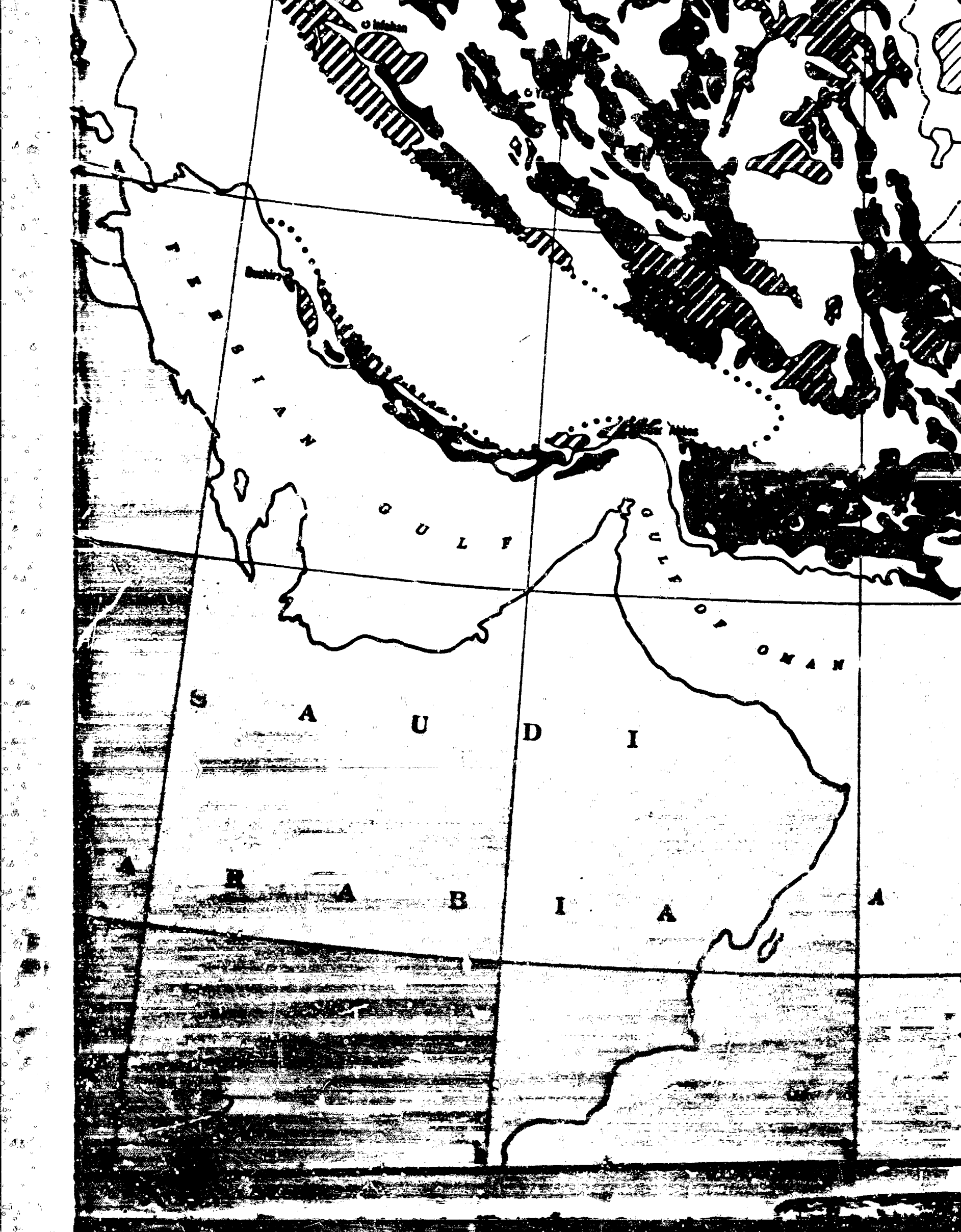
Areally predominant (70 per cent or more) rock type mapped.

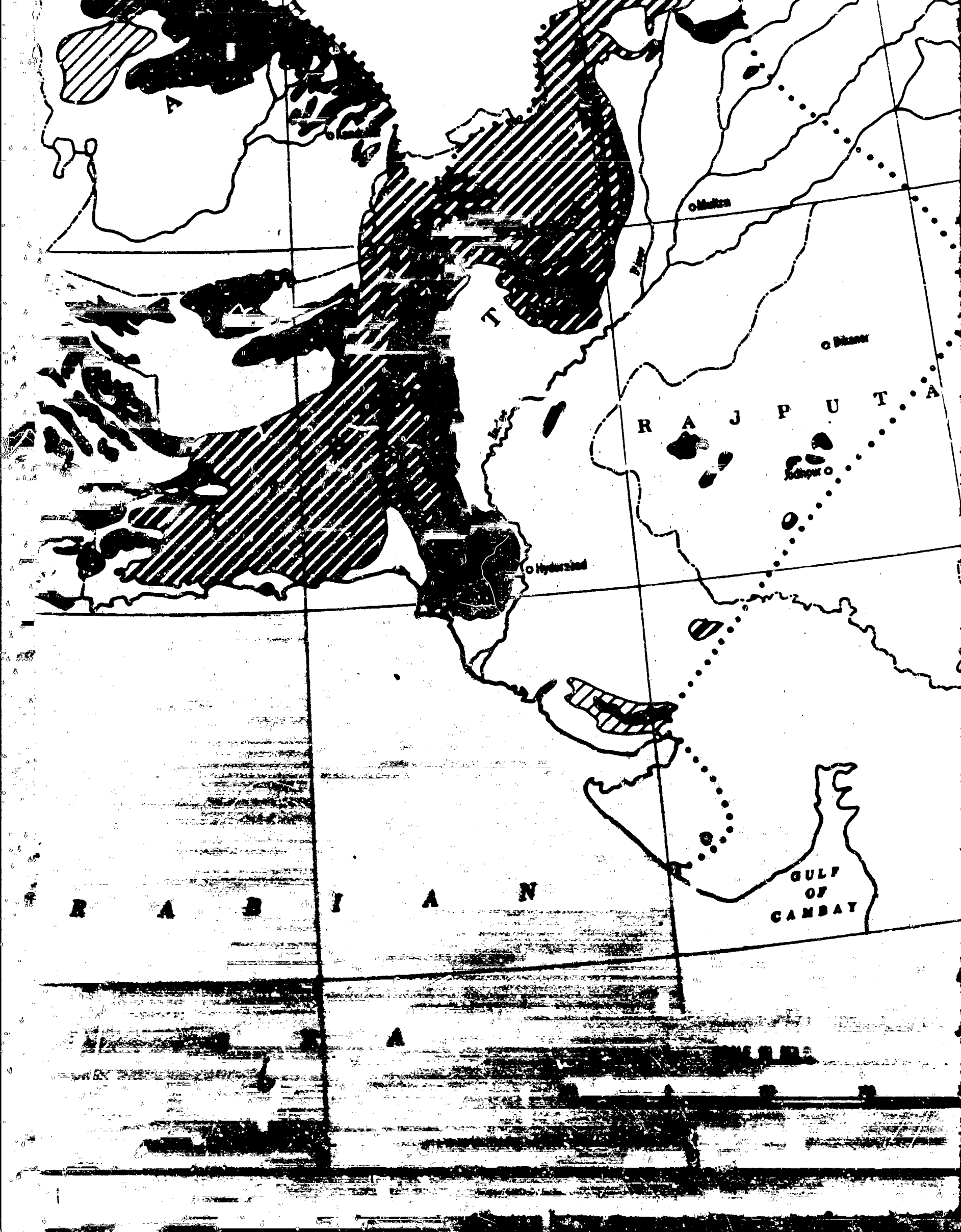
- 1 **IGNEOUS (UNDIFFERENTIATED):** Rocks formed by solidification or crystallization of a hot fluid mass.
- 2 **Intrusive:** Igneous rocks, typically crystalline, which have formed by cooling below the surface of the earth. (Granite, syenite, diorite, etc.)
- 3 **Extrusive (undifferentiated):** Igneous rocks which have formed by cooling at the surface of the earth.
 - 3a True extrusive rocks formed by solidification of molten material that poured out on the surface of the earth (e.g., basalt, diorite, etc.).
 - 3b Rocks formed by secondary cementation of loose deposits of volcanic ejecta (e.g., tuff, agglomerate, etc.).
- 4 **METAMORPHIC (UNDIFFERENTIATED):** Rocks formed from original igneous or sedimentary rocks through alterations produced by pressure, heat, or the infiltration of other materials at depths below the surface zones of weathering and cementation. The alterations are sufficiently complete throughout the body of the rock to produce a well-defined new type. (Gneiss, schist, slate, etc.)
- 5 **SEDIMENTARY (UNDIFFERENTIATED):** Rocks formed from material laid down in a more or less finely divided state, as sediment, through the agency of water, wind, or glaciers.
 - 6 Sandstone: A sedimentary rock predominantly composed of sand grains cemented together.
 - 7 Limestone: A sedimentary rock consisting essentially of calcium carbonate.
 - 8 Shale: A sedimentary rock in which the constituent particles are predominantly of clay size.
 - 9 Evaporites: A sedimentary rock whose origin is largely due to evaporation and subsequent precipitation of salt from water. (Gypsum, anhydrite, and rock salt are the only evaporites of quantitative importance.)
- 10 **ROCK COMPLEXES:** Rock complexes are mapped where no areally predominant (70 per cent or more) rock type occurs. In such instances, the two most commonly occurring rock types are mapped, the predominant is shown as the dominant color, the subordinate as the subordinate in the fractional pattern.

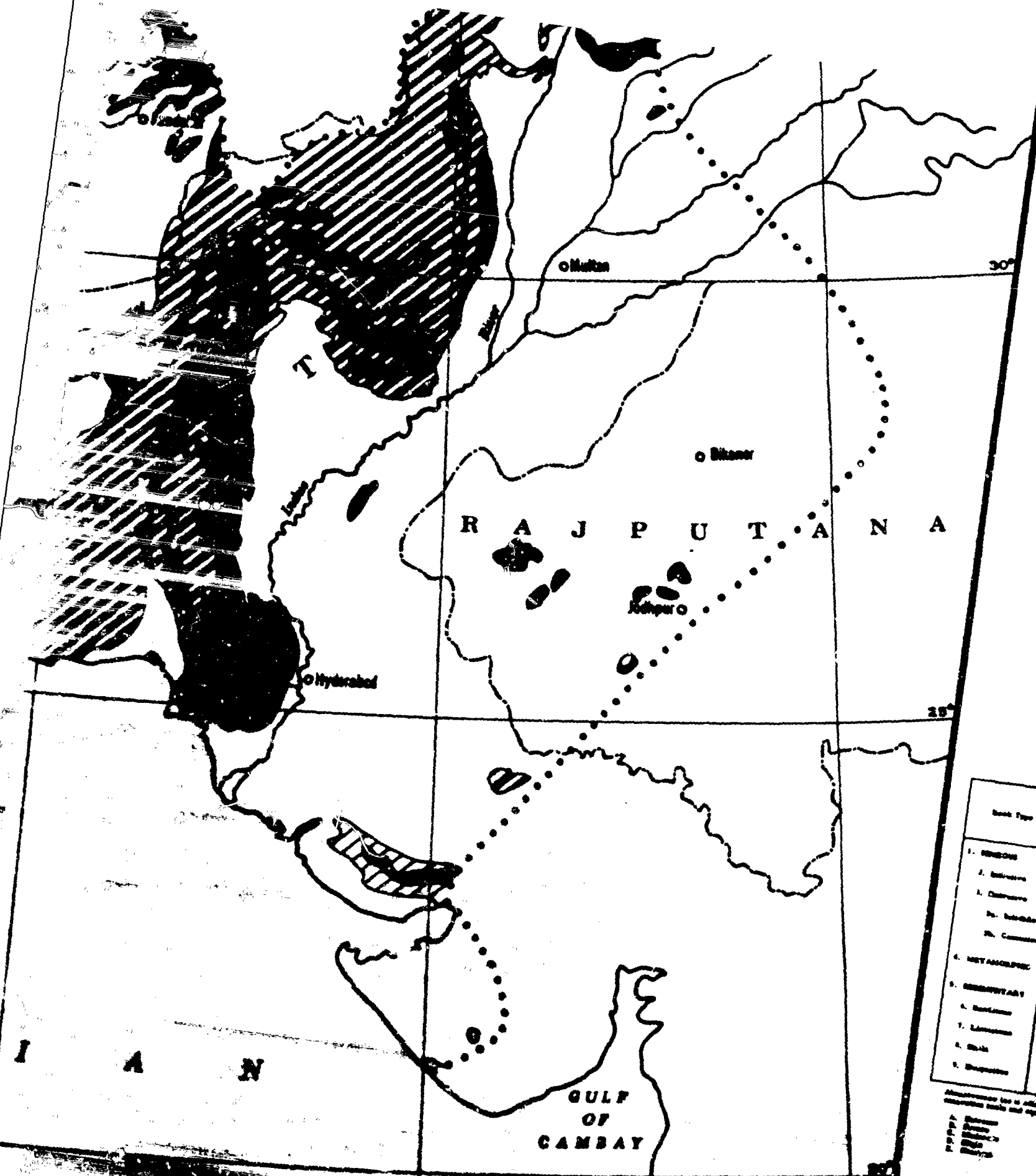
It should be realized that the scale of mapping precludes delineation, especially in mountainous regions, of many alluvial basins where the thickness of soil cover is much greater than 10 ft.

REMARKABLE ROCK FEATURES

Rock Type	BASIS OF VARIOUS CHARACTERISTICS					DEFINITION FOR				
	Abundance	Amount of Soil	Permeability	Stability in Heavy Weather	Rock Strength	Location	Geological Importance	Source of Material	Soil Source	Comments

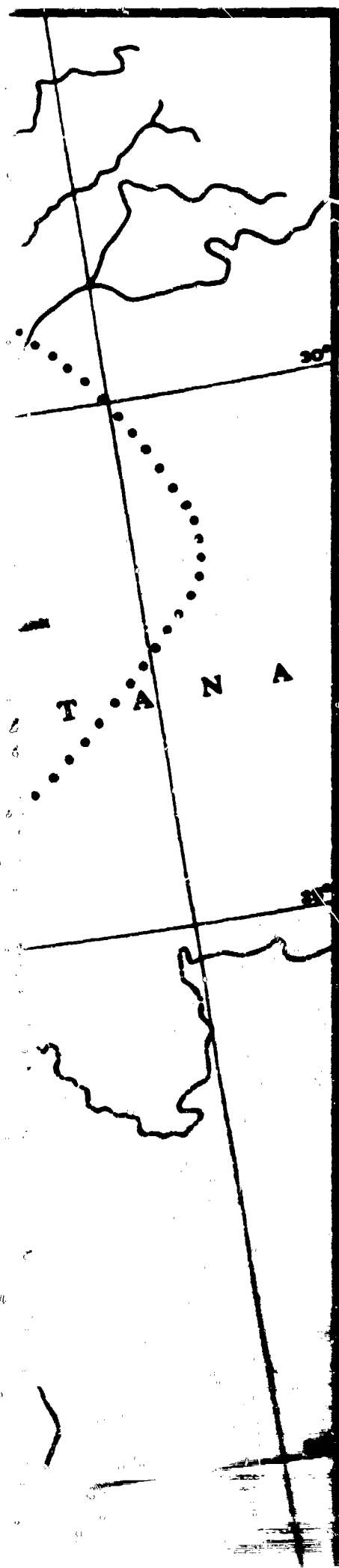






Rock Type	Abbreviations				
	A	B	C	D	E
1. BEDROCK					
2. Basaltic					
3. Dioritic					
4. Gabbroic					
5. Granite					
6. Metamorphic					
7. Sedimentary					
8. Sandstone					
9. Shale					
10. Limestone					
11. Coal					
12. Iron ore					

Scale 1:100,000
 1 inch = 2.5 miles
 1 centimeter = 0.625 miles



SURFACE ROCK

Areally predominant (70 per cent or more) rock types mapped

- 1  **IGNEOUS (UNDIFFERENTIATED):** Rocks formed by solidification or crystallization of a hot fluid mass.
- 2  **Intrusive:** Igneous rocks, typically crystalline, which were formed by cooling below the surface of the earth. (Granite, syenite, diorite, etc.)
- 3  **Extrusive (undifferentiated):** Igneous rocks which have formed by cooling at the surface of the earth.
 - 3a  True intrusive rocks formed by solidification of molten material that poured out on the surface of the earth (e.g., basalt, dacite, etc.).
 - 3b  Rocks formed by secondary cementation of loose deposits of volcanic ejecta (e.g., tuff, agglomerate, etc.).
- 4  **METAMORPHIC (UNDIFFERENTIATED):** Rocks formed from original igneous or sedimentary rocks through alterations produced by pressure, heat, or the infiltration of other materials at depths below the surface power of weathering and cementation. The alterations are sufficiently complete throughout the body of the rock to produce a well-defined new type. (Gneiss, schist, slate, etc.)
- 5  **SEDIMENTARY (UNDIFFERENTIATED):** Rocks formed from material laid down in a more or less finely divided state, as sediment, through the agency of water, wind, or glaciers.
 - 6  **Sandstone:** A sedimentary rock predominantly composed of sand grains cemented together.
 - 7  **Limestone:** A sedimentary rock consisting essentially of calcium carbonate.
 - 8  **Shale:** A sedimentary rock in which the constituent particles are predominantly of clay size.
 - 9  **Evaporites:** A sedimentary rock whose origin is largely due to evaporation and subsequent precipitation of salt from water. (Gypsum, anhydrite, and rock salt are the only evaporites of quantitative importance.)
- 6a  **ROCK COMPLEXES:** Rock complexes are mapped where no locally predominant (70 per cent or more) rock type occurs. In such instances, the two most commonly occurring rock types are mapped; the predominant is shown as the mother lode, the subordinate as the disseminator in the fractional pattern.

* It should be realized that the scale of mapping precludes delineation, especially in mountainous regions, of many alluvial basins where the thickness of soil cover is much greater than 10 ft.

[illegible]

No.	Description	Length ft.	Wings		Tail		Culmen		Tarsus		Middle toe	
			mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.
1	Known	41	•	•	•	•	•	•	•	•	•	•
2	Spaced about 1 year	1-4	•	•	•	•	•	•	•	•	•	•
3	Unspaced about 1 year	5-25	0-1	•	0-1	•	0-1	•	0-1	•	0-1	•
4	Spaced about after several years	25-50	0-1	•	0-1	•	0-1	•	0-1	•	0-1	•
5	1. With scattered bristling hairs	25-50	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
6	Spaced about 1 year after 1 year	25-50	0-1	•	0-1	•	0-1	•	0-1	•	0-1	•
7	2. With scattered and long hairs	25-50	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1	0-1
8	3. With scattered and long hairs	25-50	0-1	•	0-1	•	0-1	•	0-1	•	0-1	•
9	4. With scattered and long hairs	25-50	•	0-1	•	0-1	•	0-1	•	0-1	•	0-1
10	5. With scattered and long hairs	25-50	•	•	•	•	•	•	•	•	•	•
11	6. With scattered and long hairs	25-50	0-1	•	0-1	•	0-1	•	0-1	•	0-1	•
12	7. With scattered and long hairs	25-50	0-1	•	0-1	•	0-1	•	0-1	•	0-1	•
13	8. With scattered and long hairs	25-50	0-1	•	0-1	•	0-1	•	0-1	•	0-1	•
14	9. With scattered and long hairs	25-50	0-1	•	0-1	•	0-1	•	0-1	•	0-1	•
15	10. With scattered and long hairs	25-50	0-1	•	0-1	•	0-1	•	0-1	•	0-1	•
16	11. With scattered and long hairs	25-50	0-1	•	0-1	•	0-1	•	0-1	•	0-1	•
17	12. With scattered and long hairs	25-50	0-1	•	0-1	•	0-1	•	0-1	•	0-1	•
18	13. With scattered and long hairs	25-50	0-1	•	0-1	•	0-1	•	0-1	•	0-1	•
19	14. With scattered and long hairs	25-50	0-1	•	0-1	•	0-1	•	0-1	•	0-1	•
20	15. With scattered and long hairs	25-50	0-1	•	0-1	•	0-1	•	0-1	•	0-1	•



3

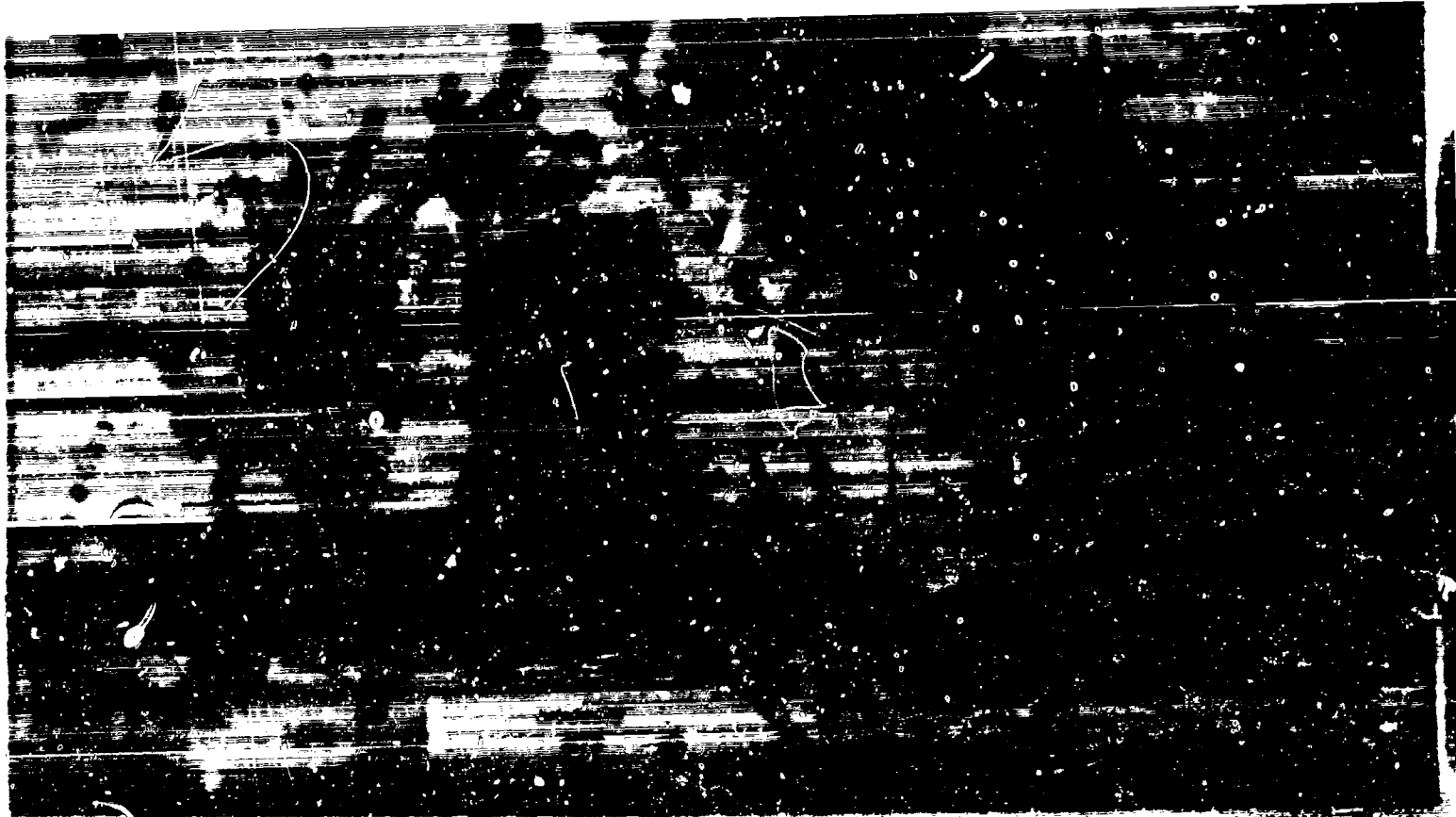
8

8

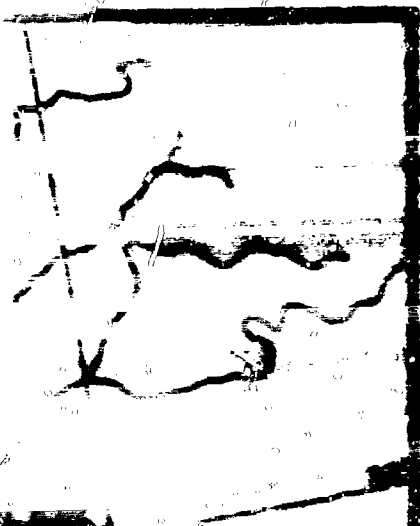
R

YUMA SAND H

4



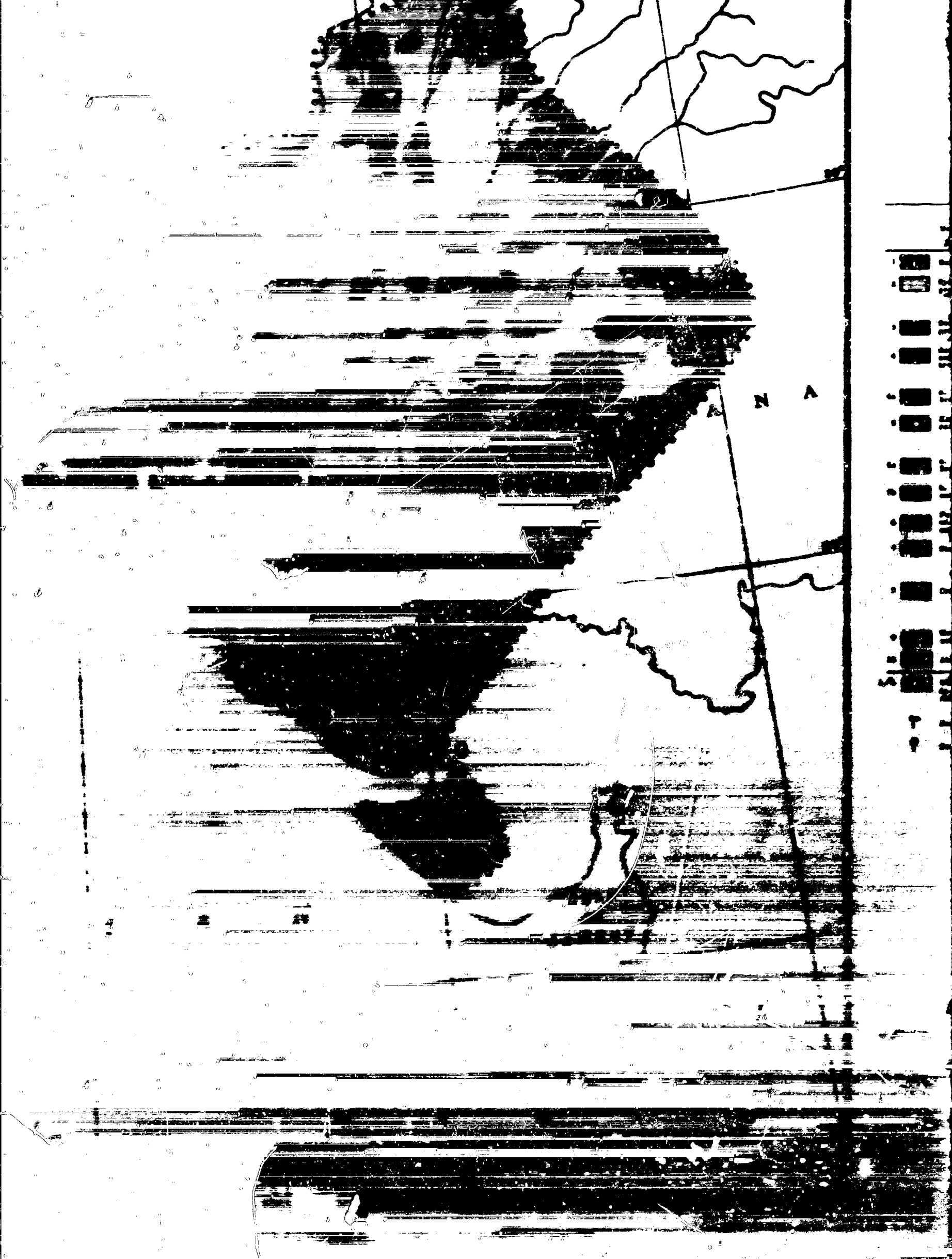
YUMA TEST STATION



Item	Description	Quantity	Unit	Price	Total
1	...	...	...	...	...
2	...	...	...	...	...
3	...	...	...	...	...
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	...	...	...	...	







GEOMETRY OF FORM ANALOGS

LEGEND

4,5,3,5 Each landscape type is identified by a series of four symbols indicating mapping units of PLAN-PROFILE (4), SLOPE OCCURRENCE (5), SLOPE (3), and RELIEF (5). Mapping units of these four factors are always designated in this order.

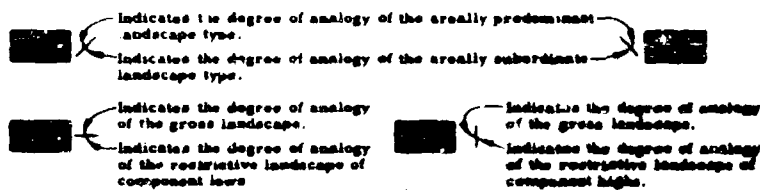
4,4,3,5 Landscapes in South Central Asia are always compared with Yuma landscapes and not vice versa. The array of symbols in South Central Asia is shown in light- and boldface type to indicate the maximum degree of analogy with Yuma, the analogy increasing as the number of lightface units increases. 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.

1,2,2,2 Areal Complex. The areally predominant landscape is the numerator of the complex, the subordinate the denominator.

7,1,1,1 Gross-Component Complex. The gross landscape is encircled and is compared only with other gross landscapes.

4		Highly Analogous	The identical 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:



* In a particular array it may be possible to choose 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 South Central Asia array 7,1,2,2 was compared with the Yuma array 7,1,2,1 rather than with Yuma 11,2,2,2. Comparison with the latter would have resulted in a symbolization 7,1,2,2.

ANALOGS OF YUMA TERRAIN IN THE SOUTH CENTRAL ASIAN DESERT GEOMETRY ANALOGS

PLATE 10

2

Kare-Bogas
Oil

U

S

CASPIAN
SEA

YERMAN

ELIM

YERMAN

YERMAN

YERMAN

YERMAN

GULF

CO



3

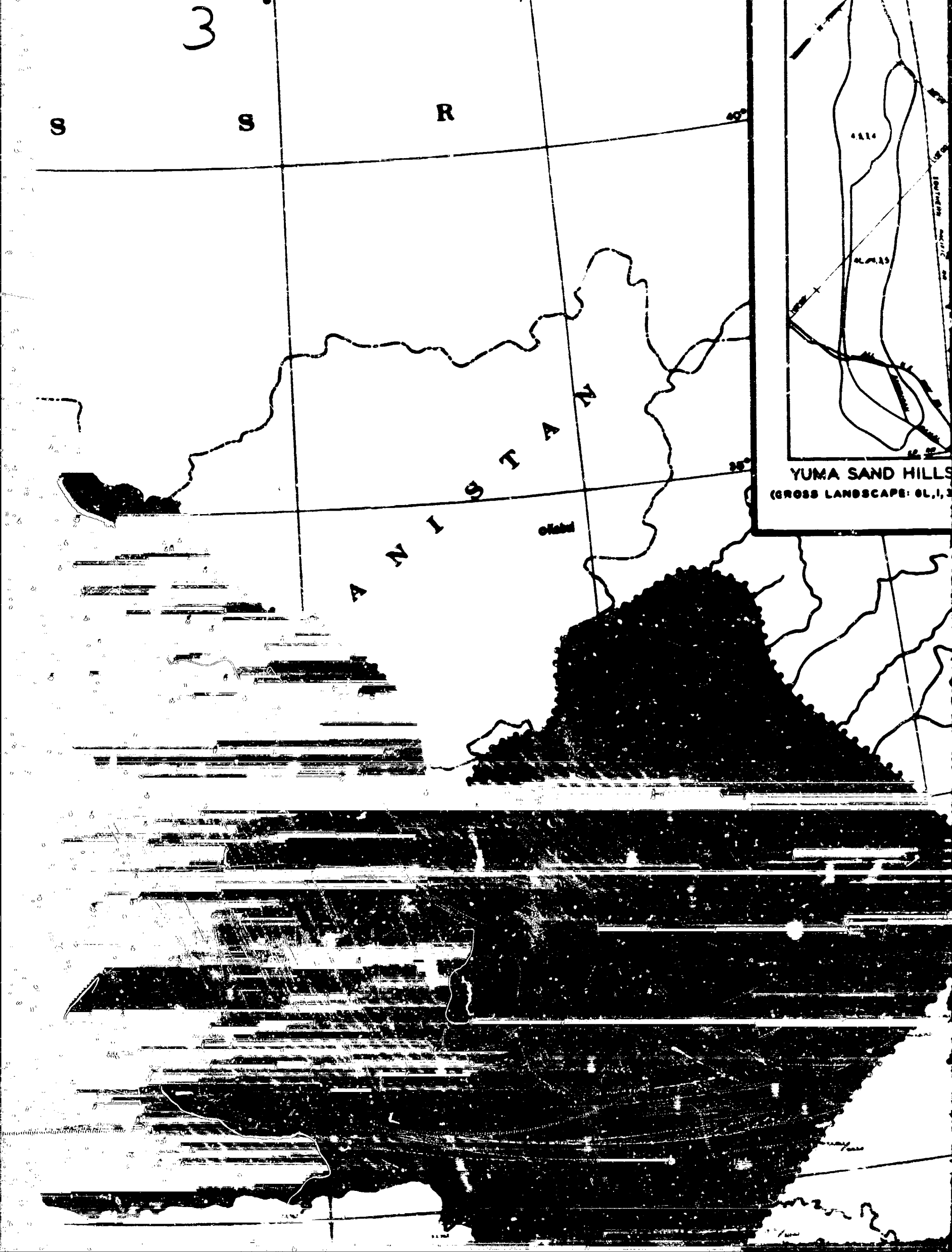
S

S

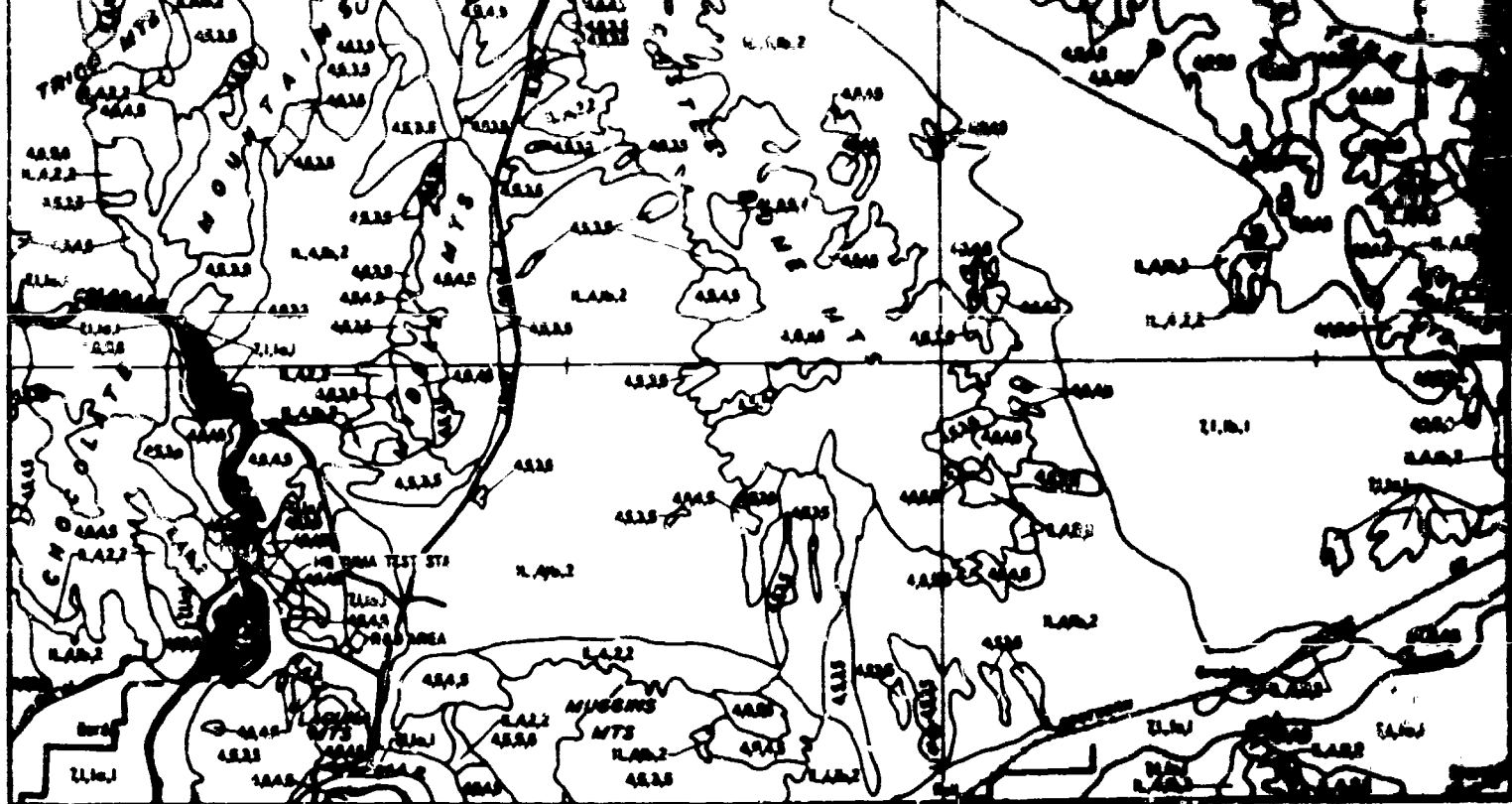
R

A N I S T A N

YUMA SAND HILLS
(GROSS LANDSCAPE: 6L, 1, 2)



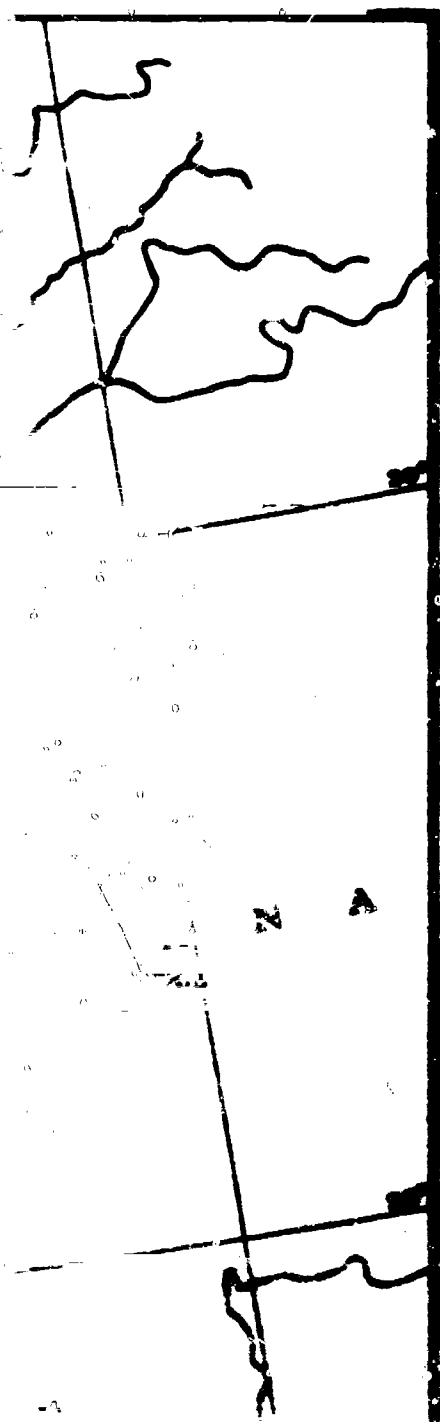
4



SCALE 0 1 2 3 4 5 6 7 8 9 10

YUMA TEST STATION (GROSS LANDSCAPE: SLN, I, S, 7)

AND HILLS
(GROSS: SLN, I, S, 5)



GEOMETRY OF A FORM ANALYSIS

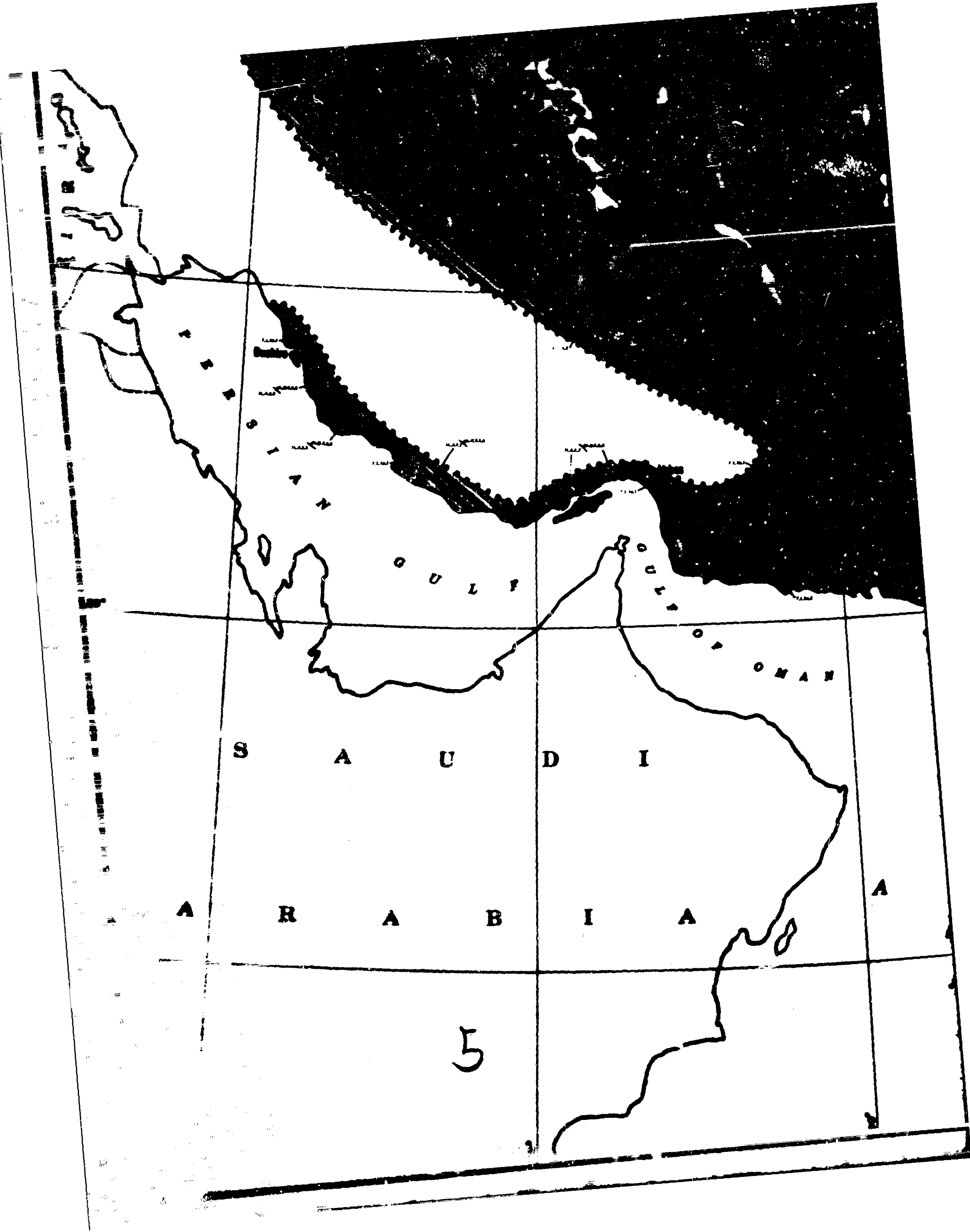
LEGEND

- 4.3.3 Each landscape type is identified by a series or an array of four symbols indicating mapping units of PLAN-PROFILE (4), SLOPE OCCURRENCE (3), SLOPE (3), and RELIEF (3). Mapping units of these four factors are always designated in this order.
- 4.3.5 Landscapes in South Central Asia are also compared with Yuma landscapes and not vice versa. The array of symbols in South Central Asia is shown in higher and bolder type to indicate the maximum degree of analogy with Yuma, the analogy increasing as the number of landscape units increases. Units shown in bolder type are not found at Yuma in combination with the remaining units of the array. Units in lighter type indicate the maximum number of units found in the closest corresponding array on the Yuma map.
- 4.3.6 Areal Complex. The areally predominant landscape is the component of the complex, the subordinate the dominant.
- 4.3.7 Green-Component Complex. The green landscape is controlled and is compared with other green landscapes.

4		Highly Analogous	The identical 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.

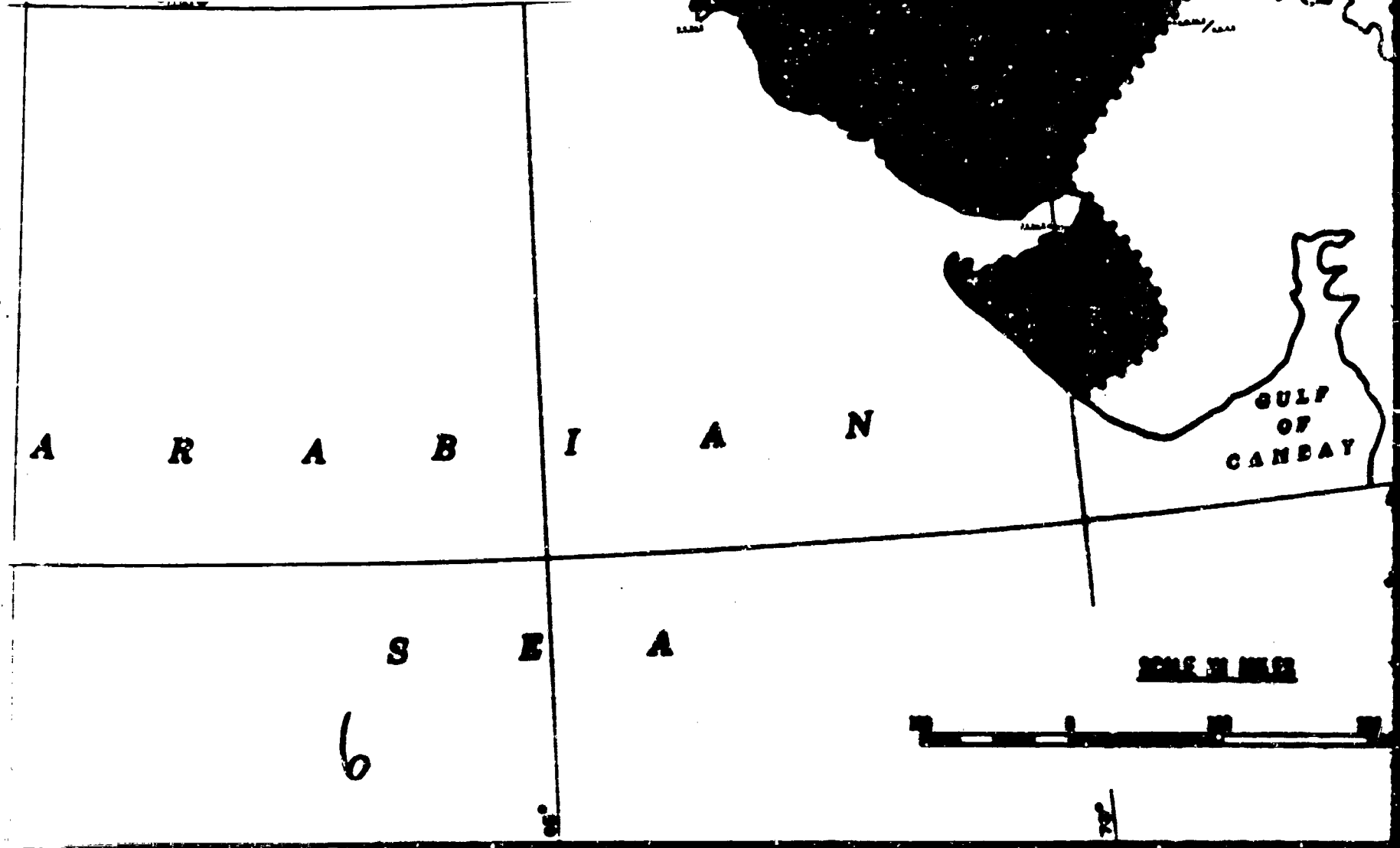
LANDSCAPE COMPLEXES

- Indicates the degree of analogy of the areally predominant landscape type.
- Indicates the degree of analogy of the areally subordinate landscape type.
- Indicates the degree of analogy of the green landscape.
- Indicates the degree of analogy of the green landscape.
- Indicates the degree of analogy of the areally predominant landscape type.
- Indicates the degree of analogy of the areally subordinate landscape type.



A

2



A R A B I A N

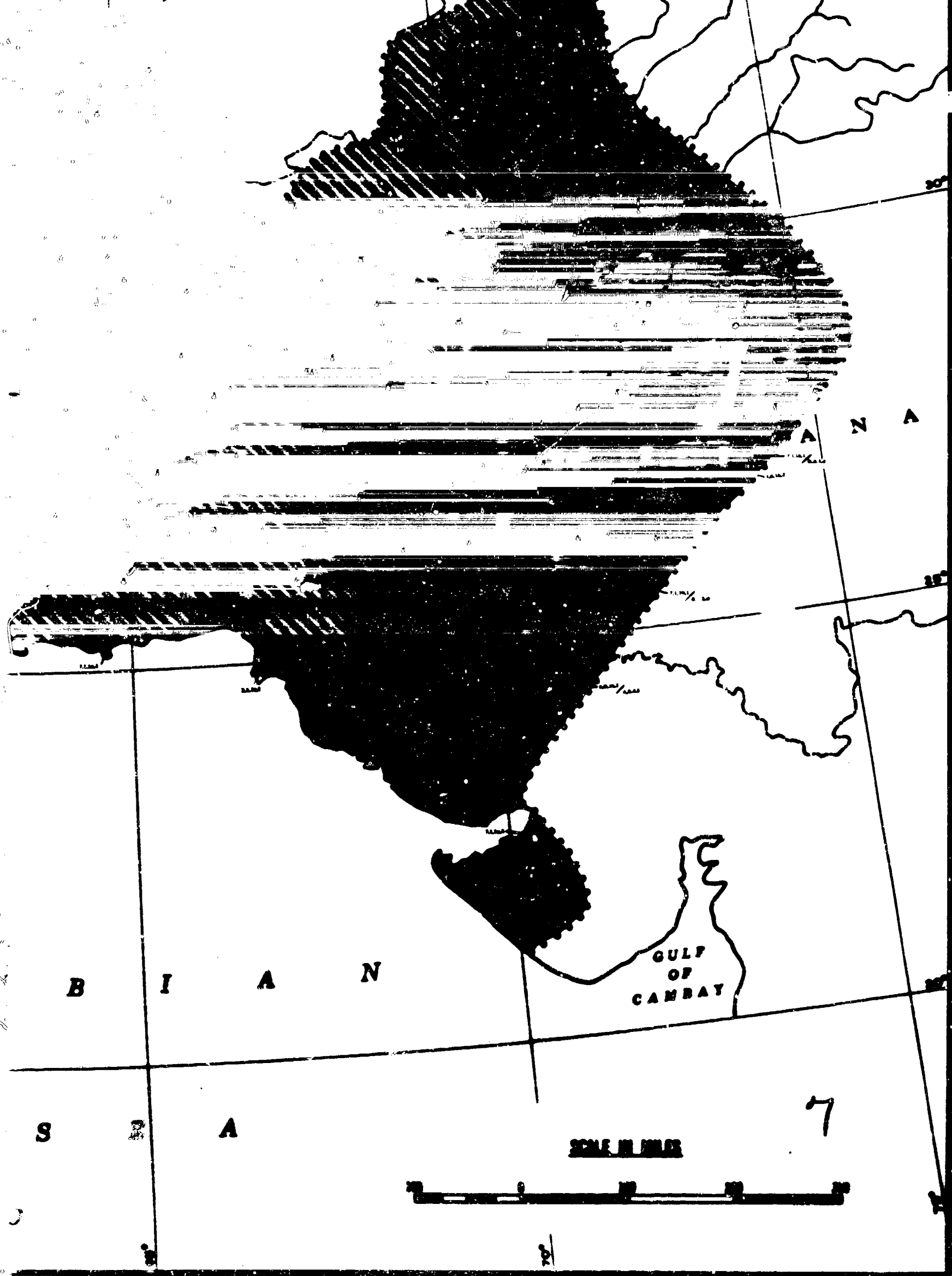
S E A

GULF
OF
CAMBAY

SCALE IN MILES

6





GROUND ANALOGS

LEGEND

- 1.7 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.
- 2.5 Ground factors in South Central Asia are always compared with Yuma ground factors and not vice versa. If both digits are lightface, the units designated are found in combination at Yuma. If one is light- and the other boldface, a combination exists at Yuma containing the lightface unit. If both digits are boldface, neither unit is found at Yuma.
- 5.1-6.10 Indicates area of ground complex. Two definite soil type-surface rock or soil-consistency combinations are present, but the scale mapping precludes delineation. The areally predominant ground factor appears first in the complex.

2	 Highly Analogous	Combination found at Yuma.
1	 Partially Analogous	One of the two units is found at Yuma.
0	 Not Analogous	None of the units are found at Yuma.

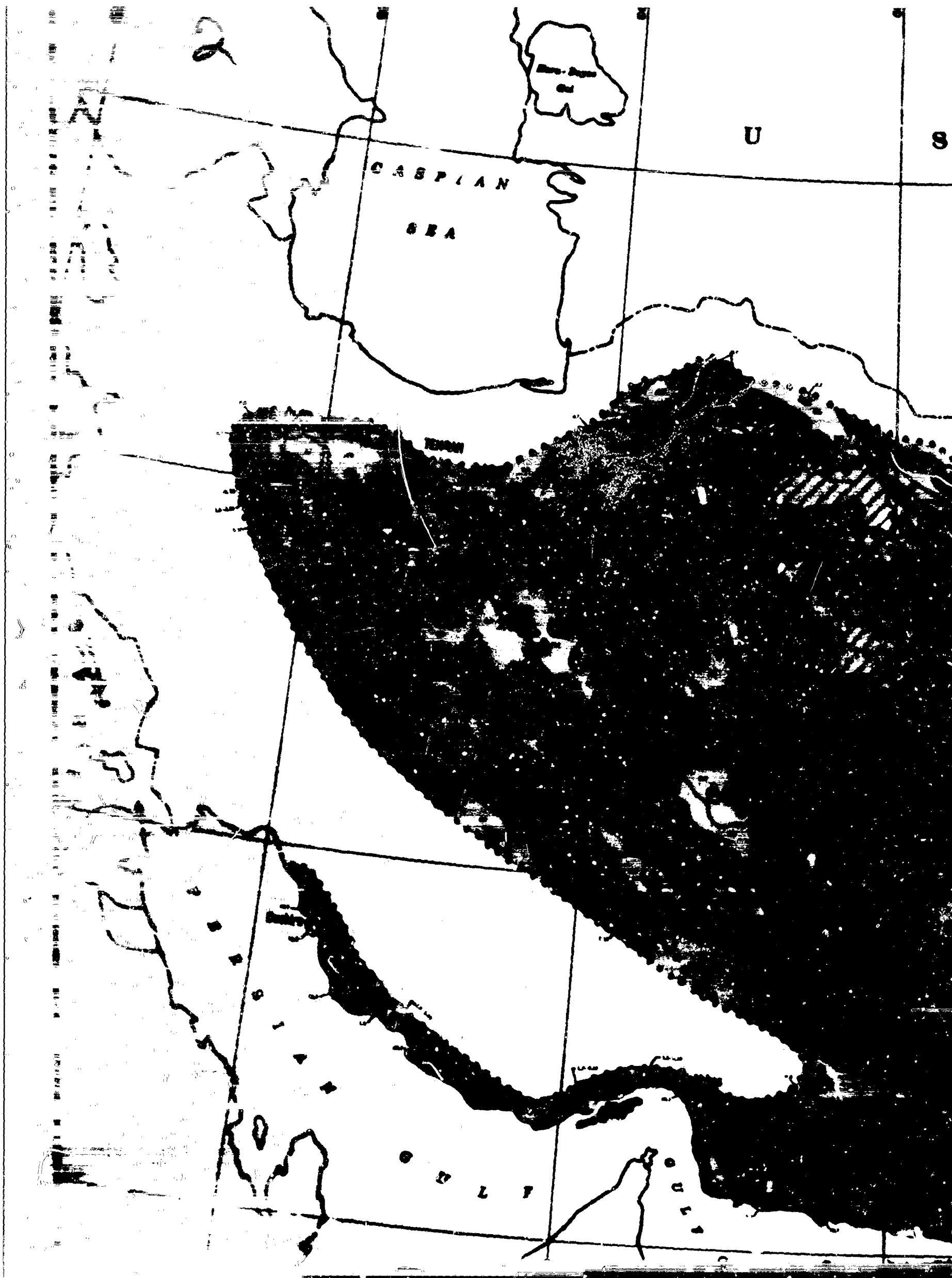
GROUND FACTOR COMPLEXES:

-  Indicates the degree of analogy of the predominant ground factor array.
-  Indicates the degree of analogy of the subordinate ground factor array.

* At Yuma surface rock unit 5 (sedimentaries undifferentiated) includes units 6, 7, and 8 (sandstone, limestone, and shale); therefore, where these units are mapped in South Central Asia, they are designated by lightface symbols.

ANALOGS OF YUMA TERRAIN IN THE SOUTH CENTRAL ASIAN DESERT GROUND ANALOGS

PLATE IV



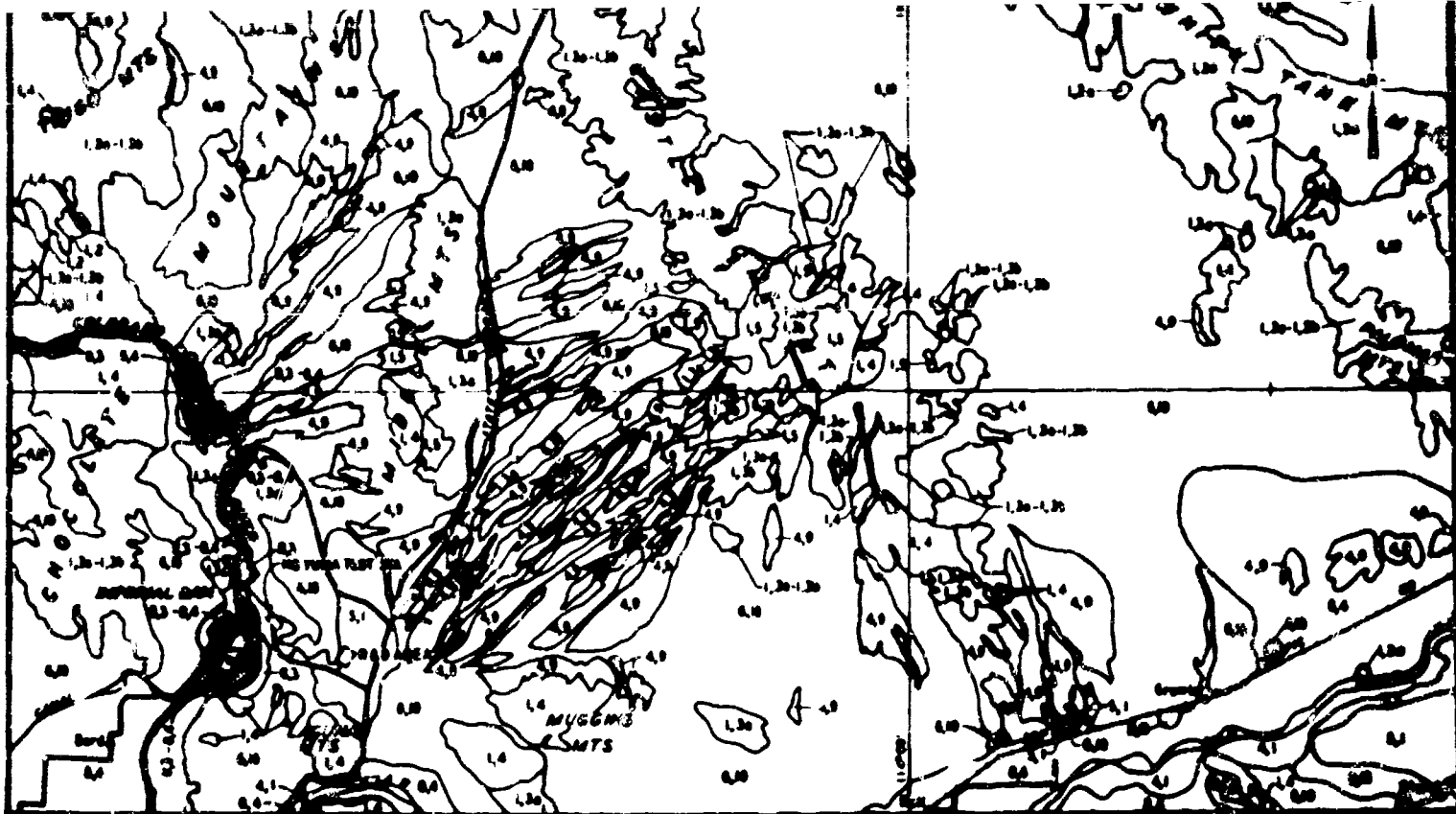
S

S

R

A
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T
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N

YUMA SAND HIL



YUMA TEST STATION

SCALE 1 M

JO HILLS



GROUND ANALOGY

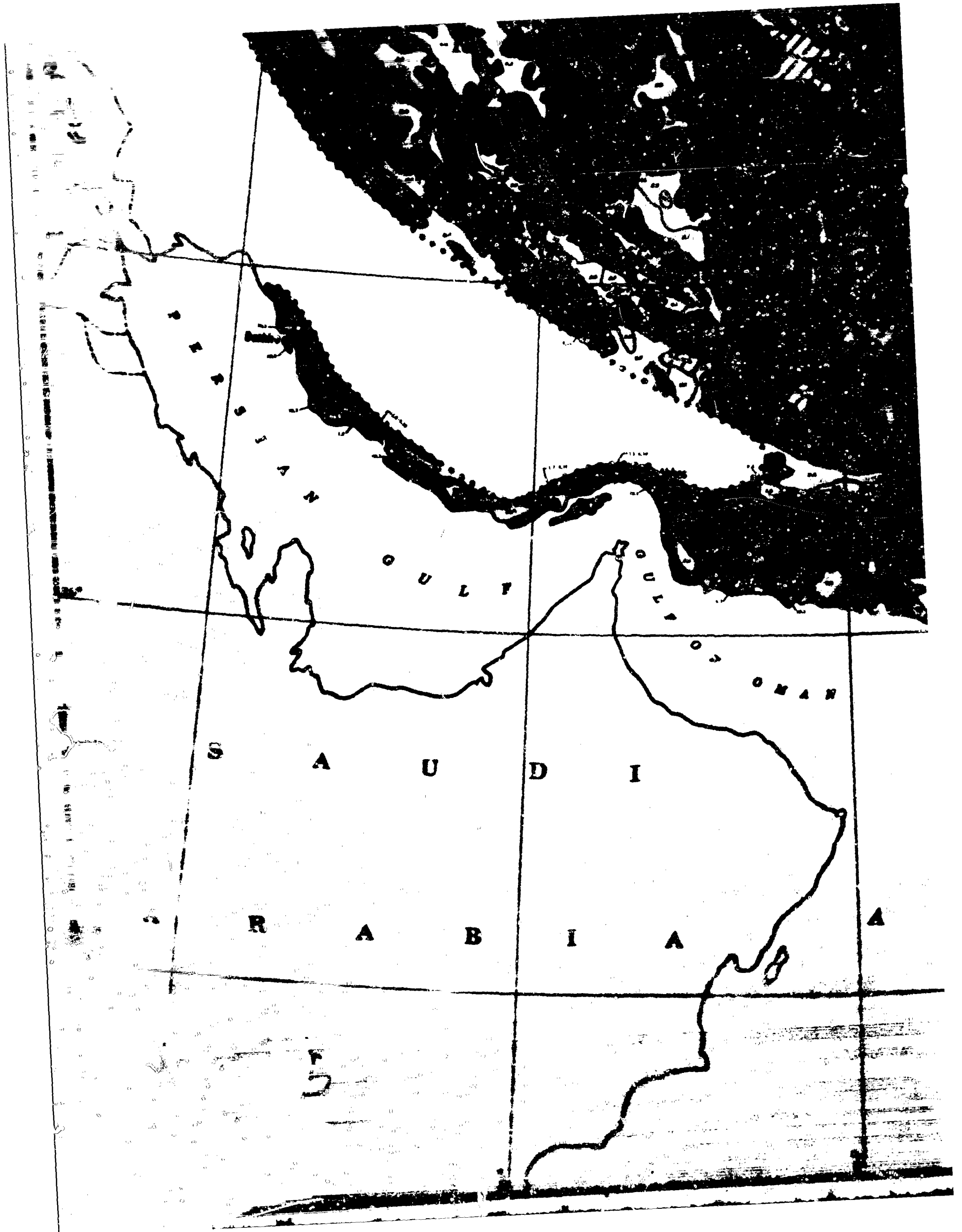
LEGEND

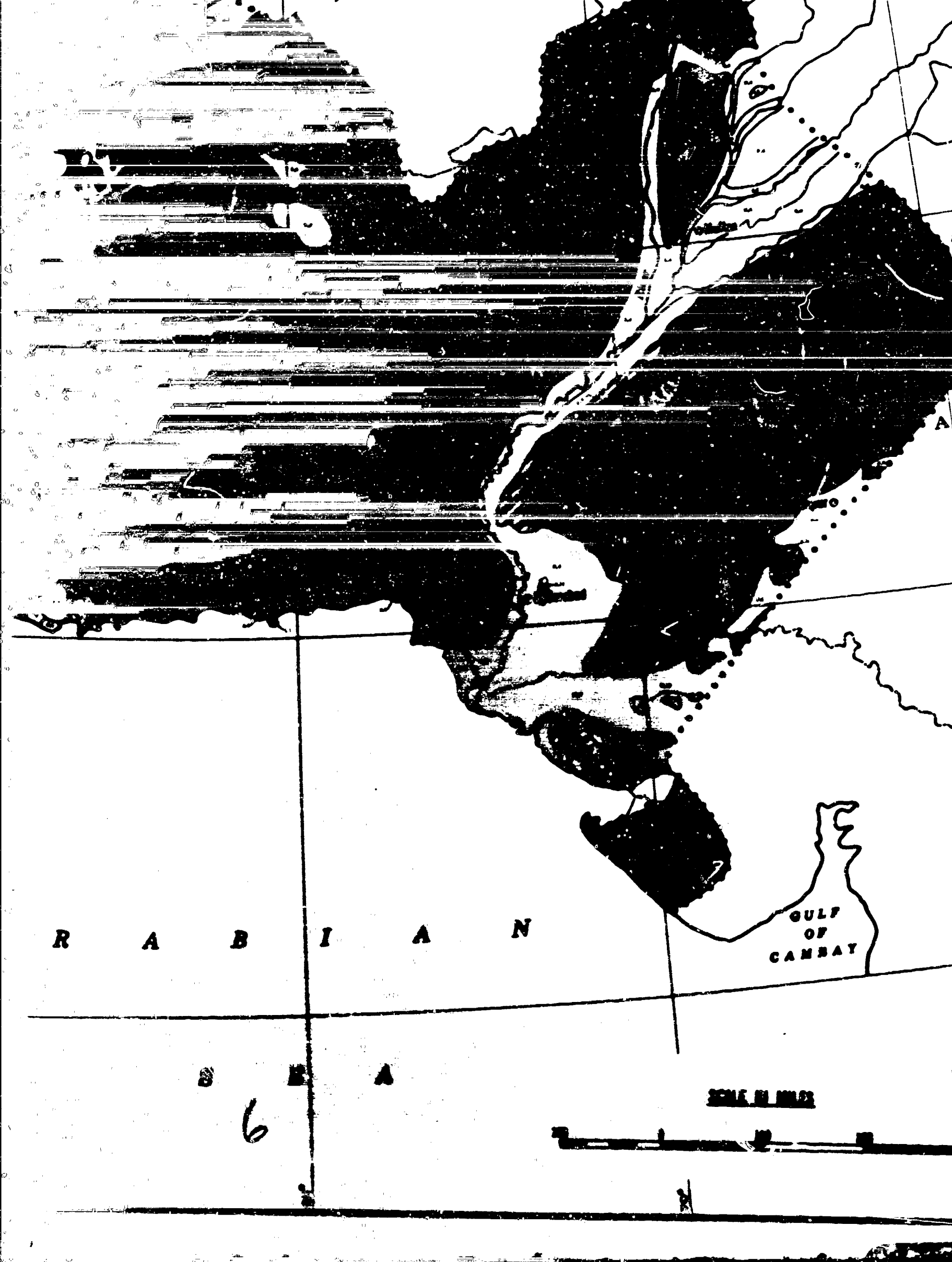
- 1.7 Numbers designate mapping units of soil type and surface rock or soil consistency, respectively. If the soil type (first number) is 1, 2, or 3, the second digit designates a surface-rock mapping unit; if the soil type (first number) is 4 or higher, the second number designates a soil-consistency mapping unit. In the example given, e.g., 1.7, the first digit is soil type, the second, surface rock.
- 2.5 Ground features in South Central Asia are always compared with Yuma ground features and not vice versa. If both digits are lightness, the units designated are found in combination at Yuma. If one is light- and the other boldface, a combination exists at Yuma containing the lighter unit. If both digits are boldface, neither unit is found at Yuma.
- 3.1-4.10 Indicates area of ground complex. Two definite soil type-surface rock or soil-consistency combinations are present, but the basic mapping percentage determination. The locally predominant ground feature appears first in the complex.

1		Lightly 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.

GROUND FACTOR COMPLEXES

- Indicates the degree of analogy of the predominant ground factor array.
- Indicates the degree of analogy of the sub-predominant ground factor array.





R A B I A N

GULF OF CAMBAY

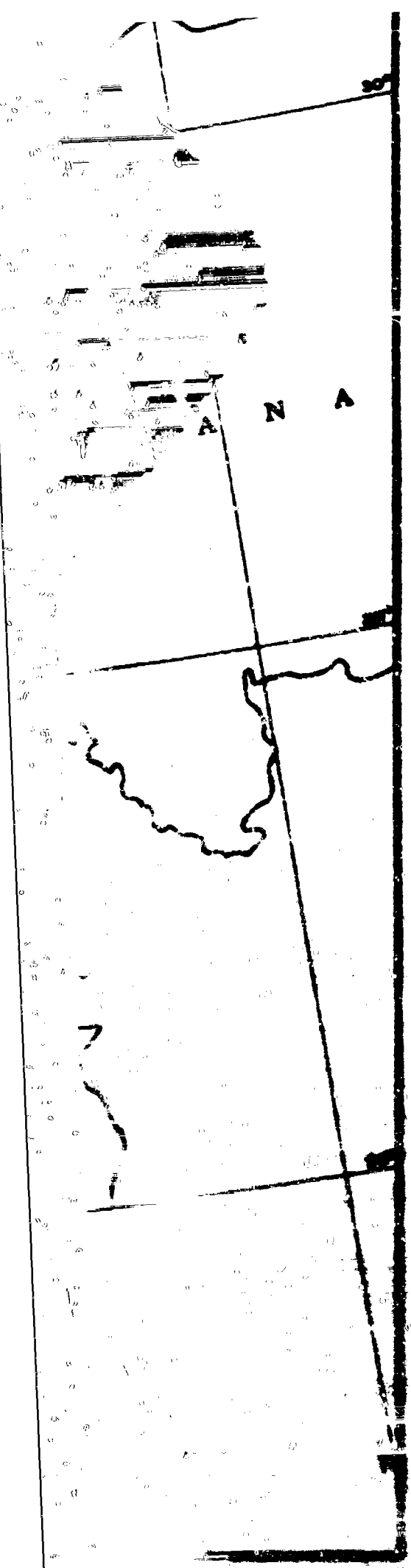
S E A

6

SCALE IN MILES







VEGETATION ANALOGUE

LEGEND

- 4 Number designates vegetation mapping unit.
- 2 Lightface number indicates that the unit is found at Yuma.
- 1 Boldface number indicates that the unit is not found at Yuma.
- 2/4 Indicates area of vegetation complex. Two definite vegetational types are present, but the scale of mapping precludes delineation. The locally predominant vegetation type appears first in the complex.

1	Highly Analogous	Unit found at Yuma.
0	Not Analogous	Unit not found at Yuma.

VEGETATION COMPLEXES:

- Indicates the degree of analogy of the locally predominant vegetation type.
- Indicates the degree of analogy of the locally subordinate vegetation type.

ANALOGUE OF YUMA TERRAIN

BY

ROUTE CENTRAL ARMY ENGINEER

VEGETATION ANALOGUE

2



U

S

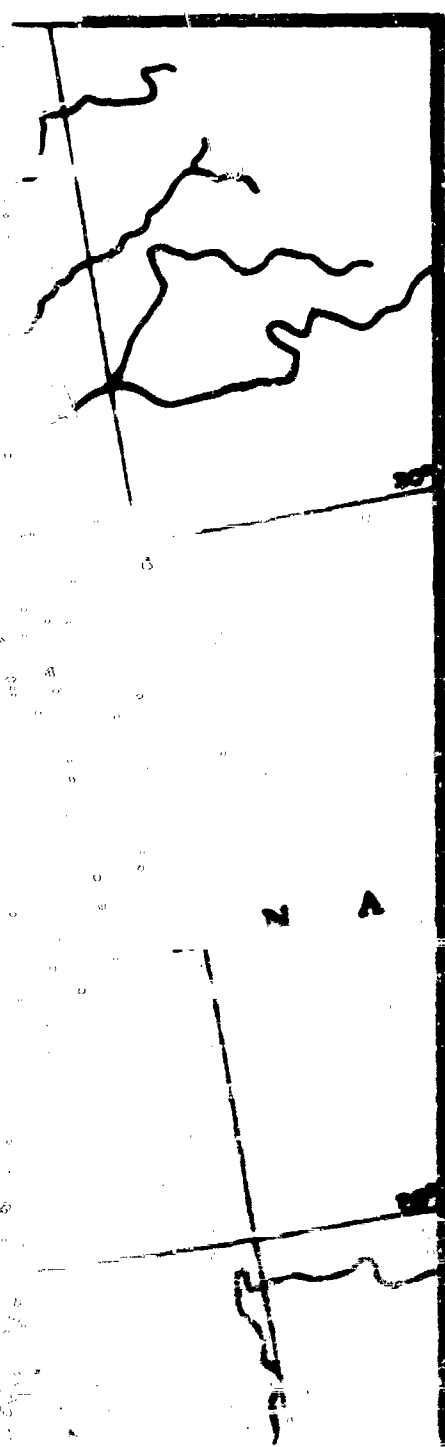
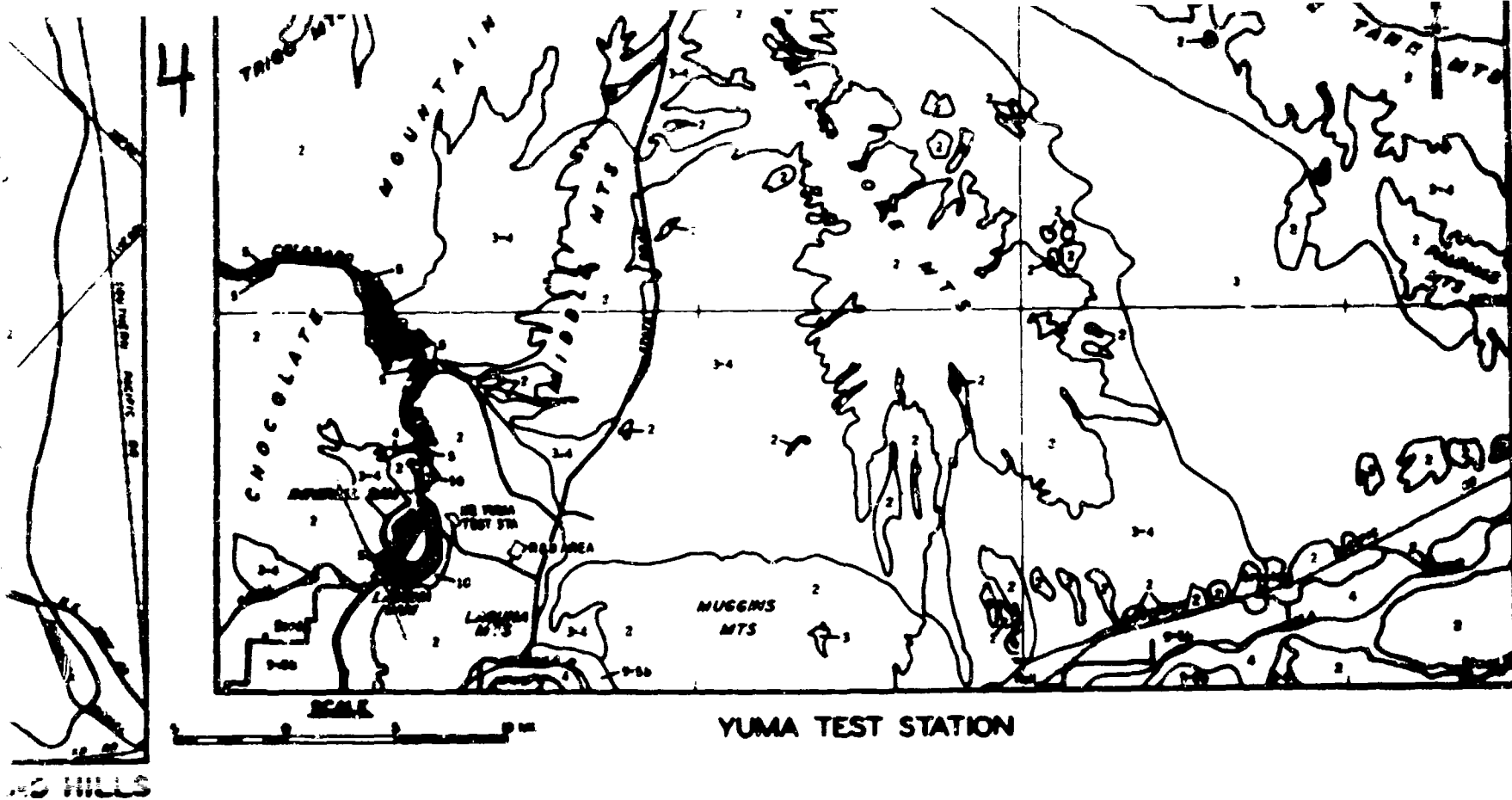
C A S P I A N
S E A

TEHRAN

O U L T







VEGETATION ANALOGUE

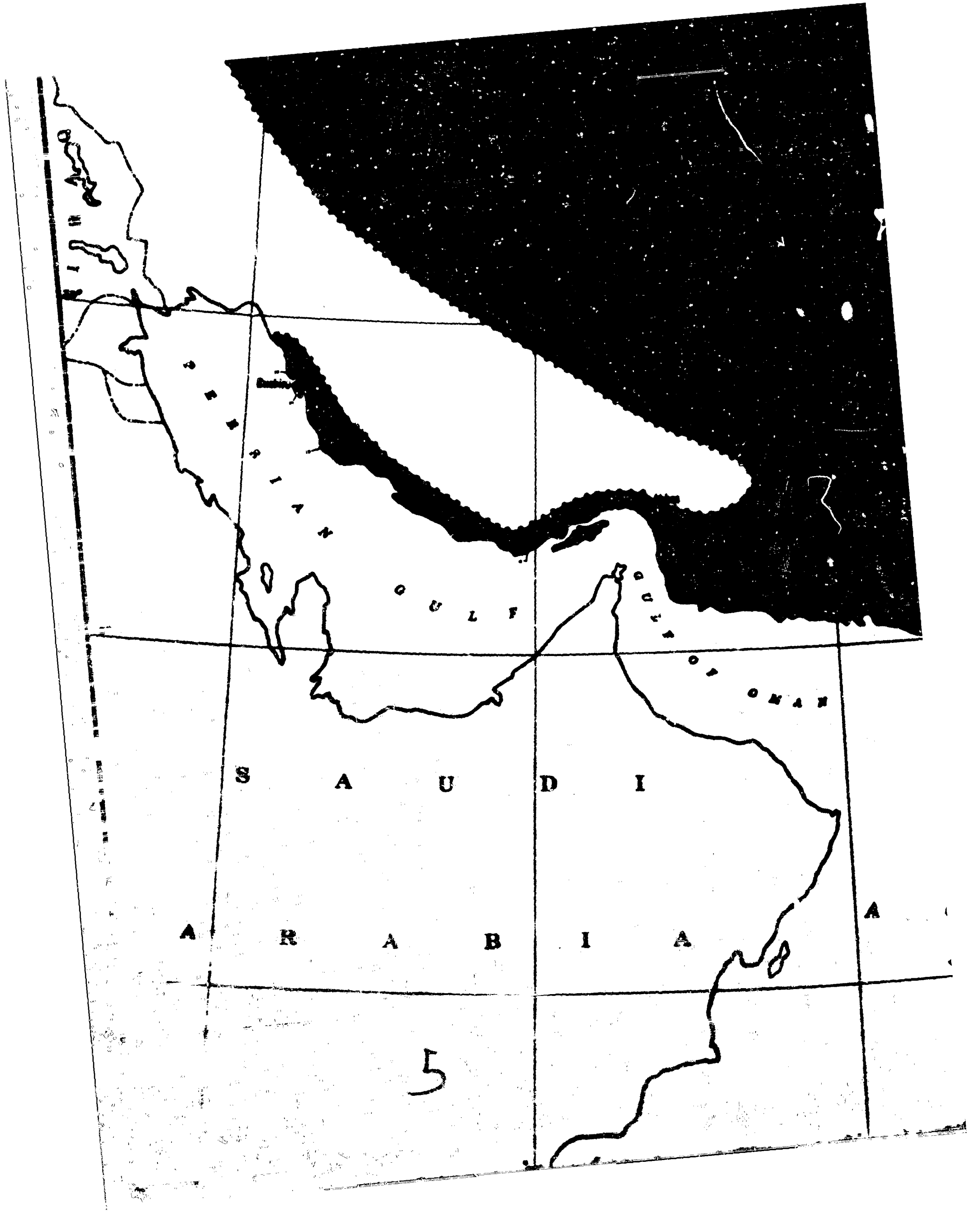
LEGEND

- 4 Number designates vegetation mapping unit.
- 2 Lighter number indicates that the unit is found at Yuma.
- 1 Darker number indicates that the unit is not found at Yuma.
- Indicates area of vegetation overlap. Two distinct vegetation types are present, but the scale of mapping precludes their separation. The locally predominant vegetation type appears first in the description.

1	Highly Analogous	Unit found at Yuma.
0	Not Analogous	Unit not found at Yuma.

VEGETATION COMPLEXITY

- Indicates the degree of complexity of the locally predominant vegetation type.
- Indicates the degree of complexity of the locally predominant vegetation type.



A

4



ARABIAN

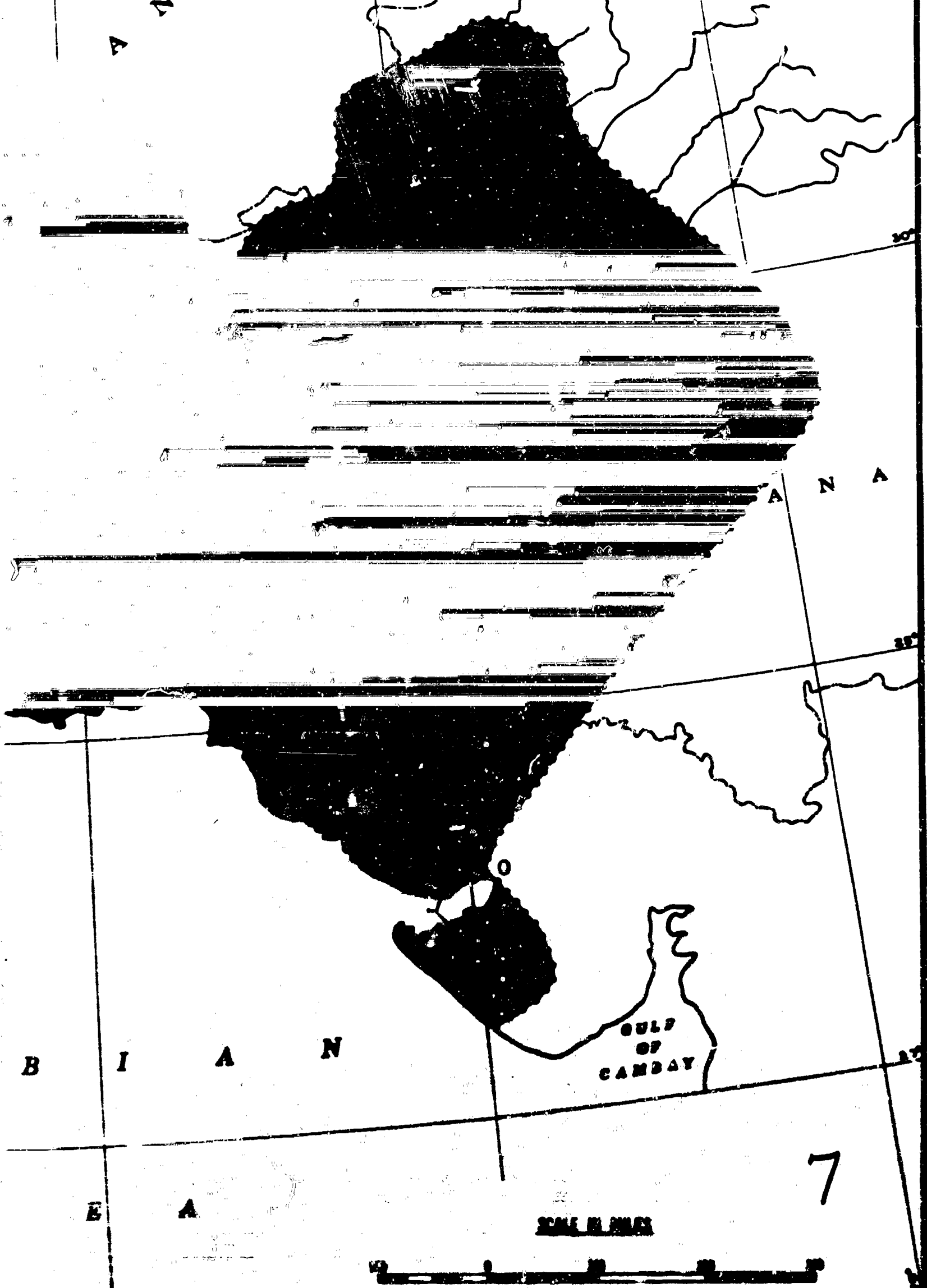
GULF OF CAMBAY

68

SCALE IN MILES



70



B I A N

GULF
OF
CAMBAY

E A

SCALE IN MILES

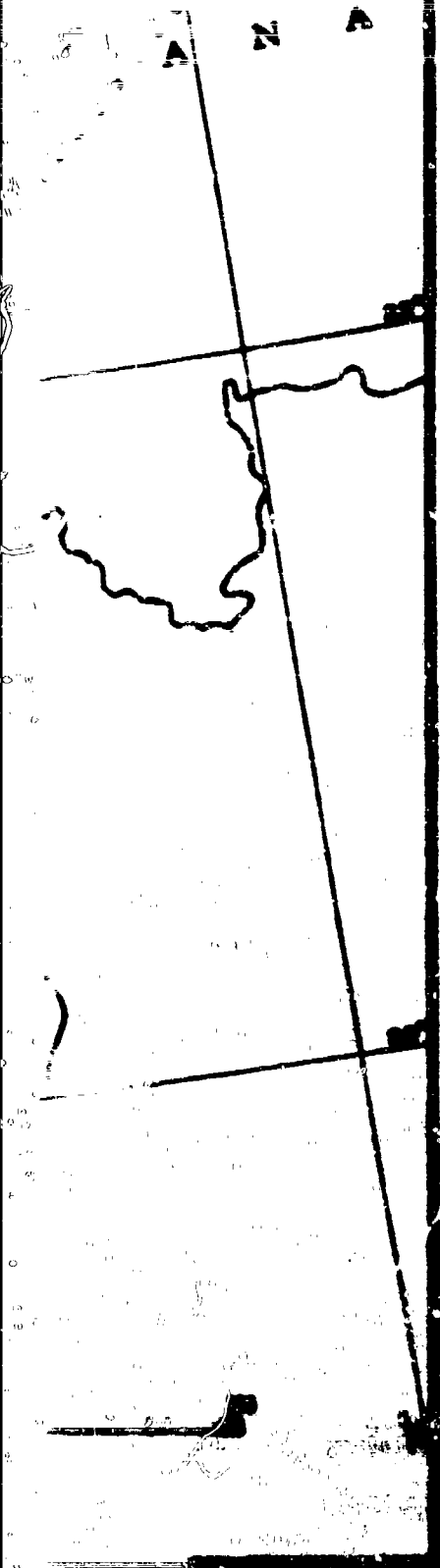
7

Total number of identical value ranges or classes of geometry, ground, and vegetation factors occurring in the most similar terrain type found at Yuma. If same result from comparing actual similarities of factor values.

TERRAIN TYPE COMPLEXES

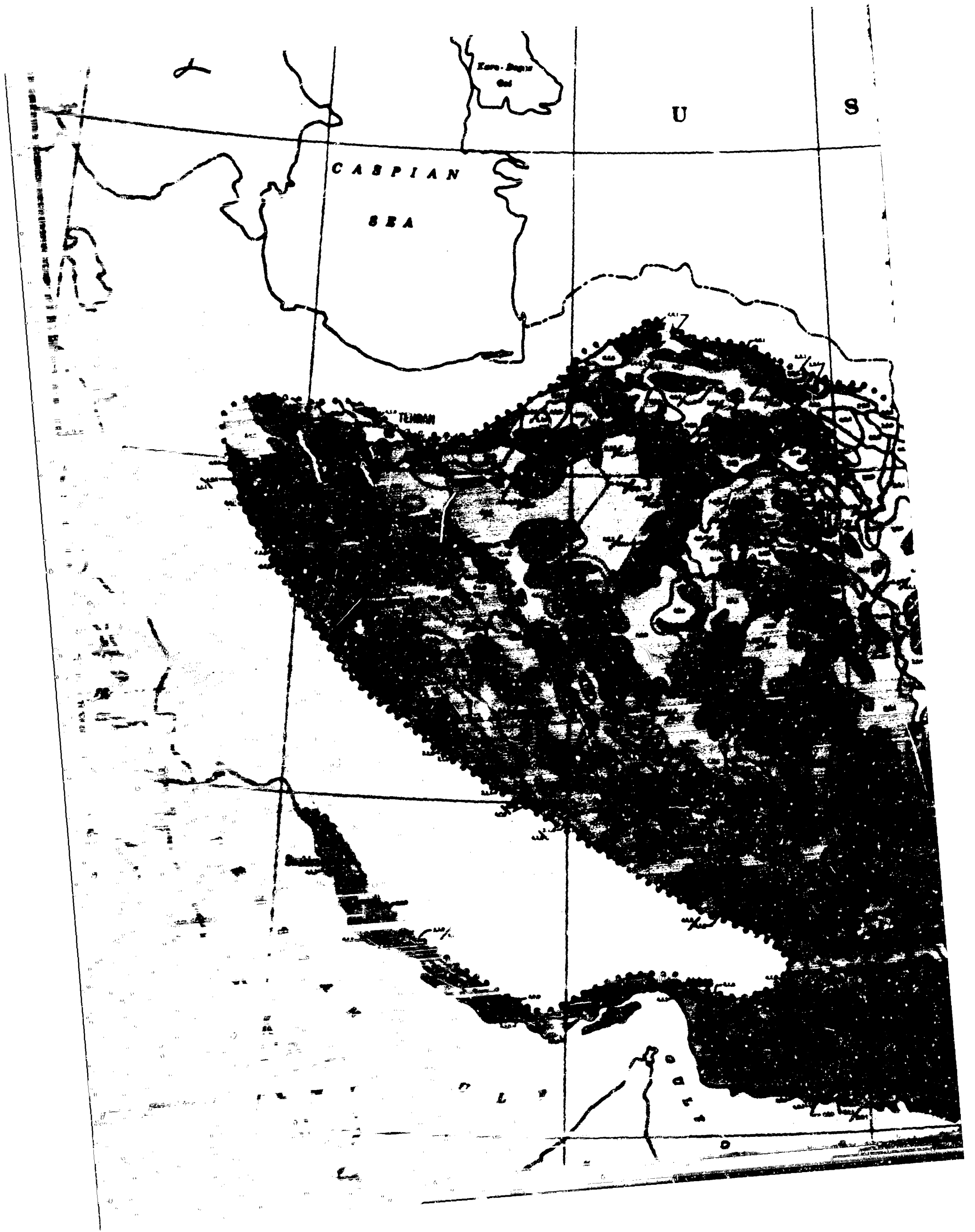
 Degree of analogy of locally predominant terrain type.  Degree of analogy of locally subordinate terrain type.

 Degree of analogy of gross terrain type.  Degree of analogy of terrain type characterizing component low or high.



**ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT
TERRAIN - TYPE ANALOGS**

PLATE 13



S

S

R

A N I S T A N

K



C H I N A

K A S H M I R

TERRAIN-TYPE ANALOGY

SECTION

A terrain type is identified by a series of seven numbers, or number-letter symbols, each representing a value range or class of a geometry factor (plan-profile, slope occurrence, slope, relief, ground factor (soil type, soil consistency, or surface rock), and vegetation.

4.2.1

Areas delineated on the terrain-type analog map are designated by three digits. These numbers are determined by comparing the terrain type characterizing the area in South Central Asia with the most similar terrain type found at Yuma. The numbers indicate, in sequence, the number of identical geometry, ground, and vegetation factor value ranges occurring in the South Central Asian terrain type that are found in combination at Yuma. Thus, the series 4,2,1 found in South Central Asia indicates that all seven terrain factor classes characterizing an area in South Central Asia are found in combination at Yuma. (The actual terrain type can be determined by examining the geometry, ground, and vegetation analog maps or the individual factor maps.) The series "1,1" indicates that, when comparing the South Central Asian terrain type with the most similar type found at Yuma, two of the four geometry factor classes, one of the two ground factor classes, and the vegetation class are found.

In selecting the most similar terrain type found at Yuma it is, of course, often possible to find two or three types having the same total number of factor classes in common with the South Central Asian type under consideration. In this event, selection is based on the order in which the factors occur in the series or array. For example, the South Central Asian terrain type 7,1,2,2 - 4,10 - 2 is compared with the Yuma type 7,1, -1 - 4,10 - 2 rather than with Yuma type 1,4,2,2 - 4,10 - 2.

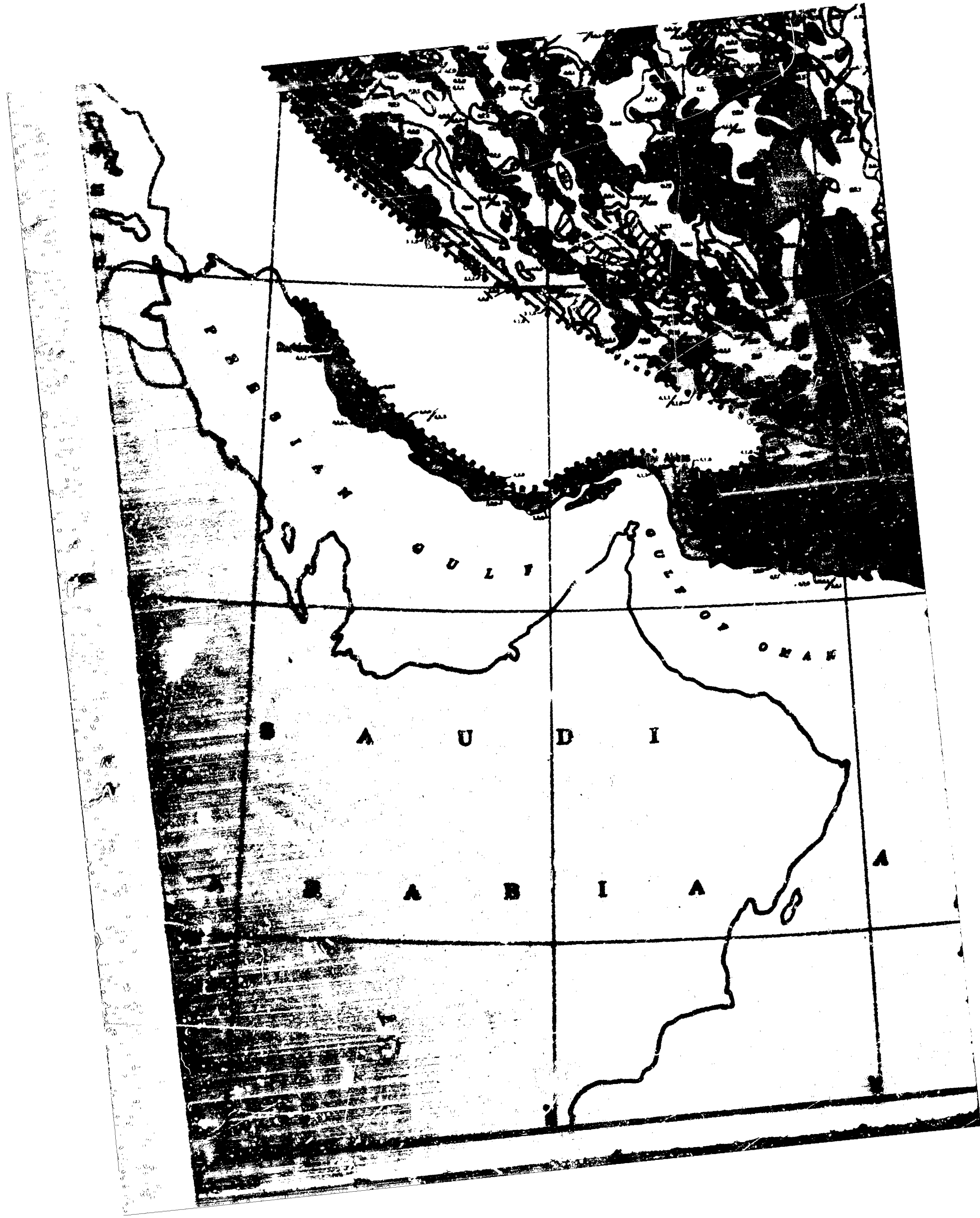
7		Highly Analogous
6		
5.5		
5		Moderately Analogous
4.5		
4		
3.5		
3		Slightly Analogous
2.5		
2		
1.5		
1		Insufficiently Analogous
0		Not Analogous

Total number of identical value ranges or classes of geometry, ground, and vegetation factors occurring in the South Central Asian type found at Yuma. Factors occur from top to bottom, and from left to right.

TERRAIN TYPE COMPLEXITY

Degree of analogy of overall mountainous terrain type
 Degree of analogy of overall alluvial terrain type

Degree of analogy of grass terrain type
 Degree of analogy of desert type (desert, scrub, and sparse low shrub)





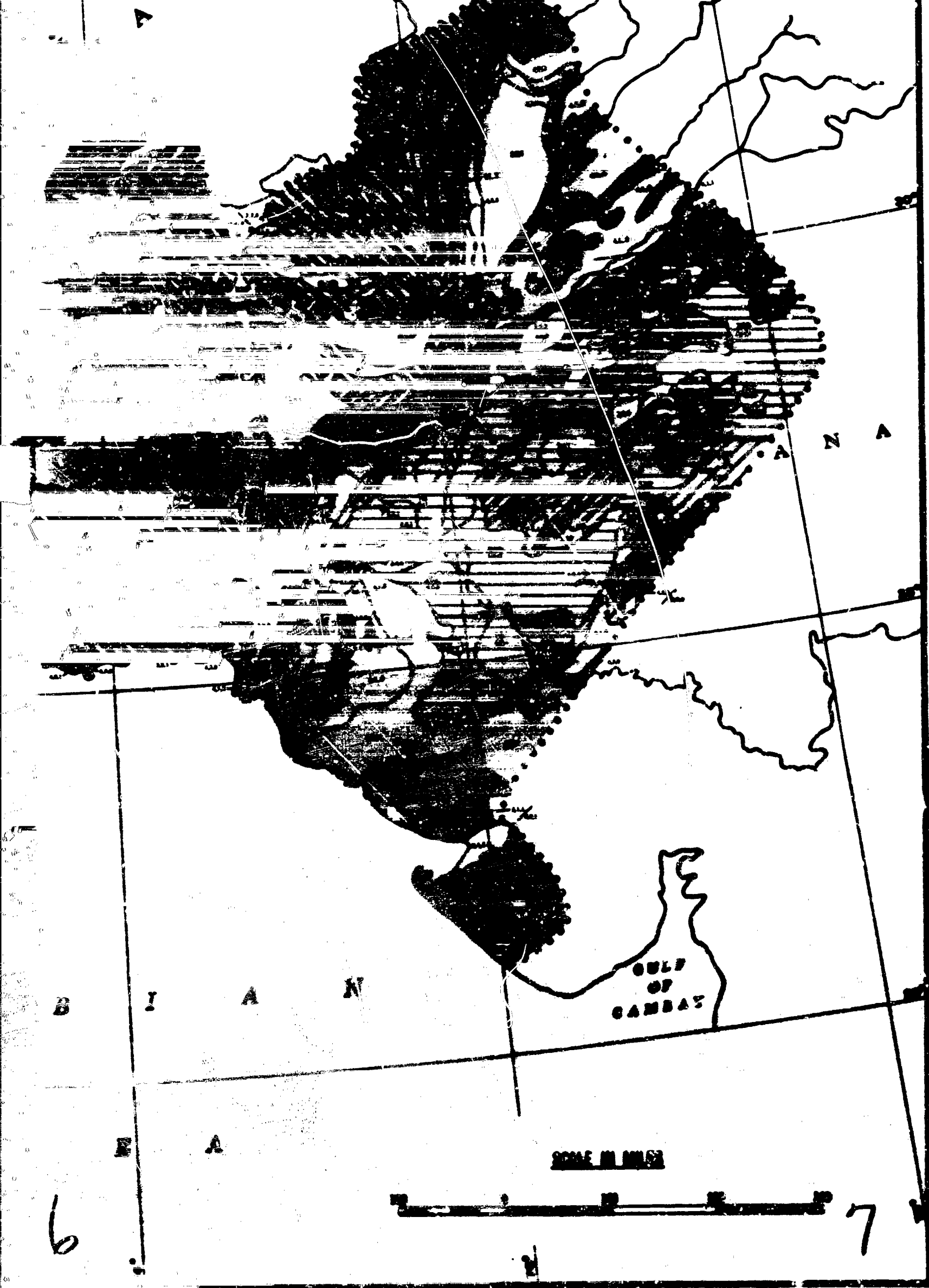
ARABIAN

GULF
OF
CAMBAY

SEA

SCALE IN MILES

6



**ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT
SECTION II: SUPPLEMENTAL MAPS
AND TABULATIONS**

A N A

ELEVATIONS

- 1  Below sea level
- 2  0 to 1,000 feet
- 3  1,000 to 2,000 feet
- 4  2,000 to 3,000 feet
- 5  3,000 to 5,000 feet
- 6  5,000 to 7,000 feet
- 7  7,000 to 9,000 feet
- 8  9,000 to 12,000 feet
- 9  12,000 to 15,000 feet

Spot elevation in feet

ANALOGS OF WINDY TERRAIN

IN THE

SOUTH COAST

OF THE

WINDY TERRAIN

OF THE

WINDY TERRAIN

OF THE

WINDY TERRAIN

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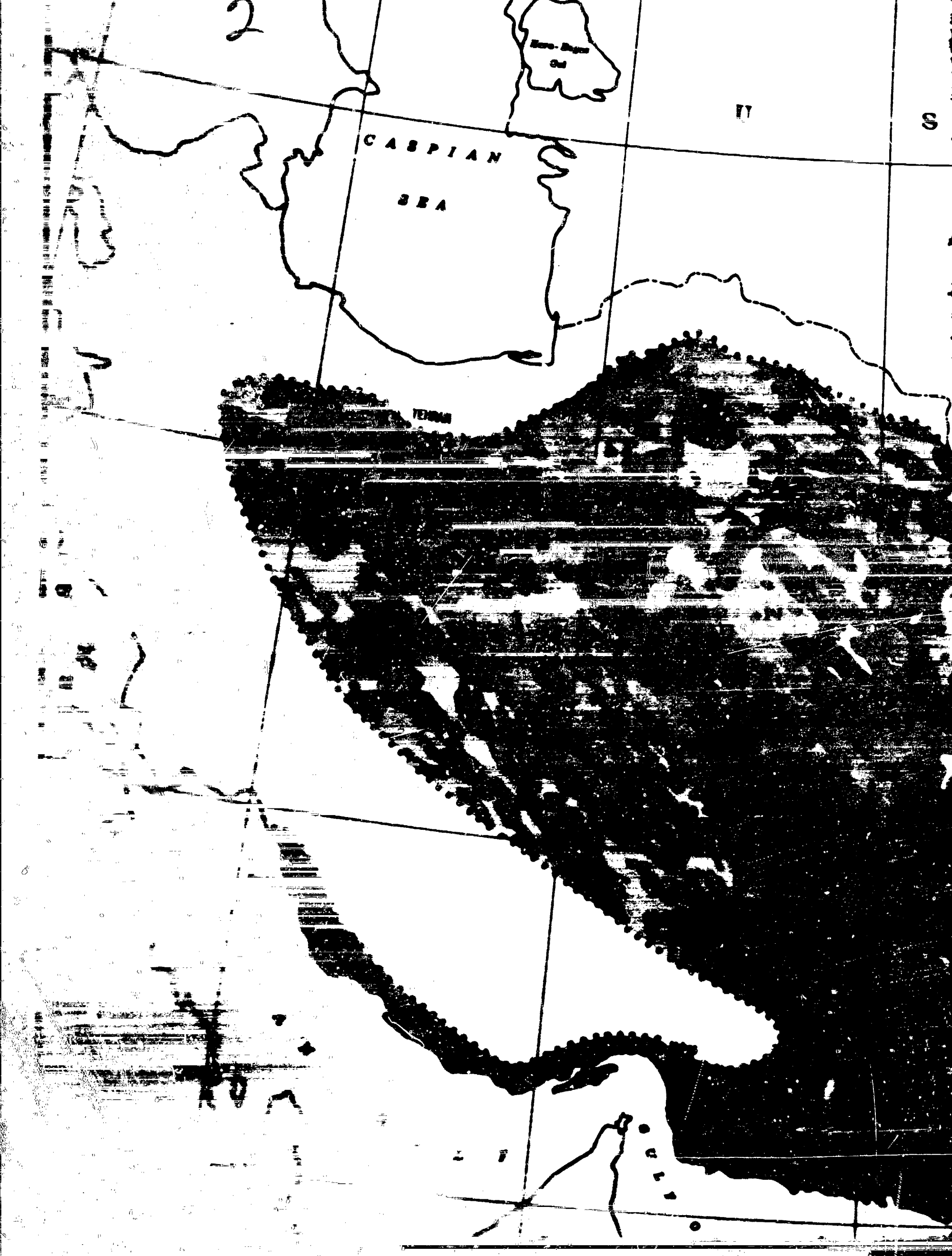
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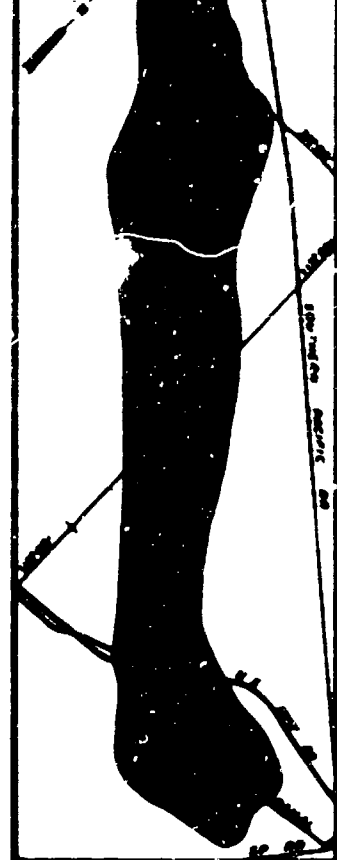
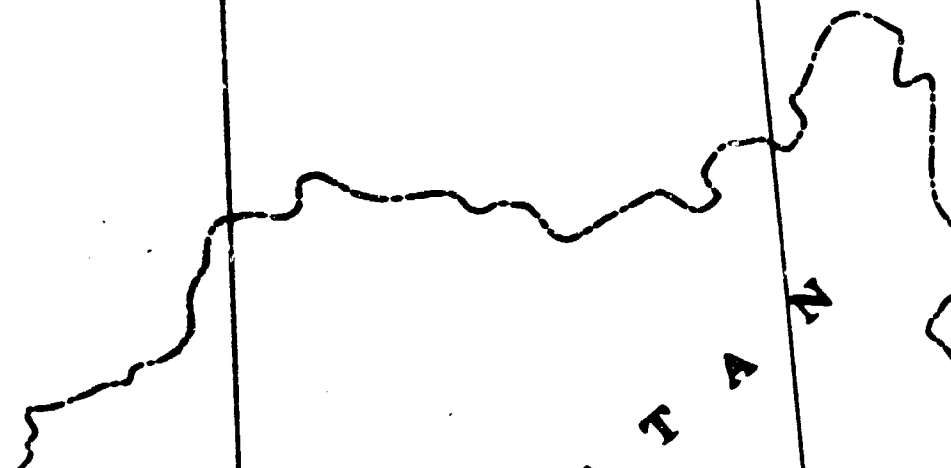
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YUMA SAND HILLS

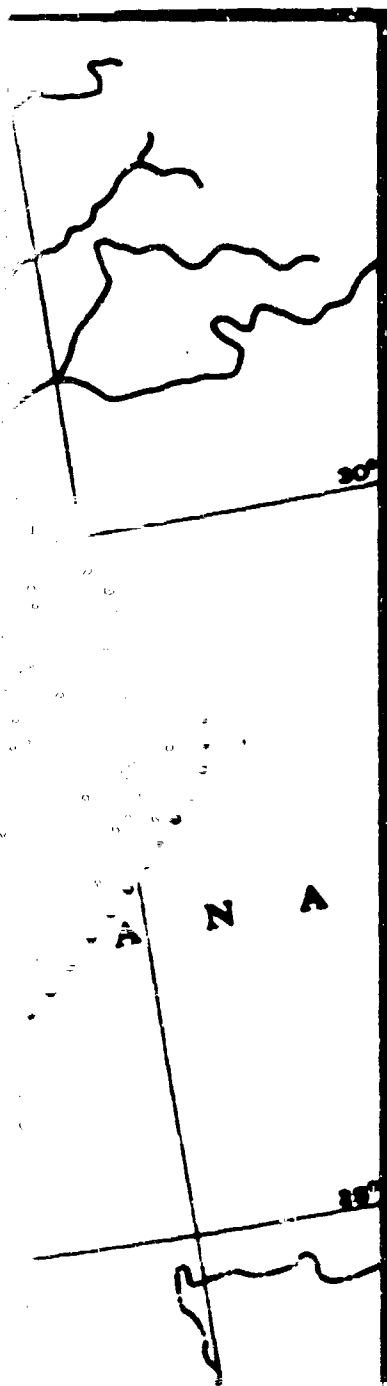
ARIZONA



This image appears to be a high-contrast, black-and-white scan of a dark surface, possibly a night sky or a microscopic view. It is densely populated with small, bright white specks and dots of varying sizes. A prominent, thin, curved white line or scratch is visible in the lower-left area. Another small, bright, irregular white shape is located in the upper-right quadrant. The overall texture is grainy and noisy, characteristic of a low-quality scan or a high-magnification photograph of a dark field.

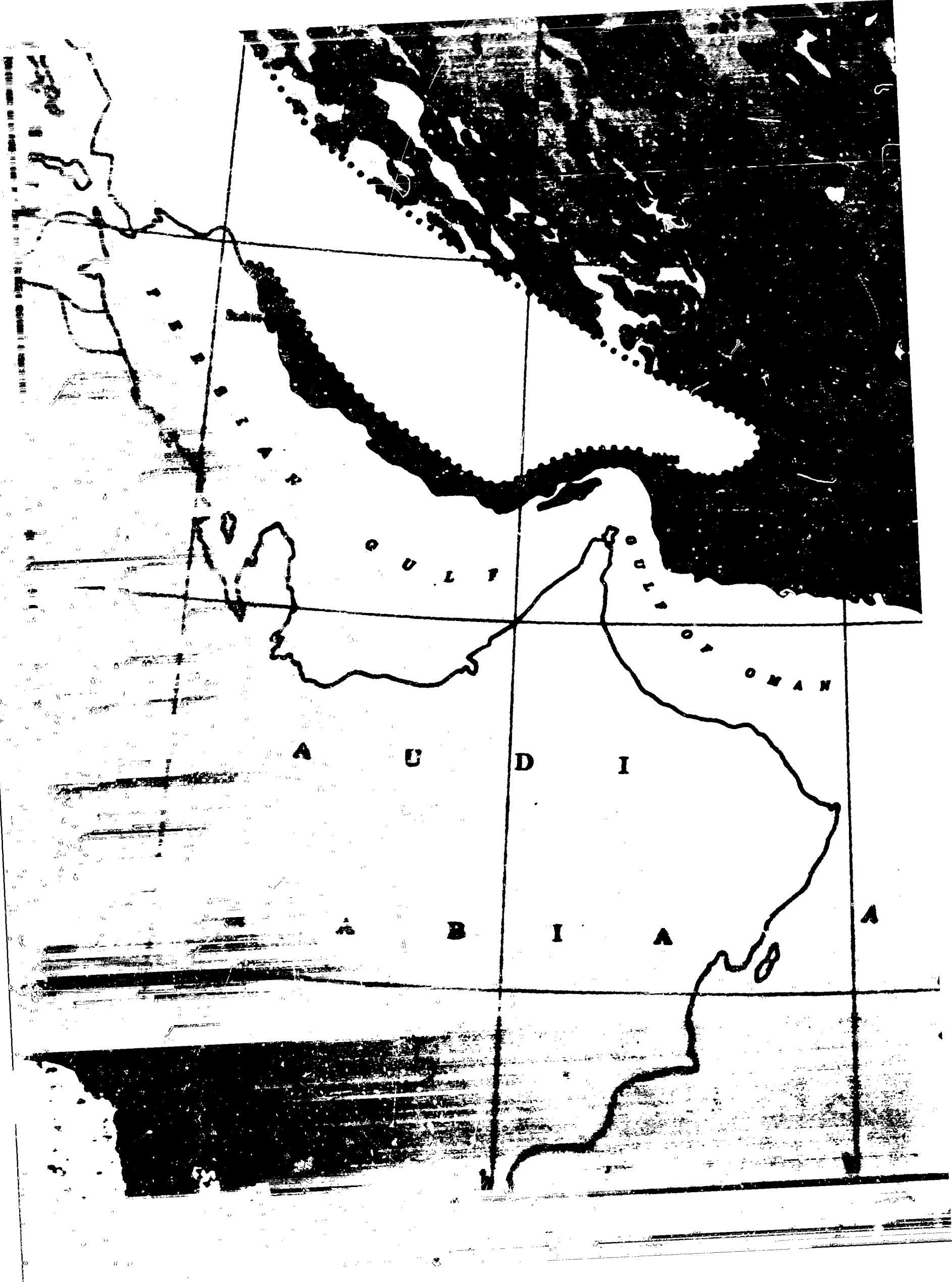
SCALE

HILLS



1		Below sea level
2		0 to 1,000 feet
3		1,000 to 2,000 feet
4		2,000 to 3,000 feet
5		3,000 to 5,000 feet
6		5,000 to 7,000 feet
7		7,000 to 9,000 feet
8		9,000 to 12,000 feet
9		12,000 to 15,000 feet

Equal opportunity in force





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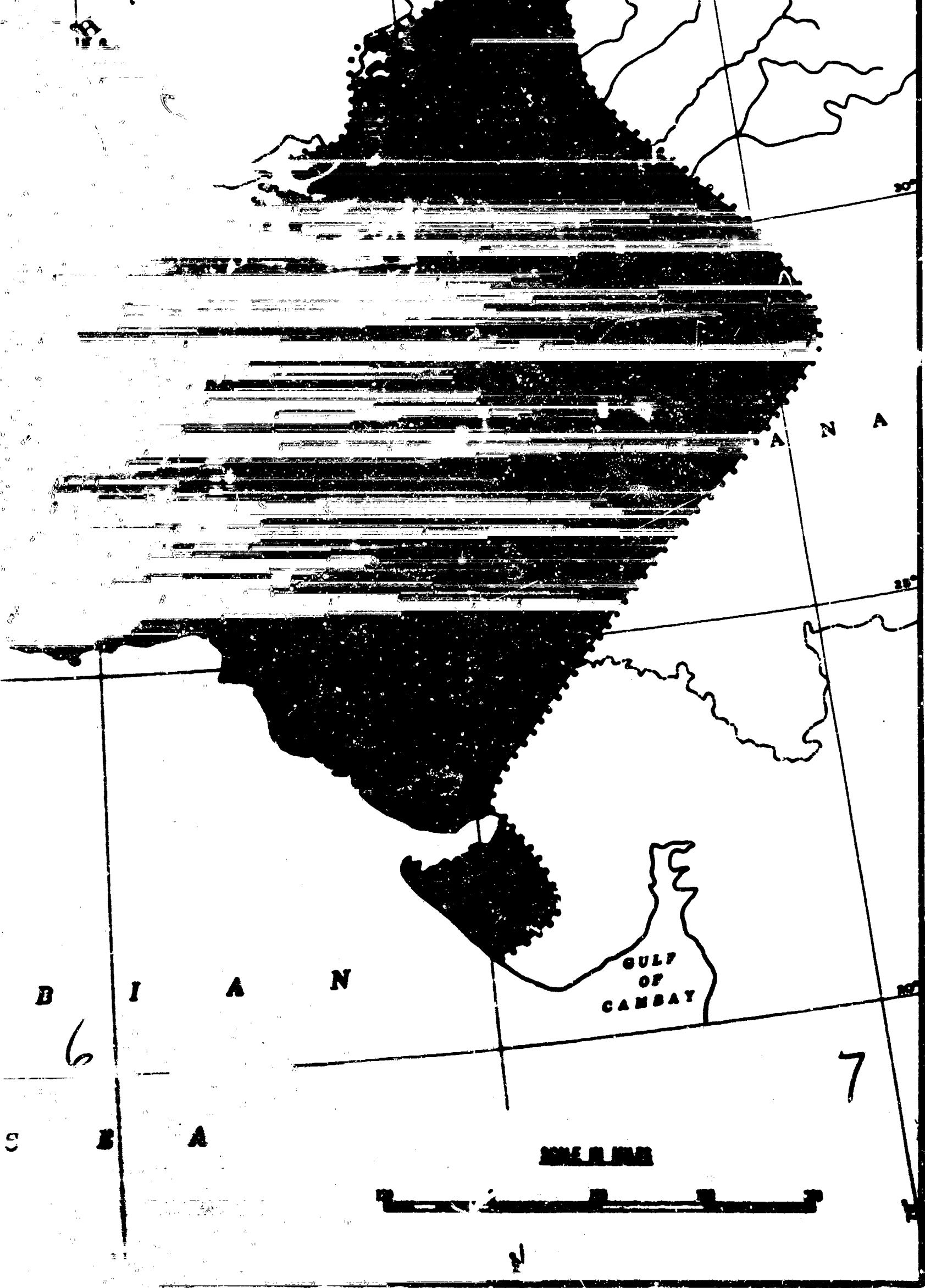
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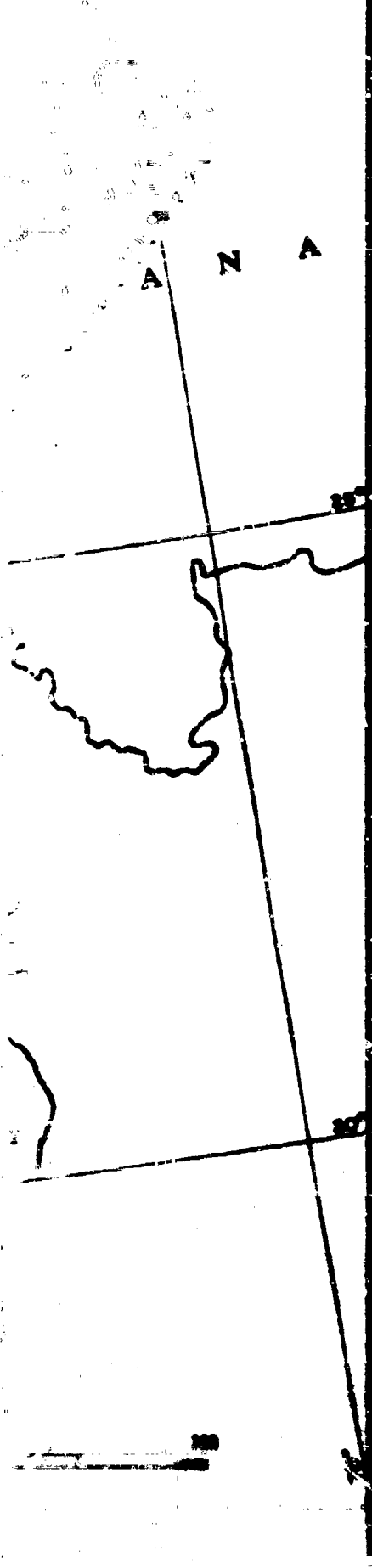
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MOUNTAINS: Masses of land, in which summit areas are small in proportion to total dimensions, rising more than 1000 feet above the surrounding terrain. The characteristic slope is declivities or steep.

Massive Mountains: Rugged multiple-peaked mountain masses characterized by either a high or locally levelled crest or an elongate crest which rises above the 5000 feet above the surrounding terrain.

Ranges: Elongate belts of massive mountains.

Massifs: Roughly circular aggregation of massive mountains.

Ridge Mountains: Continuous ridges of aligned crestal peaks typically rising less than 5000 feet above the surrounding terrain.

Single Ridge: Single, isolated mountain ridge.

Parallel Ridges: A series of roughly parallel ridges; some peaks may rise more than 1000 feet above average, surrounding valleys.

Heterogeneous Mountains: Mountain masses, commonly composed by regions of other terrain types, cover substantially more than 50 per cent of the total area. Any area so mapped is not characterized by either a high centrally located crest or an elongate crest.

Peaks and Groups of Peaks: The mountain masses consist predominantly of peaks and groups of peaks.

Random Ridges: The mountain masses consist predominantly of discontinuous, randomly oriented ridges.

PLAIN AND MOUNTAIN COMPLEX: Mountains, separated by plains with occasional hills, cover less than 50 per cent of the total area.

Isolated Peaks and Ridges: The mountain masses consist predominantly of peaks and randomly oriented discontinuous ridges.

Peak and Range: The mountain masses consist predominantly of roughly parallel ridges.

REL-LANDS: Areas characterized by predominance of small summit areas, with characteristic slopes gentle to steep, rising less than 1000 feet above the surrounding terrain. Plains regions between hills may range as high as 75 per cent of the total area.

Parallel Hills: Predominance consist predominantly of parallel elongate hills with characteristic slopes moderate to steep.

Random Hills: Predominance consist predominantly of randomly distributed hills with characteristic slopes moderate to steep.

Volcanic: Predominance consist predominantly of randomly distributed conical and irregularly shaped hill forms. Inter-hill areas characterized by rough surfaces of varying to jagged ridges and troughs. Slopes may range from gentle to precipitous. In some instances, central hills may be steep.

Small Basin: Predominance, consisting chiefly of either small, somewhat (but not necessarily) steep slopes and position rapidly. Areas characterized by a total lack of significant drainage basins and moderate to steep slopes.

PLATEAUS: Elevated masses of land characterized by extensive, more or less flat-lying summit areas bounded on one or more sides by escarpments. (Plateaus are indicated on maps by a thick line; all other boundaries are more or less graduated.) (Mountains and plateaus are indicated by a line of varying thickness less than 20 per cent of the mapped surface.)

PLAINS: Extensive tracts of land with characteristic slopes flat to gentle. Less than 25 per cent of the surface is occupied by hills, and local relief within the plains seldom exceeds 50 feet. (Because of the transitional nature of most plain types, boundary lines are often difficult to establish and in many cases are quite arbitrary.)

Alluvial Plains: Floodplains, terraces, and alluvial deltas of major streams.

Coastal Plains: Plains bordering the coast or extending inland to the nearest elevated land, or to a gradual border with another plain type.

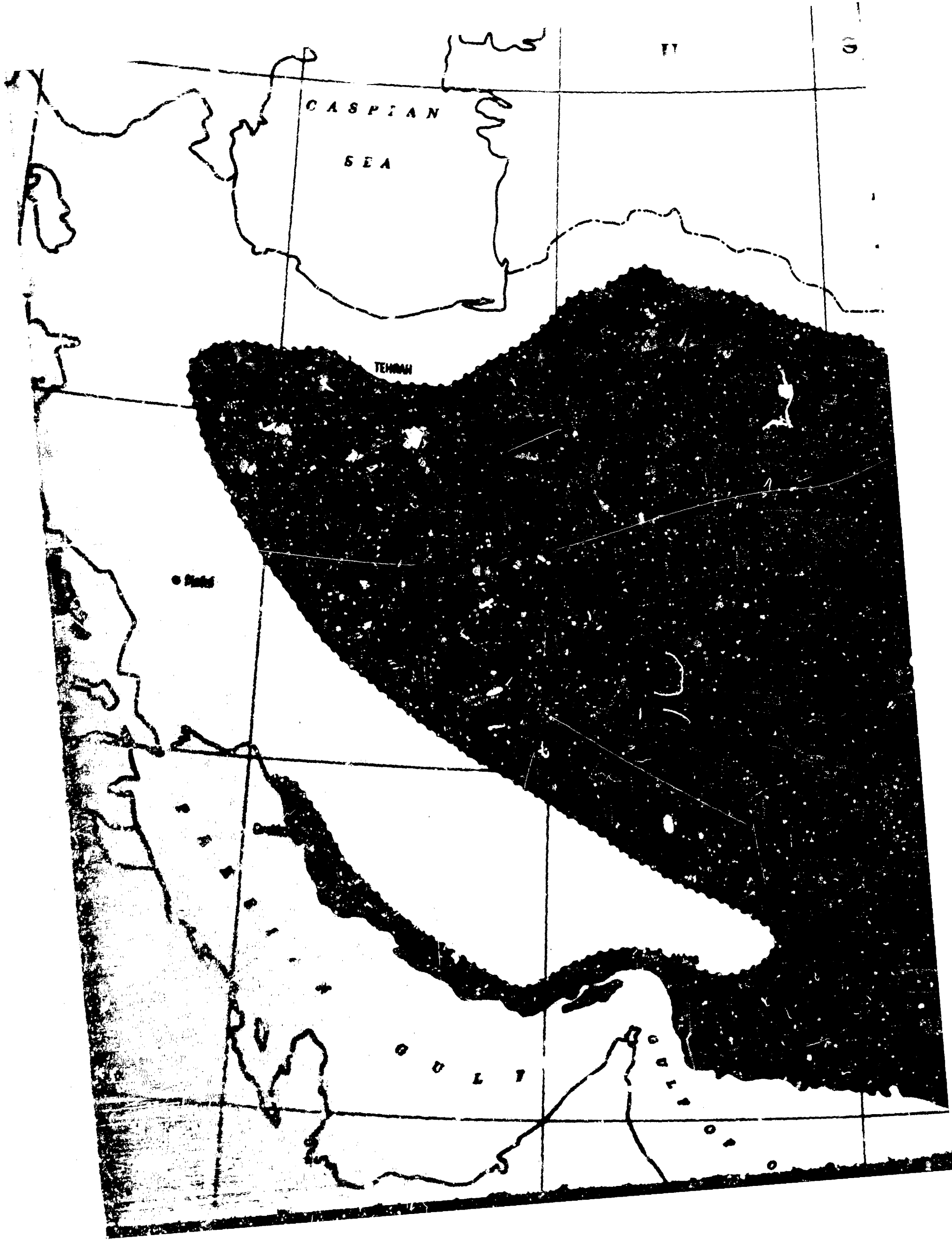
Depression Plains: Low-lying plains of interior drainage bounded on two or more sides by escarpments and commonly characterized by a centrally located broadish or saline lake, generally but not necessarily ephemeral.

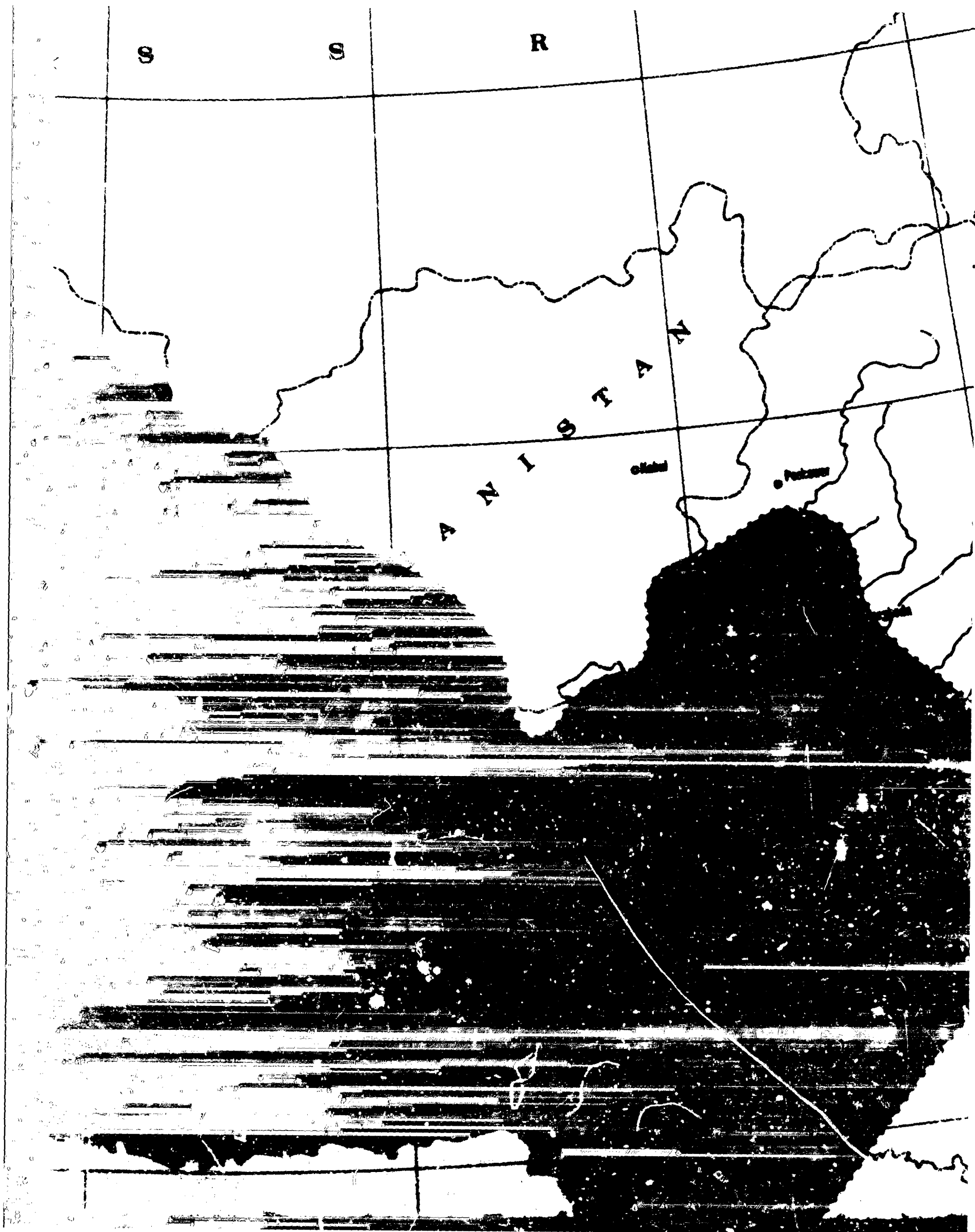
Desert Plains: Interior plains not readily identifiable as alluvial, coastal, or depression plains. These plains are often formed or significantly modified by eolian deposition or erosion.

Slope classification: flat = 0 to 2 degrees, gentle = 2 to 6 degrees, moderate = 6 to 14 degrees, declivities = 14 to 24.5 degrees, steep = 24.5 to 45 degrees, precipitous = greater than 45 degrees.

A survey is defined as a more or less continuous precipitous slope exhibiting more than 100 feet of relief.

ANALOGS OF YUMA TERRAZANO IN THE SOUTH CENTRAL ASIAN DESERT PHYSIOGRAPHY







SOUTHWESTERN UNITED STATES

SYMBOLS

MOUNTAINS: Masses of land, in which certain areas are higher in proportion to local elevations, rising more than 1000 feet above the surrounding terrain. The characteristics are in descriptive or steep.

Massive Mountains: Extensive multiple peaked mountain masses characterized by a high, centrally located peak or an elongate crest which rises more than 1000 feet above the surrounding terrain.

Ranges: Elongate belts of massive mountains.

Mountains: Roughly circular aggregations of massive mountains.

Ridge Mountains: Continuous ridges of aligned conical peaks typically rising less than 5000 feet above the surrounding terrain.

Single Ridge: Single, isolated mountain ridge.

Parallel Ridges: A series of roughly parallel ridges; some peaks may rise more than 1000 feet above the surrounding terrain.

Heterogeneous Mountains: Mountain masses, composed of regions of other mountain types, cover substantially more than 50 per cent of the total area. They are not characterized by either a high centrally located peak or an elongate crest.

Peaks and Groups of Peaks: The mountain masses consist predominantly of peaks and groups of peaks.

Random Ridges: The mountain masses consist predominantly of discontinuous, randomly oriented ridges.

PLAIN AND MOUNTAIN COMPLEX: Mountains, composed of peaks with conical hills, cover less than 50 per cent of the total area.

Isolated Peaks and Ridges: The mountain masses consist predominantly of peaks and randomly oriented discontinuous ridges.

Basins and Ranges: The mountain masses consist predominantly of roughly parallel ridges.

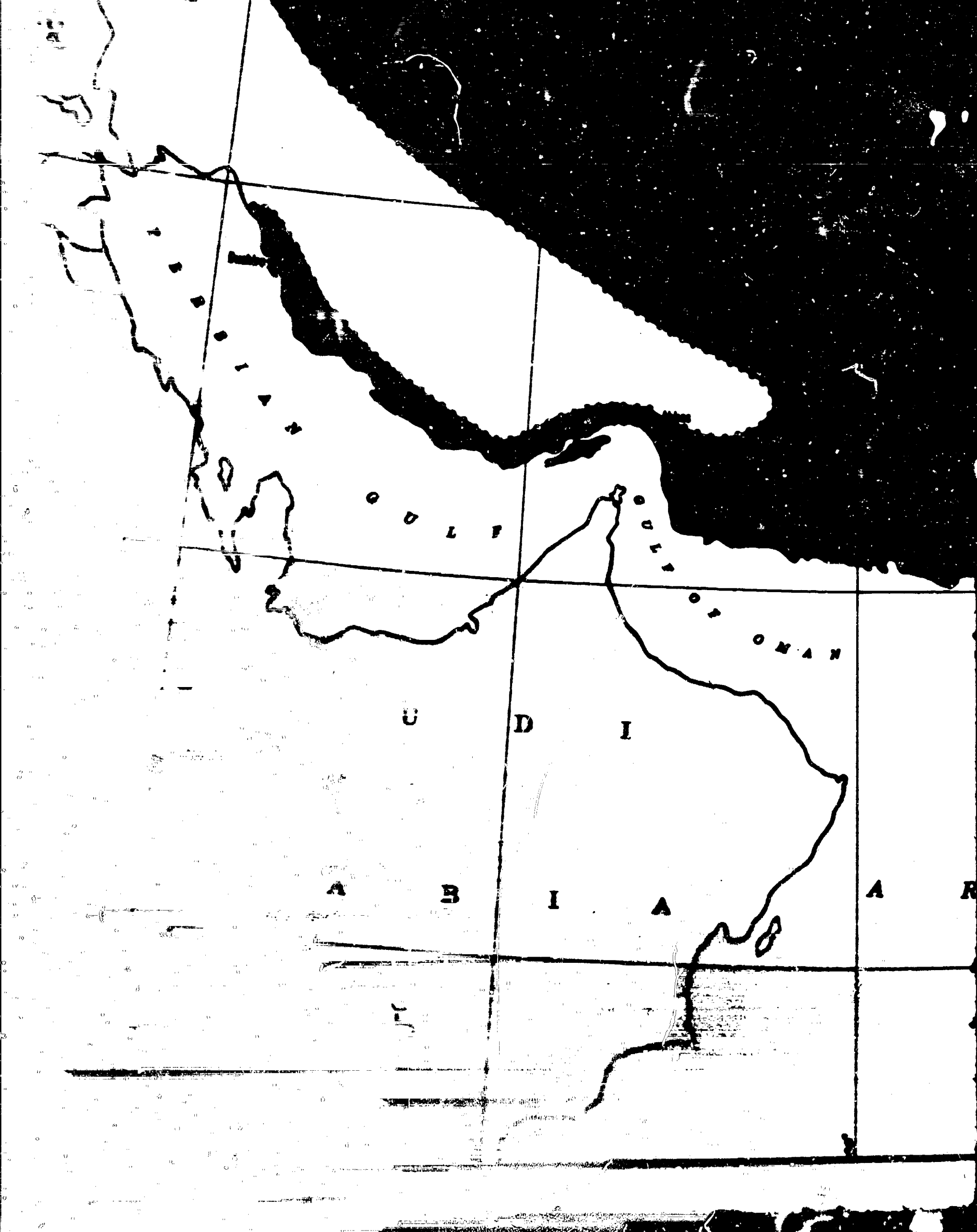
HILL LANDS: Areas characterized by prominent low, conical peaks, with elevations less than 1000 feet above the surrounding terrain. The slopes between hills may range as high as 75 per cent of the total area.

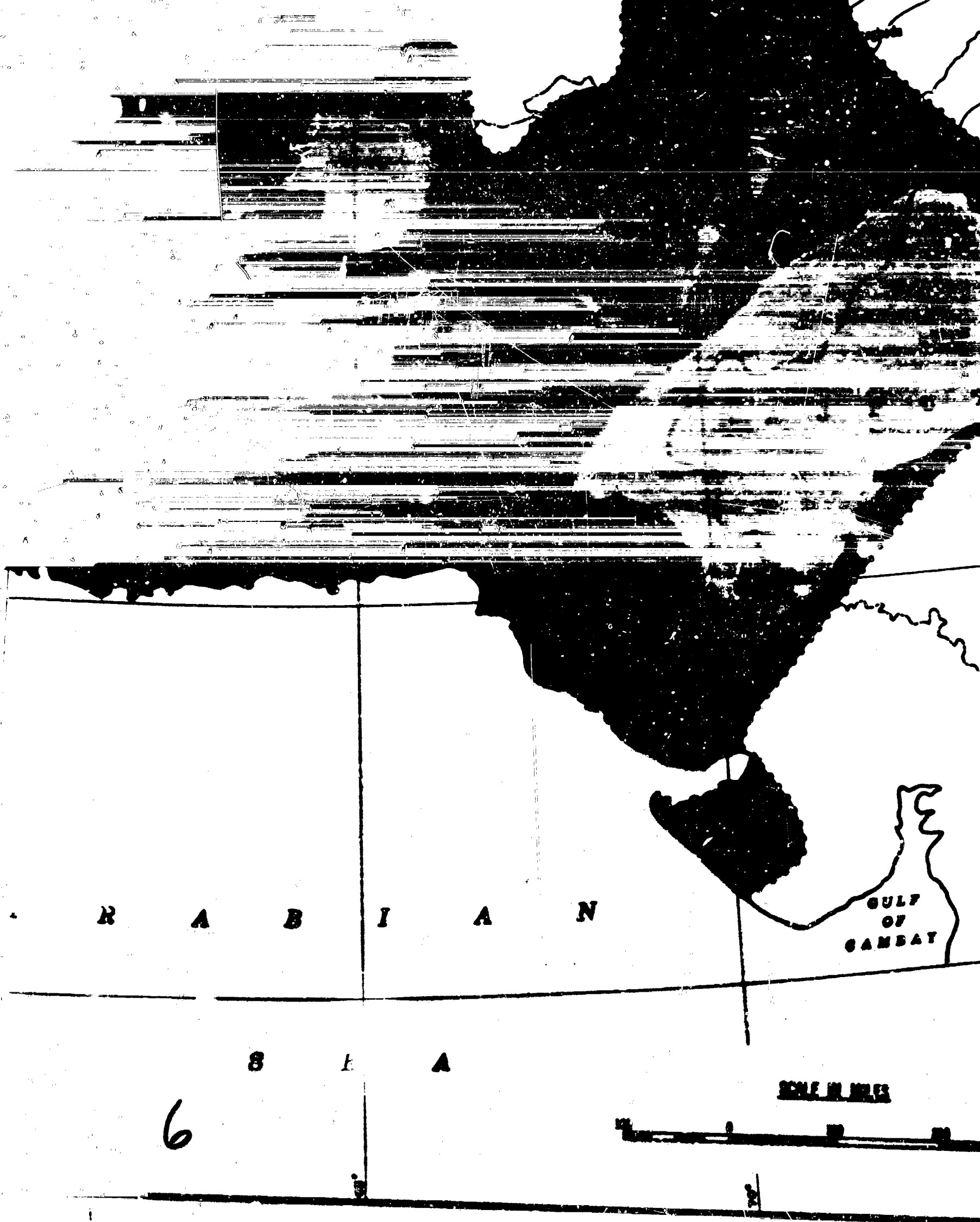
Parallel Hills: Mountains consisting predominantly of parallel elongate hills with discontinuous, steeply sloping ridges.

Random Hills: Mountains consisting predominantly of randomly oriented hills with discontinuous, steeply sloping ridges.

Volcanoes: Peaks and ridges consisting predominantly of conical, shield-shaped, and irregularly shaped hills. The slopes are steeply sloping, with a central peak or a group of peaks. The slopes may range from gentle to steep. In some cases, the slopes may be steep.

Island Peaks: Prominent, conical peaks, consisting chiefly of conical hills, commonly but not invariably steeply sloping. The slopes may range from gentle to steep. In some cases, the slopes may be steep.





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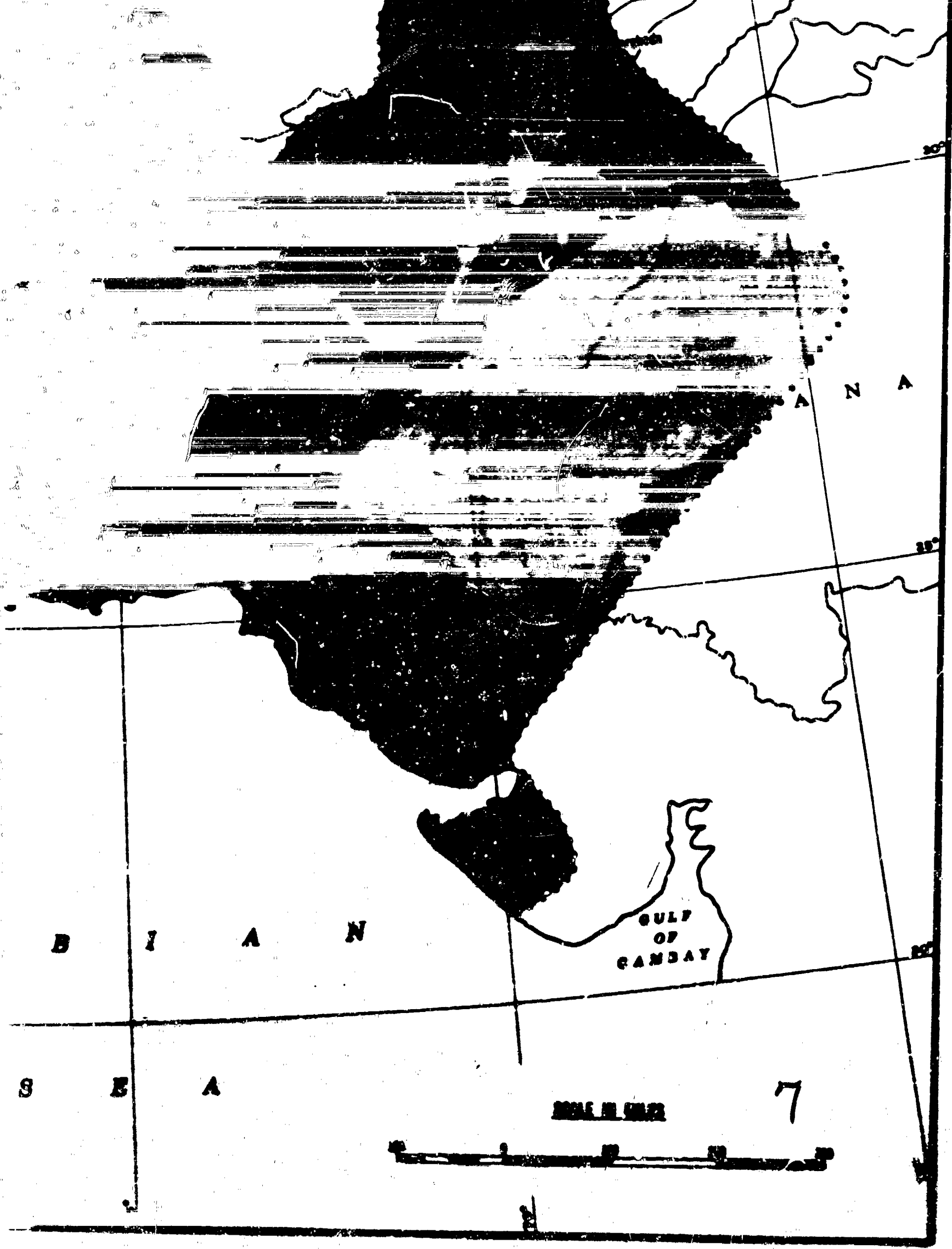
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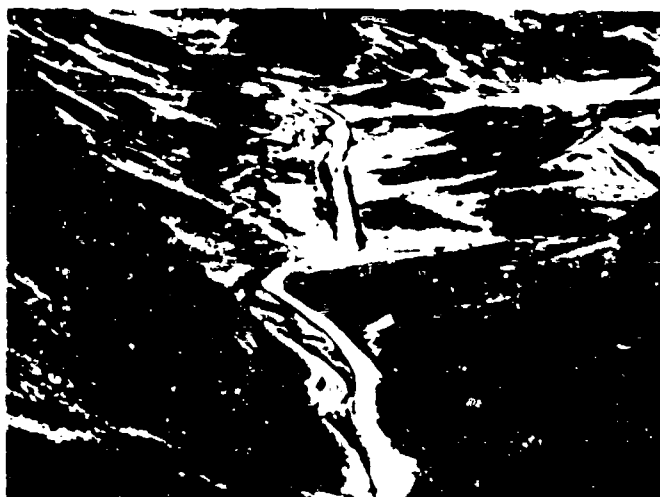
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**ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT
PHYSIOGRAPHY
DESCRIPTIONS AND PHOTOGRAPHS**

PLATE 16

pared to basal dimensions. Areas so mapped may be entirely mountainous, such as massive, ridge, and plain-mountain complexes in which the plains occupy more than 50% of the total area. The South Central Asia 50% of it being mapped as mountains. Mountains flank the area on the north, west, and south. Several north-south trending mountain ranges are for the most part continuous mountainous masses enclosing huge interior regions which are separated by roughly parallel, discontinuous mountain ranges. The mountains are characterized by bare slopes from 50 to several thousand feet. They are composed chiefly of sedimentary and extrusive rocks but locally



M-1. Massive mountains north of Meshed. Picture shows a typical intramontane valley winding between the towering, rugged ranges characteristic of the area. At 37°20' N, 59° E



M-2. The southern Zagros Mountains along the Persian Gulf. No more rugged mountains than these, with the sharp pinnacles and spikes, are to be found in the area. At approximately 28° N, 52° E



a



b

M-7. Photographs a, b, and c show the result of an earthquake that occurred in the vicinity of Quetta. Photograph a shows an escarpment caused by faulting near Mastung south of Quetta. The escarpment, lightface contrasting with the dark surface of the ground. Photographs b and c show Mount Mastung before and after the earthquake. Photograph c shows the scars of the rock falls caused by the earthquake. Photograph a at 29°45' N, 67°50' E; b and c at 30° N, 67° E

II. HILL LANDS: Hill lands are areas characterized by prominences of small summit area that rise to heights of less than 100 feet. Areas so mapped may consist entirely of hill masses or of hills separated by plains which may occupy as much as 75% of the total area and composition of hill lands vary widely. They may consist of parallel or random hills composed of igneous or sedimentary rocks; even unconsolidated materials; volcanic hills composed of lava or cinders; or sand dunes, sculptured into a variety of shapes. Within hill lands range from gentle to steep, and relief ranges from 10 to several hundred feet. The dunes, however, volcanic hills are characteristically barren whereas the random and parallel hills usually support a sparse stand of vegetation. Approximately 16% of the South Central Asian Desert.

The most widespread of the hill types are sand dunes. Dunes may be conveniently divided into two basic types: stabilized or vegetated dunes. Stabilized forms occur in the northern part of the area in Afghanistan. The height is quite arbitrary, being determined largely by the sporadic rainfall. In general, the terrain is gently undulating, reaching heights of several hundred feet. Shallow drainageways score the surface at frequent intervals, and a dense stand of vegetation.

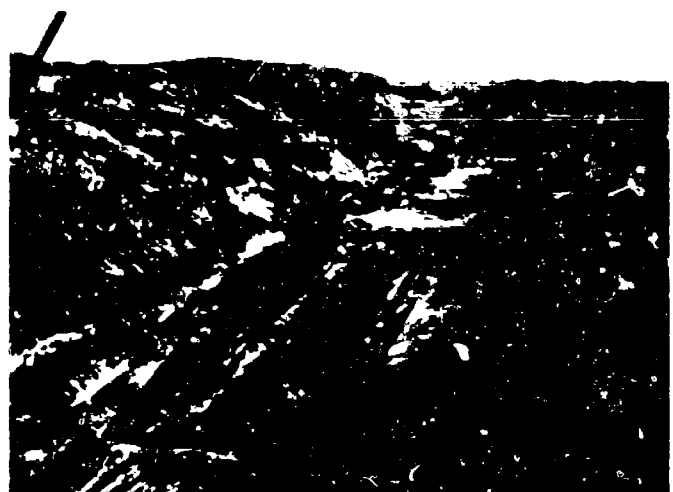
Mobile dune types are found throughout the entire area. Where not actually mapped, they occur in small, scattered types.



and the Zagros Mountains, which may be the largest mountain range in the world. The Asian Desert is very mountainous, more than 100,000 sq. mi. of land. The central ranges trend through the central Asian Desert, which are, in turn, subdivided into smaller basins and plateaus, declivitous to steep slopes and relief ranging from low to high. Locally of granites and metamorphic rocks.



the Persian Gulf with their surrounding area.



M-3. Elongate dome flanked by hogback ridges in the Zagros Mountains along the Persian Gulf. These features occur frequently throughout the area. At 27°30' N, 52°30' E



M-4. Steep wadi banks near Isfahan. The sides are precipitous to steep. Mapped extensively in the basin and range region. At 32°45' N, 51°40' E



M-5. Alluvial plain near Tehran. Photo shows braided drainage characteristic of the entire area.



Quetta in the Sulaiman Mountains of Pakistan. The prominent trends through the middle of the photo-Mount Chiltan between Mastung and Quetta earthquake. The scars are the light-colored. At 27°30' N, 67°50' E



M-8. Schuppen at Surtab in the Makran Mountains in southern Iran. Hill-like in form, they occur in elongate belts and result from the differential erosion of resistant sandstone and soft shale. At 27° N, 57°30' E



M-9. Badlands near Bandin in the southern Makran region. They are the result of severe erosion in the sedimentaries. At 25°35' N, 59°30' E

more than 1000 ft above the surrounding terrain. Areas such as 75% of the total area. The characteristics of igneous, metamorphic, and sedimentary rock or into a wide variety of shapes by the wind. Slopes of dunes, except for vegetated dune areas, and the sparse vegetative cover. Hill lands comprise ap-
 types: (1) mobile or active dunes and (2) sta-
 The boundaries of the vegetated dune areas are
 relating to rolling with crests of stabilized dunes
 dunes, and their beds are often covered by a fairly
 well isolated patches within other physiographic





near Isfahan.
to steep.
basin and
N, 51°40' E



M-5. Alluvial fans near Rey, southeast of Tehran. Photograph shows the characteristic braided drainage pattern. Fans and aprons are characteristic of hills and mountains throughout the entire area. At 32°35' N, 51°25' E



M-6. High rugged mountains and steep intramontane valleys near Chin in the western Zagros. The mountain in the left foreground rises 3000 ft above the valley. At approximately 31° N, 50°50' E



M-9. Badlands near Bandini in the southern Makran region. They are the result of severe erosion in soft sedimentaries. At 25°35' N, 59°30' E



M-10. Badlands east of Bir in the southern Makran. Badlands such as these would be almost impossible to negotiate. At approximately 25°30' N, 59°50' E



M-11. Kuh-i-Nanak south of Bushire in the Zagros Mountains. The drawing shows the broad salt dome with a salt glacier measuring 1-1/2 miles in width flowing down the northwestern flank. This is one of some 150 known domes in the southern Zagros Mountains. At 28°45' N, 52°40' E



a



b

M-7. Photographs a, b, and c show the result of an earthquake that occurred in the vicinity of Quetta. Photograph a shows an escarpment caused by faulting near Mastung south of Quetta. The escarpment, the lightface contrasting with the dark surface of the ground. Photographs b and c show the scars of the rock falls caused by the earthquake. Photograph c shows the scars of the rock falls caused by the earthquake. Photograph a at 29°45' N, 67°50' E; b and c at 30° N.

II. HILL LANDS: Hill lands are areas characterized by prominences of small summit area that rise to heights of less than 100 feet. They may consist of parallel or random hills composed of igneous or volcanic materials; volcanic hills composed of lava or cinders; or sand dunes, sculptured into various shapes. The relief within hill lands range from gentle to steep, and relief ranges from 10 to several hundred feet. The dunes and volcanic hills are characteristically barren whereas the random and parallel hills usually support a sparse stand of vegetation.

The most widespread of the hill types are sand dunes. Dunes may be conveniently divided into two basic types: stabilized or vegetated dunes. Stabilized forms occur in the northern part of the area in Afghanistan. The dunes are quite arbitrary, being determined largely by the sporadic rainfall. In general, the terrain is gently undulating, reaching heights of several hundred feet. Shallow drainageways score the surface at infrequent intervals.

Mobile dune types are found throughout the entire area. Where not actually mapped, they occur in small patches.



H-1. Complex dunes of the Lut in southern Iran. The Lut is described as a confused, closely spaced mass of dunes with no apparent orientation but, rather, combinations of basic dune types. It is one of the most difficult dune areas in the world to negotiate. At 30°30' N, 59°40' E



H-2. Yardangs of the southern Lut. Wind-eroded silt deposits occur in roughly parallel bands separated by flat troughs. Heights vary from 10 to 200 ft. Movement parallel to the bands is unimpeded but transverse movement is impossible. At 30° N, 59°15' E



b



c



M-8. Schuppen at Surtab in the Makran Mountains in southern Iran. Hill-like in form, they occur in elongate belts and result from the differential erosion of resistant sandstone and soft shale. At 27° N, 57° 30' E.

that occurred in the vicinity of Quetta in the Sulaiman Mountains of Pakistan, trending south of Quetta. The escarpment trends through the middle of the photograph. Photographs b and c show Mount Chiltan between Mastung and Quetta. The scars of the rock falls caused by the earthquake. The scars are the light-colored. At 29° 45' N, 67° 50' E; b and c at 30° N, 67° 50' E.

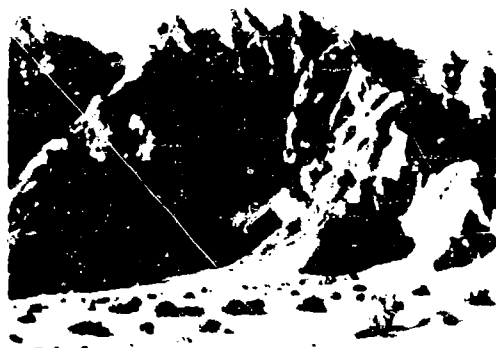
Area that rise to heights of less than 1000 ft above the surrounding terrain. Areas of plains which may occupy as much as 75% of the total area. The characteristics are parallel or random hills composed of igneous, metamorphic, and sedimentary rock or dunes; or sand dunes, sculptured into a wide variety of shapes by the wind. Slopes are 10 to several hundred feet. The dunes, except for vegetated dune areas, and the parallel hills usually support a sparse vegetative cover. Hill lands comprise approximately

conveniently divided into two basic types: (1) mobile or active dunes and (2) stabilized dunes. The boundaries of the vegetated dune areas are general, the terrain is gently undulating to rolling with crests of stabilized dunes. The surface at infrequent intervals, and their beds are often covered by a fairly

Actually mapped, they occur in small isolated patches within other physiographic



H-2. Yardangs of the southern Lut. These wind-eroded silt deposits occur as low hills in roughly parallel bands separated by wide, flat troughs. Heights vary from several feet to 200 ft. Movement parallel to the yardangs is unimpeded but transverse movement is impossible. At 30° N, 59° 15' E.



H-3. Severely eroded igneous hills south of Sargodha in the Punjab. These inselbergs or ridges may rise to heights as great as several hundred feet above the alluvial plain. They occur chiefly between Sargodha and Chenab. At 32° N, 72° 40' E.



H-4. Granite hills near Rajputana. The hills are the intrusion of an igneous formation. They are characterized by sharp sides and may attain heights of several hundred feet. At approximately 33° 35' E.



Mountains of Pakistan.
Middle of the photo-
stung and Quetta
the light-colored



M-8. Schuppen at Surtab in the Makran Mountains in southern Iran. Hill-like in form, they occur in elongate belts and result from the differential erosion of resistant sandstone and soft shale. At 27° N, 57°30' E



M-9. Badlands near Bandini in the southern Makran region. They are the result of severe erosion in soft sedimentaries. At 25°35' N, 59°30' E



M-10. Badland in southern Makran as these would be negotiable at 25°30' N

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H-3. Severely eroded igneous hills south of Sargodha in the Punjab. These inselbergs or ridges may rise to heights as great as several hundred feet above the alluvial plain. They occur chiefly between Sargodha and Chenab. At 32° N, 72°40' E



H-4. Granite hills near Desuri in western Rajputana. The hills were formed by the intrusion of an igneous mass followed by denudation. They are characteristically smooth-sided and may attain heights of several hundred feet. At approximately 25°15' N, 73°35' E



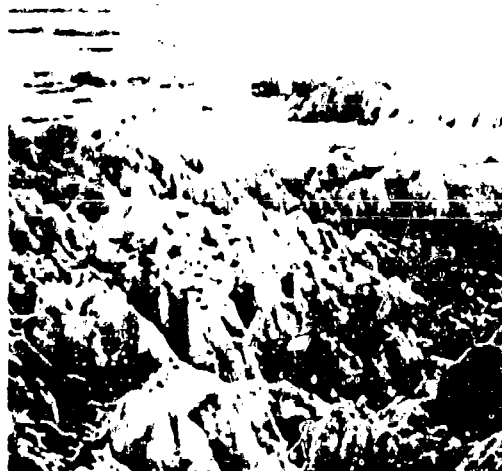
H-5. Bouldery surficial fan at the base of Range north of Jhelum Punjab. Movement of the bouldery plains is due to 33° N, 75°30' E

characteristic of hills and mountains through-
out the entire area. At 32°35' N, 51°25' E

places 7000 ft above the valley. At approxi-
mately 31° N, 50°50' E



lands near Bandini in the
Makran region. They are
of severe erosion in soft
rocks. At 25°35' N,

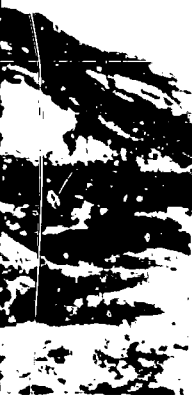


M-10. Badlands east of Bir in the
southern Makran. Badlands such
as these would be almost impos-
sible to negotiate. At approxi-
mately 25°30' N, 59°40' E



M-11. Kuh-i-Namak south of
Bushire in the Zagros Mountains.
The drawing shows the broad salt
dome with a salt glacier measur-
ing 1-1/2 miles in width flowing
down the northwestern flank.
This is one of some 150 known
domes in the southern Zagros
Mountains. At 28°45' N, 52°40' E

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M-5. Bouldery surface of an allu-
vial fan at the base of the Salt
Range north of Jhelum in the
Punjab. Movement through these
bouldery plains is difficult. At
33° N, 73°30' E



H-6. Mud volcano in the Makran
Mountains. The volcanoes are
formed by the eruption of sulfu-
rous and bituminous mud from a
central vent. At 25°30' N,
59°55' E

ANALOGS OF YUMA TERRAIN IN THE SOUTH CENTRAL ASIAN DESERT PHYSIOGRAPHY

DESCRIPTIONS AND PHOTOGRAPHS

1

**ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT
PHYSIOGRAPHY
DESCRIPTIONS AND PHOTOGRAPHS**

PLATE 16A

III. PLATEAUS: Plateaus are elevated masses of land characterized by extensive, more or less flat-lying summit areas greater than 100 ft in height. Dissected plateaus have been mapped where less than 85% of the original South Central Asian Desert is mapped as plateau. None of the South Central Asian plateaus are dissected; plateau summit is usually less than 1 degree; however, some summits have surfaces which are more undulating up to 6 degrees. Relief on the flat-lying summits may range up to 10 ft, whereas the rolling plateau tops have dissection along the major drainageways may occasionally exceed 1000 ft. The plateaus of South Central Asia are composed of igneous rocks capped by layers of volcanic rock. In general, summit elevations lie between 0 and 1000 ft.

IV. PLAINS: Plains are extensive tracts of land characterized by flat to gentle slopes. Hills may be found within these tracts. Plains occupy approximately 25% of the South Central Asian Desert and may be subdivided on the basis of origin. Plains bordering the sea, coastal plains; plains formed by the deposition of sediments from major rivers are termed alluvial plains; and interior plains not readily classifiable in the above categories are termed desert plains. Dissected plains exhibit relief ranging from 0 to approximately 10 ft. Relief within dissected plains is characteristically up to 100 ft. The soil and rock types associated with the plains of South Central Asia vary widely. Most of the plains are less than 2000 ft; however, smaller ones are found between 2000 and 3000 ft.

More than 9% of the South Central Asian plains have been mapped as desert plains. Although this figure may seem small, the term "desert plain" as used here embraces a variety of types. Included in this classification are: the great salt plains in some cases, but sometimes dissected to an extent that would seriously impede cross-country movement, with low mountains; the salt plains occurring in the great arid basin of Iran range in size from several to thousands of miles; these plains are composed of a thick crust of salt underlain by mire. Exposed to the intense heat of the sun, the salt crusts are often rendering it impossible to traverse; the great sandy plains, swept by the wind, and with their monotony in appearance common in the interior of the study area; and the featureless expanses of bare rock, their surfaces denuded by the action of the desert plain. Chances of survival in such plains would be minute due to the lack of both water and vegetative cover.

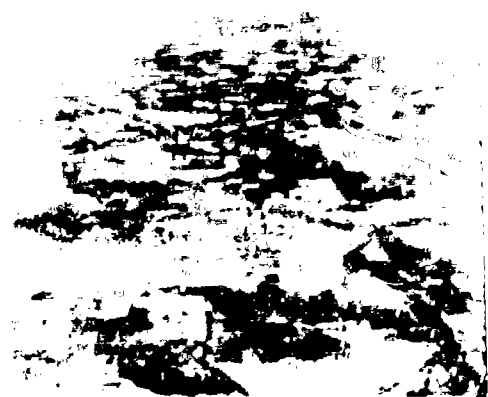
The coastal plains of South Central Asia occur as discontinuous areas of varying width which extend from Bushi in the north to the Kathiwar Peninsula, their continuity being broken occasionally by rugged mountains extending to the sea.

Alluvial plains occupy a significant portion of the study area. The Indus River, from its entrance into the Arabian Sea, is bordered by a wide, flat floodplain. The Punjab, land of five rivers, is another large alluvial tract.

The depression plains are relatively small in area, but are of physiographic interest. These depressions usually are the result of solution, and/or faulting. The depression plains of South Central Asian Desert worthy of mention are the Seistan Basin, the boundaries of Iran, Pakistan, and Afghanistan, and the Jaz Murian Basin in southwest Iran north of the Makran Mountains. These plains are flat, with relief ranging from several to tens of feet. Scarps bordering the plains commonly range from 100 to 1000 ft. Characteristic of depressions include: alluvial fans, low dunes, scarps, amphitheaters, salt-encrusted playas, talus, etc.



P-1. Desert plain in western Rajputana showing typical vegetation. The loose sandy soil is called retli. The trees in the right foreground and seen scattered throughout the background are known as kedhra. Vegetation in these areas seldom reaches a density that would seriously impede cross-country movement. At approximately 25° N, 72° E



P-2. Floodplain of the Indus River. The dark patches are irrigated areas. The low dunes which form the transition between the floodplain and the Thar Desert are visible in the east. At approximately 26° 30' N, 72° E

PHYSIOGRAPHY: DESCRIPTIO

masses of land characterized by extensive, more or less flat-lying summit areas bounded on one or more sides by scarps. Dissected plateaus have been mapped where less than 85% of the original surface remains. Approximately 1% of the desert is mapped as plateau. None of the South Central Asian plateaus are dissected plateaus. The characteristic slope of the plateau is less than 1 degree; however, some summits have surfaces which are more undulating or rolling and exhibit slopes ranging from 1 to 10 ft, whereas the rolling plateau tops have relief ranging from 10 to 50 ft. Depth of drainage ways may occasionally exceed 1000 ft. The plateaus of South Central Asia occur in an area of flat-lying sedimentary rocks of volcanic rock. In general, summit elevations lie between 0 and 1000 ft.

of land characterized by flat to gentle slopes. Hills may be found within these tracts but occupy less than 25% of the total area. Approximately 25% of the South Central Asian Desert and may be subdivided on the basis of origin or physiographic relation. Floodplains of major rivers are termed alluvial plains; plains bordering the sea, coastal plains; low-lying plains of interior drainage are termed depression plains; and interior plains not readily classifiable into the other types, desert plains. Undissected plains ranging from 0 to approximately 10 ft. Relief within dissected plains is characteristically between 10 and 50 ft and occasional hills and rock types associated with the plains of South Central Asia vary widely. Most of the plains lie between elevations of 0 and 3000 ft.

Central Asian plains have been mapped as desert plains. Although this figure may seem high it should be understood that the area here embraces a variety of types. Included in this classification are: the great intermontane plains, relatively undissected; the great dissected to an extent that would seriously impede cross-country movement, which separate the discontinuous ranges of mountains occurring in the great arid basin of Iran range in size from several to thousands of square miles in extent. The surfaces of the plains are of a thick crust of salt underlain by mire. Exposed to the intense heat of the sun, the surface cracks into large blocks of salt, which are difficult to traverse; the great sandy plains, swept by the wind, and with their monotony interrupted only by occasional dunes, are the study area; and the featureless expanses of bare rock, their surfaces denuded by the wind, represent still another type of terrain. Survival in such plains would be minute due to the lack of both water and vegetative cover.

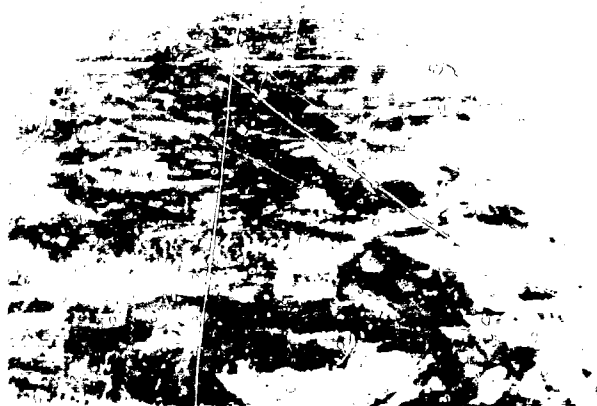
Central Asia occur as discontinuous areas of varying width which extend from Bushire at the head of the Persian Gulf to the north, the continuity being broken occasionally by rugged mountains extending to the sea.

significant portion of the study area. The Indus River, from its entrance into the area in Northern Pakistan to its mouth at the Arabian Sea, is a wide, flat floodplain. The Punjab, land of five rivers, is another large alluvial tract.

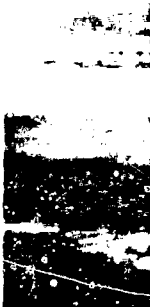
relatively small in area, but are of physiographic interest. These depressions usually originate through the process of erosion, the depression plains of South Central Asian Desert worthy of mention are the Seistan Basin which lies just north of the common border of Iran, Afghanistan, and the Jaz Murian Basin in southwest Iran north of the Makran Mountains. The floors of all the depressions are from several to tens of feet. Scarps bordering the plains commonly range from 100 to several thousand feet. Landforms include: alluvial fans, low dunes, scarps, amphitheaters, salt-encrusted playas, talus slopes, salt lakes, and salt marshes.



ern Rajputana showing typical desert vegetation. The soil is called retli. The vegetation is scattered throughout and seen scattered throughout the area as kedhra. Vegetation in this area is of a density that would seriously impede movement. At approximately



P-2. Floodplain of the Indus River. Dark patches are irrigated areas. The light areas with dark spots are sandy areas of plains and low dunes which form the transition between the floodplain and the Thar Desert to the east. At approximately 26°30' N, 67°50' E



P-3. Alluvial fan. The scattered patches are practically no obstacle to movement. At approximately 72°40' E



plains are generally ranging from 0 to approximately 10 ft. Relief within dissected plains is characteristically not usually up to 100 ft. The soil and rock types associated with the plains of South Central Asia vary widely. Most of the plains are 2000 ft; however, smaller ones are found between 2000 and 3000 ft.

More than 9% of the South Central Asian plains have been mapped as desert plains. Although this figure may seem high, the term "desert plain" as used here embraces a variety of types. Included in this classification are: the great intermontane plains, in some cases, but sometimes dissected to an extent that would seriously impede cross-country movement, which separate the mountains; the salt plains occurring in the great arid basin of Iran range in size from several to thousands of square miles; these plains are composed of a thick crust of salt underlain by mire. Exposed to the intense heat of the sun, the surface is often rendering it impossible to traverse; the great sandy plains, swept by the wind, and with their monotony interrupted by common in the interior of the study area; and the featureless expanses of bare rock, their surfaces denuded by the wind, is a desert plain. Chances of survival in such plains would be minute due to the lack of both water and vegetative cover.

The coastal plains of South Central Asia occur as discontinuous areas of varying width which extend from Bushire at the tip of the Kathiwar Peninsula, their continuity being broken occasionally by rugged mountains extending to the sea.

Alluvial plains occupy a significant portion of the study area. The Indus River, from its entrance into the area in Northern Arabian Sea, is bordered by a wide, flat floodplain. The Punjab, land of five rivers, is another large alluvial tract.

The depression plains are relatively small in area, but are of physiographic interest. These depressions usually originate through solution, and/or faulting. The depression plains of South Central Asian Desert worthy of mention are the Seristan Basin which is the boundaries of Iran, Pakistan, and Afghanistan, and the Jaz Murian Basin in southwest Iran north of the Makran Mountains. These plains are flat, with relief ranging from several to tens of feet. Scarps bordering the plains commonly range from 100 to several feet. Characteristic of depressions include: alluvial fans, low dunes, scarps, amphitheaters, salt-encrusted playas, talus slopes, etc.



P-1. Desert plain in western Rajputana showing typical vegetation. The loose sandy soil is called retli. The trees in the right foreground and seen scattered throughout the background are known as kedhra. Vegetation in these areas seldom reaches a density that would seriously impede cross-country movement. At approximately 25° N, 72° E



P-2. Floodplain of the Indus River. Dark patches are irrigated areas. The light areas with dark spots are sandy areas of plains and low dunes which form the transition between the floodplain and the Thar Desert to the east. At approximately 26°30' N, 67°50' E



P-6. The floodplain south of Sargodha. This flat alluvial plain of silty sand is extensively cultivated. The range of hills in the background is an erosional remnant of an igneous intrusive. At approximately 32° N, 72°45' E



P-7. Incised bed of the River Tirkha Lora in loessial deposits northwest of Sargodha. Note the floodplain along the river and the excellent terraces along the far side. At approximately 30°15' N, 67°05' E



P-8. Braided river in the Indus River. The colored areas in the foreground are sand which are composed of river material. At approximately 26°15' N, 68° E

of the plains lie between elevations of 0 and

seem high it should be understood that the intermontane plains, relatively undissected which separate the discontinuous ranges of square miles in extent. The surfaces of the surface cracks into large blocks of salt, interrupted only by occasional dunes, are by the wind, represent still another type of cover.

shire at the head of the Persian Gulf to the area in Northern Pakistan to its mouth at the coast.

ally originate through the process of erosion, in Basin which lies just north of the common mountain ranges. The floors of all the depressions from 100 to several thousand feet. Landforms include salt slopes, salt lakes, and salt marshes.



P-1. Indus River. Dark water. The light areas are sandbars. Transition between desert to the river. At approximately 26°15' N, 67°50' E



P-3. Alluvial plain south of Sargodha with scattered igneous hills. The plains between are practically undissected, and except for occasional canals in irrigated areas, offer no obstacles to movement. At 31°50' N, 72°40' E



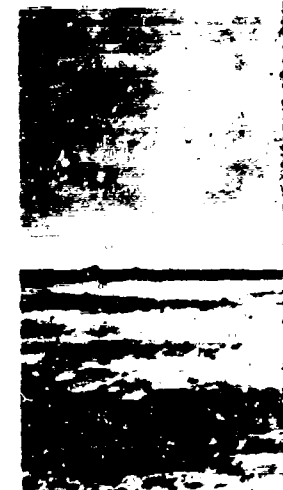
P-4. Desert plain and vegetated dune area north of Karachi. At approximately 24°55' N, 67°10' E



P-8. Braided stream topography in the Indus River. The light-colored areas in the left foreground are sandbar deposits which are common all along the river. At approximately 26°15' N, 68° E



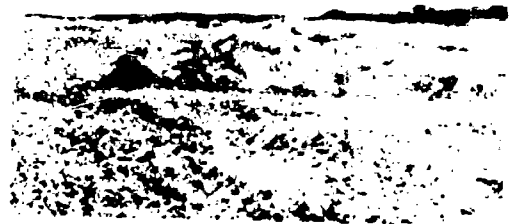
P-9. Low, flat portion of the coastal plain southwest of Karachi. The light-colored patches are surfaces covered with dried salt. The dark areas are patches of salt-tolerant grasses. At approximately 24°50' N, 66°55' E



P-10. Sabkha south of Karachi. The sabkha is of the moist variety and is principally of sand. At approximately 24°50' N

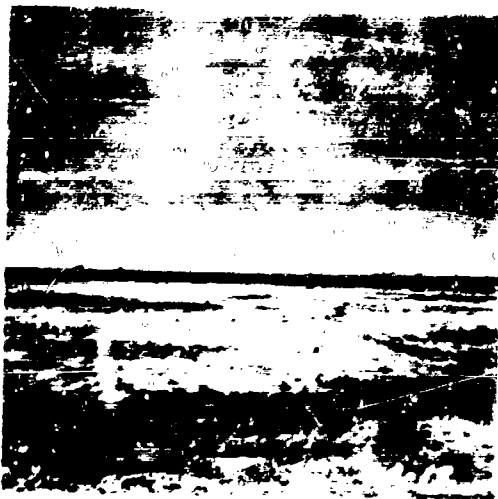


P-4. Desert plain and small vegetated dune area northeast of Karachi. At approximately 24°55' N, 67°10' E

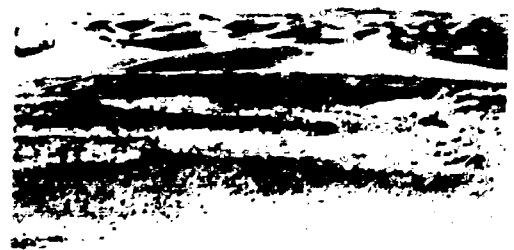


P-5. Braided stream deposits in the Hal River northwest of Karachi. The sand and gravel were deposited when the channel chose a new course. At approximately 25° N, 66°55' E

6



P-10. Sabkha southwest of Karachi. The sabkha is of the salt-encrusted, moist variety and is composed principally of sandy silt. At approximately 24°50' N, 66°55' E



P-11. Low dunes along the coast east of Karachi. These dunes are commonly less than 50 ft high and are probably of the complex dune type. At approximately 24°50' N, 67°05' E

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PURIFIED WATER (Container 4)

PURIFIED WATER (Container 4)

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圖 2 研究對象之年齡分佈

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2002.4.20

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***** France *****

Abstract

SECRET

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Results

Page 1

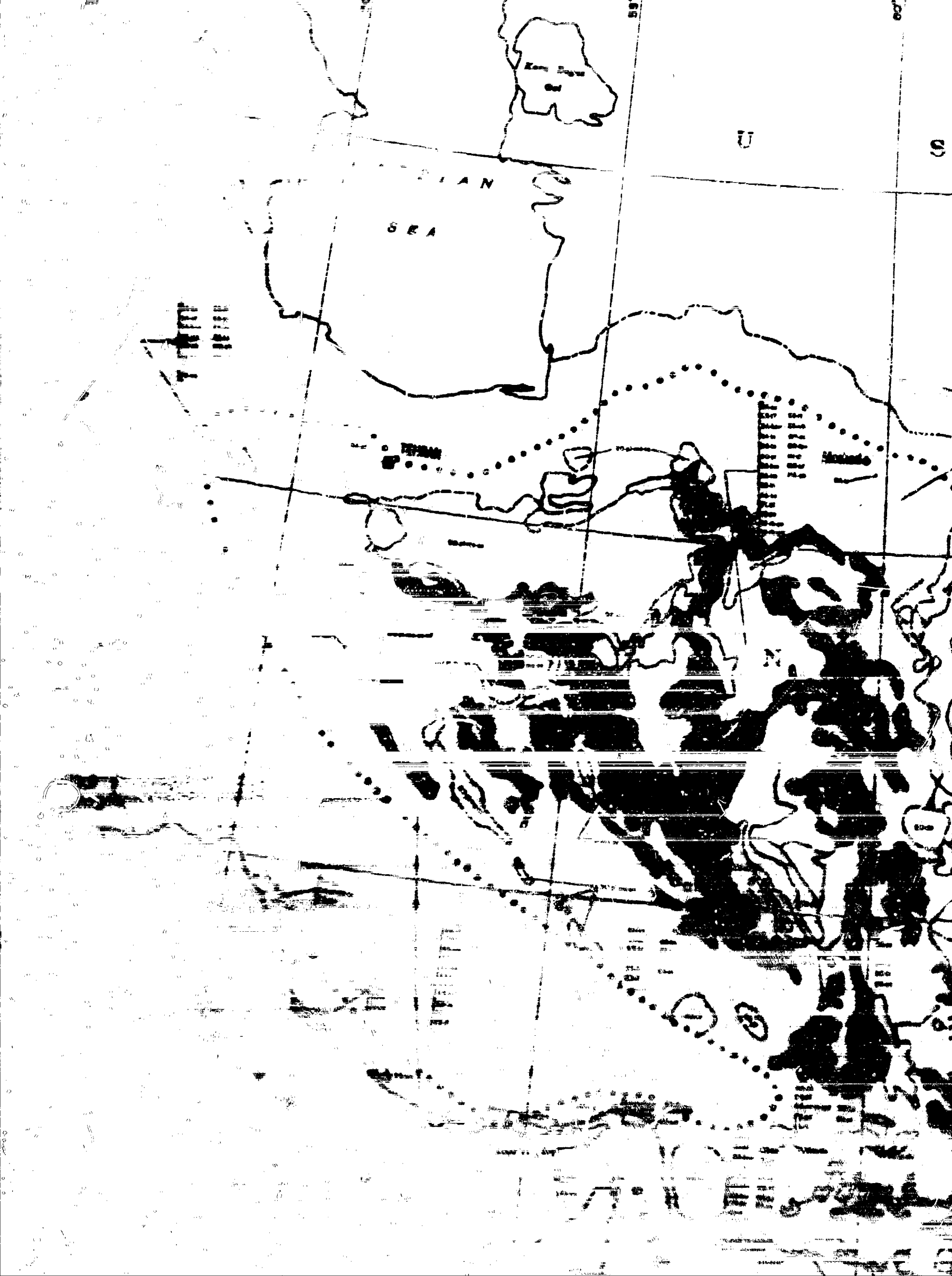
VOLCANIC

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1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.

2. THE STATE OF TEXAS

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S

S

R

YULA SAND HILL

Handwritten notes and symbols on the left margin, including a vertical line of dots and a large, illegible scribble.



The image is a high-contrast, black-and-white scan of a document page that is severely degraded. The background is a dark, grainy black, while the text and other markings are represented by bright white lines and shapes. A prominent feature is a series of horizontal white streaks and scratches that run across the entire width of the image, likely caused by physical damage to the original document or the scanning process. In the upper right corner, there is a small, faint rectangular box containing the number '10'. Below this, on the right side, is a handwritten number '17'. The rest of the page is filled with illegible white markings, including what appear to be fragments of text and various symbols, all obscured by the heavy noise and damage.

U.S. _____

• **Stress Management:** Stress management techniques such as deep breathing, meditation, and yoga can help reduce stress and improve overall health.

1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2680, 26

17-00000

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Figure 1 is a schematic diagram of the experimental setup. It shows a subject seated at a table, looking at a video screen. A video camera is positioned above the screen. A target is placed on the table. A horizontal bar is positioned between the subject and the target. A vertical bar is positioned between the subject and the video camera. A horizontal bar is positioned between the subject and the video camera. A vertical bar is positioned between the subject and the video camera. A horizontal bar is positioned between the subject and the video camera. A vertical bar is positioned between the subject and the video camera.

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1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.

1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.

2. Once the problem is identified, the next step is to define the objectives and goals of the project. This helps to clarify what needs to be achieved and provides a clear direction for the work.

3. The third step is to develop a plan or strategy to address the problem. This involves breaking down the problem into smaller, manageable tasks and determining the resources and timeline needed to complete them.

4. The fourth step is to implement the plan. This involves putting the strategy into action and monitoring progress to ensure that the objectives are being met.

5. The final step is to evaluate the results of the project. This involves assessing the outcomes against the objectives and identifying any lessons learned for future projects.

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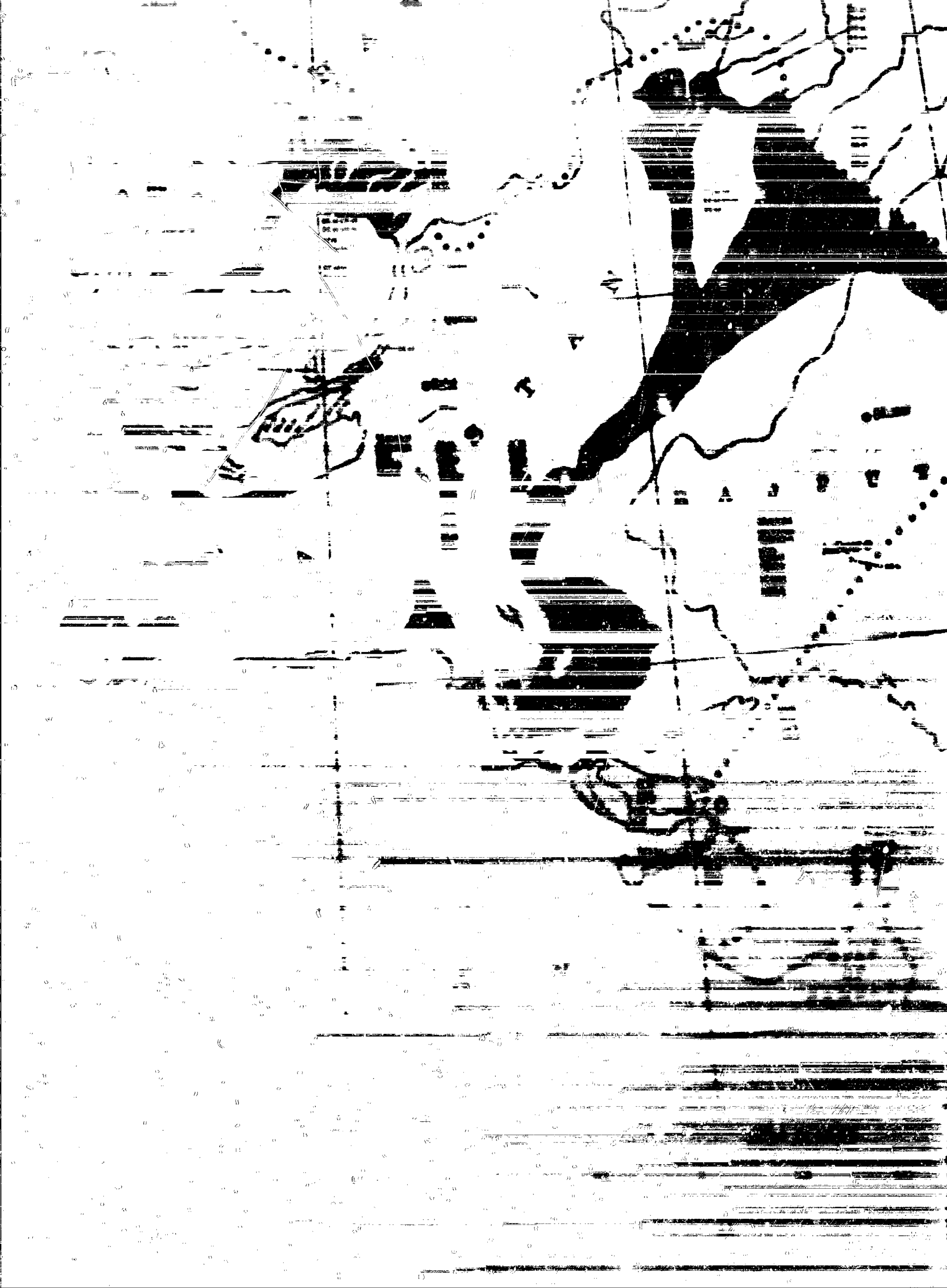
The diagram illustrates the experimental setup. A subject is seated at a table, looking at a video screen. A video camera is positioned above the screen to capture the subject's view. A light source is positioned to the left of the screen. The subject is viewing a video screen that displays a target. The video camera is positioned above the screen. The light source is positioned to the left of the screen. The subject is seated at a table, viewing a video screen. A video camera is positioned above the screen. A light source is positioned to the left of the screen.

Figure 1 consists of four black and white photographs arranged horizontally. The first photograph on the left shows a large, dark, irregular mass (likely a tumor) on a light-colored background. The mass is labeled 'C' in the upper left corner. The second photograph shows a similar mass, labeled 'D' in the upper left corner. The third photograph shows a mass labeled 'E' in the upper left corner. The fourth photograph on the right shows a smaller, more defined mass labeled 'F' in the upper left corner. The masses appear to be growing or changing in shape over time.

100-33-7

1







**ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT
LANDFORMS - SURFACE CONDITIONS
DESCRIPTIONS AND PHOTOGRAPHS**

PLATE 18

Photo No.	CLASSIFICATION AND DESCRIPTION	TYPICAL GEOMORPHIC	
		Range at Yuma	Range in
I. DEPOSITIONAL	ALLUVIAL	Plan-Profile Units	Slope Occurrence Units
			Number of slopes greater than 50% per 10 miles
1	Abandoned courses: Abandoned courses are lengthy segments of a river abandoned when the stream chooses a new course across the floodplain.	*NA NA	NA NA
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.	1L, 7 1, 1L 1, 1L, 7	To 0 To 0
3	Alluvial fans: Alluvial fans are cone-shaped features occurring at the base of mountains, hills, escarpments, etc., where streams experience a sufficient reduction in gradient to deposit their loads. These fans, steepest near the mountains, slope gently outward with a continually decreasing gradient and are characterized by braided stream channels which scour their surfaces.	1L 1, 1L 1, 1L	
4	Boulder-choked wadies: Boulder-choked wadies are relatively narrow and deep, intermittent streambeds, generally in mountainous or plateau regions, where boulders have been amassed in numbers sufficient to retard or prevent vehicular movement.	NA NA	NA NA
5	Braided stream topography: Braided streams are shallow anastomosing channels, usually carrying heavy loads and/or flowing at moderate gradients. Topography formed by such streams usually consists of irregular bars separated by shallow active or abandoned channels.	7 7	Lacking Lacking
6	Deltas: Deltas are alluvial tracts of land, usually triangular in shape, formed at the mouth of a river. Inland boundaries of deltas often, but not invariably, coincide with the farthest upstream distributaries of a river.	7 7	Lacking Lacking
7	Floodplains: Floodplains are relatively smooth, flat lands bordering a stream. They are built of sediments deposited by the stream and inundated by floodwaters.	7 7, 1 7, 1, 1L	Lacking To 0 To 0
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. A steplike arrangement of several terraces often flanks larger floodplains.	7 7, 1 7, 1	Lacking To 0 To 0
9	Intermittent fresh-water lakes: Intermittent fresh-water lakes are standing bodies of inland fresh water which become dry during certain periods of the year.	NA NA	NA NA
10	Intermontane plains: Basins of interior drainage between mountain ranges composed of fine-grained alluvium deposited by streams issuing from the adjacent mountains.	7, 1 7, 1, 1L	To 0 To 0
11	Marsh: Marsh is a tract of low (in reference to surrounding terrain), wet ground, usually marshy and covered with rank grass and sedge vegetation and confined to fresh-water areas.	This phenomenon is classed as a surface condition and mapped in terms of surface characteristics featureless.	
12	Natural levees: Natural levees are long, relatively narrow alluvial ridges, higher near the river and gradually sloping away from it, which are built up on either side of a stream by overbank flow. Surface drainage patterns range from minute drainageways to major crevasses, commonly found at right angles to the direction of levee elongation.	NA NA	NA NA
13	Salt lakes: Salt lakes are permanent or intermittent bodies of saline water, generally of considerable size. Surface evaporation of water exceeds inflow, thus creating saline conditions.	NA	NA
COLLUVIAL			
14	Mud flow topography: Mud flow topography is formed by jumbled colluvial debris which slides down steep mountain sides during infrequent rains. This phenomenon occurs chiefly on steep slopes of loose shale, ash, and residual clay.	7 7, 4, 1	NA NA
15	Talus: Talus is an unconsolidated, sloping heap of fairly large rock fragments or debris formed at the base of an escarpment or steep slope through gravitational accumulation.	NA NA	NA NA
EOLIAN			
	Accumulations near barriers		

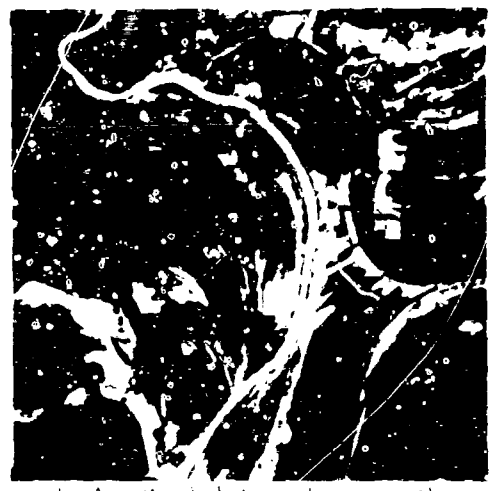
TYPICAL GEOMETRY FACTOR RANGES
 Range in South Central Asian Desert

3

☐ World-wide Range

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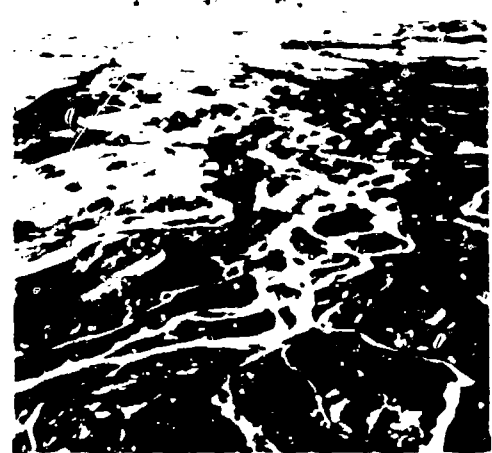
tems of surface roughness or microrelief rather than geometry-factor ranges. Marshes are



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



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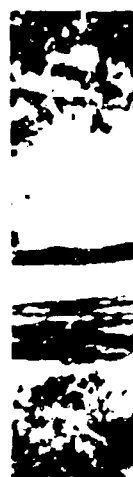
5. Braided or multichannel river



6. Pres
Mission



9. Intermittent fresh-water lakes



10. Intc
45125001



15. A salt lake (trough) is a
crystalline salt



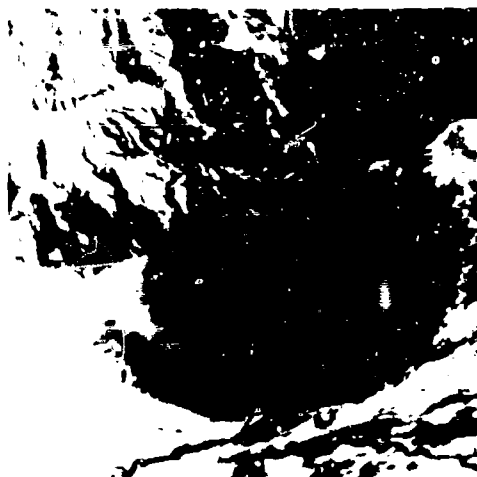
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524
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3. Showing the boulder in an eroded channel.



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



5. A vertical photograph of an alluvial fan.



4. Boulder-choked wadi.



1. Channel river.



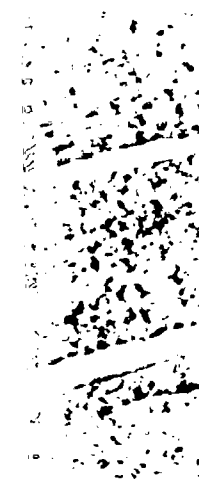
6. Present distributary system of the Mississippi River Delta.



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



8. A series of river terraces within a mountainous region.



9. Water lakes.



10. Intermontane plain as viewed from adjacent mountains.



11. Marsh.



12. Cultivation on natural levees.



13. White.



14. Steeply sloping talus cone flanking a river channel, as seen from the river channel looking southward.



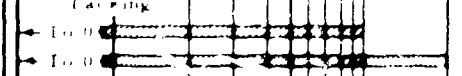
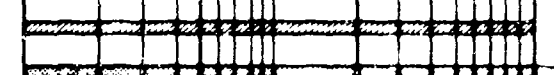
15. Steeply sloping talus cone flanking a river channel, as seen from the river channel looking southward.

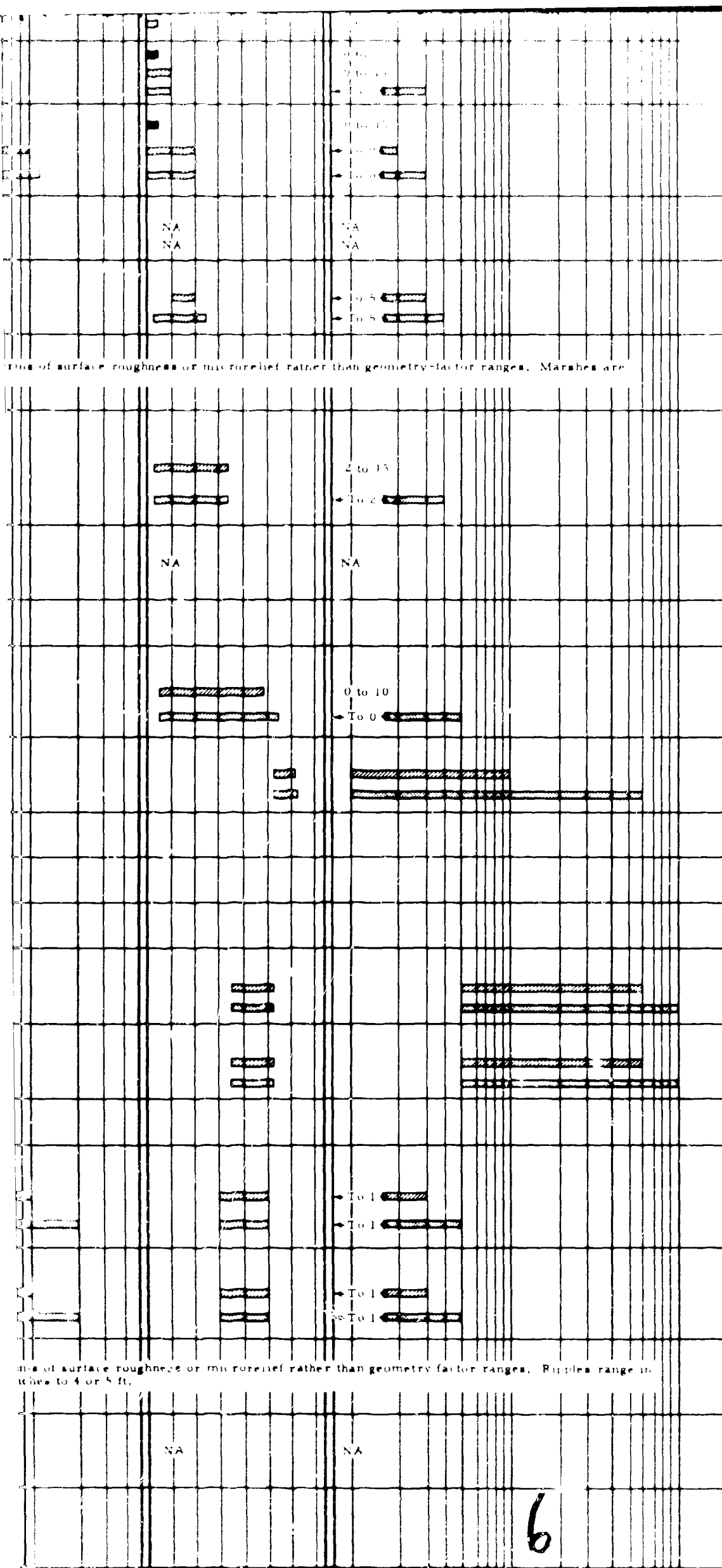


16. A large, dark, rounded boulder, as seen from the river channel looking southward.



17. A large, dark, rounded boulder, as seen from the river channel looking southward.

	view of deltaic items, but not necessarily, coincide with the farthest upstream distributaries of a river.	7	Lacking	
7	Floodplains: Floodplains are relatively smooth, flat lands bordering a stream. They are built of sediments deposited by the stream and inundated by floodwaters.	7 7, 1 7, 1, 11	Lacking To 0 To 0	
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. A step-like arrangement of several terraces often flanks larger floodplains.	7 7, 1 7, 1	Lacking To 0 To 0	
9	Intermittent fresh-water lakes: Intermittent fresh-water lakes are standing bodies of inland fresh water which become dry during certain periods of the year.	NA NA	NA NA	
10	Intermontane plains: Basins of interior drainage between mountain ranges composed of fine-grained alluvium deposited by streams issuing from the adjacent mountains.	7, 1 7, 1, 1L	To 0 To 0	
11	Marsh: Marsh is a tract of low (in reference to surrounding terrain), wet ground, usually muddy and covered with tall grass and sedge vegetation and confined to fresh-water areas.		This phenomenon is classed as a surface condition and mapped in terms of a characteristically featureless.	
12	Natural levees: Natural levees are long, relatively narrow alluvial ridges, higher near the river and gradually sloping away from it, which are built up on either side of a stream by overbank flow. Surface drainage patterns range from minute drainageways to major crevasses, commonly found at right angles to the direction of levee elongation.	NA NA	NA NA	
13	Salt lakes: Salt lakes are permanent or intermittent bodies of saline water, generally of considerable size. Surface evaporation of water exceeds inflow, thus creating saline conditions.	NA	NA	
	COLLUVIAL			
14	Mud flow topography: Mud flow topography is formed by jumbled colluvial debris which slides down steep mountain sides during infrequent rains. This phenomenon occurs chiefly on steep slopes of loose shale, ash, and residual clay.	7 1, 4, 1	NA NA	
15	Talus: Talus is an unconsolidated, sloping heap of fairly large rock fragments or debris formed at the base of an escarpment or steep slope through gravitational accumulation.	NA NA	NA NA	
	EOLIAN			
	Accumulations near barriers			
	Large extensive obstacles			
16	Climbing sand drifts: These are massive accumulations of wind-blown sand which form to the windward of extensive obstacles such as plateau scarps, hills, and mountains.	7 7	Lacking Lacking	
17	Falling sand drifts: Falling sand drifts are massive accumulations of wind-blown sand which form to the leeward of extensive obstacles such as plateau scarps, hills, and mountains.	7 7	Lacking Lacking	
	Small isolated obstacles			
18	Sand dams: Sand dams are crescent-shaped mounds or ridges of wind-blown sand which form near the windward side of relatively small obstacles. The horns of the crescent extend downwind, often flanking the obstacle, and exhibit steep inward-facing slopes.	5, 6 5, 6		
19	Sand shadows: Sand shadows are elongate triangular mounds of wind-blown sand which form to the leeward of relatively small obstacles. Sand dams are usually found to the windward of these obstacles.	5, 6 5, 6		
20	Rippled surfaces: Washboardlike surfaces caused by the heaping up of sand by wind action. They are normally found on the gentler slopes of dunes or in flat, sandy areas.		This phenomenon is classed as a surface condition and mapped in terms of a height from 1 or 2 in. to 3 ft and are spaced at intervals of several inches to 4 ft.	
21	Sand-choked wadis: Sand-choked wadis are intermittent stream beds generally within plain or plateau areas which have been almost completely or partially filled with wind-blown sand.	NA	NA	
	* Not applicable.			



1. Lake or depression



9. Intermittent fresh-water lakes



13. A salt lake fringed by white crystallized salt



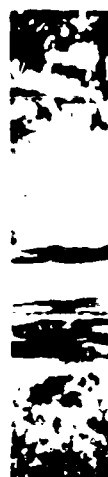
17. A falling sand drift blanketing a plateau escarpment.



21. Salt-encrusted areas appear as white bands at a place through the high, loose vegetation.



2



10. Top of a hill



14. Top of a hill



18. Salt lake



1. A close-up view of a rocky, arid landscape with sparse vegetation.



2. A wide view of a desert valley with a winding river and distant mountains.



3. A view of a river flowing through a desert landscape.



4. A view of a desert landscape with a winding river and distant mountains.



5. A view of a desert landscape with a winding river and distant mountains.



6. A view of a desert landscape with a winding river and distant mountains.



7. A view of a desert landscape with a winding river and distant mountains.



8. A view of a desert landscape with a winding river and distant mountains.



9. A view of a desert landscape with a winding river and distant mountains.



10. A view of a desert landscape with a winding river and distant mountains.



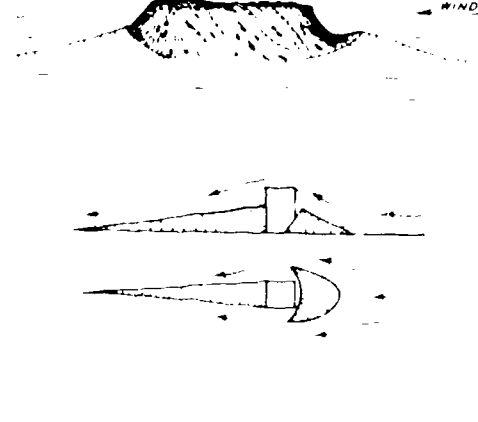
11. A view of a desert landscape with a winding river and distant mountains.



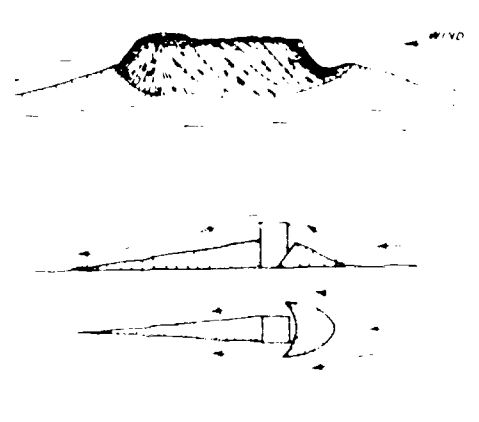
12. A view of a desert landscape with a winding river and distant mountains.



13. A view of a desert landscape with a winding river and distant mountains.



14. A view of a desert landscape with a winding river and distant mountains.



15. A view of a desert landscape with a winding river and distant mountains.



16. A view of a desert landscape with a winding river and distant mountains.



17. A cross-section diagram of a desert landscape showing a sand dam and wind direction.



18. A cross-section diagram of a desert landscape showing a sand shadow and wind direction.



19. A cross-section diagram of a desert landscape showing a sand dam and wind direction.



20. A view of a desert landscape with a winding river and distant mountains.

17

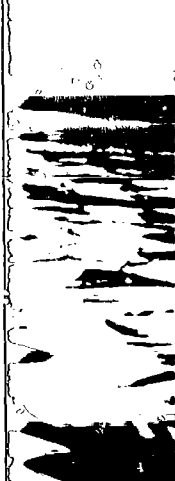
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ANALOGS OF YUMA TERRAIN IN THE SOUTH CENTRAL ASIAN DESERT LANDFORMS - SURFACE CONDITIONS DESCRIPTIONS AND PHOTOGRAPHS

**ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT
LANDFORMS - SURFACE CONDITIONS
DESCRIPTIONS AND PHOTOGRAPHS**

PLATE 18A

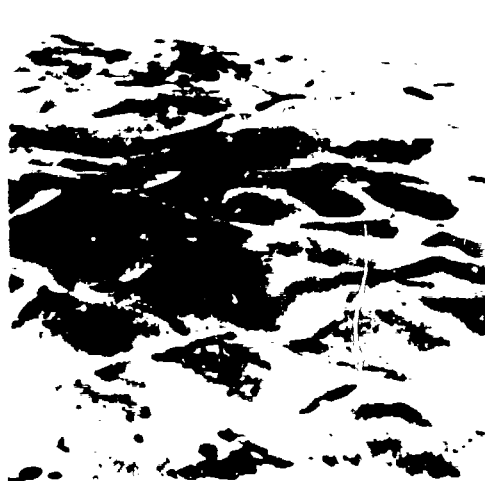
Photo No.	CLASSIFICATION AND DESCRIPTION	Range of Profile Units	Range of Y-axis	Range of X-axis	TYPE A
	I. DEPOSITIONAL (CONT.) EOLIAN			Slope Occurrence Units	
				1 2 3 4 5	
				1 5 20 100	
	Sand dunes: Mobile heaps of wind-blown sand independent of fixed objects or underlying topography.				
22	Barchans: Barchans are dunes having a crescentic ground plan with the convex side facing the wind and horns extending leeward. The profile is asymmetric with the gentler slope on the convex side and the steeper slope on the concave or leeward face.	4 4, 5, 6 4, 5, 6**			
23	Complex dunes: Complex dunes are irregular masses of sand not readily classifiable into types.	4 4, 4L 4, 4L, 5, 5L, 5L#, 6L, 6L#**			
24	Peak and fulji: These occur where the tips or horns of a east-moving barchan join or intersect the windward side of another barchan, thus forming a circular or horseshoe-shaped hollow known as a fulji. The crest of the barchan slip-face which flanks the fulji is referred to as the peak.	4 4 4**			
25	Transverse dunes: Transverse dunes are strongly asymmetric ridges extending transverse to the direction of dominant sand-moving winds. The leeward slope is steep; the windward, comparatively gentle.	4L# 5L#, 6L 4L, 4L#, 5L, 5L#, 6L, 6L#**			
26	Longitudinal dunes: Longitudinal dunes usually consist of a single continuous ridge which swells and rises at regular intervals to form a chain of summits connected by a continuous wavy crest. The profile is asymmetric with one side exhibiting a moderate slope; the other, a steep or slip face. Longitudinal dunes are aligned parallel to dominant sand-moving winds.	5L#, 6L# 5L, 5L#, 6L, 6L#**			
27	Stabilized free or active form: Active dune types which have been stabilized by vegetation but which still retain their initial form.	6 4, 4L, 4L#, 5, 5L, 5L#, 6L, 6L#**	Lacking Lacking		
28	Upsiloidal dunes: Upsiloidal dunes are U- or V-shaped dunes which are concave toward the wind. They are usually found in vegetated areas and are typically associated with a vegetation-free windward depression or "blowout" which provides a sand source for the dune.	5, 6 4, 5, 6	Lacking Lacking		
	LACUSTRINE				
29	Lacustrine terraces: Terraces which mark the shorelines of ancient lakes, or earlier high-water stages of existing lakes. They have nearly horizontal surfaces with relatively steep slopes facing the central portion of the lake.	7 7, 1	5-9/100 mi To 0		
	MARINE				
30	Beaches: Beaches are gently sloping strips of land bordering the sea, usually recognized as that part which lies between high- and low-water marks and formed by the action of the sea.	7 7	Lacking Lacking		
31	Mangrove swamps: Salt or brackish swamps along the coast where there are abundant mangrove trees.	7 7	Lacking Lacking		
32	Quicksand: Sand which is or becomes shifting, easily movable, or semiliquid upon the access of water. Found extensively in coastal areas of N. C. A.	This phenomenon is classed as a surface condition and mapped in terms of its exhibit flat, featureless surfaces.			
33	Tidal mud flats: Marshy or muddy lands covered and uncovered by the rise and fall of the tide.	7 7	Lacking Lacking		
	ORGANIC-CHEMICAL				
34	Caliche: Caliche is a calcareous deposit occurring at or near the surface which has accumulated from charged ground water moving upward and evaporating.	This phenomenon is classed as a surface condition and mapped in terms of its most desert areas within plains of gentle slope. It may occur as deposits of diameters up to several inches.			
35	Salt-encrusted surfaces: Surfaces characterized by thin encrustations of salt. They are common near coasts and in many alluvial plains areas.	This phenomenon is classed as a surface condition and mapped in terms of its of these surfaces would be wholly dependent upon the geometry of the encrust-			
36	Salt marsh: Salt marshes are flat, poorly drained parts of a coastal region whose surfaces are so near the level of the mean high tide that they are covered by the majority of high tides.	7 7	Lacking Lacking		
	Playas: Playas are nearly flat areas of salt or salty fine-grained soils occupying basins where water collects				



ies north of



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



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



25. Transverse dunes in the vicinity of Delta, Utah



line of a



27. Stabilized sand dune area



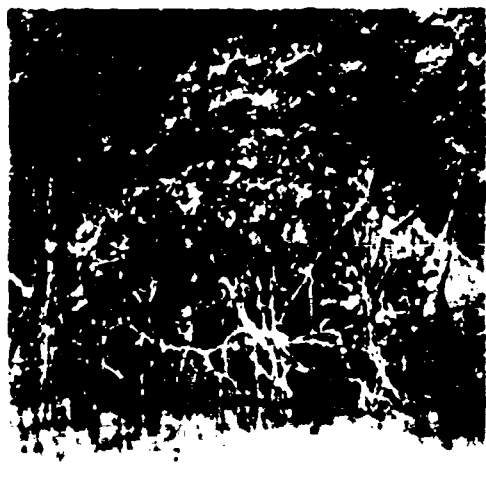
28. A upailoidal dune developed along the northern edge of a blowout



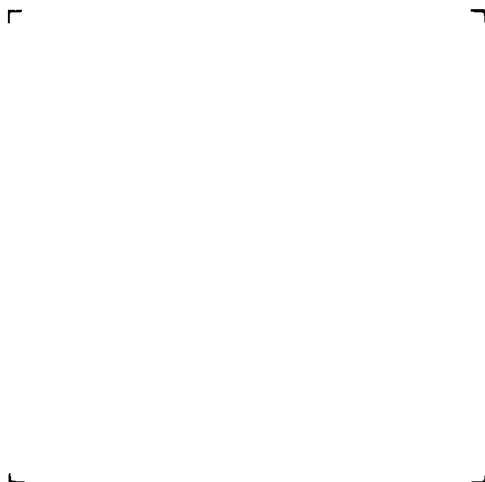
29. Several flat-topped, steep-fronted lacustrine terraces flanking a mountain range in Utah



Died by the
by the sea



31. Mangrove swamp



32. Quicksand - NPA



33. Close-up of a tidal mud flat at low tide



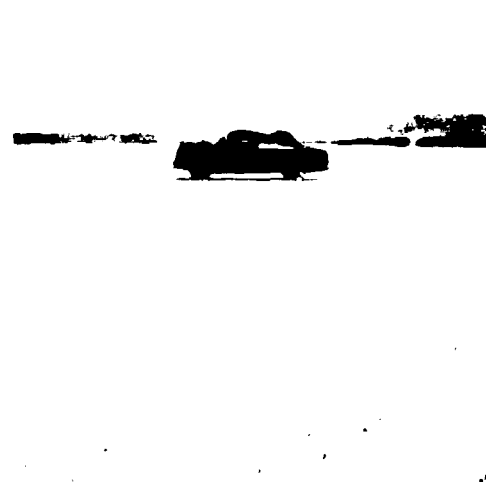
is overlain by



35. Salt-encrusted surface

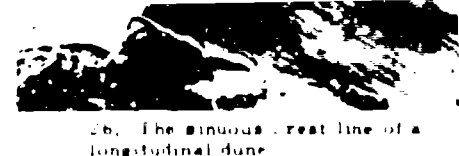
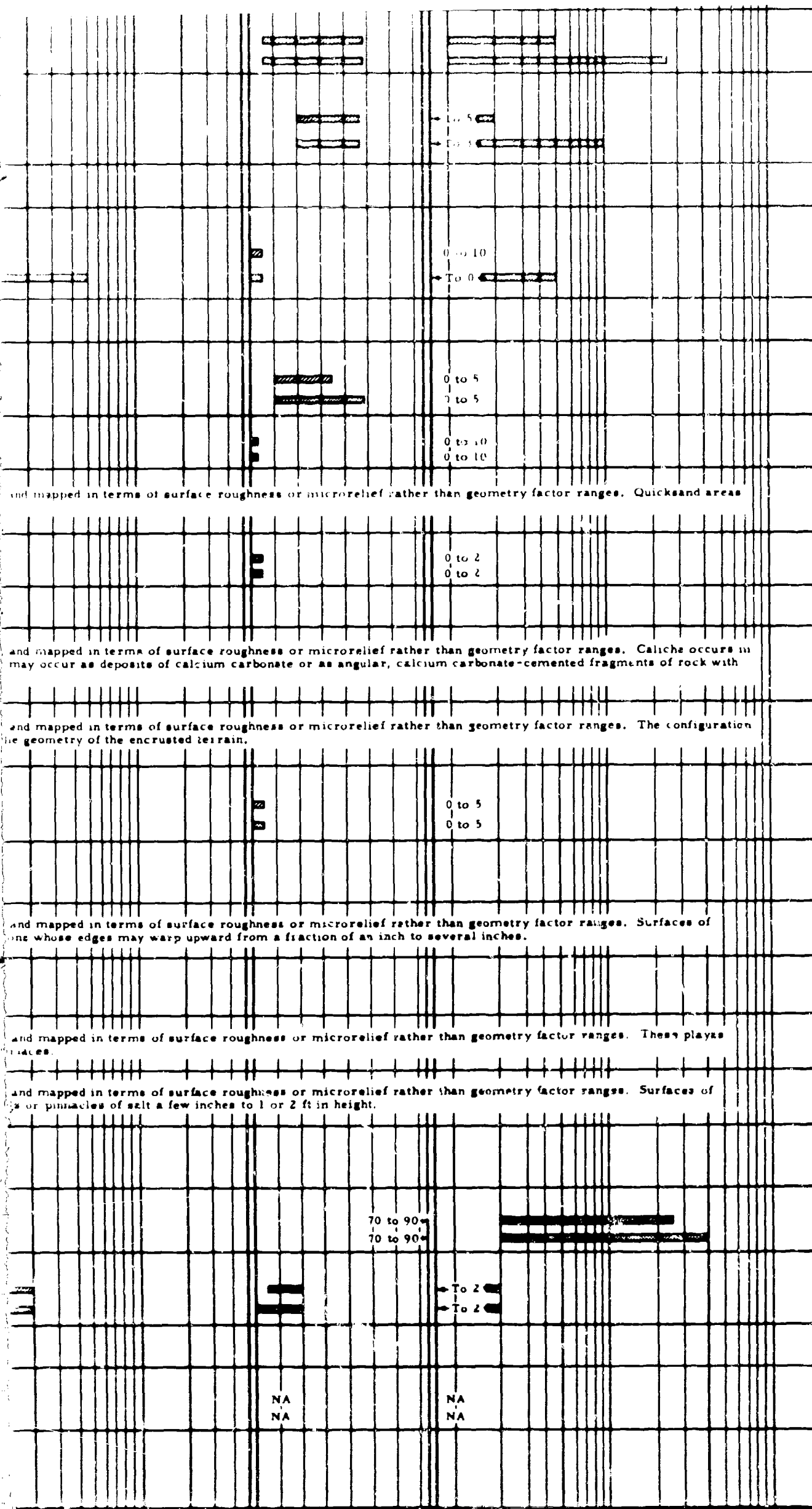


36. Salt marsh



37. Desiccation cracks on the surface of a dry play

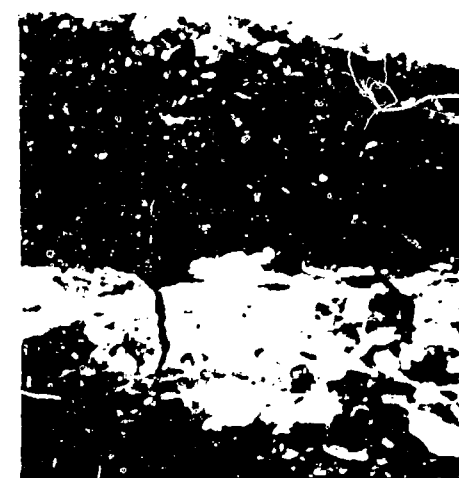
	retain their initial form.	4, 41, 41*, 5, 51, 51, 6, 61, 61,	Lacking Lacking
28	Upsidoidal dunes: Upsidoidal dunes are U- or V-shaped dunes which are concave toward the wind. They are usually found in vegetated areas and are typically associated with a vegetation-free windward depression or "blowout" which provides a sand source for the dune.	5, 6 4, 5, 6	Lacking Lacking
	LACUSTRINE		
29	Lacustrine terraces: Terraces which mark the shorelines of ancient lakes, or earlier high-water stages of existing lakes. They have nearly horizontal surfaces with relatively steep slopes facing the central portion of the lake.	7 7, 1	5-9/100 mi 
	MARINE		
30	Beaches: Beaches are gently sloping strips of land bordering the sea, usually recognized as that part which lies between high- and low-water marks and formed by the action of the sea.	7 7	Lacking Lacking
31	Mangrove swamps: Salt or brackish swamps along the coast where there are abundant mangrove trees.	7 7	Lacking Lacking
32	Quicksand: Sand which is or becomes shifting, easily movable, or semiliquid upon the access of water. Found extensively in coastal areas of S. C. A.		This phenomenon is classed as a surface condition and mapped in terms of surface exhibit flat, featureless surfaces.
33	Tidal mud flats: Marshy or muddy lands covered and uncovered by the rise and fall of the tide.	7 7	Lacking Lacking
	ORGANIC-CHEMICAL		
34	Caliche: Caliche is a calcareous deposit occurring at or near the surface which has accumulated from charged ground water moving upward and evaporating.		This phenomenon is classed as a surface condition and mapped in terms of surface most desert areas within plains of gentle slope. It may occur as deposits of calcium diameters up to several inches.
35	Salt-encrusted surfaces: Surfaces characterized by thin encrustations of salt. They are common near coasts and in many alluvial plains areas.		This phenomenon is classed as a surface condition and mapped in terms of surface of these surfaces would be wholly dependent upon the geometry of the encrusted ter
36	Salt marsh: Salt marshes are flat, poorly drained parts of a coastal region whose surfaces are so near the level of the mean high tide that they are covered by the majority of high tides.	7 7	Lacking Lacking
	Playas: Playas are nearly flat areas of salt or salty fine-grained soils occupying basins where water collects and evaporates after moderate or torrential rains.		
37	Dry: Dry playas are characterized by very hard, smooth, flat surfaces of fine-grained soil.		This phenomenon is classed as a surface condition and mapped in terms of surface these playas are characterized by desiccated polygons whose edges may warp upwa
	Moist: Moist playas are characterized by irregular, puffy surfaces with a thin friable surface crust which is underlain by soft, spongy ground.		
38	Clay-encrusted: Clay-encrusted playas are moist playas with a surface crust of clay.		This phenomenon is classed as a surface condition and mapped in terms of surface are characterized by slightly rolling and spongy surfaces.
39	Salt-encrusted: Salt-encrusted playas are moist playas with a surface crust of salt.		This phenomenon is classed as a surface condition and mapped in terms of surface these playas are characterized by soft, puffy mounds or pinnacles of salt a few inch
	II. EROSIONAL		
	MARINE		
40	Wave-cut cliffs: Steep cliffs of bare rock, or occasionally un-indurated materials, resulting from wave erosion marking the seaward limit of the coast.	*NA NA	NA NA
41	Wave-cut terraces: Steplike, narrow strips of land adjacent to or near the sea, which have been sculptured by the waves and current. Each terrace records a landward advance of littoral erosion.	7, 1 7, 1	To 0  To 0
	SURFACE WATER		
42	Amphitheatres: Amphitheatres are semicircular erosion bays, formed at the head of drainage, which often scallop plateau scarps in arid regions.	NA NA	NA NA
	* Not applicable. ** Indicates plan-profile designations are both gross and restrictive.		



26. The sinuous crest line of a longitudinal dune



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



34. The light-colored caliche is overlain on a dark sandy clay area



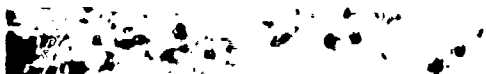
38. Soft and spongy surface of a clay-encrusted playa



42. Two well developed amphitheatres in the face of an escarpment



25. Great line of a



27. Stabilized sand dune area



28. A spindly dune developed along the northern edge of a blowout



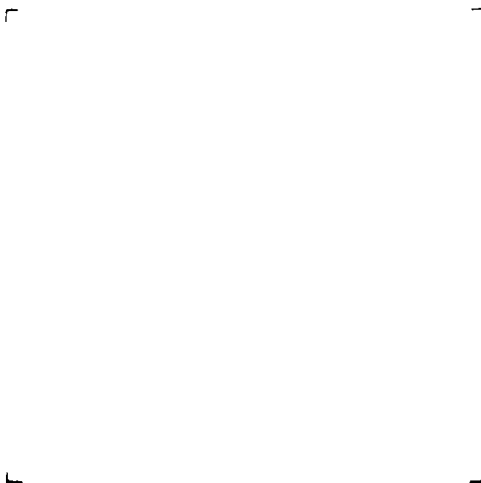
29. Several flat-topped, steep-fronted lacustrine terraces flanking a mountain range in Utah



30. A beach bounded by the dune chain and the sea



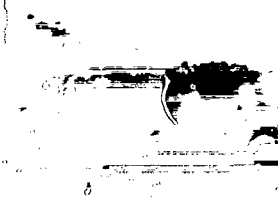
31. Mangrove swamp



32. Quicksand - NPA



33. Close-up of a tidal mud flat at low tide



34. Red caliche is overlain by a spongy surface



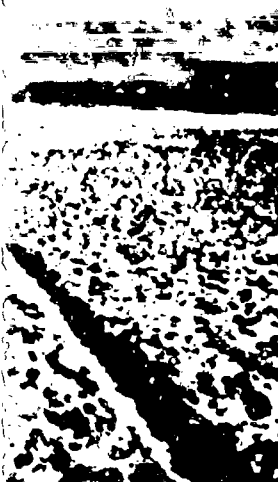
35. Salt-encrusted surface



36. Salt marsh



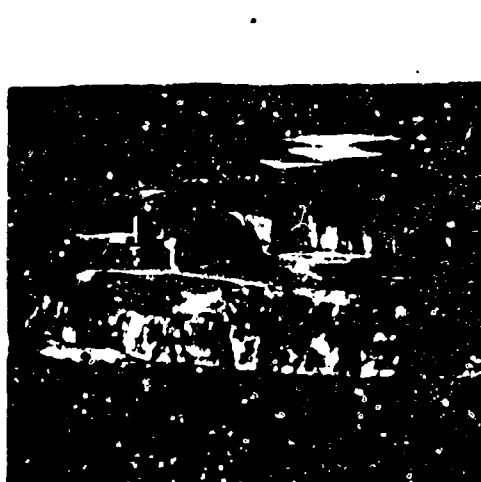
37. Desiccation cracks on the surface of a dry playa



38. Spongy surface of a dry playa



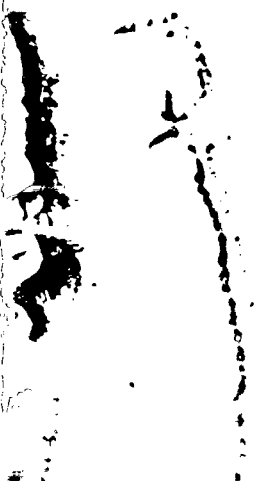
39. Rough surface of a salt-encrusted playa



40. Wave-cut cliffs



41. A wave-cut terrace surmounted by several stacks



42. Developed amphitheatres on a steep escarpment

**ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT
LANDFORMS - SURFACE CONDITIONS
DESCRIPTIONS AND PHOTOGRAPHS**

PLATE 18B

Photo No.	CLASSIFICATION AND DESCRIPTION	TYPICAL SLOPE										
		Range at 1:1000										
		Range										
II. EROSIONAL (CONT.) SURFACE WATER		Plan-Profile Units	Slope Occurrence Units									
			Number of slopes greater than 5% (1:1000)									
			1	2	3	4	5	20	100	2		
43	Aqabas: Aqabas are gaps in asymmetrical ridges which connect basins of different elevations that occur between the ridges.	*NA NA	NA NA									
44	Badlands: Regions nearly devoid of vegetation where erosion, instead of carving hills and valleys of the ordinary type, has cut the land into an intricate maze of narrow ravines, sharp crests, and pinnacles.	4 4									200 ft 100 ft	
45	Buttes and mesas: Isolated residual prominences with very steep or precipitous slopes left as erosional remnants of a plateau area. Mesas have distinctively flat tops; buttes have been so eroded that only small flat tops or peaks remain.	† (2, 3) (2, 3, 5, 6)										
46	Dry waterfalls: Dry waterfalls are precipitous drops or scarps found in dry wadi beds.	NA NA	NA NA									
47	Flatirons: Triangular remnants of an eroded hogback ridge often occurring in series on the flank of a mountain.	7 7	Lacking Lacking									
48	Foothills: Foothills are lower subsidiary hills at the foot of mountains or higher hills. They form transitional zones between the highlands and the adjacent lower land.	4 4, 4L										
49	Hanging valleys: Hanging valleys occur where the valley floor of a tributary wadi is higher than the floor of the trunk valley in the area of junction.	NA NA	NA NA									
50	Hogbacks: Hogbacks are sharp-crested ridges produced by unequal erosion in steeply inclined rock.	(5L, 6L) (5L, 6L)										
51	Inselbergs: Inselbergs are prominent steep-sided residual hills or mountains, isolated or in groups, which rise abruptly from surrounding lowland surfaces of erosion.	4, (5, 6) 4, (5, 6)										
52	Knife-edged spurs: Sharp-crested rock ridges forming inter-stream divides which extend outward from mountain masses.	(6L) (5L, 5L, 6L, 6L)	← To 0 ← To 0									
53	Outliers: Isolated remnants of rock separated from the main mass to which they were formerly joined.	(6) (3, 6)										
54	Pediments: Pediments are relatively smooth rock plains gently inclined away from hill or mountain masses. They are sometimes partly covered by a thin veneer of alluvium.	1, 1L 1, 1L										
	Random hills: Randomly oriented masses rising 1000 ft above the level of the surrounding country.											
55	Unconsolidated random hills: Consist of unconsolidated material such as clay, silt, sand, or gravel.	4 4, 4L 4, 4L										
56	Consolidated random hills: Consist of masses of sedimentary, igneous, or metamorphic rock.	4 4, 4L 4, 4L										
57	Rock terraces: Rock terraces are relatively narrow benches left when a stream cuts a new valley below the level of the erosional plain which is cut into the bedrock.	1, 7 1, 7	← To 0 ← To 0									

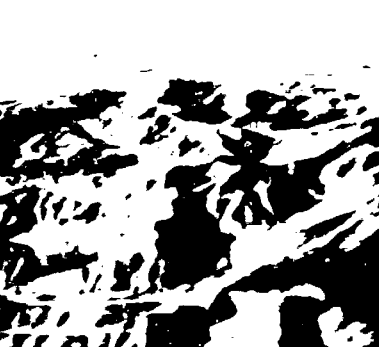
3

 Range in South Central Asian Desert

Range in South Central Asian Desert

World-wide Range

51. Inselbergs rising above the surrounding plain, east of Castle Dome Range, Arizona



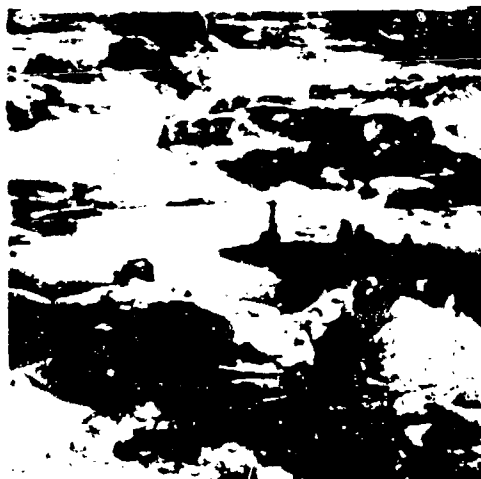
1. The first step is to identify the problem or question that needs to be answered.

AND PHOTOGRAPHS

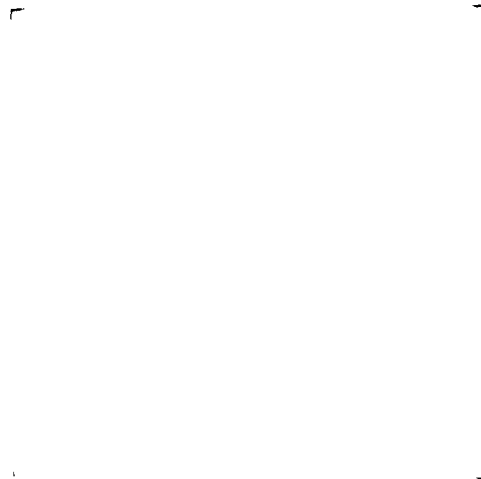
4



44. Badlands



45. Buttes and mesas



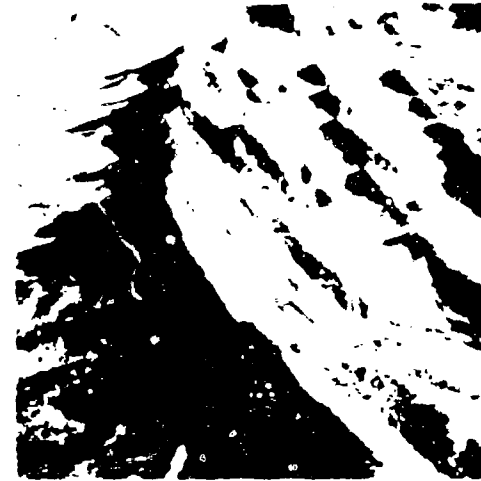
46. Dry waterfalls - NPA



48. A band of foothills at the base of mountain range



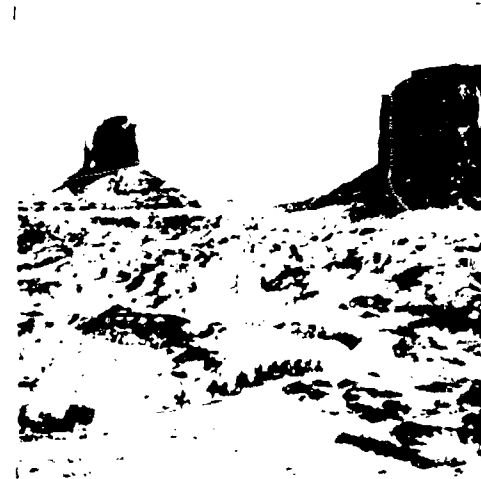
49. Hanging valley



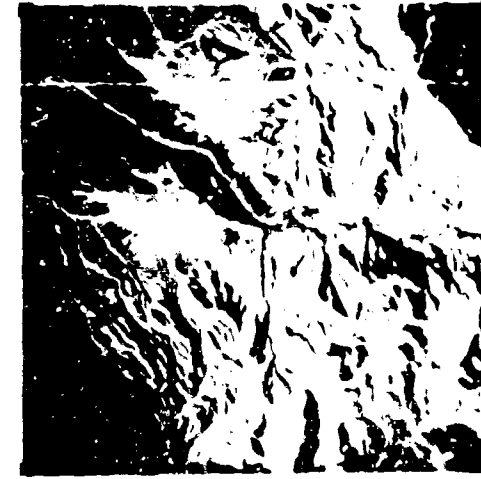
50. Hogbacks



52. Knife-edged spurs extending from a mountain range



53. Outliers



54. A gently sloping sediment flanking the Grand Atlas Mountains in southern Morocco



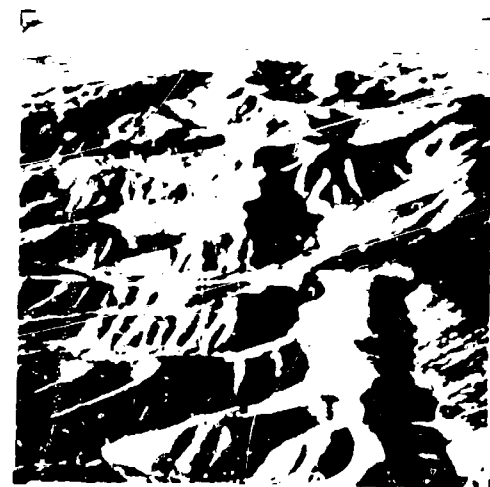
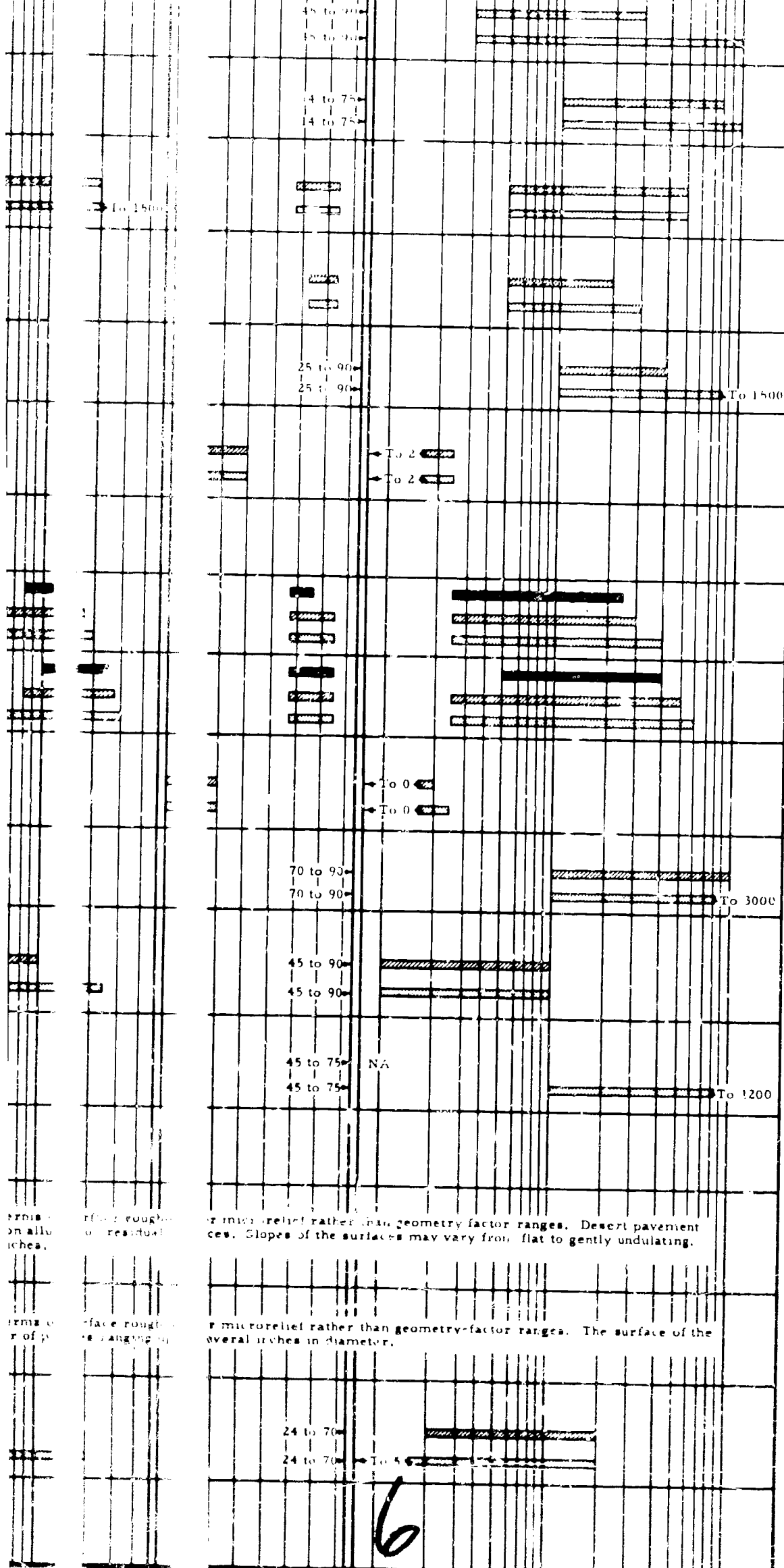
56. Rounded crystalline hills rising above a desert plain



57. Broad terraces, closely covered with dense vegetation, overlooking the sea



58. Steep slope





48. A band of foothills at the base of a mountain range



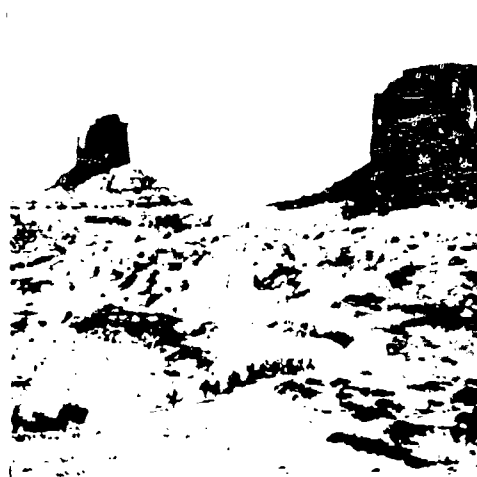
49. Hanging valley



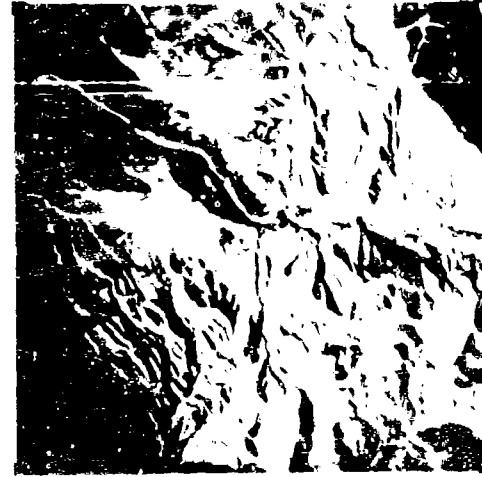
50. Hogbacks



52. Knife-edged spurs extending from a mountain range



53. Outliers



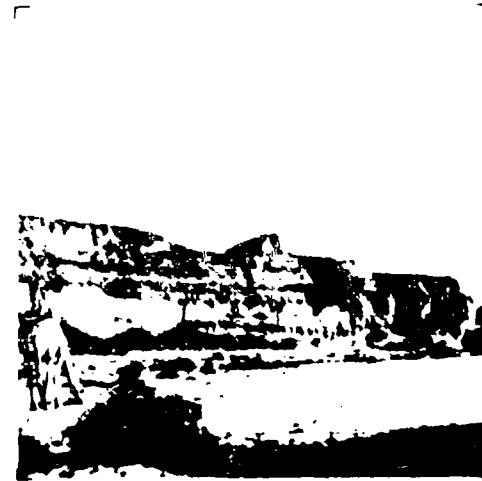
54. A gently sloping pediment flanking the Grand Atlas Mountains in southern Morocco



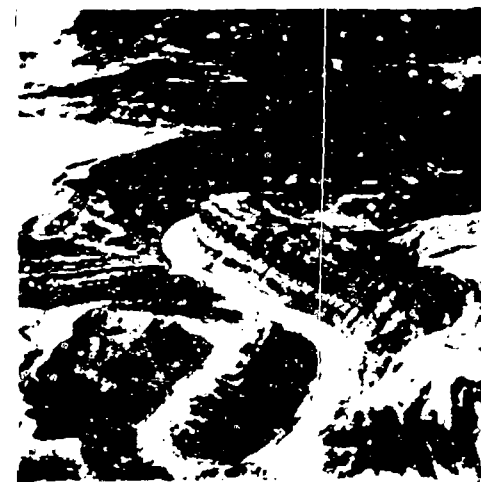
56. Rugged crystalline hills rising above a desert plain



57. Bedrock terraces, thinly veneered with gravel along a meandering stream



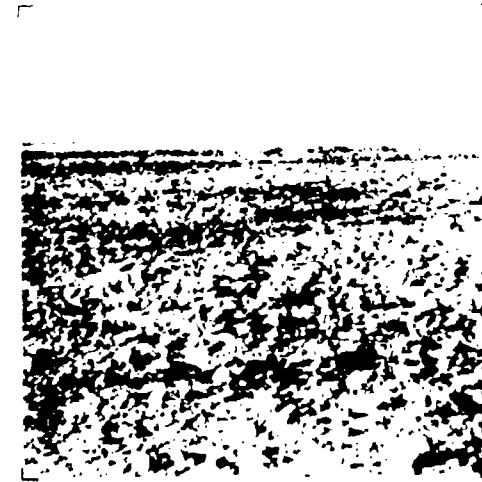
58. Scarps



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



61. A smooth surface of desert pavement. The tire tracks have penetrated the underlying silt



62. The rocky surface of a hamada

**ANALOGS OF YUMA TERRAIN
IN THE
SOUTH CENTRAL ASIAN DESERT**

LANDFORMS - SURFACE CONDITIONS

DESCRIPTIONS AND PHOTOGRAPHS

80523

PLATE 18C

Photo No.	CLASSIFICATION AND DESCRIPTION	TYPICAL G																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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64	II. EROSIONAL (CONT.) WIND Flint strewn plains: Flint-strewn 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 the parent rock.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

FACE CONDITIONS: DESCRIPTIONS AND PHOTO

ICAL GEOMETRY FACTOR RANGES

Range in South Central Asian Desert

World-wide Range

Slope Units		Relief Units		Relief Type I		Relief Type II	
5	6	1b	2	3	4	5	6
Degrees		Feet					
100	200	1	2	4	5	6	7
1	2	4	8	16	32	64	
10	50	100	400	1000			

ms of surface roughness or microrelief rather than geometry factor ranges. The angular
ters ranging up to several inches.

NA
NA

NA
NA

24 to 75
To 2

24 to 75
To 2

To 3

ms of surface roughness or microrelief rather than geometry factor ranges. These cracks may
on a fraction of an inch to as much as 10 ft deep. They enclose polygonal areas several inches
1 or 2 in. to several feet above the central portion.

ms of surface roughness or microrelief rather than geometry factor ranges. Grus consists of
diameters of several feet.

ms of surface roughness or microrelief rather than geometry-factor ranges. Slopes of the
s are fine-grained. Heat cracks several inches wide form in limited areas

ms of surface roughness or microrelief rather than geometry-factor ranges. The boulders may
orphic rocks. The boulders may range in diameter from 10 in. to a few feet

64. Flint-strown plains - NPA



68. Schuppen resulting from the unequal
weathering of a steeply dipping shale-
sandstone sequence

69. The

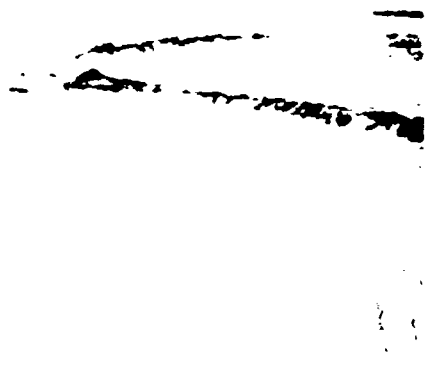


72. Clay plains - NPA

73. A



74. NPA - See photo of weathered



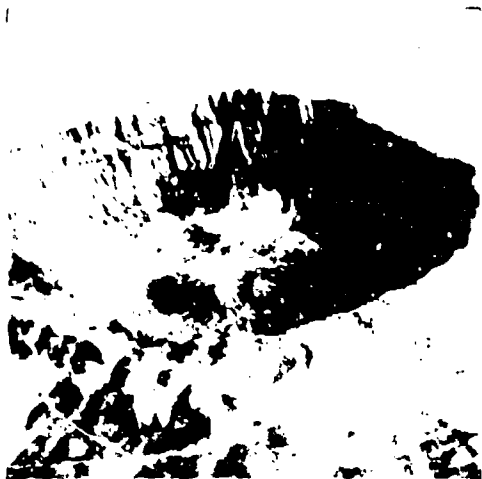
65. Dikes radiating from a volcanic neck



66. Diagram of Kuh-i-Namok salt dome and glacier in western Iran



67. A granite knob rising abruptly above a desert plain



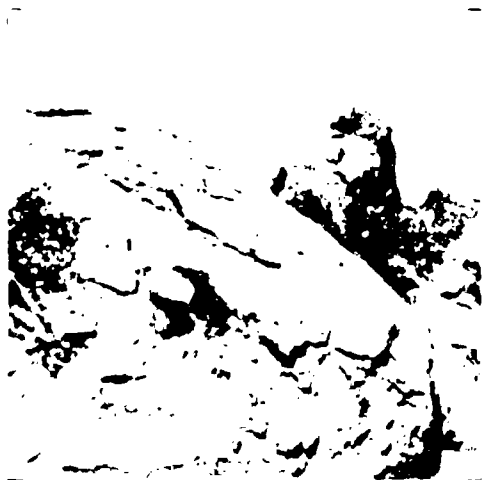
69. The famous Arizona meteor crater



70. Heat cracks



71. Grus deposit resulting from weathering of igneous rock



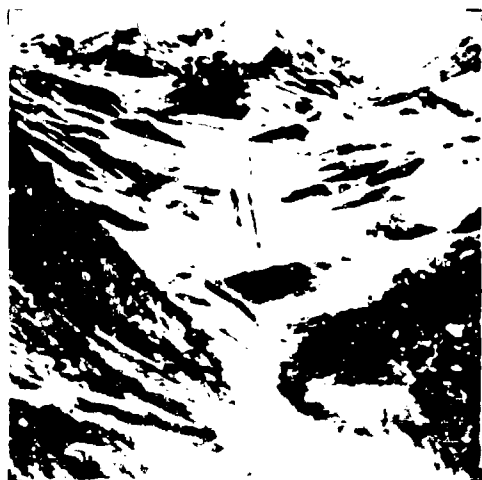
73. A close-up of an exfoliated boulder showing the typical spalling action



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



75. A vertical photograph of a breached elongate dome with inner dendritic drainage



77. A motor road following the bottom of a mountainous valley

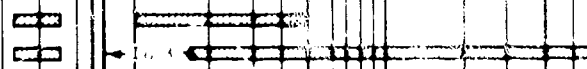


78. A broken lava flow partially buried under ash and sand



79. Cinder cone

68	same one sequence. The softer shales erode leaving the harder materials standing at considerable heights above the surrounding terrain (after Harrison).	4, 4			
	METEORIC				
69	Meteor craters: Steep-walled, saucer-shaped depressions produced by the impact and accompanying explosion of an object of extraterrestrial origin.	NA NA	NA NA		
	RESIDUAL				
70	Heat cracks: Irregular cracks which form in clayey soil by desiccation.				This phenomenon is classed as a surface condition and mapped in terms of slope from a fraction of an inch to several inches wide at the top and from a fraction to several feet across. The edges of the polygon warp upwards from 1 or 2 in.
71	Grus: The accumulation of countless discrete particles on the surface of granite and sometimes extending to depths greater than 10 ft which have formed from weathering of the various minerals forming the rock.				This phenomenon is classed as a surface condition and mapped in terms of angular fragments of weathered granite which may exhibit maximum diameter
72	Clay plains: Clay plains are extensive, generally level to undulating regions of fine-grained soil, characteristically featureless except for widely spaced isolated hills and rocky outcrops. Although these regions become seas of mud after infrequent rains, heat cracks are common after prolonged drought.				This phenomenon is classed as a surface condition and mapped in terms of slope. Plains are flat to gently undulating with only slight local relief. Soils are fine
73	Exfoliated boulders: A term applied to boulders whose surfaces have broken or peeled off as scales, lamellae, or concentric sheets.				This phenomenon is classed as a surface condition and mapped in terms of slope. Be angular or rounded fragments of igneous, sedimentary, or metamorphic rock
	TECTONIC				
74	Basin ranges: Ranges of hills or mountains formed by faulted and tilted blocks of strata (separated by basins).	4 4 4, 4L, 5L, 5L, 6L, 6L			
75	Elongate domes: Elongate domes are elliptical upfolds, the beds dipping away from centrally located axes.	4, 4L 4, 4L			
76	Scarps: Scarps are more or less continuous, precipitous slopes exhibiting more than 100 ft of relief.	NA NA	NA NA		
77	Intramontane valleys: Intramontane valleys are narrow valleys or troughs with exterior drainage lying between mountains.	1, 1L 1, 1L			
	VOLCANIC				
78	Broken lava flows: Flat to undulating lava areas characterized by sharp-edged rocks and boulders.				This phenomenon is classed as a surface condition and mapped in terms of slope. The flow is composed of large, angular blocks of lava having diameters ranging
79	Cinder cones: Cinder cones are conical hills formed by the accumulation of volcanic ash or clinkerlike material around a vent.	6, 6L 4, 4L, 5, 5L, 6, 6L			
80	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, while calderas have diameters several times larger.	NA NA	NA NA		
81	Lava flows: Lava flows are solidified stationary masses of igneous rock which issued from a volcanic cone or fissure.				This phenomenon is classed as a surface condition and mapped in terms of slope. The surface of these flows varies from flat to gently undulating. Surface irregularities several inches to 10 ft.
82	Cinder fields: Cinder fields are flat to undulating areas, often miles in extent, composed of volcanic ejecta that has mantled the pre-existing landscape.				This phenomenon is classed as a surface condition and mapped in terms of slope. Slopes which are determined to some extent by the underlying pre-existing landscape ranging between 4 and 32 mm.
83	Mud volcanoes: Small cone-shaped mounds built of clay and ordinarily formed by the eruption of sulfurous and bituminous mud from a central vent or orifice.	3, 3L, 6L 4, 4L, 5, 5L, 6, 6L			
84	Necks and plugs: Necks and plugs are lava-filled conduits of an extinct volcano exposed by erosion.	4 4, 4L			
	1 (2, 3) Circular plains; profile designations indicate gross landscape. * Not applicable.				



65. The surface is covered by a thin layer of soil and is very rough.

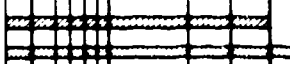
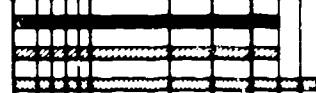
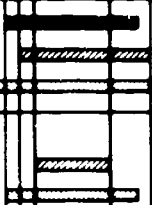
and mapped in terms of surface roughness or microrelief rather than geometry-factor ranges. These cracks may be at the top and from a fraction of an inch to as much as 10 ft deep. They enclose polygonal areas several inches up upwards from 1 or 2 in. to several feet above the central portion.

and mapped in terms of surface roughness or microrelief rather than geometry-factor ranges. Grus consists of small maximum diameters of several feet.

and mapped in terms of surface roughness or microrelief rather than geometry-factor ranges. Slopes of the local relief. Soils are fine-grained. Heat cracks several inches wide form in limited areas.

72. Clay plains - NPA

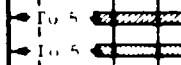
and mapped in terms of surface roughness or microrelief rather than geometry-factor ranges. The boulders may be igneous or metamorphic rocks. The boulders may range in diameter from 10 in. to a few feet.



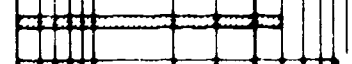
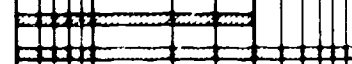
70 to 90
70 to 90

To 3000

76. NPA - See cross-sectional surface sketch



and mapped in terms of surface roughness or microrelief rather than geometry-factor ranges. The surface of lava having diameters ranging up to several feet.



To 4000

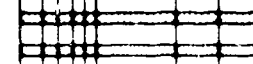
80. A boulders field, some boulders, and craters of various sizes.

and mapped in terms of surface roughness or microrelief rather than geometry-factor ranges. The surface is undulating. Surface irregularities such as fragments of lava and fissures in the surface may vary from

and mapped in terms of surface roughness or microrelief rather than geometry-factor ranges. Under the surface are underlying pre-existing landforms. The boulders themselves are angular and numerous and have diameters



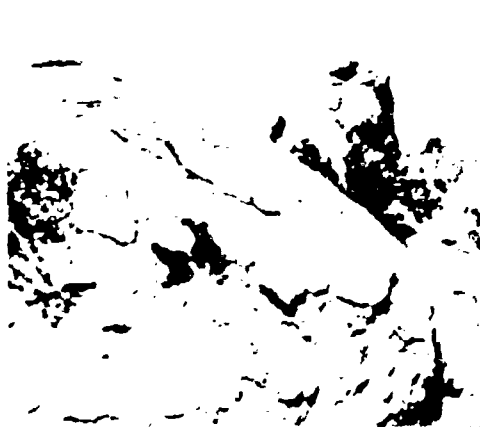
60 to 70
60 to 70



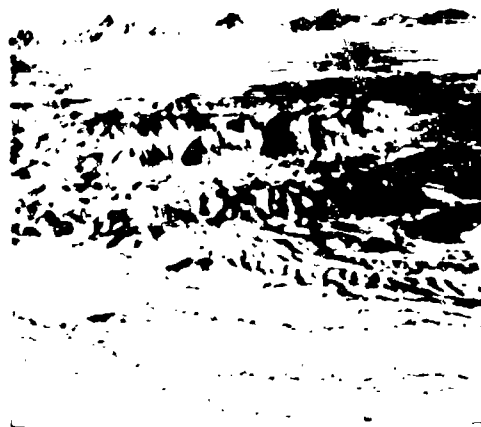
6



81. Boulders of various sizes.



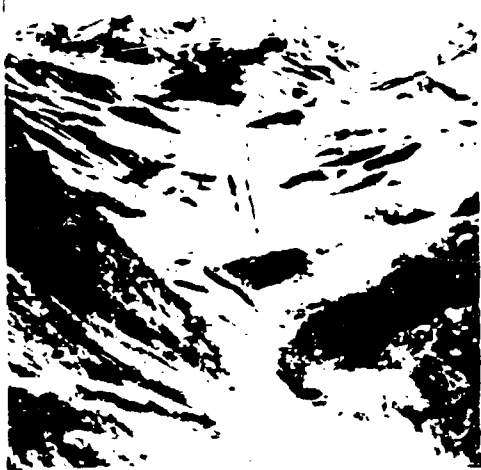
73. A close-up of an exfoliated boulder showing the typical spalling action.



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



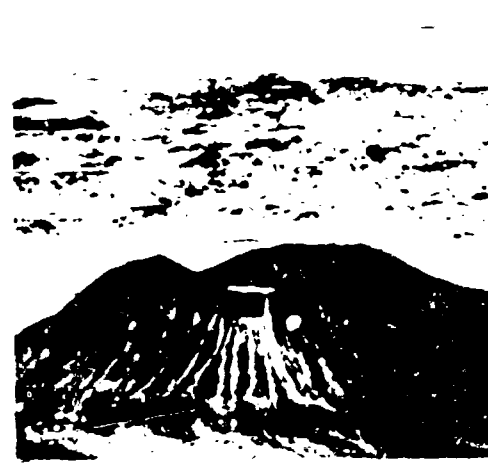
75. A vertical photograph of a breached elongate dome with inner dendritic drainage.



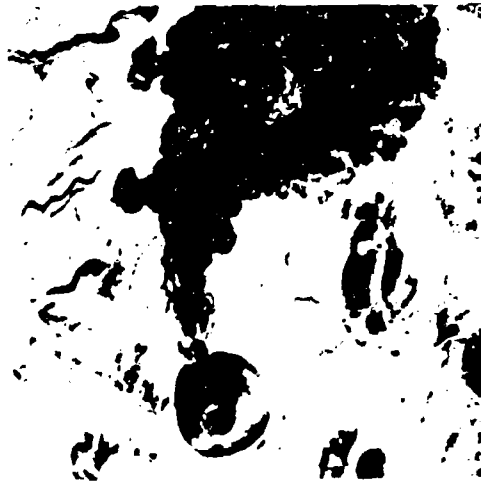
77. A motor road following the bottom of an intramontane valley.



78. A broken lava flow partially buried by wind-blown sand.



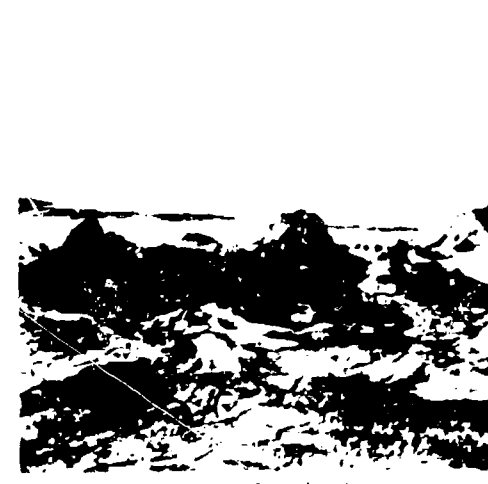
79. Cinder cone



81. A vertical photograph showing a basaltic flow extending from a cinder cone.



82. An undulating cinder field with spatter cones in the foreground.



83. A group of mud volcanoes.