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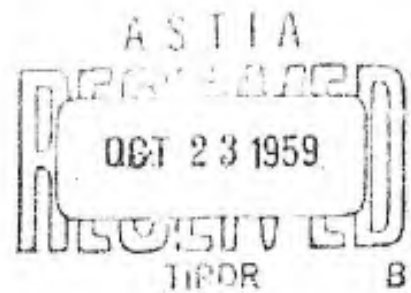
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TECHNICAL REPORT  
EP-118



SOUTHWEST ASIA:  
ENVIRONMENT AND ITS RELATIONSHIP  
TO MILITARY ACTIVITIES

AD No. 227067

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QUARTERMASTER RESEARCH & ENGINEERING CENTER  
ENVIRONMENTAL PROTECTION RESEARCH DIVISION

JULY 1959

NATICK, MASSACHUSETTS

HEADQUARTERS  
QUARTERMASTER RESEARCH & ENGINEERING COMMAND, US ARMY  
Quartermaster Research & Engineering Center  
Natick, Massachusetts

ENVIRONMENTAL PROTECTION RESEARCH DIVISION

Technical Report  
EP-118

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SOUTHWEST ASIA: ENVIRONMENT AND ITS RELATIONSHIP TO  
MILITARY ACTIVITIES

Project Reference:  
7-82-01-007

July 1969

## FOREWORD

Military history provides many instances in which the environment (climate and/or local weather conditions, terrain, and culture or mores of indigenous peoples) has been a decisive factor in the success or failure of military operations, frequently as a result of the ability of a commander to exploit the environment to obtain a military advantage, or as a result of ignorance of conditions and failure to take adequate precautions against adverse conditions. Napoleon's retreat from Moscow and Wolfe scaling the cliffs to reach the Plains of Abraham are examples so well-known as to need no discussion. A causative factor in the Sepoy Rebellion in India was the failure of the British to recognize and respect religious taboos. Since any aspect of environment (in its widest sense) may be significant to military activities, the designer of equipment, as well as the military planner and the operator, must consider all the implications of man-machine-environment interrelationships if the full potential of military power is to be realized. The increasing complexity, variety, and distribution of military activities make attention to these interrelationships even more imperative in the future than it has been in the past.

Many attempts have been made to predict Army capabilities in relationship to environmental conditions. Most of these efforts have produced general statements containing little specific information. Even now, some important problems can be treated only by a simple warning that precautions should be taken. Reliable data concerning the capabilities of man and the limitations imposed on equipment operability by environmental stresses are sparse; often, information is available only in widely-scattered or relatively inaccessible sources. Moreover, knowledge regarding certain environmental conditions in many parts of the world is still incomplete. Nevertheless, there is considerable information available on these subjects which, if properly evaluated, integrated (with other data), and presented, can provide useful guidance surpassing that now at hand.

In this report, an attempt has been made to present available information in a concise understandable form, while retaining its quantitative characteristics, in such a manner that interrelationships among the man-equipment-environment complex are readily discernible. Suggestions for improvement, corrections of information, and additional equipment-performance data, will be welcomed from our readers, since only experience can lead to improvement and refinement of this experimental approach to presentation of information for use in designing military equipment, planning military operations, and providing adequate logistic support.

Although this report was prepared by Environmental Protection Research Division, it is a Command effort, since information and suggestions have been supplied by various elements of QM R&E Command.

AUSTIN HENSCHEL, PH. D.  
Chief,  
Environmental Protection Research Division

Approved:

CARL L. WHITNEY, Lt. Col., QMC  
Commanding Officer  
QM R&E Center Laboratories

DALE H. SIELING  
Scientific Director  
QM Research & Engineering Command

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ABSTRACT

↙  
The environment of Southwest Asia, relationships between the environment and the soldier, and relationships between the environment and materiel are shown on maps and graphs. Most of the military problems of the region are caused by excessive heat and aridity, although the combination of heat and high humidity near the Persian Gulf and the Red Sea cause extreme discomfort at times in these particular areas. In much of the region, summer heat causes impairment of man's ability to work and increases his water requirements. The environment also causes storage and operating difficulties.  
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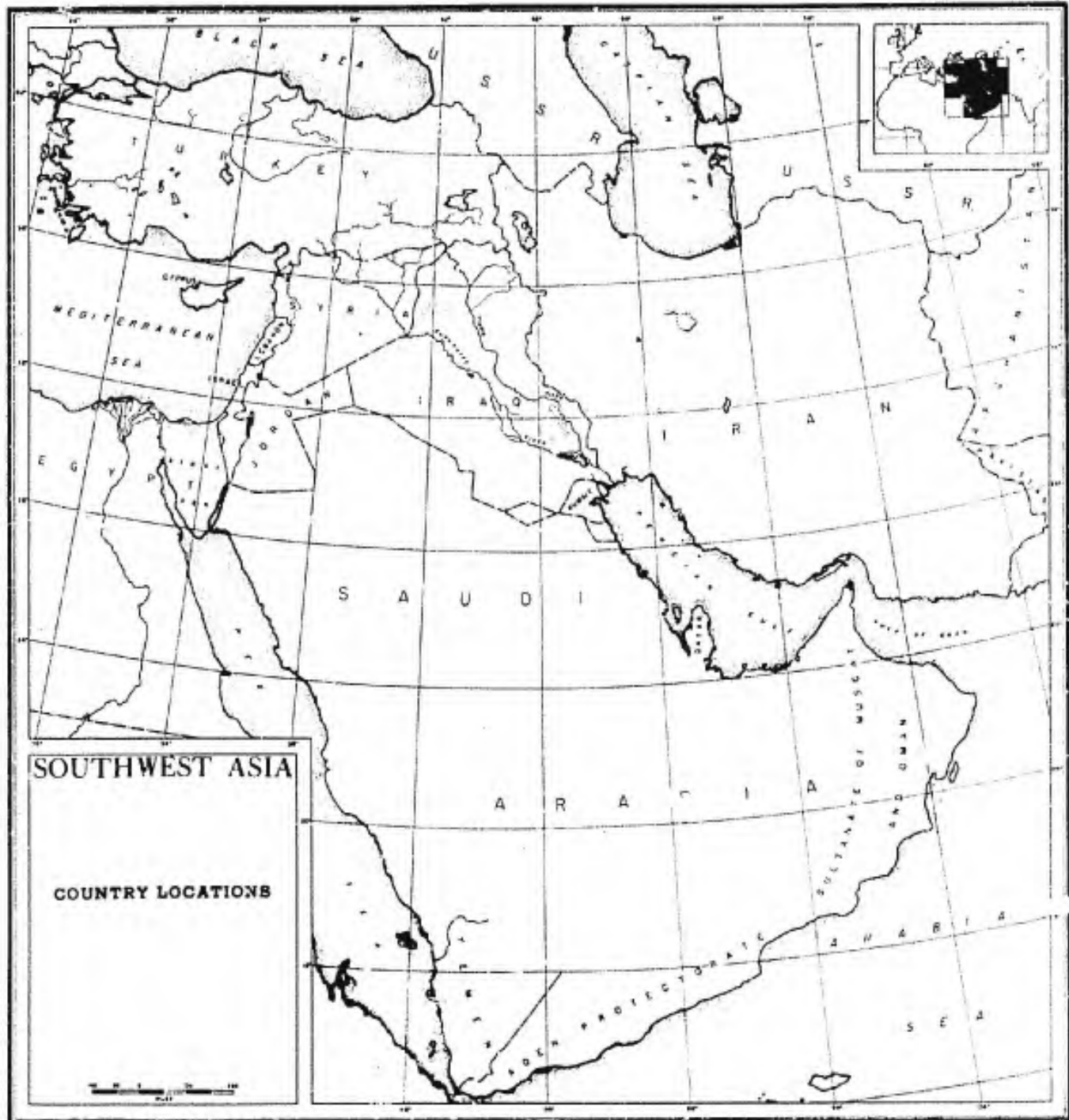


Fig. 1: There are three maps in this report that may be used for general orientation. The map above shows only the countries and major water bodies of Southwest Asia. Figure 2 (page 2) locates many of the physiographic regions, and Figure 3 (page 11) shows the locations of most of the cities.

SOUTHWEST ASIA: ENVIRONMENT AND ITS RELATIONSHIP  
TO MILITARY ACTIVITIES

INTRODUCTION

Southwest Asia, for this report, includes Turkey, Cyprus, Syria, Iraq, Iran, Lebanon, Israel, Jordan, the Sinai Peninsula, and the Arabian Peninsula. National boundaries are shown on Figure 1. The region is only a small part of Asia, but it is two-thirds as large as the United States. From south to north, Southwest Asia extends from 12°N to 42°N and, if superimposed on North America, it would almost span the distance from the Panama Canal to the Great Lakes. From western Turkey to the eastern border of Iran is approximately 2,500 miles, a distance equivalent to that from New York to Seattle.

The mountainous backbone of the region from the Mediterranean and Black Seas to Afghanistan and Pakistan is a significant part of the 12,000-mile barrier of mountains, plateaus, basins, and deserts that almost encircles Eurasia from the Pyrenees to the Bering Strait (Fig.2). In this complex of mountains and deserts, natural routes of land travel are few, and water transportation is important. The Suez Canal, connecting the Red and Mediterranean Seas, provides easy access to western Europe and North America from the Persian Gulf.

Southwest Asia is essentially dry, with extensive deserts and pronounced temperature contrasts. Some areas are seasonally quite cold, but the outstanding climatic characteristics of the region as a whole are the aridity and summer heat. In much of the region, temperatures over 100°F are frequent during summer, and in some places, especially near the Persian Gulf, the effects of high temperatures on human comfort and work capabilities are intensified by accompanying high humidities.

Because this report is intended to provide estimates of the effects of the environment on men, military activities, and equipment, no attempt is made to provide a complete treatment of the environment. Nevertheless, brief summaries of the terrain and climate of the region are included in order to make essential background information immediately available. Although this report is not fully documented, specific references are made on maps and in the text where possible. In many instances, derived or estimated quantities based on competent professional knowledge and judgment are used as a means of providing information of a quantitative nature not otherwise available. A glossary is provided in the back for the definition of some terms that may not be commonly known.

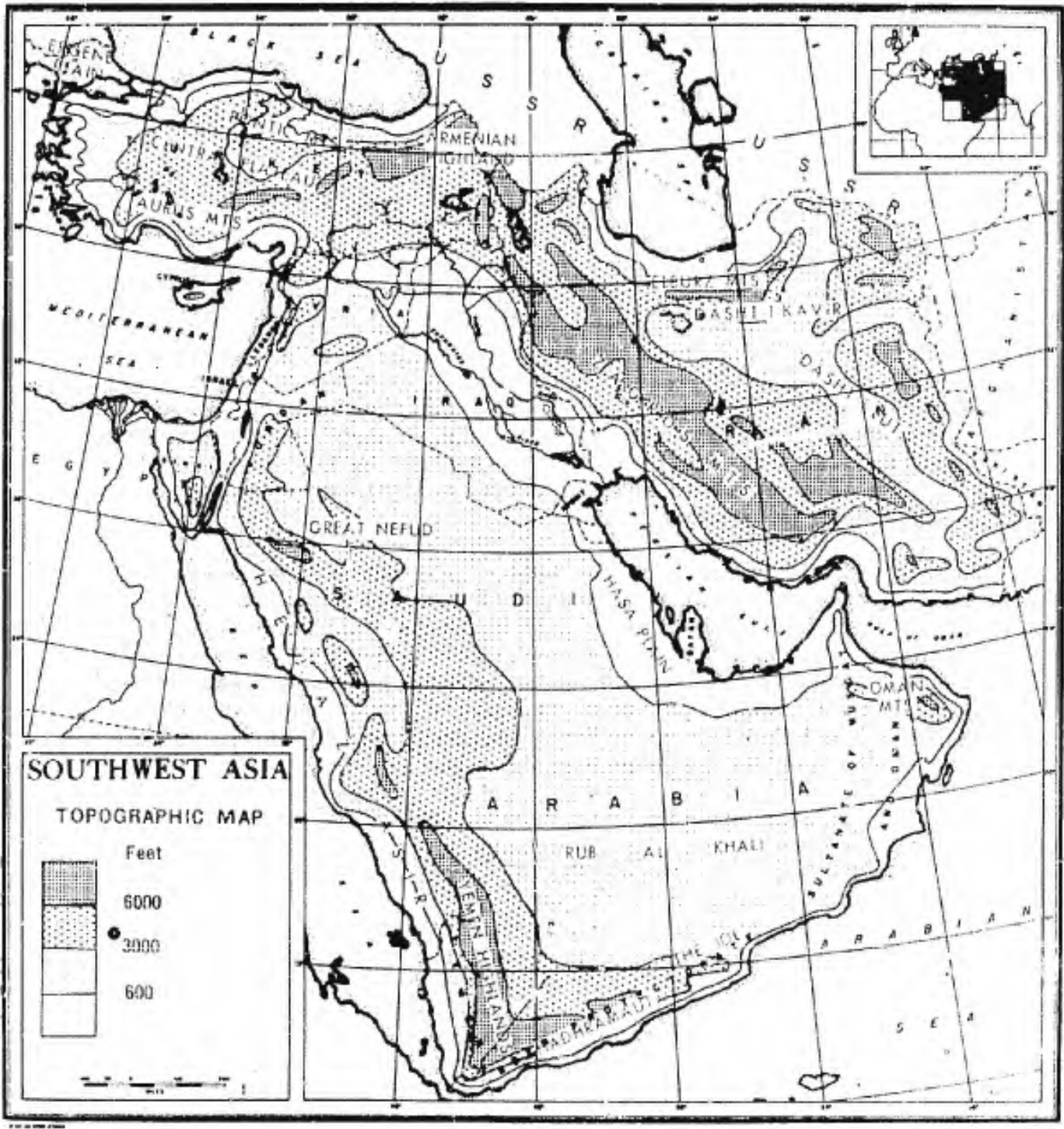


Fig. 2: The above map shows, by means of contours, the location and extent of the high mountains of the region. Note the general barrier extending across Turkey and Iran that effectively separates the southwestern part of Asia from the rest of the continent. Many of the regional names shown on the map are referred to in the terrain section.

## ENVIRONMENTAL CHARACTERISTICS

### 1. Terrain

For convenient reference, the following brief description of terrain features in Southwest Asia is organized by country or groups of countries. Figures 1 and 2 will be helpful in locating some of the features mentioned in this section.

#### a. Turkey

Turkey is a mountainous country with miniature, scattered coastal lowlands, narrow valleys extending from the sea up into the mountains, and small interior basins. The largest lowland area is the Ergene Plain in the European part of Turkey. The two next largest lowlands, the Cilician Plain and the Plain of Antalya, are both near the south coast. Together, these three lowland areas comprise about 5 percent of the total area. The Central Plateau, consisting largely of low mountains and basins, is completely enclosed by higher mountains, the Pontic Mountains in the north, and Armenian Highland in the east, the Taurus Mountains in the south, and the so-called Aegean Mountains in the west. Both the Pontic and Taurus Mountains are S-shaped ranges that have a general east-west orientation.

All the lowland areas are subject to flooding and wet ground conditions, at least in winter and spring. Central Plateau surfaces are generally snow-covered in winter, but brown and dry in summer. Violent dust storms are common over the dry salt and alkali flats from June through September and on the mud flats after the lakes recede in August and September. Anywhere in the interior of Turkey, snow may fall at any time from November to April, and 6 inches or more may lie on the ground for several days.

Because of the rocks and forests of the coastal uplands, land transport is restricted to the narrow valleys on all sides of the Central Plateau. The high, sharp peaks of the Taurus Mountains are frequently snow-capped; lower summits are covered with thick bush growth. There are high pastures of dry grassland in the Pontic Mountains, but the mountain flanks are steep slopes of rough granite and basalt, deeply dissected by rivers flowing to the sea.

#### b. Iran

Approximately half of Iran is mountainous; the remainder is largely desert. There is cultivation along the Caspian Sea coast, and there are irrigated districts near the Karun River, along part of the Persian Gulf coast, and in some of the intermontane basins.

The largest lowlands in Iran are basins of interior drainage, the Dasht-i-Kavir and the Dasht-i-Lut, which together comprise approximately 7 percent of the country. These are largely salt flats completely devoid of vegetation, but their floors may be at least partly covered with water in March or April. The southern and eastern parts of the Dasht-i-Lut, along with several other smaller depressions, are sandy deserts.

There are two major mountain masses in Iran, the Zagros and the Elburz. The Zagros are parallel ranges which form a barrier 100 to 150 miles wide all along the western and southwestern sides of Iran. The very high Elburz Mountains form a compact barrier across northern Iran. In general, ground surfaces are rough and dry in Iran, although there are marshes and mud flats in the lowlands at the head of the Persian Gulf. Also, in the interior basins, the thin salt crust of a dry lake may be merely a deceptive covering for a thick bed of soft mud.

c. Israel, Lebanon, Syria, Jordan, and Iraq

Beginning at the Suez Canal, the 100-mile-wide sandy coastal plain of the eastern end of the Mediterranean Sea gradually narrows in the north in Lebanon and Syria, where it is interrupted by mountain spurs reaching the sea. Inland, a belt of highlands consisting of slightly folded limestones runs parallel to the coast. This range is split by the Great Jordan Rift Valley which is occupied by Lake Huleh, the Sea of Galilee, the Dead Sea, the Gulf of Aqaba, and the Jordan River. The Dead Sea is almost 1,300 feet below sea level.

Most of Syria is desert, with surfaces alternating between rugged lava flows and sandy plains. Much of Iraq is composed of the valleys and deltas of the Euphrates and Tigris Rivers. The delta consists of large irrigated areas near the rivers, silt banks with countless canals, large marshy areas, and small forested plains. On the lateral margins of this lowland are great stretches of salt basin topography with bare plains and low sand drifts.

d. Cyprus

This island is approximately 140 miles long and 60 miles wide. It consists of two low east-west mountain ranges separated by a desert plain. The interior plain, sometimes called the Plain of Nicosia, is about 10 miles wide, and it includes numerous areas of grain fields. The rivers of Cyprus are little more than mountain streams with rough and stony beds, dry in summer and torrents in winter. After winter rains these narrow water courses are filled with muddy water which spreads out over the alluvial fans at the base of the mountains. The only other wet ground conditions are a few coastal marshes at either end of the central plain.

e. Arabian Peninsula

Almost surrounding the Arabian Peninsula is a mountain rim, and the interior is a tilted plateau which slopes from the mountains behind the Red Sea to the Persian Gulf. The Rub al Khali, or "empty quarter," in the southern interior is a sandy desert, although there are some rocky and clay surfaces. Central Arabia consists of a series of alternating scarps and plateaus extending from the vicinity of Medina across the peninsula to the Hasa Plain bordering the Persian Gulf. The Medina Basin, floored with sand and desert pavement and bordered by intrusive and crystalline rock outcrops, is typical of many plains in central Arabia. The Great Nefud in northern Arabia is another sandy desert which is actually connected to the Rub al Khali by a sandy belt that extends in an arc between the two regions. The mountainous rim of Arabia consists of the Plateaus of Hejaz, Asir, Yemen, Hadhramaut, and Jol, and the Oman Mountains. The plateaus are deeply dissected and rugged; summit elevations vary from 2,000 to 10,000 feet above sea level. The Oman Mountains, just inland from the Gulf of Oman, rise to about 10,000 feet.

Sharp stones, abrasive sands, and dry-ground conditions characterize the ground surfaces in nearly all of the Arabian Peninsula. The only wet land in Arabia is found in the small irrigated fields of the oases and in the highland farming areas on the Asir and Yemen Plateaus and in the Oman Mountains. Sand is the greatest surface problem in Arabia, in that frequent strong winds cause sand and dust storms. Grit and abrasive particles cause rapid destruction of footgear and mechanical equipment, and drifting sand quickly covers small items on the ground. Fine windborne material also penetrates into closed containers. Most of the through travel routes across Arabia avoid the great dune areas of the Nefud and Rub al Khali, but a thin sheet of sand covers many valley floors even in the mountainous areas. The sharp lava flows covering much of the highlands also cause rapid wear of footgear and vehicle tires.

f. Sinai Peninsula

Along the Mediterranean coast of the Sinai Peninsula is an area of high sand dunes, an extension of southern Israel. The central part is a sandy plateau, and in the south is a barren crystalline structure with one peak exceeding 8,600 feet in elevation.

2. Climate

The outstanding aspects of the climate of Southwest Asia are heat and drought. Some parts of the region have high temperatures and little or no rain for a summer period ranging from 3 to 5 months; other parts

have cold and wet winters. In order to describe the differences in climate from place to place, winter and summer conditions are discussed separately for the various countries of Southwest Asia. Winter is considered to last from December through February, and summer is from June through August. Figures 4 through 24 show many of the climatic characteristics of the area.

a. Summer

The summer circulation over Southwest Asia is controlled largely by a thermal low centered over Pakistan and Baluchistan in combination with the Azores high. Dry continental winds from the north result from the action of these systems, cloudless skies allow the maximum radiation, and the region is one of the warmest on earth.

(1) Turkey

Summer is the dry season in most of Turkey; most stations receive less than one inch of rain in July, and many stations have no rain for several consecutive summers. Major exceptions are the eastern Black Sea coast and the eastern mountains. All but the highest portions of Turkey are subject to high temperatures. Highest temperatures are recorded in the east in the upper reaches of the Tigris and Euphrates Rivers. Diyarbakir, on the Tigris, has a mean daily maximum in August of 102F. Farther west on the Mediterranean coast, conditions are milder but still hot. The Black Sea coast is still milder; temperatures above 90F are rare.

(2) Iran

Summer temperatures are high throughout all but the Caspian Sea coast and the higher elevations of Iran. Highest temperatures occur in the interior basins and in the lowland near the head of the Persian Gulf. The highest mean monthly temperature in the country, 106F, is reported for Shahdad on the edge of the Dasht-i-Lut. Only at exposed locations on the Caspian Sea coast are absolute maxima below 100F, although temperatures at the higher elevations, where data are unavailable, are probably lower. On the Persian Gulf and Gulf of Oman coasts, temperatures are not so high as in the interior, but the heat is intensified by high humidities and warm nights.

Summer is the dry season over all of Iran except the Caspian area. North of the Elburz Mountains frequent orographic rains occur, and this is the only part of Iran not dependent on irrigation for agriculture. At some interior locations there is practically no likelihood of even a shower during summer.

(3) Israel, Lebanon, Syria, Jordan, Iraq, and Cyprus

The effect of the Mediterranean on the summer climate of the coastal areas of Israel, Lebanon, and Syria is quite noticeable. For example, at Beirut on the coast of Lebanon, the mean daily maximum temperature in August, the warmest month, is 89F. The mean daily maximum temperature in August at Palmyra, Syria, 125 miles inland, is 101F. In August, the absolute maximum at Palmyra is 117F, compared to 99F at Beirut. Unusually high temperatures sometimes occur along the coast in early spring when southerly winds, known as siroccos, bring in hot air from the Sahara. For example, Haifa has recorded 104F in March, higher than any March value at interior stations. During summer, the most intense heat is in Iraq, where all lowland stations have frequent afternoon temperatures above 100F in the period from June through September, and absolute maximum temperatures are above 120F in July and August. The portion of Iraq near the Persian Gulf also has periods of very high humidity in summer.

(4) Arabian Peninsula

The few climatic data available for interior Arabia indicate that temperatures in summer often are above 120F. Probably the Rub al Khali is one of the largest "hot" areas of the world, rivaled only by the interior of the Sahara. At Dhahran on the Persian Gulf coast, afternoon temperatures are lower and nighttime temperatures are higher than in the interior. Along the coast, as already mentioned for Iran and Iraq, high humidities in conjunction with high temperatures cause very oppressive conditions. Figure 21 shows that summer dewpoints above 80F (equivalent to a vapor pressure of 26 mm) have been recorded near the Persian Gulf and along the Red Sea coast. Another phenomenon found along the Arabian coast of the Persian Gulf is the occurrence in summer of the shamal, a hot, desiccating wind from north which brings normal activity to a halt for a few days almost every year.

Rainfall is at a minimum throughout most of the Arabian Peninsula. In the south, however, southwest winds bring orographic rains to high exposed areas of the mountains in Yemen, Aden, and Oman. At some locations on the Arabian Sea coast, cool water upwells and causes condensation in the warmer air, and drizzle, fog, and low cloudiness are common. The rest of Arabia is practically rainless during the summer months.

(5) Sinai Peninsula

Summers are hot and rainless in the Sinai Peninsula. Mean daily maximum temperatures range from the high 80's at Port Said to near 100F at Suez. Relief from the heat can be found in the highlands of the

south, although even there cooler conditions will be most noticeable at night. For example, Nekhl (1,312 feet) has a mean daily maximum of 95F in August, but the mean daily minimum is a pleasant 61F.

Rainfall has not been recorded in the Sinai Peninsula during July, August, and September, and it has been reported only rarely in June.

#### b. Winter

In winter a belt of high pressure lies to the north and north-east over Mongolia and Siberia. Outflowing air from this high dominates the circulation of all of Southwest Asia except the southern portion of the Arabian Peninsula. Temporary weakening of high pressure in the interior permits modified maritime polar air from the North Atlantic to invade the area in migrating storms which generally follow the low pressure track over the Mediterranean Sea into the region. When these storms are well developed, they pull warm or hot air from the south Arabian and Saharan areas into them and bring the warmest winter conditions to the Mediterranean coasts of Israel, Lebanon, Syria, and to some extent Turkey. These storms also bring rain to the entire area, again excepting southern Arabia. Precipitation is heaviest near the coasts of the Mediterranean and Black Seas where mountains intercept the eastward movement of the lows.

#### (1) Turkey

The warmest portions of Turkey in winter are the coasts of the Mediterranean and Aegean Seas. On these coasts, temperatures are often above 60F during the day, and freezing temperatures are rare. Winters are also mild along the Black Sea coast, but temperatures are lower than along the Mediterranean, and frosts are more frequent, particularly in the east.

In interior Turkey, winters are cold; nighttime temperatures usually are well below freezing. In the high mountains of the east, intense cold sometimes prevails and most winters have little thaw. The data for Erzerum and Kars illustrate the severity of the winters. At Erzerum, temperatures below zero often occur, the lowest recorded being -22F. At Kars (5,740 feet high), most nights in January have temperatures below zero, and the absolute minimum is -32F. Lower temperatures have been recorded at higher elevations. In the west, conditions are more moderate, with temperatures above freezing on most days. Ankara has a January mean daily maximum of 38F and a mean daily minimum of 23F.

Winter is the season of maximum rainfall in most of Turkey; most of the country receives at least one inch in each winter month.

The principal exception is the northeastern mountains, where winter is the driest season, and some stations have less than one inch of precipitation during at least one winter month. Heaviest mean precipitation amounts are recorded along the Mediterranean coast, but inland at higher elevations, snow cover lasts into late spring, particularly on northern exposures. Some locations on the Black Sea coast also receive heavy rainfall in winter. For example, Rize has 30 inches of precipitation during winter, falling mostly as rain. The amount and frequency of snow increases rapidly inland from the Black Sea coast. Heaviest amounts occur in the high mountains of the east, where some of the higher passes are clear of snow only during the summer months. Snow cover is usually continuous from December through March at Kars and Erzerum, and at Ankara there is a snow cover on an average of 21 days a year.

## (2) Iran

In winter, the northern part of Iran is cold and much of the remainder of the country is subject to cold periods. Few data are available for the northwestern mountain provinces and the high Elburz, but the data for Erzerum and Kars in Turkey indicate that below-zero temperatures often occur at higher elevations. North of the Elburz, on the Caspian Sea coast, winters are milder; January average temperatures are generally above 40F. South of the mountains, winters are less severe, but temperatures below freezing can be anticipated. Teheran, at 4,000 feet, normally has daytime temperatures in the 40's and nighttime temperatures below freezing in January. The coasts of the Persian Gulf and the Gulf of Oman are warmer. At Abadan, nighttime minimum temperatures average near 50F, higher than January maximum temperatures at Teheran. At Jask, temperatures in the 60's and 70's are common, and frost has never been reported.

Precipitation in Iran decreases from north to south and from west to east, except for some spots where relief interrupts these trends. Even though winter is the "rainy" season in most of Iran, few stations receive more than 6 inches of rain in the 3-month period. The wettest portion of Iran is the Caspian area, although here winter precipitation comprises only about one-fourth of the annual total; both spring and autumn have more rain than winter. Few data are available for the mountains, but it has been estimated that the high elevations of the Zagros Mountains receive 8 to 12 inches of precipitation during winter.

## (3) Israel, Lebanon, Syria, Jordan, Iraq, and Cyprus

The coasts of Israel, Lebanon, and Syria have a typical Mediterranean climate, and winters are wet. The coastal mountains, however, cast a rain shadow to the east in Syria and Jordan, and these countries along with Iraq receive little rain. In January, mean daily maximum temperatures along the Mediterranean coast range from 56F at

Latakia, Syria, to 65F at Haifa, Israel. Nighttime temperatures normally are between 45F and 55F, and frosts are rare. In the interior, most stations have mean daily maximum temperatures above 60F.

Winter is the rainy season throughout the region. Along the coast, January precipitation decreases from 7.2 inches at Beirut to 4.4 inches at Haifa. Greater amounts are recorded in the coastal mountains, but in the Jordan Valley and the eastern areas precipitation is much lighter. Snow is a winter problem in all of the mountains. Even in Jerusalem snow has accumulated in winter to a depth of 3 feet.

#### (4) Arabian Peninsula

The winter climate of the Arabian Peninsula is dry and warm. Winter temperatures increase from averages near 50F in the north to averages above 70F on the southern coast. Frosts can occur almost everywhere in the interior, but they are frequent only in the north and in the southern and eastern mountains. The interior of southern Arabia can be quite warm with daytime temperatures often above 80F and sometimes above 90F. The range of wintertime daily temperatures probably averages 30F or more in all of the interior, but along the coast the daily range may be as little as 10F.

Although winter is the season in Arabia most likely to have precipitation, there are few stations that average more than 1 inch of rainfall in any of the winter months. Most dependable records are those for Muscat on the Gulf of Oman (38-year record) and Aden in the extreme south (50-year record). Muscat has an average of 2.5 inches of rain in the three winter months; Aden averages less than 1 inch during this period and less than 2 inches during the year. The primary source of winter precipitation is cyclonic activity, and because the probability of such activity is greatest in the north, it can be supposed that average precipitation is greatest there. Occasionally the cyclones move farther south, and heavy rains and flooding occur in the interior of Arabia. On the other hand, these desert areas may be rainless for years between storms. Snow is a phenomenon that probably has occurred in the north and is known to have occurred in the mountains of southern Arabia.

#### (5) Sinai Peninsula

Winter temperatures on the coast are slightly warmer than those farther north. Port Said, on the Mediterranean coast at the northern end of the Suez, has a January mean daily maximum of 66F and a mean daily minimum of 51F. At the other end of the Canal, temperatures are similar. Inland, daytime temperatures are slightly lower, and nights are considerably cooler. Nekhl, at an elevation of 1,312 feet, has a mean daily minimum in January of 33F and an absolute minimum of 18F. Since much of the Sinai Peninsula is higher than Nekhl, temperatures below freezing can be anticipated often at night during the winter season.

Precipitation is very light in the entire Sinai Peninsula even during the winter or wet season. Port Said averages only 1.5 inches during the 3-month period, and the interior is even drier. Along the Suez Canal in the winter period there is occasional dense fog. In some years there may be two or three days during the season with enough fog to tie up traffic in the Canal, but the average at Suez (10-year record) is one day per year with dense fog.



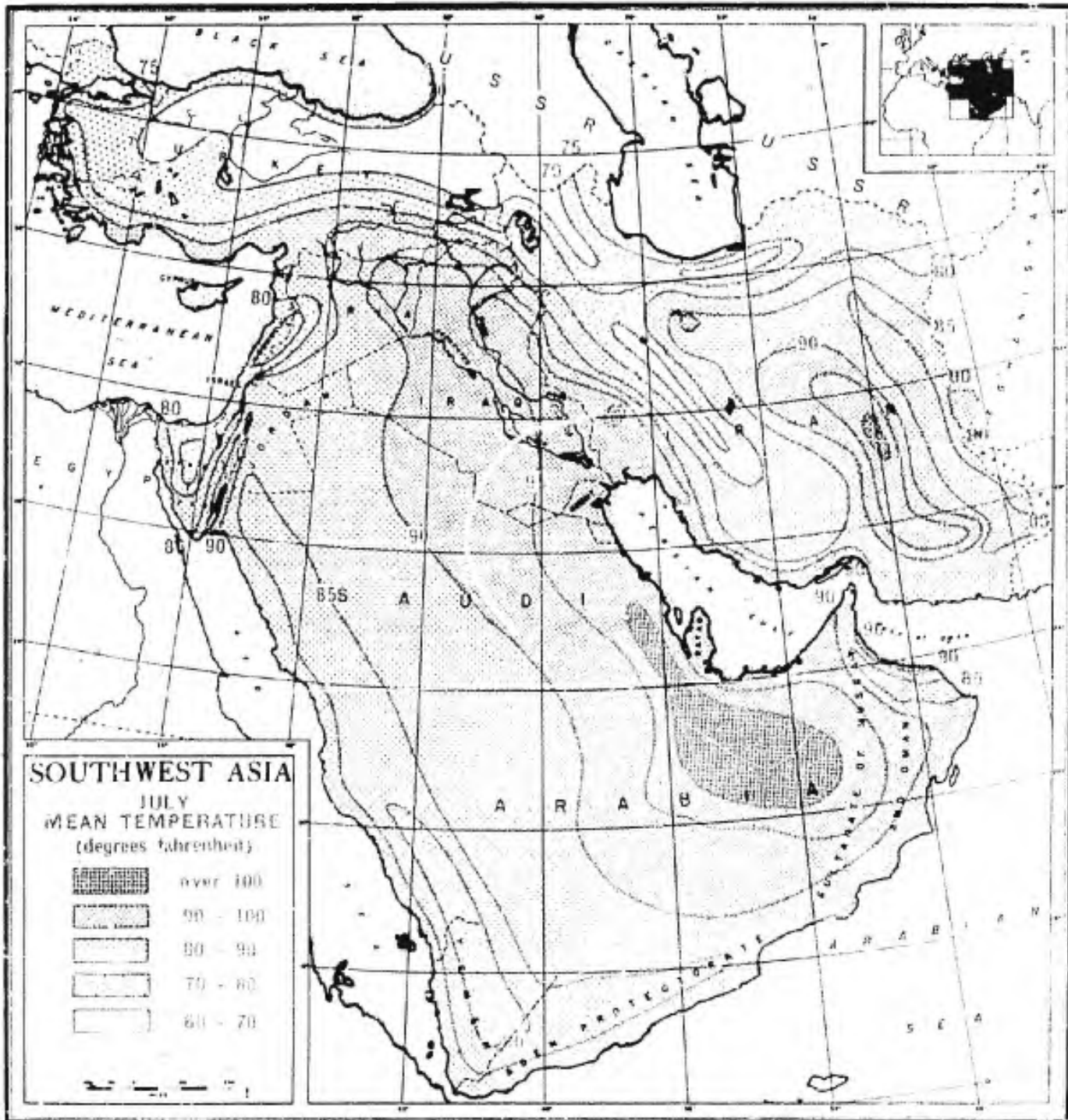


Fig. 4: This map of average temperatures for July shows the large extent of hot areas in the region. Except for Turkey and the mountains of Iran, the average July temperature almost everywhere is above 75F, and in some places mean temperatures are over 100F. (Figure 18 compares mean July temperatures in Southwest Asia with those for Yuma, Arizona, one of the hottest stations in the United States.)

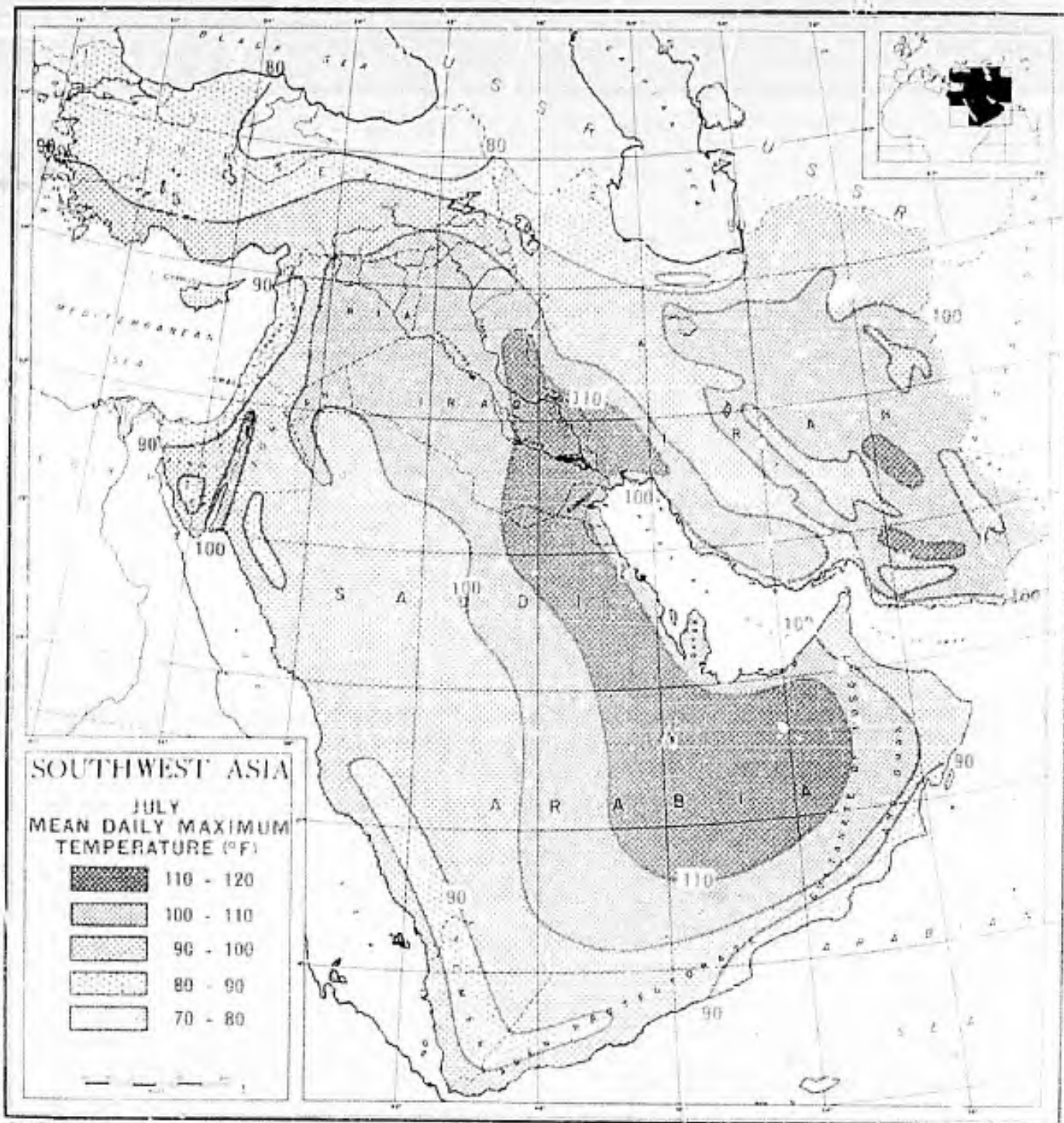


Fig. 5: The above map, based on average daily high temperatures in July, gives some idea of the high temperatures likely to be reached during the day. Because the figure is an average, however, approximately half the days will have higher temperatures, and the other half will not be so hot. The map indicates that over a vast area many days in July will have temperatures above 90°F; in a smaller but no less important area, temperatures above 100°F are common.

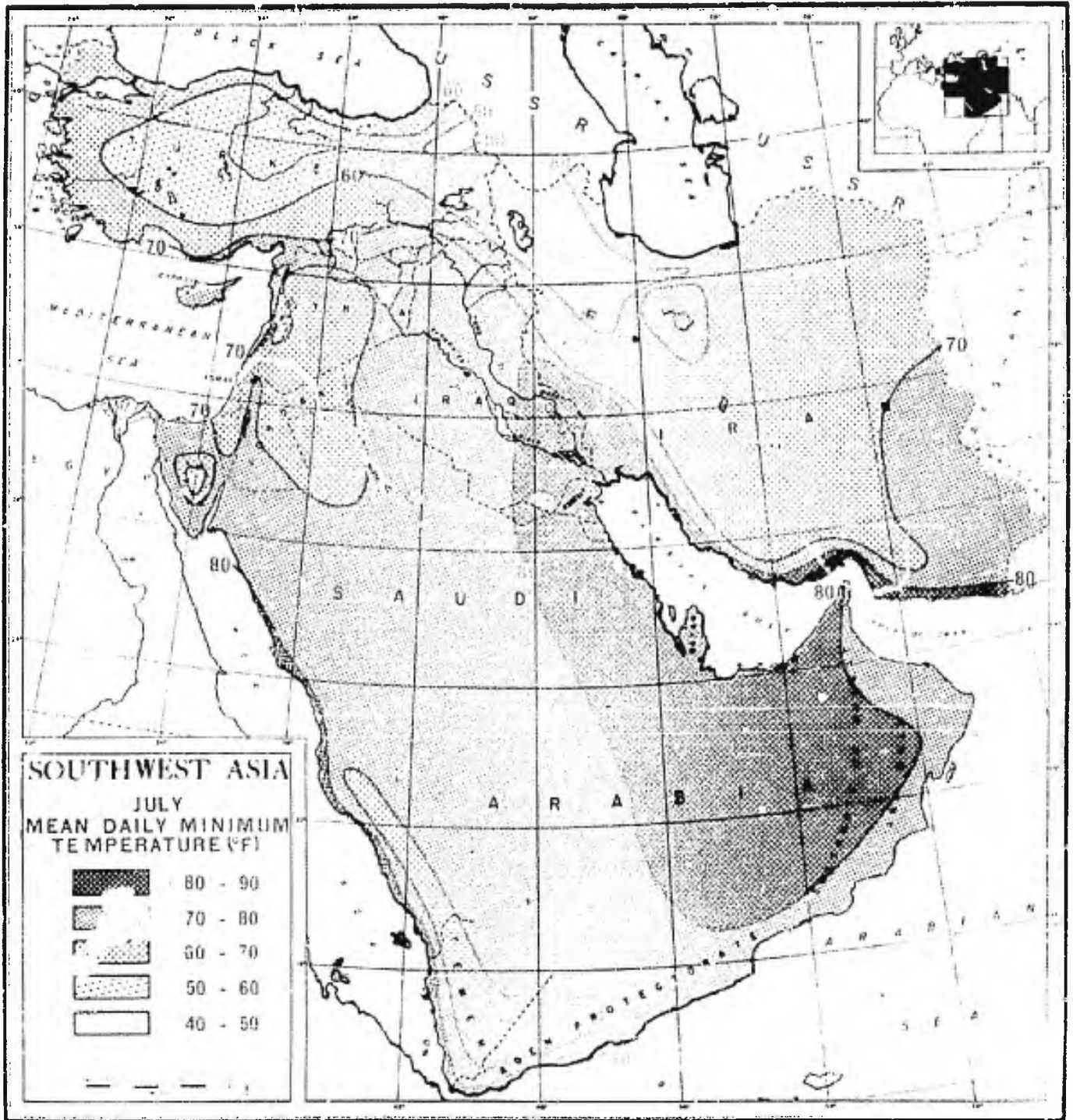


Fig 6: July average daily minimum temperatures, as the map shows, remain above 70F over much of Southwest Asia and above 80F over a fairly large area. When used with the map of mean daily maximum temperatures (Fig. 5), one can get some idea of the range of temperatures to be expected on a summer day.

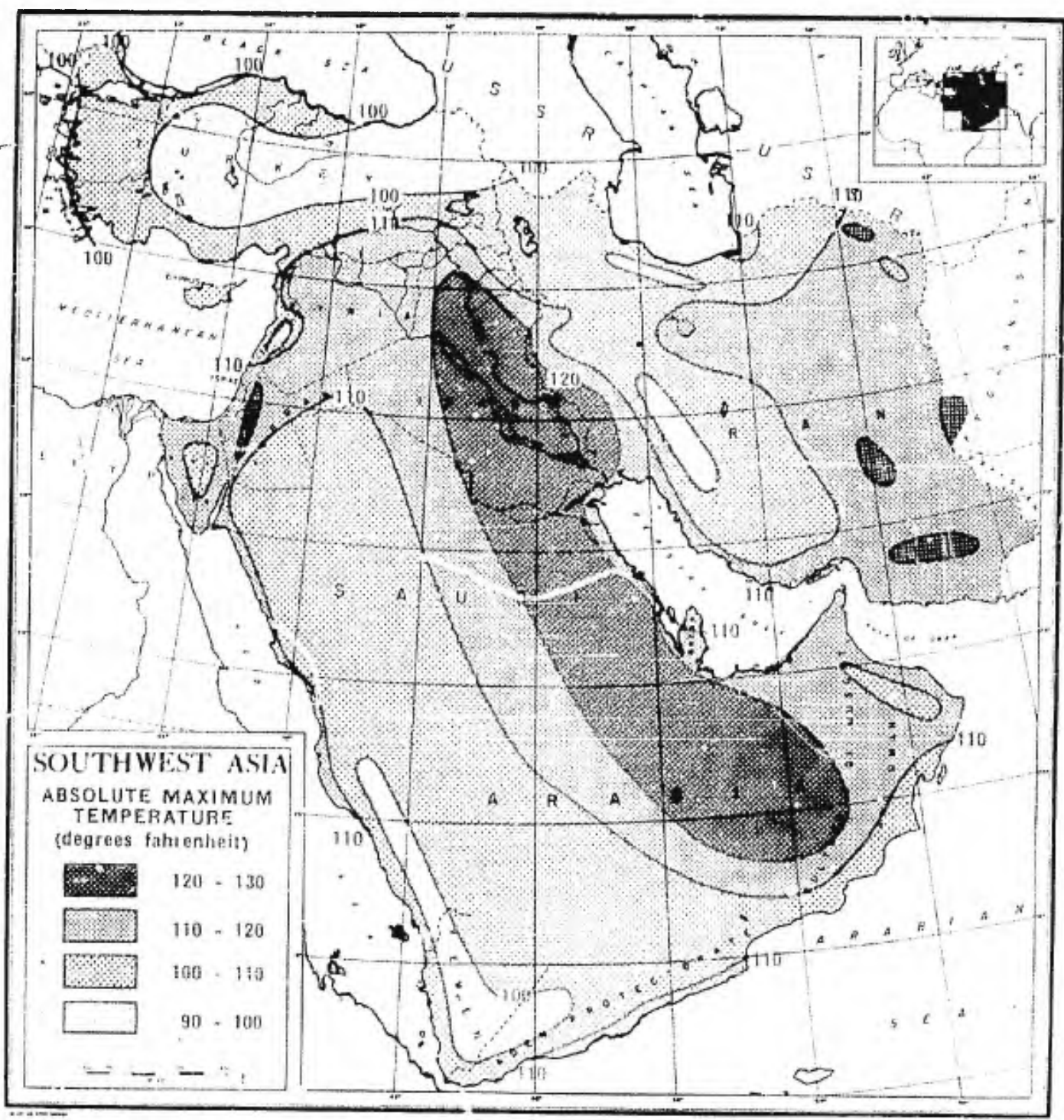


Fig. 7: Absolute maximum temperature figures are of limited practical value, but this map indicates in a general way the extremes likely to be reached. It is of interest that the extreme high temperatures are likely to occur at least slightly inland from the coast.

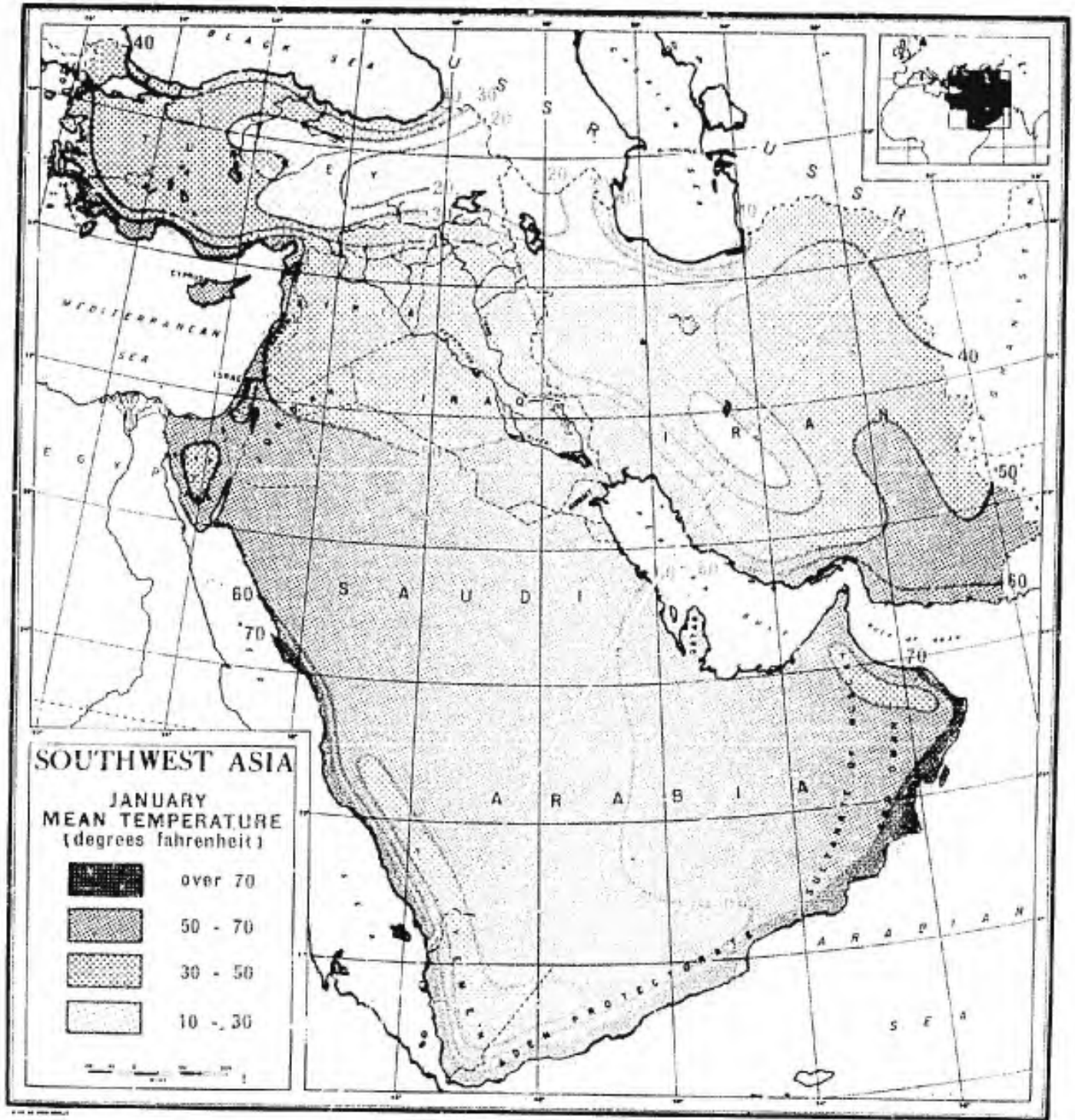
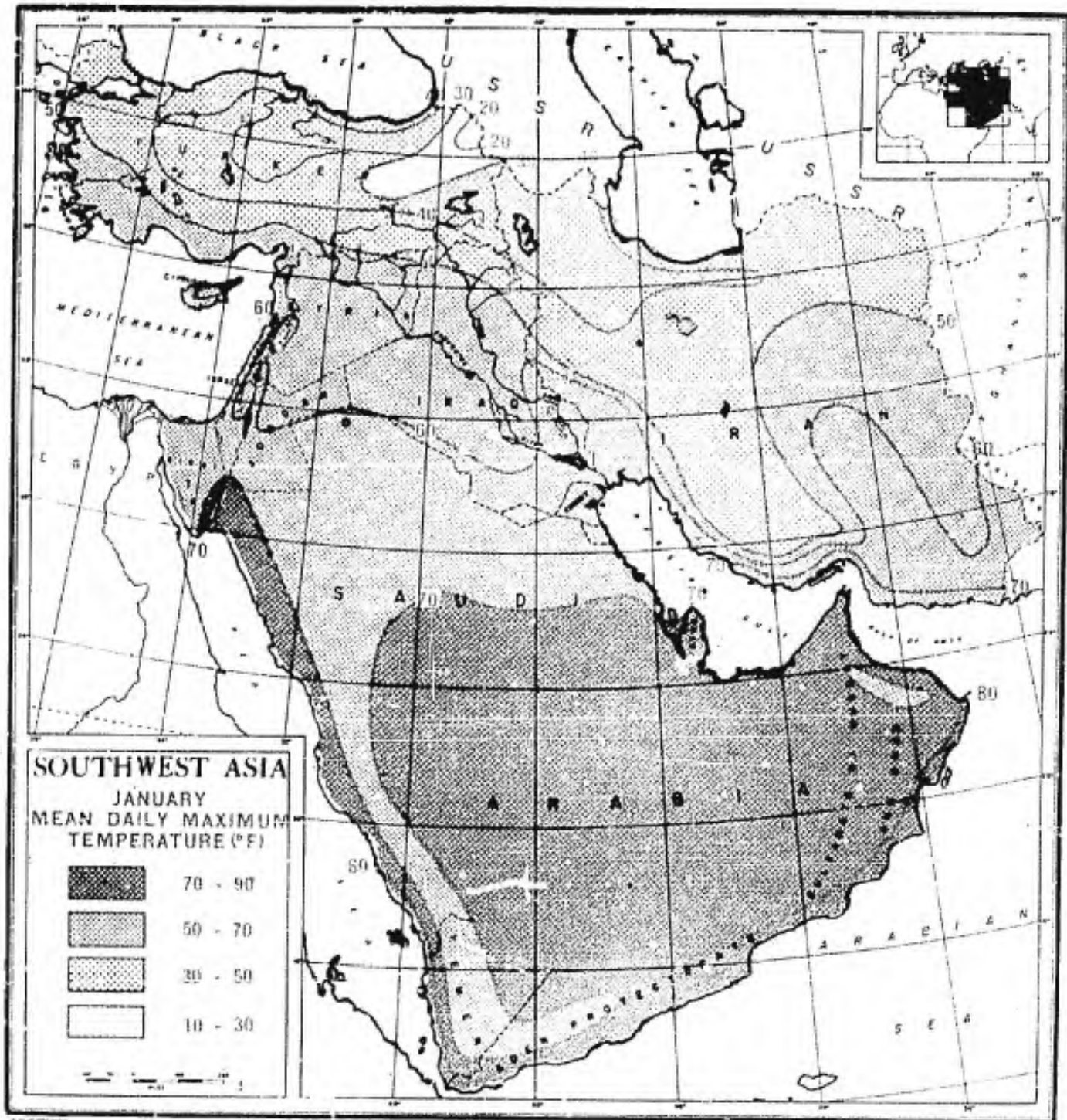
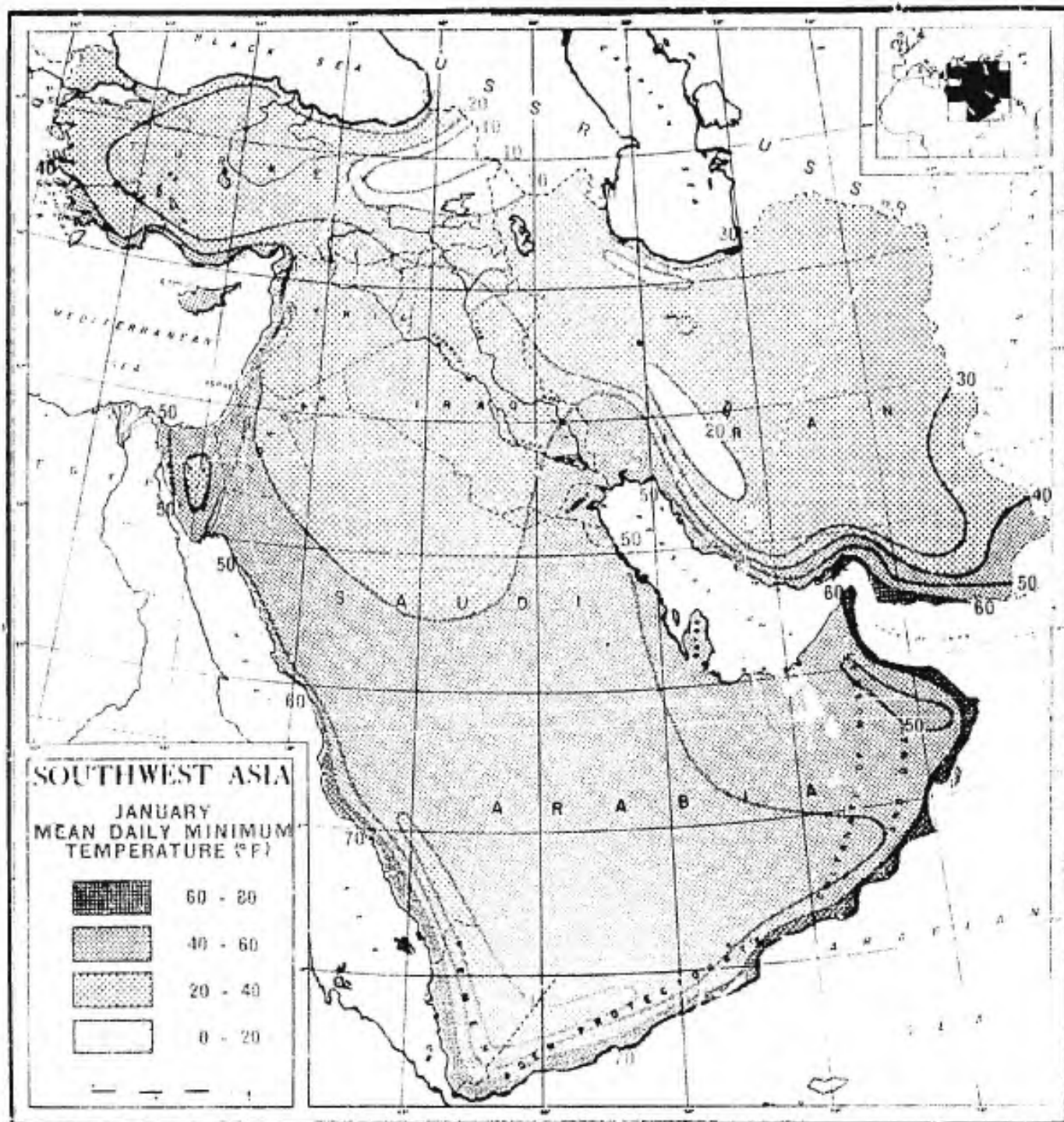


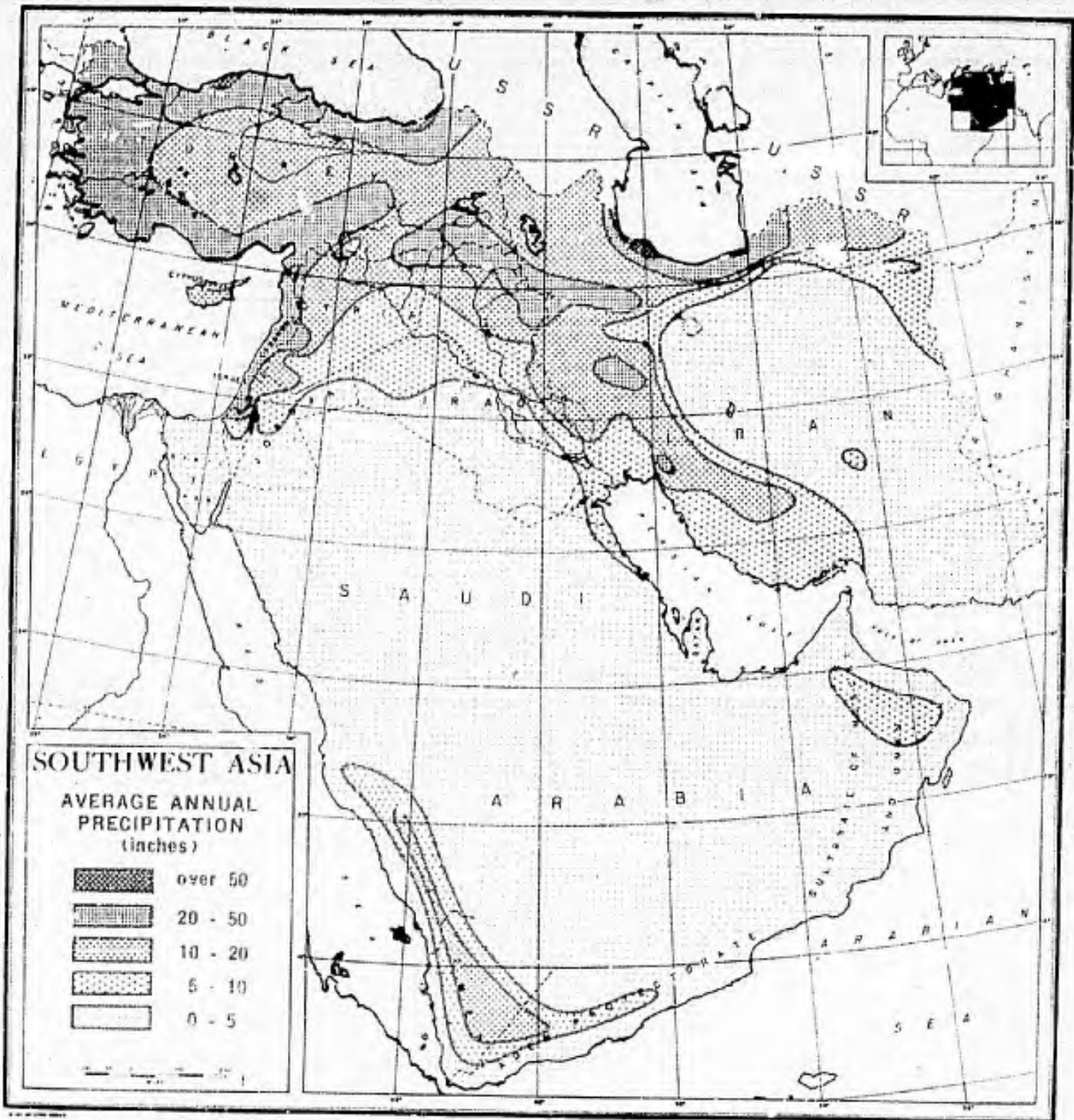
Fig. 8: Although this report places major emphasis on problems connected with heat, this map shows that fairly large areas in the northern mountains have winter mean temperatures below 20F.



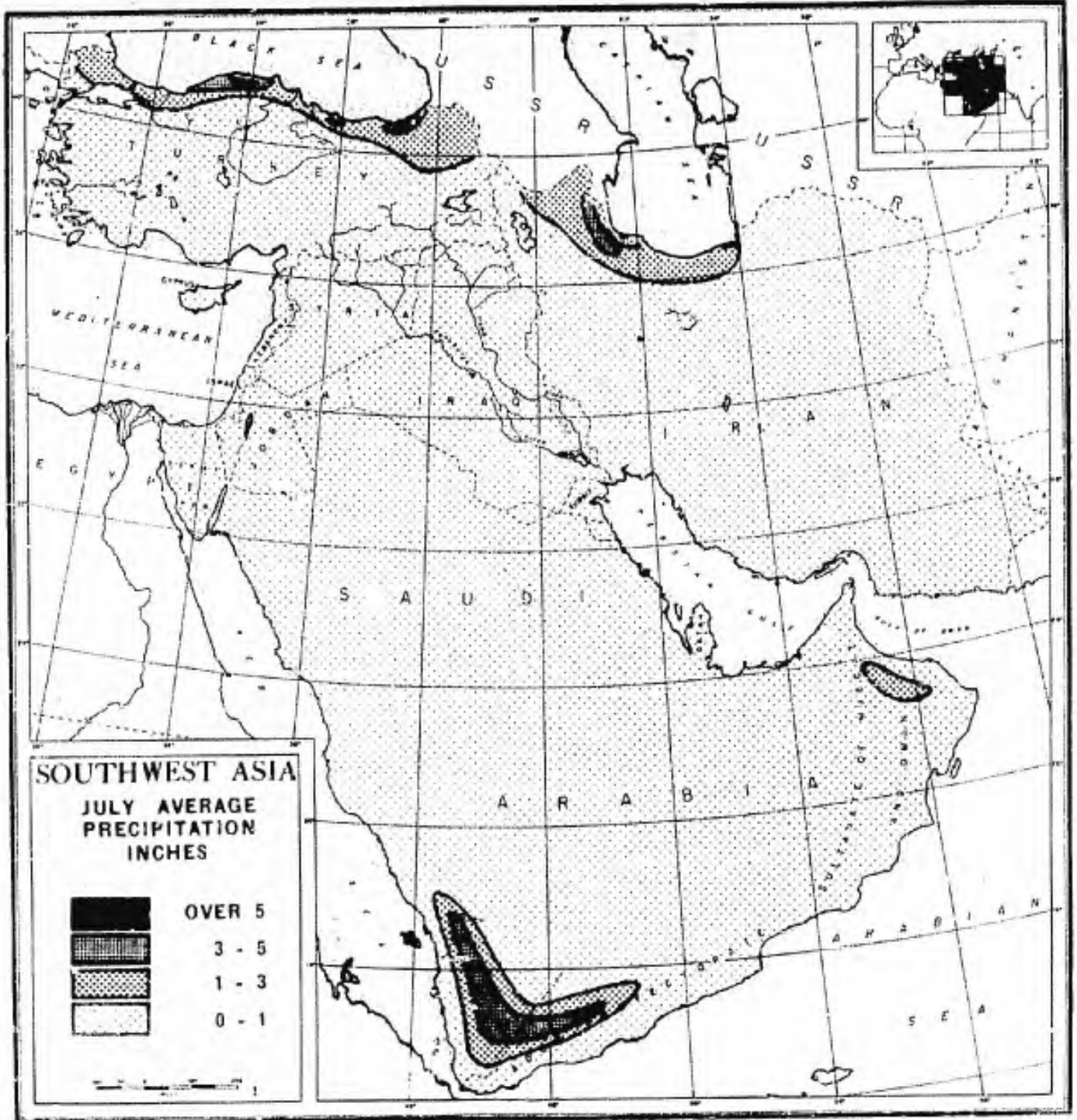
**Fig. 9:** Average daily maximum temperatures are fairly high in the southern part of the region, even in January, the coldest month. Farther north, however, daytime temperatures are enough lower to cause some cold-weather problems.



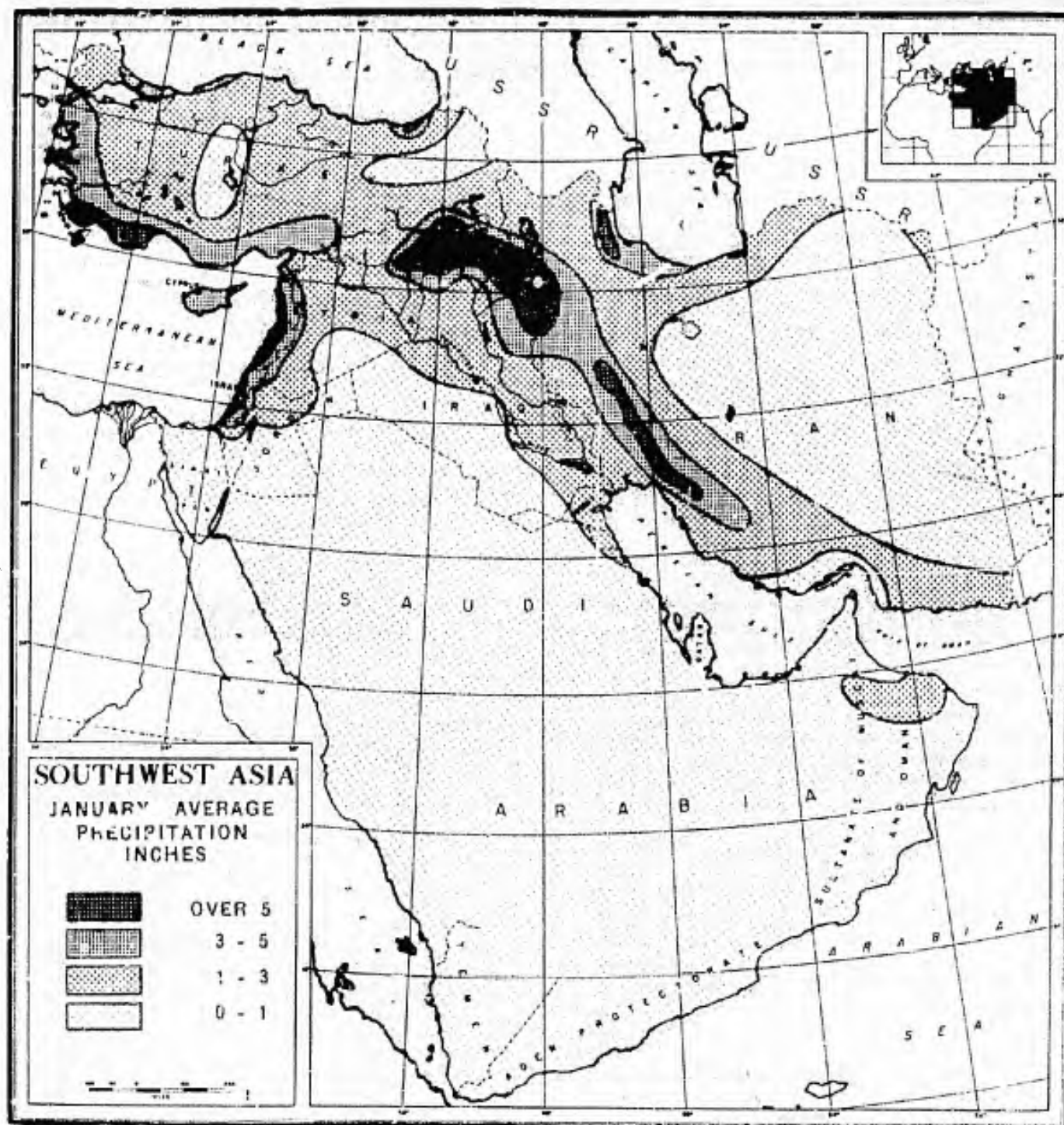
**Fig. 10:** As the above map shows, night and early morning temperatures are likely to drop to fairly low levels in the north. In the southern part of the region there are few problems caused by low temperatures except in the mountains.



**Fig. 11:** Much of the region, particularly Arabia, rarely receives any rain and when there is rainfall it is likely to be in the form of heavy, sudden downpours. Vegetation in all the areas with less than 10 inches is desertic except in the irrigated areas. In the north, some areas are well watered and capable of supporting dense vegetation.

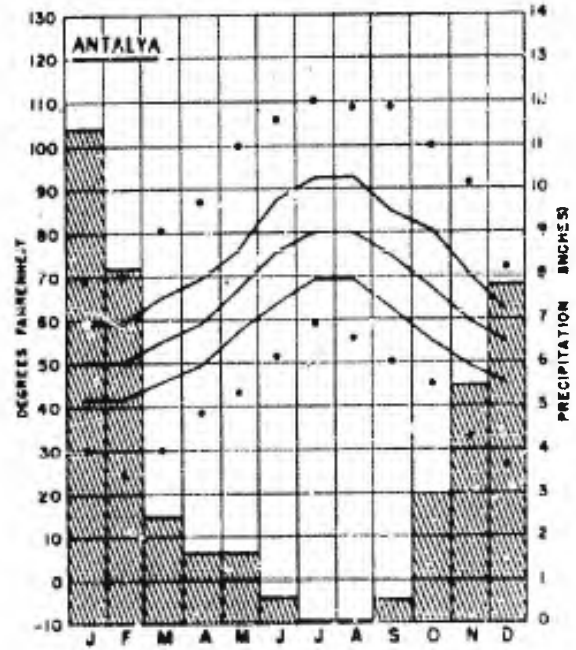
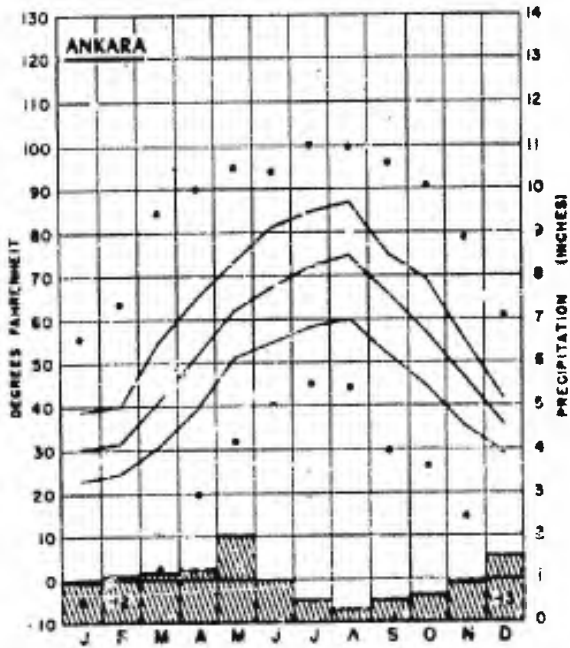
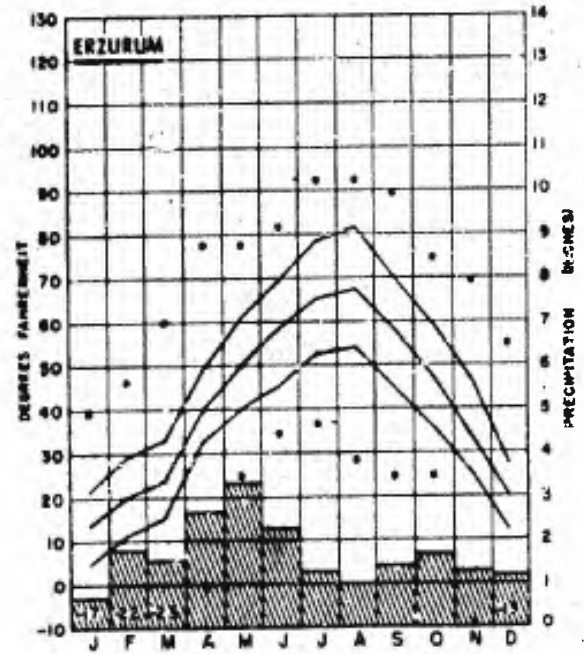
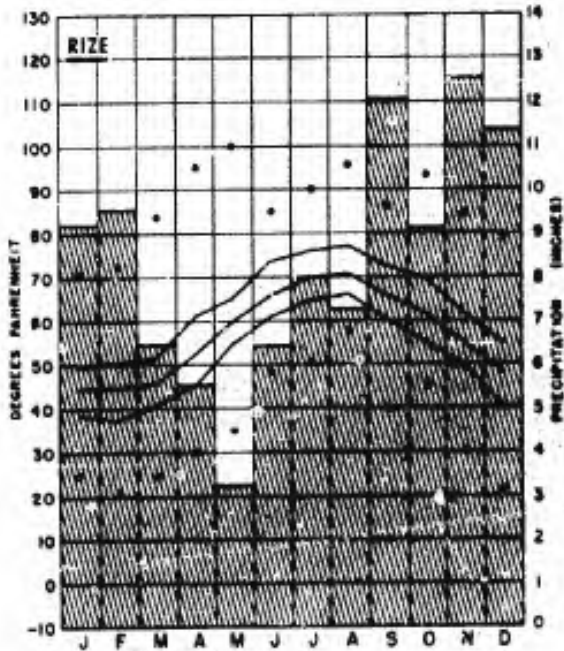


**Fig. 12:** Inasmuch as Southwest Asia is primarily a region of winter precipitation, the areas receiving more than an inch of rain in July are quite small.



**Fig. 13:** Much of the winter precipitation in the mountainous areas is in the form of snow. Even in Jerusalem, heavy snowfalls have occurred on rare occasions. The map shows that the entire Arabian Peninsula and a large part of Iran remain dry throughout the winter, unaffected by the cyclonic activity of the Mediterranean.

## ANNUAL TEMPERATURE AND PRECIPITATION REGIMES AT SELECTED STATIONS IN TURKEY



- Absolute maximum temperature (upper dot)
- Mean daily maximum temperature (upper line)
- Mean monthly temperature (middle line)
- Mean daily minimum temperature (lower line)
- Absolute minimum temperature (lower dot)
- Mean monthly precipitation

Fig 14

## ANNUAL TEMPERATURE AND PRECIPITATION REGIMES AT SELECTED STATIONS IN LEBANON, SYRIA, AND IRAQ

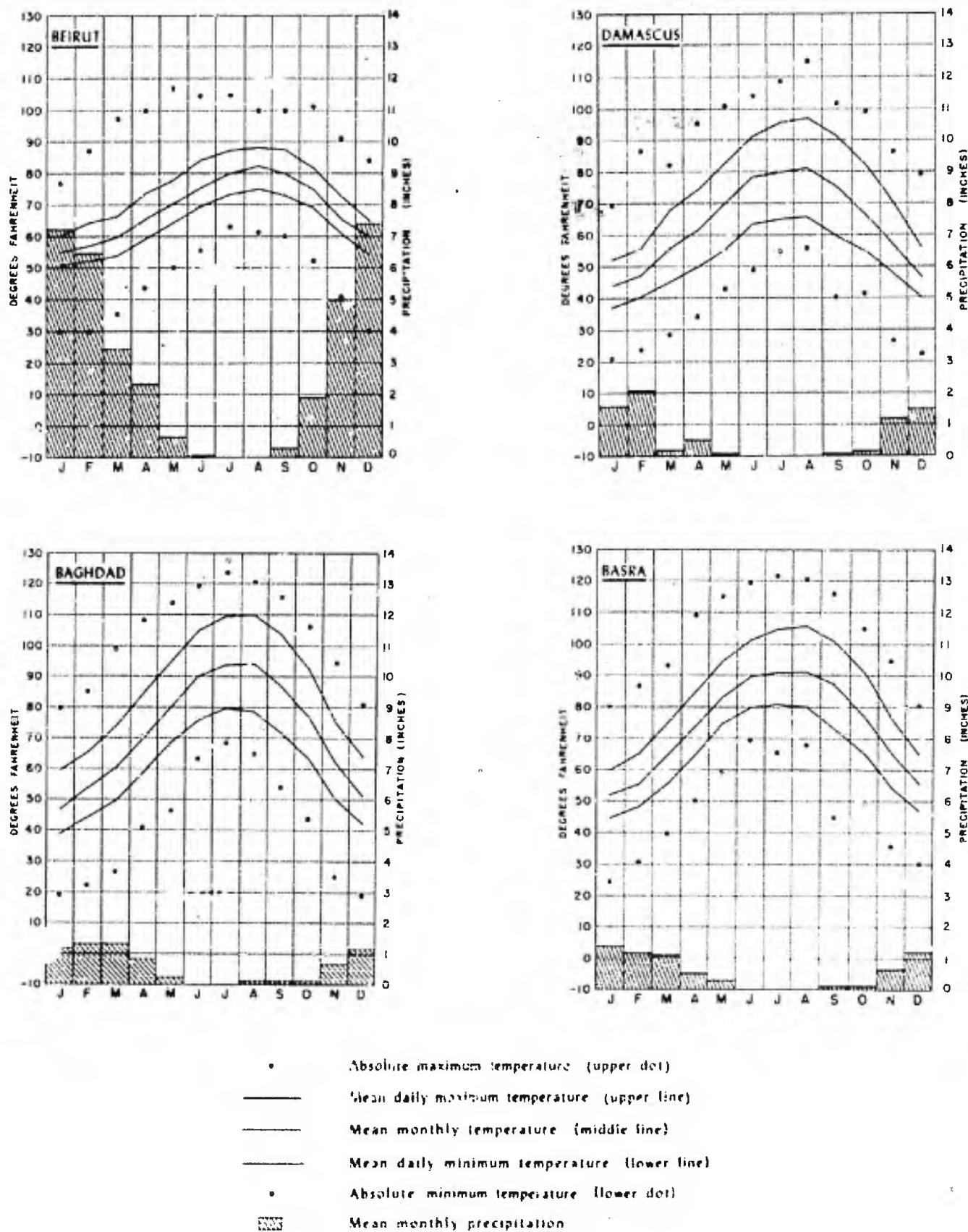
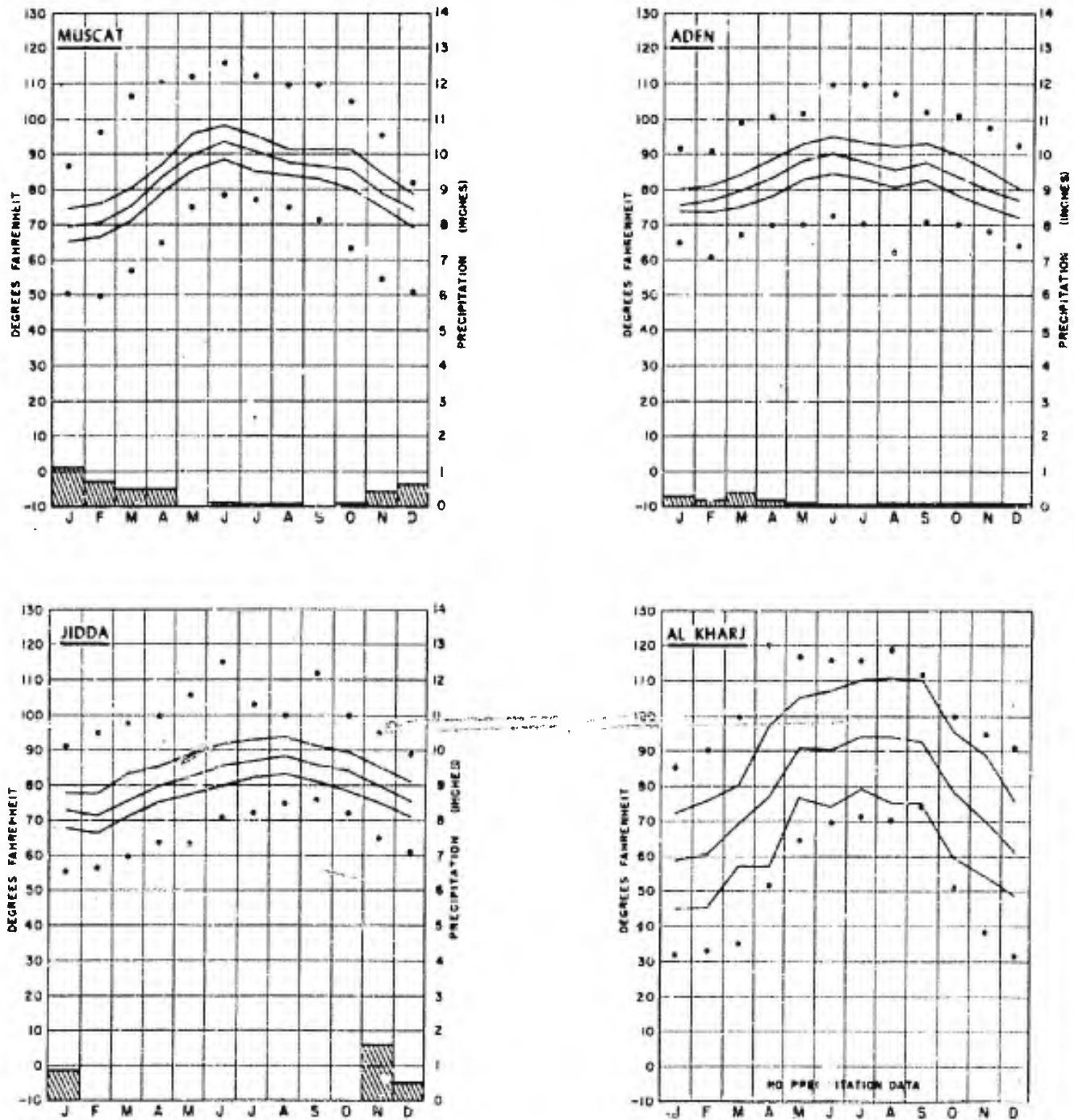


Fig 15

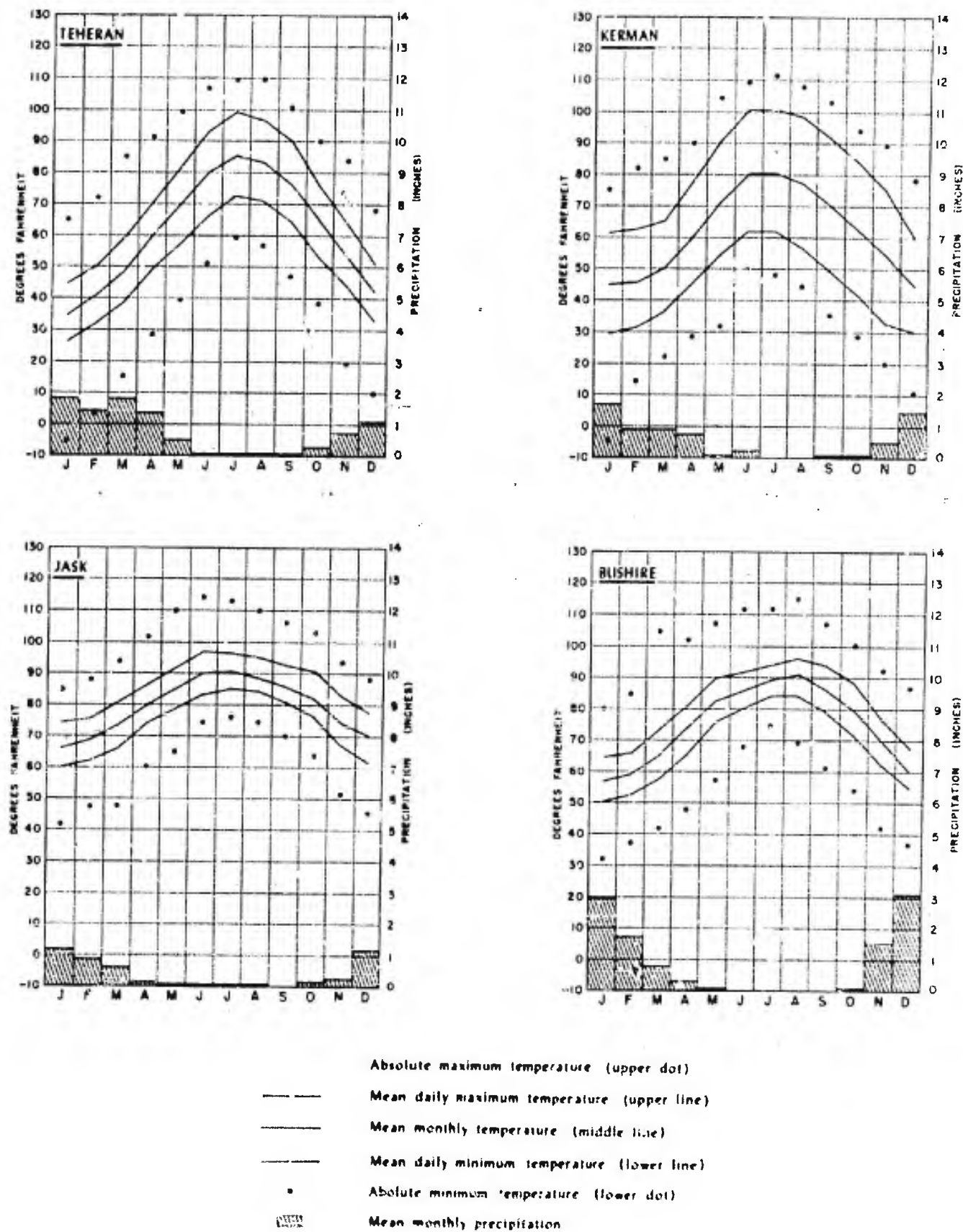
## ANNUAL TEMPERATURE AND PRECIPITATION REGIMES AT SELECTED STATIONS IN ARABIA



- Absolute maximum temperature (upper dot)
- Mean daily maximum temperature (upper line)
- Mean monthly temperature (middle line)
- Mean daily minimum temperature (lower line)
- Absolute minimum temperature (lower dot)
- ▨ Mean monthly precipitation

Fig 16

## ANNUAL TEMPERATURE AND PRECIPITATION REGIMES AT SELECTED STATIONS IN IRAN



**Fig. 17**

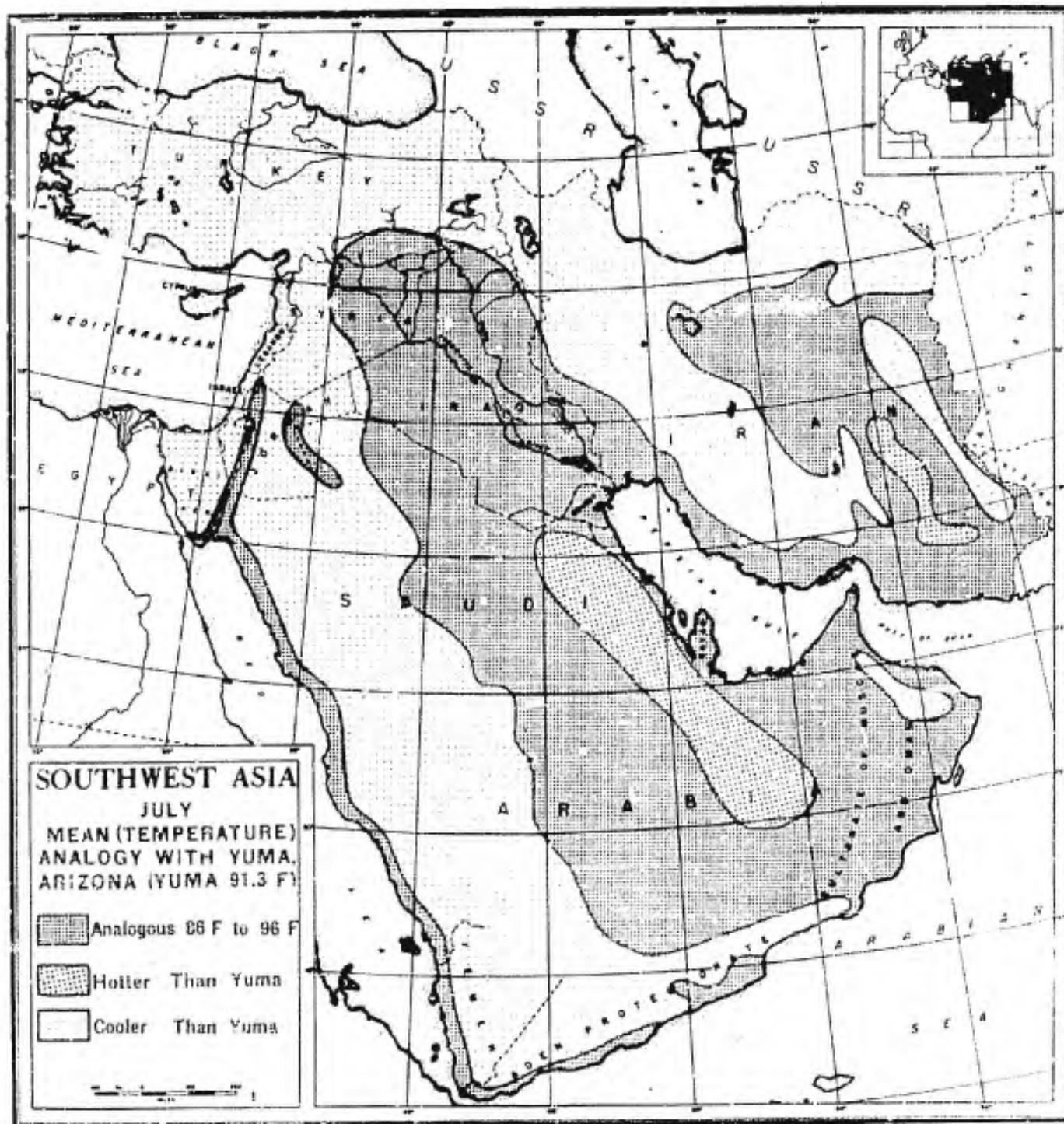
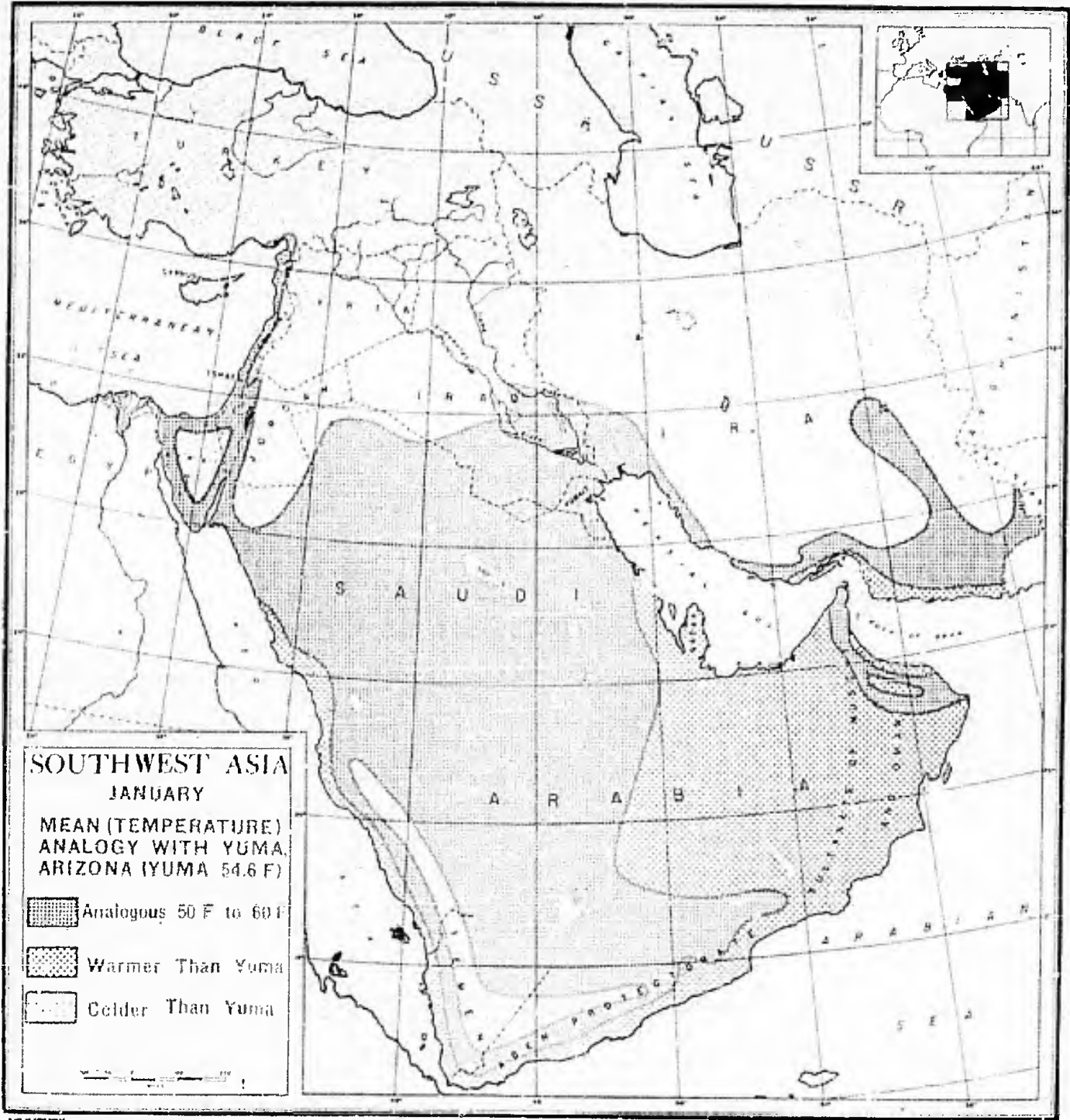


Fig. 18: This map compares July mean temperatures in Southwest Asia with the mean temperature at Yuma, Arizona, the location of one of the Army's test sites. For purposes of this comparison, the temperature is considered analogous if it is not more than 5F different from that at Yuma. The map shows that July temperatures in much of Southwest Asia are analogous to or warmer than those at Yuma.



**Fig. 19:** The above map, similar to Figure 18, shows the areas analogous to Yuma in January. In general, the analogous area shifts southward in winter.



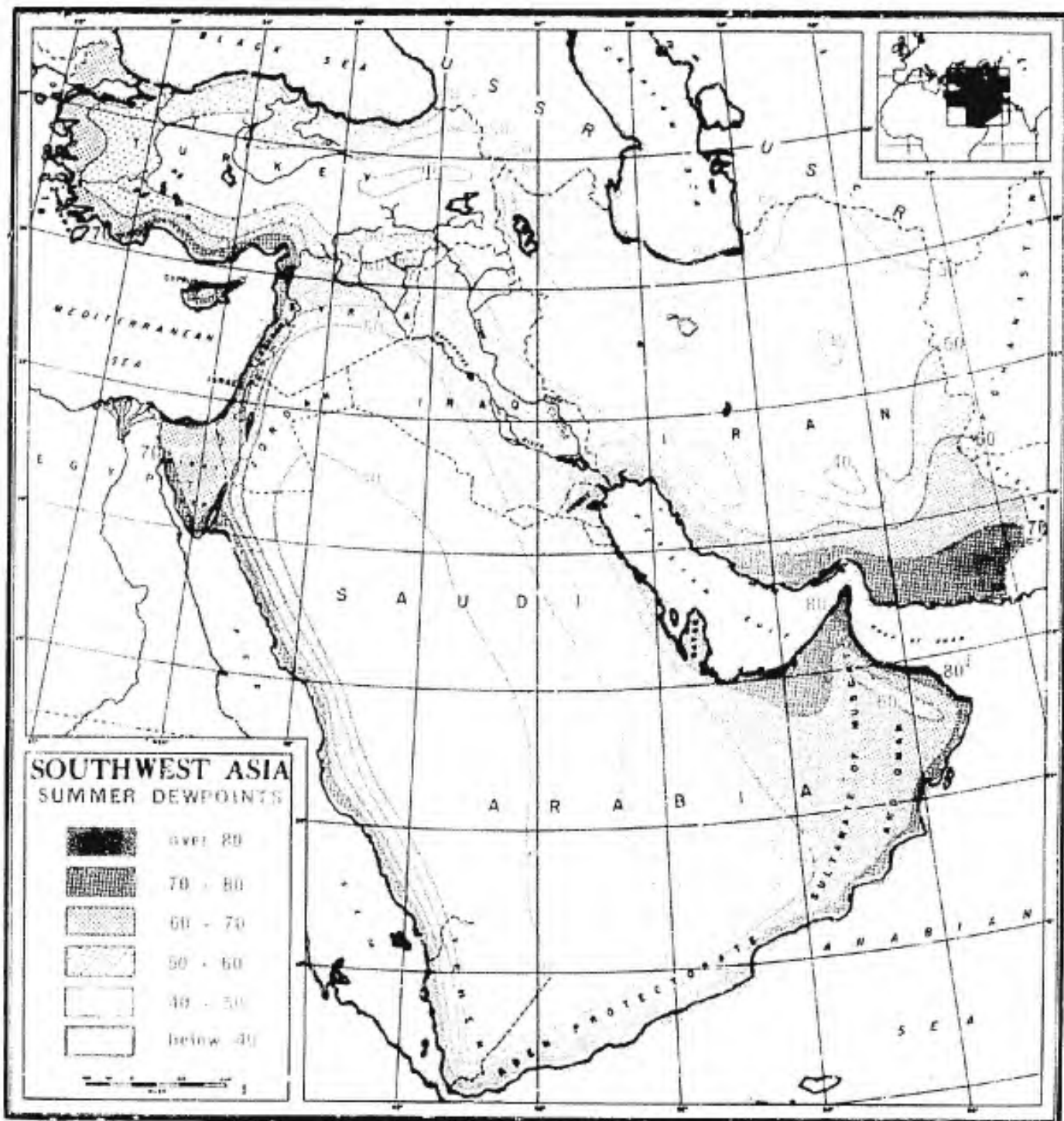


Fig. 21: Mean monthly dewpoints are shown for the summer month in which they are highest. Dewpoints near the coasts are high throughout the region and are excessive (as high as anywhere in the world) on the Persian Gulf and Red Sea coasts. Vapor pressure data (directly convertible to dewpoints) were available for some stations, but for many places mean temperatures and relative humidity data were used to obtain a good estimate of the mean dewpoint.

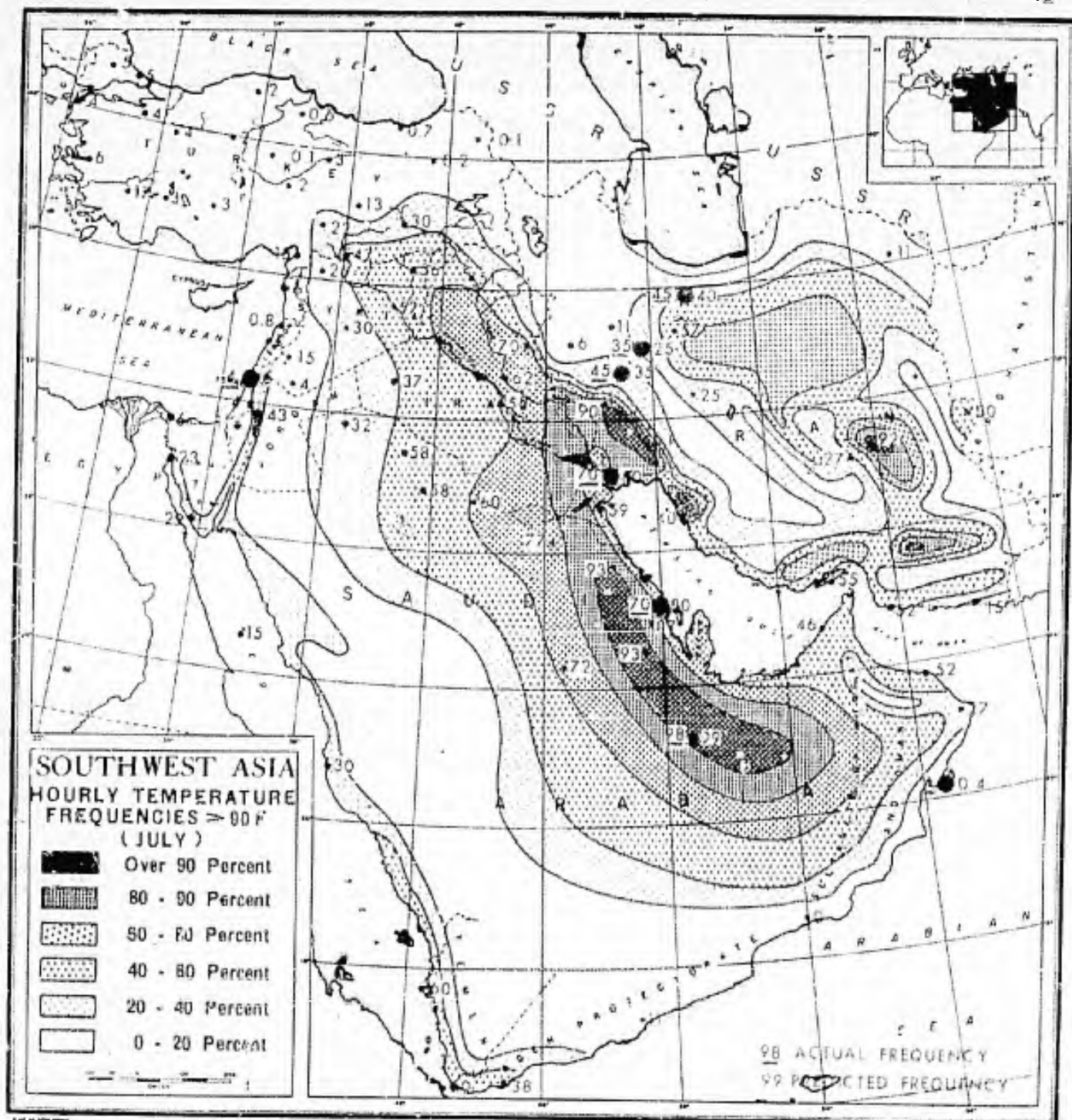


Fig. 22: There are three temperature frequency maps, Figures 22, 23, and 24, which give an estimate of the amount of time in an average July that temperatures will be above certain levels (90, 100, 110°F). For a few stations there are actual frequency records available (these figures are underlined), but for most places the frequencies are estimated. Hourly frequency data are useful for many purposes, but they must be interpreted with some care. For example, they suggest the amount of time during a month a certain condition may prevail, but furnish no information about the number of days of occurrence.

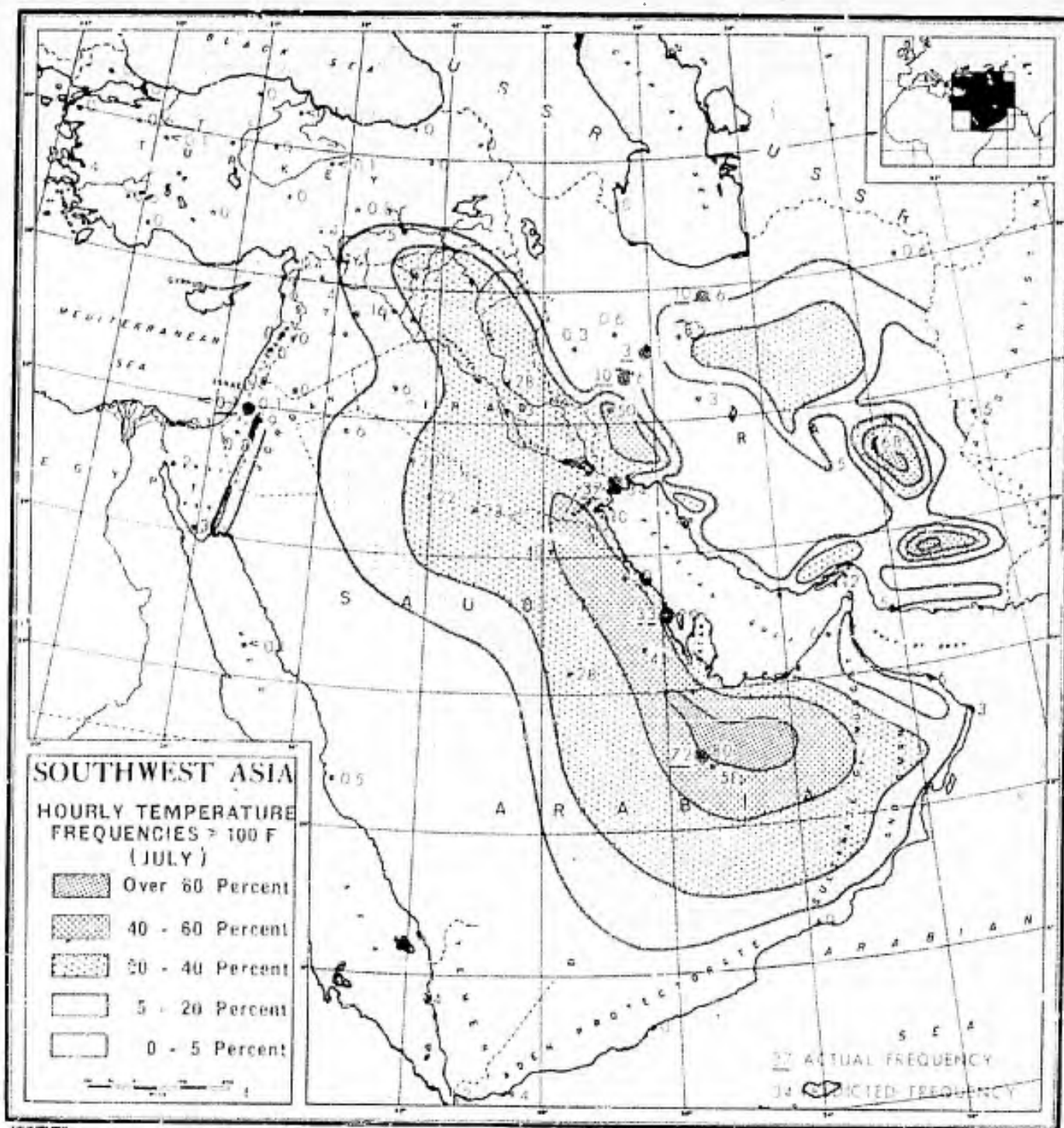


Fig. 23: (Same as Fig. 22, except that frequency of temperatures above 100F is the criterion used.)

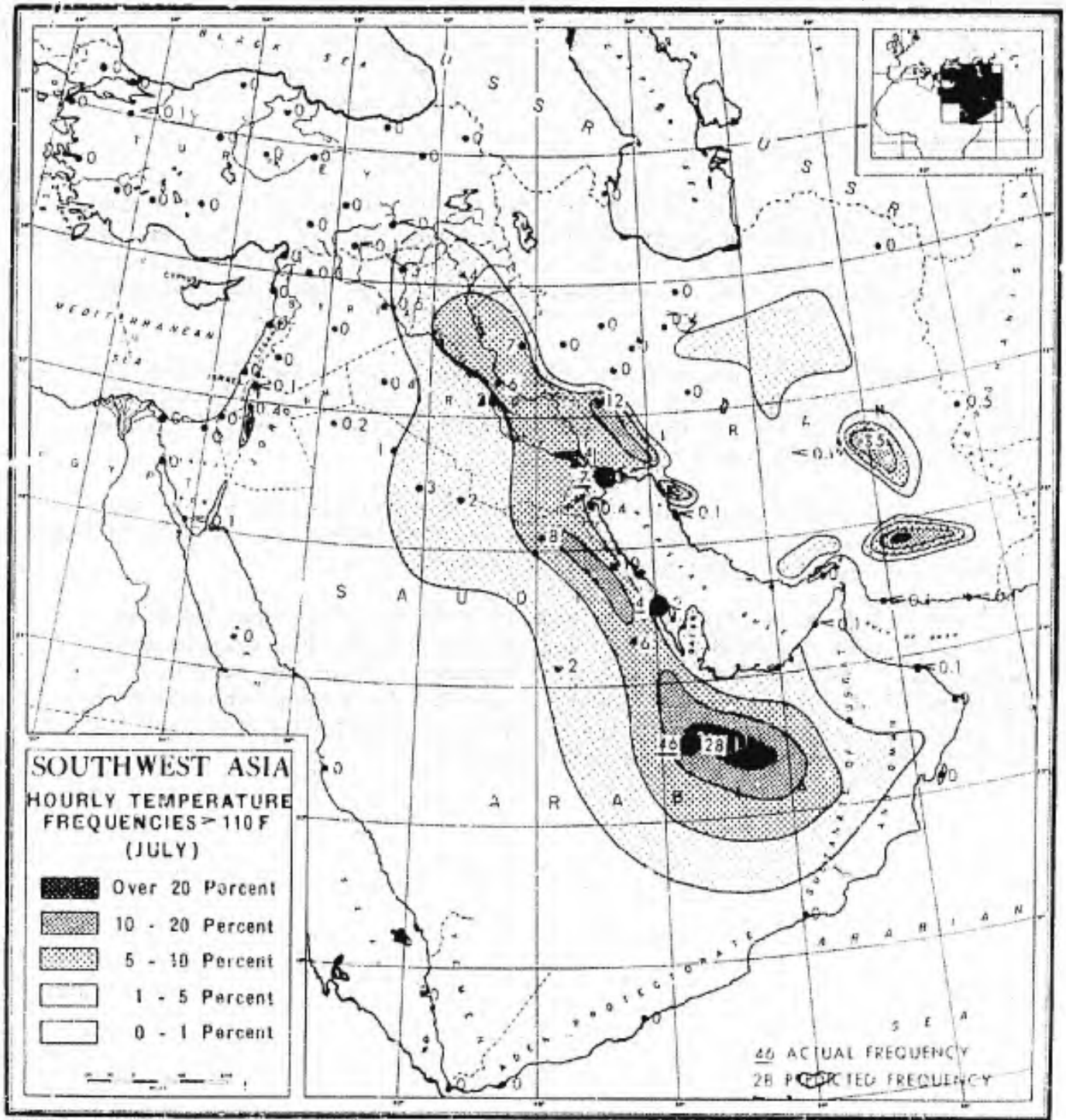


Fig. 24: (Same as Fig. 22, except that temperatures are above 110F.)

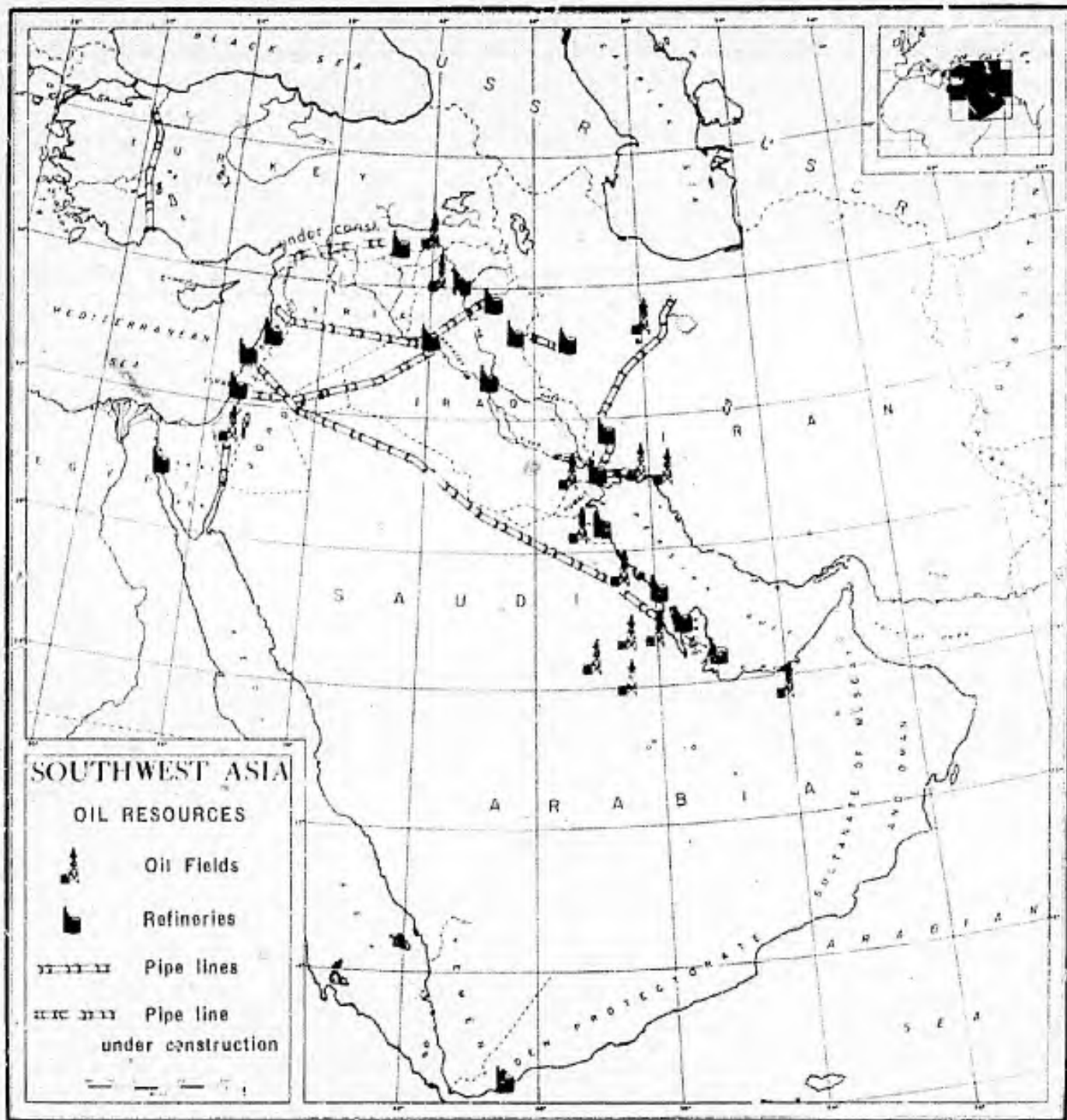
### 3. Physical Resources

The primary reason, of course, for the current importance of Southwest Asia in world affairs is the presence of huge oil reserves in Kuwait, Saudi Arabia, Iraq, and Iran. The area is also strategically located with respect to the Suez Canal and the narrow passages between the Black Sea and the Mediterranean.

At present, the region contains approximately three-fourths of the world's known oil reserves, and great amounts of oil are being taken from Arabia, Iraq, and Iran. Figure 25 shows the general locations of the oil fields, refineries, and pipelines in the region.

Other fuel resources, which might be of considerable importance to military operations, are generally absent in Southwest Asia. Figure 26 shows the distribution of the few solid fuels of the region.

Transportation facilities in Southwest Asia are poor compared with those in most of the United States and western Europe, but the populated centers are interconnected. The map in Figure 27 shows the general locations of the railroads and important roads. Because of the building difficulties, transportation routes across the mountain barriers are few and tend to be funneled into the lower passes.



**Fig. 25:** This map shows all the major oil-producing areas, refineries, and pipelines as of the summer of 1958. Changes in the situation are rapid, however, and within only a few years there may be several additional facilities.

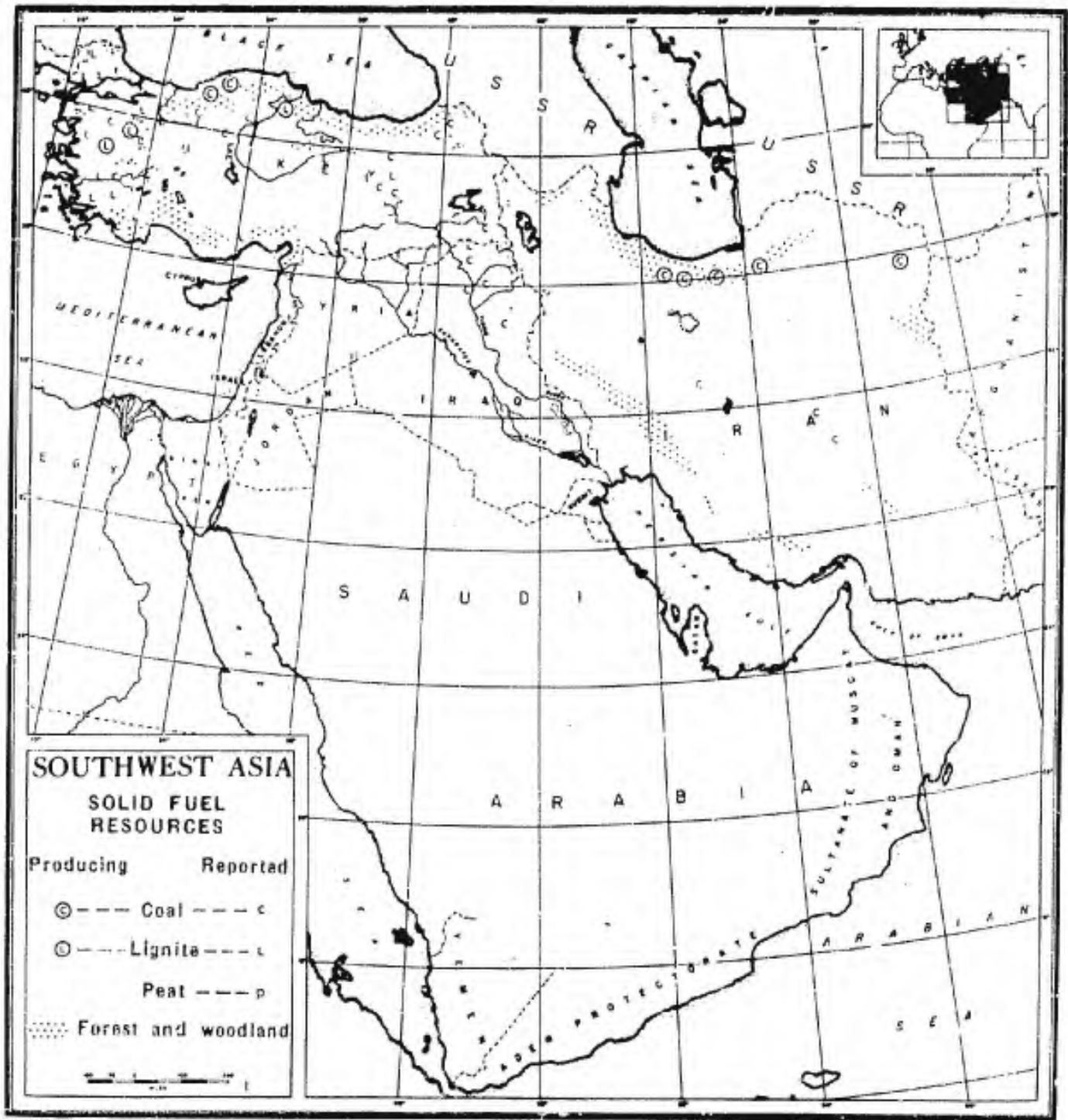


Fig. 26: Brushwood and dung, widely used as domestic fuel in Southwest Asia, are the most important fuel sources in some countries; however, there is too little available for military significance. Areas with fuelwood, shown as "forest and woodland", in general do not have supplies in excess of local requirements, since most forests are over-exploited and in poor condition. Wood is often reduced to charcoal for domestic use. Deposits of other fuels shown as "reported" are not known to be currently worked, although some have been mined on a small scale in the past. Development of the peat deposit in the Lake Huleh region of Israel is planned. Coal is highly variable in quality; that of Iraq is very lowgrade, and deposits in Iran and Turkey are of poor to good quality.

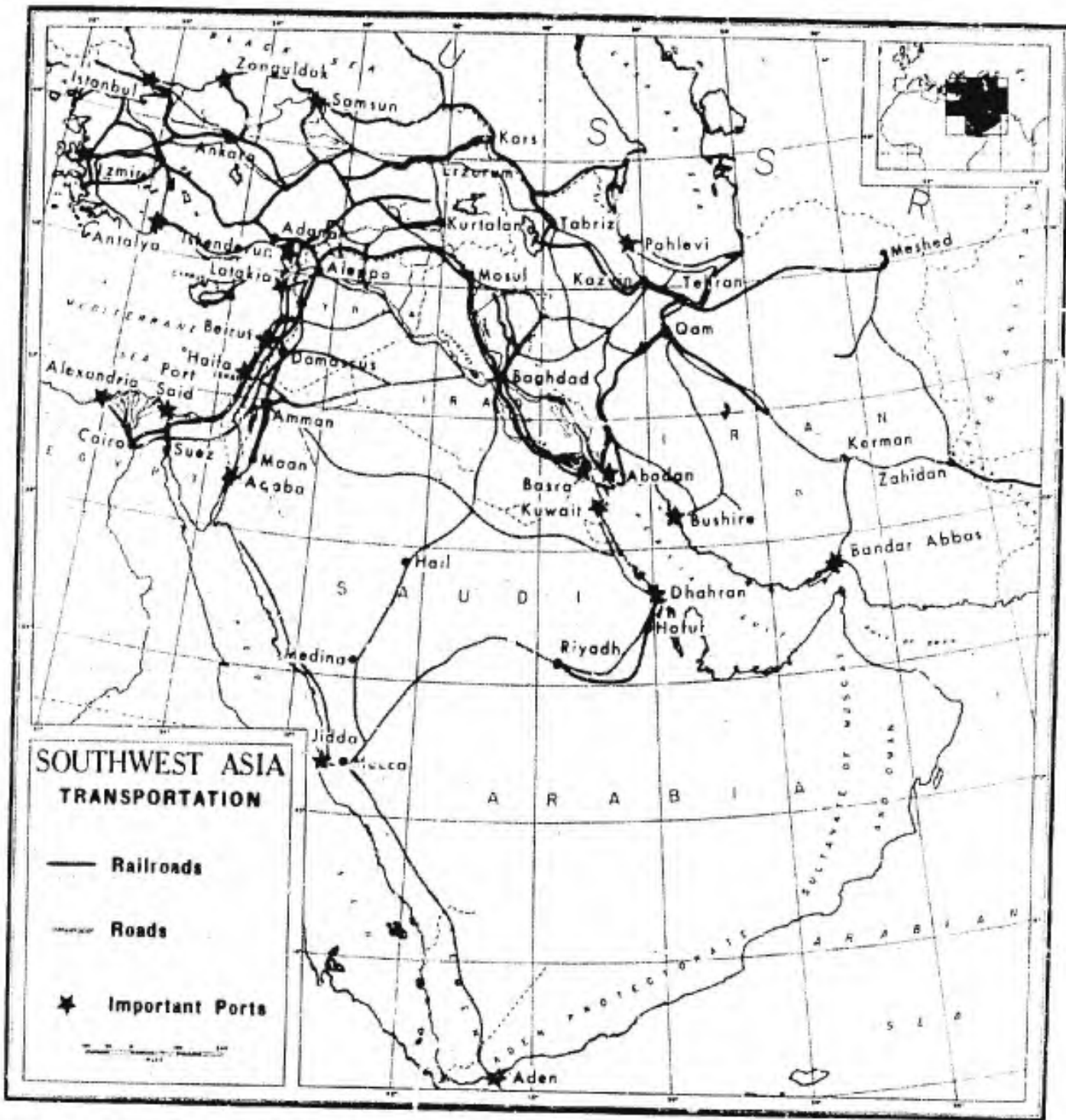


Fig. 27: This map shows the railroads and important roads in Southwest Asia. In many cases, the routes are not of uniform quality throughout their extent, and more detailed information must be obtained before plans can be made for using the transportation facilities.

#### 4. Culture

The social characteristics of the people have an obvious bearing on military operations, especially when the military forces desire to use indigenous labor.

The spirit of nationalism and the unifying effects of a strong central government have become increasingly important in recent years in the various countries of Southwest Asia. Nevertheless, the fundamental characteristic of society in this part of the world remains one of compartmentalization. The society of Southwest Asia is like a mosaic. Many distinct ethnic patterns are laid side by side against a common background. Multiple lines of cleavage (political, economic, religious, and linguistic) divide the people of the region into a great number of social compartments, or communities. Even within the dominant tribe or community in any given area, there are likely to be strong factional hostilities.

The social group to which an individual belongs is still frequently indicated by his dress, speech, and other external appearance. There is a strong in-group feeling and sense of dependence. Most important, occupational specialization generally is based upon the social compartmentalization, and a given craft, business, or employment tends to be monopolized by one social group.

One characteristic example of the socio-economic cleavage in Southwest Asia is the basic division between landlord and peasant, found in nearly every country. In the Arab world the nomad (bedawi or arab), the settled agriculturist (fellah); and the educated person (effendi) are all representative of definite social classes. In most of the tribes of Southwest Asia there is a marked class and status stratification of noble or ruling families (sheikhs or khans), ordinary tribesmen, and ignoble persons (slaves and other dependent groups). In some areas there is also a religious aristocracy, the sayids.

Deep-rooted antipathies between the various social, ethnic, and religious groups always exist, and are a potential source of trouble. In terms of relationships between military personnel and indigenous groups, it is easy to see that the multiplicity of cultural lines (political, economic, religious, and social) can cause problems of considerable magnitude, some of which are considered in conjunction with the following maps.

a. Population

Although there are only about 75 million people in Southwest Asia, the population pressure, measured against the economy, is great. Only in Iraq could a sizable population increase be handled without considerable hardship. At the current rate of population increase (2 to 3 percent annually) expansion of cultivated areas must be rapid just to keep pace.

In general, the population has been concentrated near water supplies that are adequate for some kind of agriculture. Other points of concentration have been trade and religious centers. At present, overpopulation, under-employment in rural areas, and industrialization are causing increased concentration in the urban centers. Extensive slums have developed in Baghdad, Teheran, and other burgeoning cities.

Rural-urban population ratios are roughly estimated in the table below. For this purpose, towns with over 10,000 people are considered urban. Estimated population figures for the various countries and the larger cities of Southwest Asia are shown on the next page. Figure 28 shows the areal relationships of the population centers.

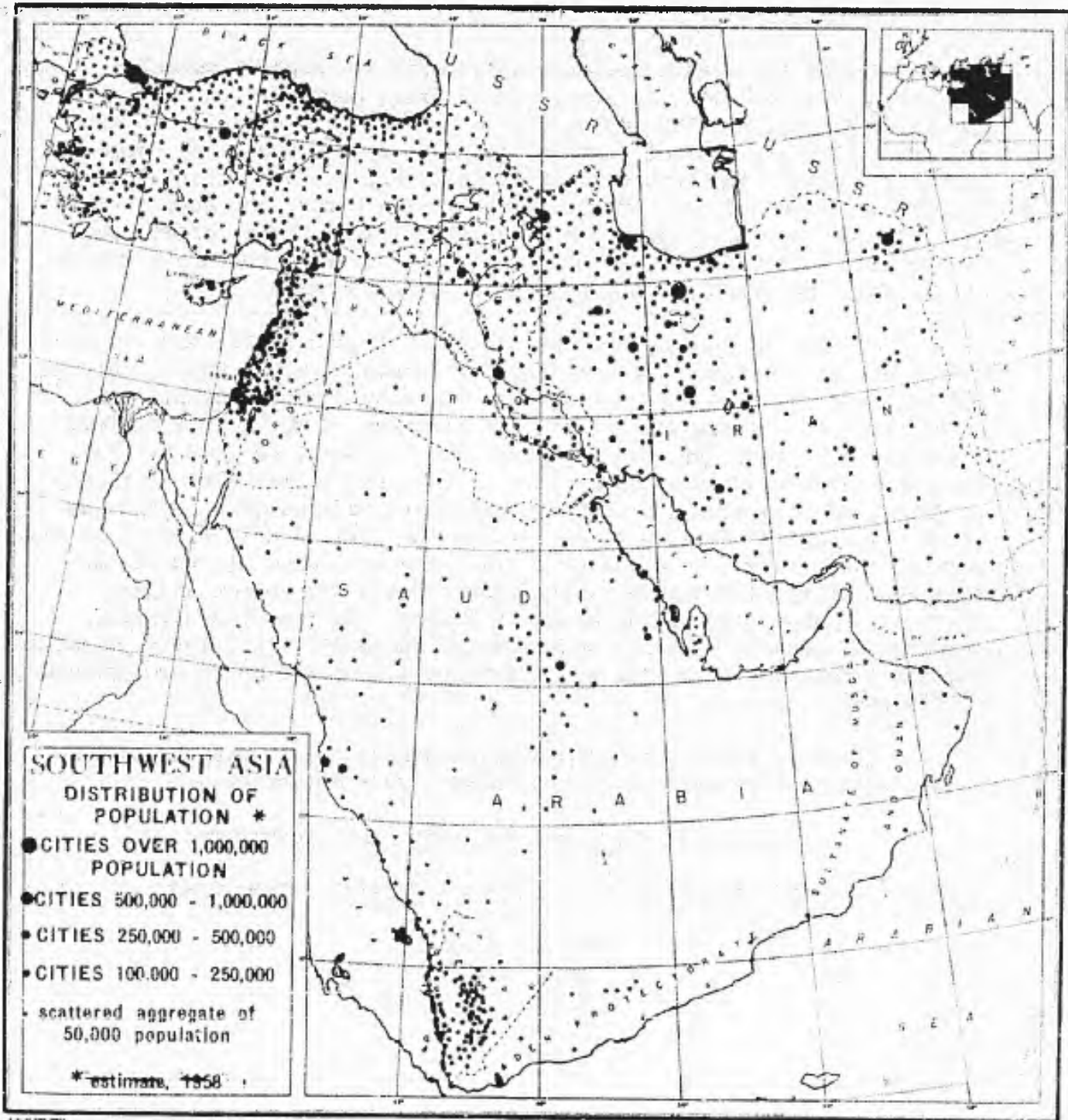
RURAL - URBAN POPULATION RATIOS IN SOUTHWEST ASIA

<u>Country</u>	<u>Rural</u> (%)	<u>Urban</u> (%)
Cyprus	65	35
Iran	75	25
Iraq	75	25
Israel	35	65
Jordan	70	30
Lebanon	60	40
Saudi Arabia	80	20
Syria	70	30
Turkey	75	25
Yemen	80	20

## SOUTHWEST ASIA POPULATION ESTIMATES\*

	Population (thousands)		Population (thousands)
<u>Turkey</u>	<u>25,000</u>	<u>Kuwait</u>	<u>220</u>
Adana	260	Kuwait	180
Ankara	590		
Bursa	230	<u>Saudi Arabia</u>	<u>6,500</u>
Erzurum	100	Hofuf	150
Eskisehir	170	Jidda	250
Gaziantep	135	Mecca	300
Istanbul	1,300	Riyadh	280
Izmir	480		
Kayseri	110	<u>Yemen</u>	<u>4,500</u>
Konya	130	Sana	110
Samsun	100		
Uskudar	100	<u>Aden Protectorate</u>	<u>520</u>
<u>Syria</u>	<u>4,200</u>	<u>Aden (Crown Colony)</u>	<u>180</u>
Aleppo	490	Aden	110
Demascus	440		
Hama	185	<u>Iran</u>	<u>22,000</u>
Homs	315	Abadan	300
Latakia	130	Ahwaz	120
		Arak	360
<u>Lebanon</u>	<u>1,500</u>	Ardabil	120
Beirut	475	Hamadan	450
Tripoli	110	Isfahan	630
		Kashan	120
<u>Israel</u>	<u>1,900</u>	Kerman	120
Haifa	165	Kermanshah	240
Jaffa (Tel Aviv)	380	Meshed	530
		Qom	150
<u>Jordan</u>	<u>1,600</u>	Resht	350
Amman	180	Rizaiyeh	100
Jerusalem	160	Shiraz	300
		Tabriz	530
<u>Cyprus</u>	<u>540</u>	Teheran	2,000
Nicosia	110	Yazd	150
<u>Iraq</u>	<u>5,200</u>		
Baghdad	570		
Basra	220		
Karbala	180		
Kirkuk	100		
Mosul	350		

\*The figures given are 1958 estimates.



**Fig. 28:** The population map shows clearly that most of the large cities and most of the people of the region are concentrated in the northern countries. Especially heavy concentrations are found in Israel and Lebanon. The larger cities of Arabia are associated with government, religion, or irrigation.

b. Languages

Within the Arabic-speaking area there are several mutually unintelligible dialects, in Oman, Yemen, Iraq, northwestern Arabia, and the Sinai Peninsula. The spoken Persian (Iran) language also is not uniform; there are several regional dialects spoken among the large tribal elements. The Turkic language in Iran, Turkomani, Azari, and Qashqai are also mutually unintelligible. The Kurds, who have at least four dialect groups, display the linguistic fragmentation often found in mountain environments. Figure 29 is a map showing the distribution of the most important languages used in Southwest Asia.

Unlike the spoken language, literary Arabic is the same everywhere, and it provides a common basis of communication. Egypt, through its film and magazine output, tends to dominate literary Arabic in Southwest Asia. Classical Arabic, the language of the Koran, differs from literary Arabic to such a degree that it cannot be read by the literate Arab without special study. Literary Persian also is likely to differ greatly from its spoken counterpart because of a continuing effort to "purify" Persian by discarding the large Arabic element in its popular vocabulary. To a lesser degree, the same kind of patriotic language reform, and the resultant gulf between the spoken and the written languages, is taking place in Turkey. Hebrew, the official language of Israel, is still unfamiliar to the majority of the population. Kurdish literature is relatively undeveloped, and the Kurds are generally illiterate.

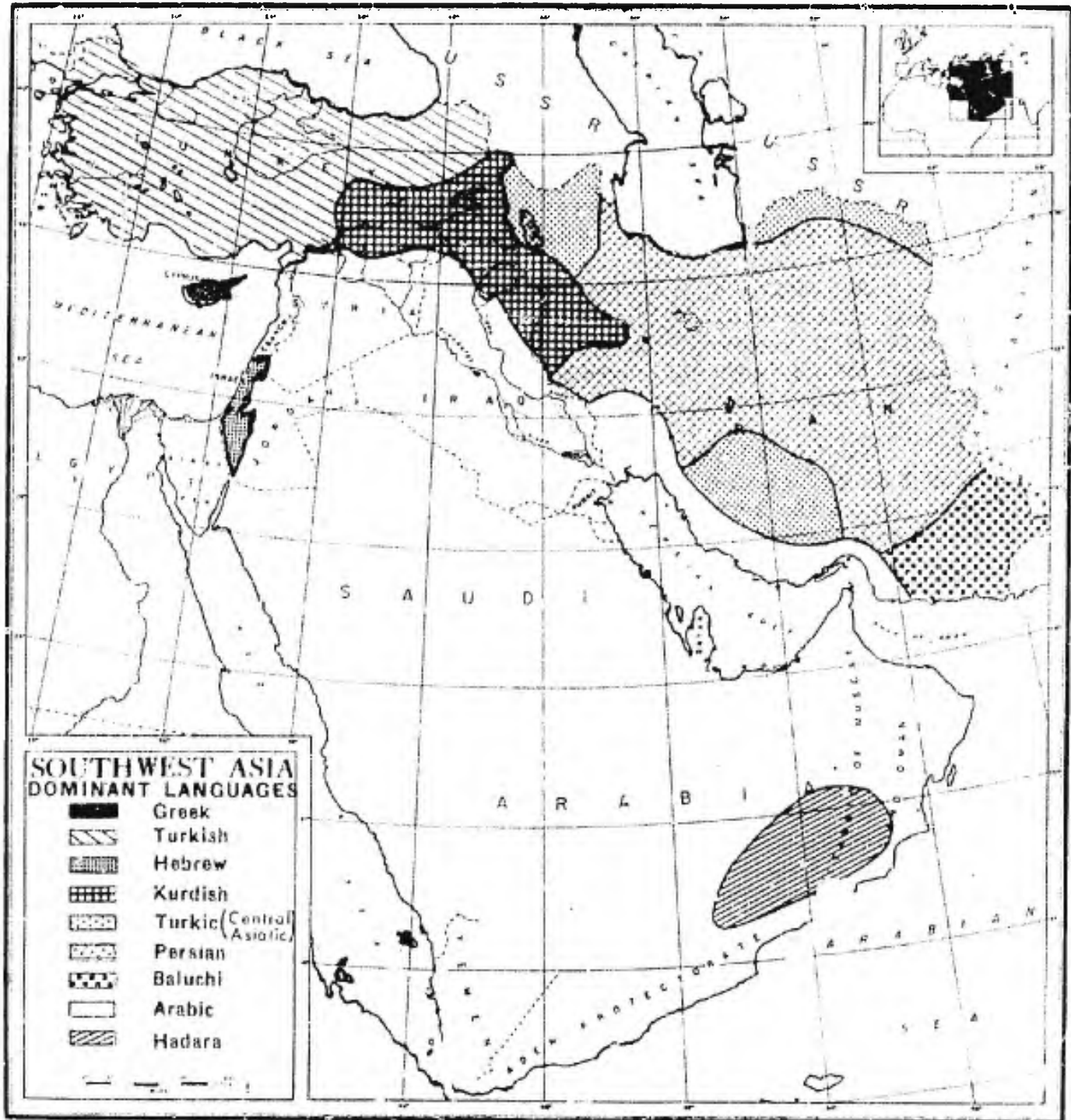
Literacy rates for the countries of Southwest Asia are shown below, but these rates must be considered crude estimates.

Literacy in Principal Southwest Asia Countries

<u>Country</u>	<u>Male (%)</u>	<u>Female (%)</u>	<u>Country</u>	<u>Male (%)</u>	<u>Female (%)</u>
Cyprus	80	50	Muscat & Oman	5	1
Iran	20	4	Saudi Arabia	10	1
Iraq	24	8	Syria	60	32
Israel	90	80	Turkey	54	30
Jordan	60	16	Yemen	7	1
Lebanon	65	40			

Literacy rates are generally much higher in cities than in rural areas, and there are some extreme ethnic variations in literacy. For example, the Kurds in Turkey have a literacy rate of less than 10 percent, in comparison with the national average of 42 percent.

Bilingualism is found mainly among members of minority groups, and in the areas of contact of different languages. The total number of persons who speak English in Southwest Asia is probably no greater than 300,000, and not more than 20 percent of these may be considered fluent. English speakers are found among the Armenians, Assyrians, returned emigrants, and the educated classes, as well as in the oil-producing areas and in Aden Colony. French is as popular as English in Turkey and Iran, and it is much more widely known than English in Syria and Lebanon.



**Fig. 29:** Other languages, not indicated on the map, are spoken in Southwest Asia by relatively small communities. These languages include Armenian, Circassian, Gilaki, Mazanderani, Brahui, Mhlay, Swahili, Somali, Syriac, Aramaic, Laz, Georgian, and Yiddish.

c. Nomadism

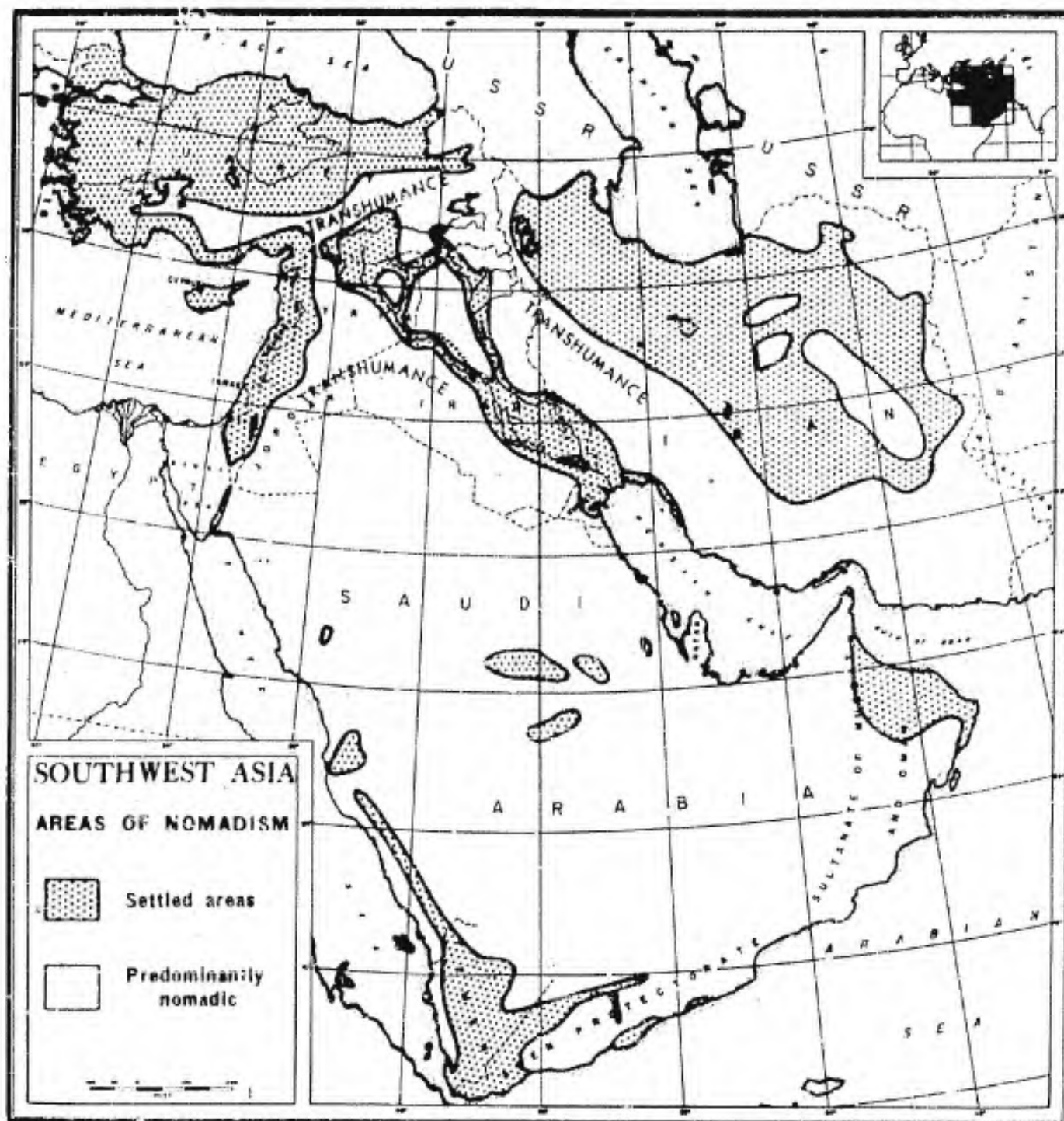
Nomadism is the term used to describe the existence of those people who have no fixed home, but continually wander from place to place in search of pasture. The parts of Southwest Asia where people are primarily nomadic are shown in Figure 30.

The scarcity of water in Southwest Asia severely limits the area suitable for settled agriculture. In the Arabian and Syrian deserts, as well as in southeastern Iran, only camel nomads can survive, and in the hot season, even they congregate near supplies of water. The dry central Iranian desert is just as inhospitable.

The Arabs carefully classify themselves by economic type. The true Badawi (bedouin) is a pure camel nomad, and the most noble of the lot. Those who keep sheep as well as camels are next in status, and the nomadic shepherds are in a still lower class. Even less respected are the transhumants, who make two fixed migrations each year and plant and harvest a crop in addition to their pastoral activities. Settled farmers (fellahin) traditionally are the least regarded of the Arabs, but they are still considered superior to non-Arabs.

In Iran and Turkey the nomadic tribes (Kurds, Pers, Bakhtiariis, and Qashqais) are not considered social aristocracy as they are in Arabia, but they are still feared because of their addiction to raiding and looting. For this reason, every government in Southwest Asia is seeking to settle its nomadic people as rapidly as possible, and the proportion of nomads and transhumants in the total population is shrinking. Many tribesmen are employed in the oil industry in Iran and the Arabian Peninsula. Nevertheless, apparent transformation of nomads into tame villagers may be deceptive. With any weakening of central authority, they return instantly to that way of life which they idealize as the only one fit for virile men: the fast horse or camel, the defense of an exaggerated honor, and the excitement of raid and booty.

The camel nomads remain close to rivers, oases, or other sources of water supply during the hot season. From October to March, however, when local showers produce temporary pools and cause sudden spurts of vegetation, the bedouins move into the desert to follow the capricious rains and to obtain pasture. In contrast to this lateral type of nomadism, transhumance is a matter of altitude. The transhumant tribes winter in lowland or coastal areas, and, with the onset of the summer season, move with their flocks up to mountain pastures, often making a difficult trip of a hundred miles or more.



**Fig. 30:** The boundary lines between settled areas and areas of nomadism are indefinite, and are complicated by the areas of transhumance, occupied by people who make two migrations each year.

d. Ethnic Groups

A majority of the political entities of Southwest Asia are more or less dominated by Arab peoples who share a common language, religion, and culture. However, the Arabs in Southwest Asia are far outnumbered by the Turks and the Persians (Iranians). Each of these peoples is quite distinct from, and is indeed hostile to the Arabs. In addition to Turkey and Iran, Israel and Cyprus are distinctive non-Arab countries. Lebanon is a special case - a nation of complex, precarious balance among several minority groups and traditions.

Southwest Asia has been a crossroads of people for thousands of years. The results remain today in the form of a patchwork of ethnic pockets and compartments, the intricate details of which are scarcely suggested by the accompanying map. For simplification, religious divisions are included on a separate map, although most religious communities are also social minorities. (See Figs. 31 and 32.)

Ethnic groups are important sources of instability in most of the countries, especially in Iraq, Iran, and Lebanon. For example, the issue of a Kurdish state is a perennial and explosive one. After World War II the U.S.S.R. attempted to create an Azerbaijani state in Northwest Iran, which would be linked to its adjoining Azerbaijan S.S.R.

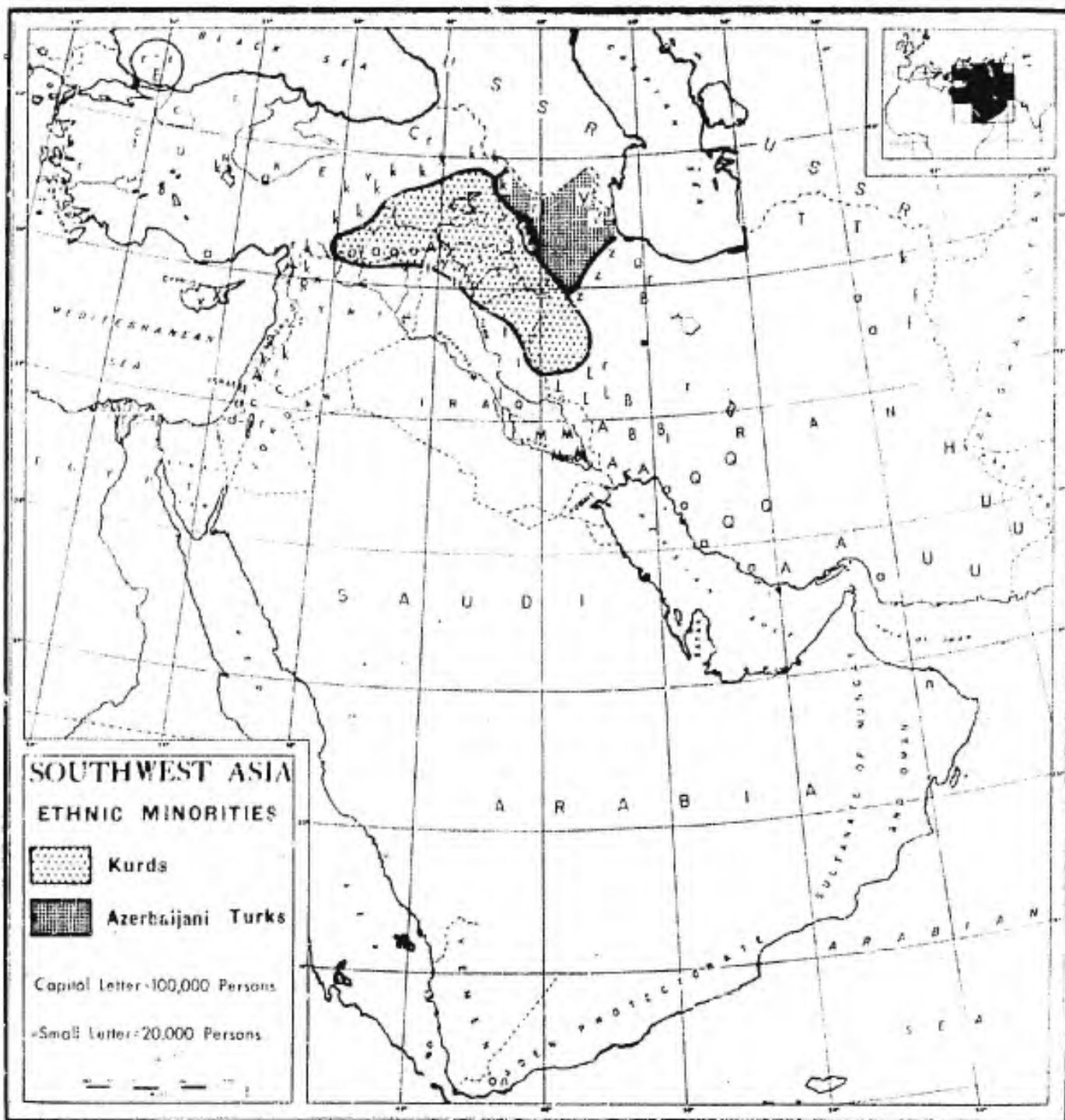


Fig. 31: In the above map the general locations of ethnic minorities are shown as indicated in the legend. The areas for Kurds and Azerbaijani Turks are shown by pattern because of the great number of symbols that would otherwise be required.

(Capital letter = 100,000 persons, small letter = 20,000 persons)

A, a	Arabs	H, h	Brahms	R, r	Armenians
B, b	Bakhtiaris	I, i	Iranians		(scattered)
C, c	Circassians ' and Caucasians	K, k	Kurds	S, s	Assyrians
E, e	Greeks	L, l	Lurs	T, t	Turkmen
F, f	Afghans	N, n	Na'dan	U, u	Baluchis
G, g	Gypsies (widely scattered)	N, n	Indians - Pakistanis	V, v	Shahsavans
		O, o	Somalis	X, x	Turks
		Q, q	Qashqais	Y, y	Yezidis
				Z, z	Azerbaijani Turks

### e. Religious Communities

Major religious communities in Southwest Asia (Fig. 32) have approximately the following numbers:

Sunni (orthodox, traditional Moslems)	42,000,000
Shiah (main body of non-orthodox Moslems)	27,000,000
Christian	2,500,000
Jewish	2,000,000
Ismaili, Ibadi and other non-orthodox Moslem sects	1,000,000
Miscellaneous religious groups	500,000

The main religious schism in Southwest Asia is that between Sunni and Shiah Moslems. It developed essentially out of a dispute over succession to the spiritual authority of the Prophet Mohammed. The Sunnis accept the Sunna, or body of traditional scriptures, as holy writ along with the Koran. The Shiites do not regard it as such, but, unlike the Sunnis, recognize the institution of the Imam, or spiritual head of the faith. Shiites and Sunnis differ in many details of theological belief and practice, but local and sectarian variations within each group are as great as those between the two groups.

Sunni Islam as practiced by the Turks is very different from Sunni Islam in the other countries, reflecting a liberal spirit in Turkey and emancipation from sectarian taboos and fanaticism. The puritanical ruling Wahhabis of Saudi Arabia, on the other hand, condemn all other Sunnis as backsliding heretics. In some areas, especially in southern Arabia and among the bedouins of the Syrian desert, Islam is still overshadowed by pagan pre-Islamic religious forms.

Shiites are also divided into numerous groups. The Zaidi sect of Shiites in Yemen differs little from the Sunnis except for their allegiance to the Imam of Yemen, spiritual and temporal ruler of the country. In Iran, Shiah Islam is the state religion, and it symbolizes Iran's general hostility towards the Arab world. Among the Baluchias of Iran it is difficult to determine whether the people are predominantly Shiah or Sunni in their allegiance and practice.

Christians in Southwest Asia are also splintered into a myriad of sectarian communities. The largest compact groups are the Greek Orthodox of Cyprus and the Maronites of Lebanon. Most of the Arab-speaking Christians in Syria and Iraq are Arab-oriented in culture and ideology.

The only possible broad generalization relative to religious communities in Southwest Asia is that divisive and factional hostilities are actually or potentially widespread, and outbreaks are usually unpredictable. This statement applies equally to differences based upon nationality, ethnic group, or even lineage or locality.

Religious fervor and loyalty, regardless of sect, generally influence the behavior of the people of Southwest Asia to a remarkable degree. Anti-Christian feeling traditionally is pronounced among the Mitvalis of southern Lebanon, the Ibadis of Oman, and the Wahhabis of Saudi Arabia. Fanatic behavior is relatively easily aroused in the vicinity of sacred shrines and at the time of religious holidays.

Moslems observe Friday as the Sabbath. In many areas, however, workers are quite willing to work on that day, and prefer to be free on Thursday afternoon and evening for festive or religious observances. Since the Moslem day is reckoned as beginning at sunset, Thursday evening is actually a part of the Sabbath. Noon and midnight occur at about six o'clock according to this traditional reckoning of time.

Secular holidays vary from country to country, but are unimportant in comparison with religious holidays. These are mainly based upon the Moslem calendar, which consists of 12 lunar months, totalling 354 days. Thus, Moslem dates are not fixed in relation to the Western calendar, but occur approximately 11 days earlier in each successive year.

The most important holiday period is the month of Ramadan, when a strict fast is observed during the daylight hours. Tempers run short at this time, and the foreign visitor should behave with caution. Ramadan is terminated by a three-day feast, Id al Fitr, or "Little Festival". Id al Adha, the "Great Festival", or Sacrificial Feast, takes place in the month of Dhul Hijja and lasts four days. An animal is sacrificed by each family, and there are very few suitable sheep or goats available for meat at the end of the holiday. The Id festivals are called Bairam in Turkey.

Among Shiites, the principal religious holiday is Moharram, celebrating the martyrdom of Mohammed's grandsons Hassan and Hussin. Moharram is an occasion for public self-flagellation and unbridled emotions, especially in Iran. New Year's day, celebrated at the vernal equinox, is an important holiday in Iran.

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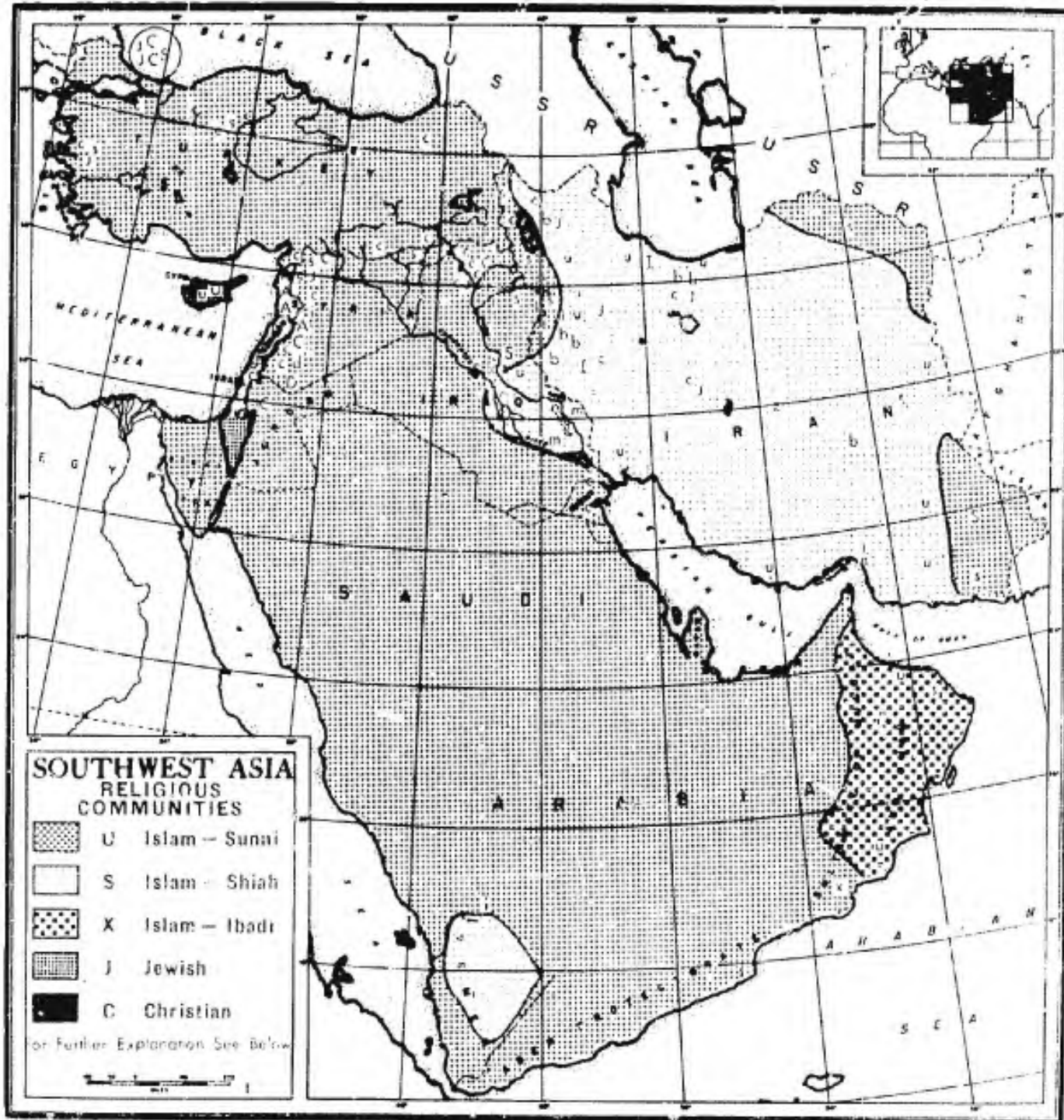


Fig. 32: The shading on the above map shows areas where the indicated religious groups are predominant. Letters are used to indicate areas of concentration of the following listed religious minorities:

(A capital letter = 100,000 persons; Small letter = 20,000 persons)

A, a	Alavi	M, m	Mandaeen
B, b	Bahai	Q, q	Qizilbashi
C, c	Christian	S, s	Islam (Shiite sect)
D, d	Druse	U, u	Islam (Sunni sect)
I, i	Islam (Ismaili sect)	X, x	Islam (Ibadi sect)
J, j	Jewish	Y, y	Yezidi
K, k	Shabak	Z, z	Zoroastrian
L, l	"Ali-Ilah"		

## ENVIRONMENT AND THE SOLDIER

Some of the effects of hot environments on man have been investigated at length, and it is well known that the environment strongly influences work capacity, water requirements, survival time, sweat rate, and many other physiological variables. Certain types of human performance such as perception, alertness, and vigilance may be affected indirectly in hot environments. High ambient temperatures may induce psychological and physiological states that influence ability to perceive and to remain alert, but the basic processes involved appear to be unaffected by climatic elements as such. There is no concrete evidence to show that severe ambient conditions (temperatures up to 117F with dewpoints as high as 76F) have any effect upon the acuity of vision and hearing, or upon distance of directional discrimination. There is likewise no effect upon reaction times. On the other hand, high temperatures coupled with high humidities may indirectly influence readiness to respond by lowering motivation in tasks requiring sustained mental concentration.

Chronic discomfort caused by sweating or skin irritation may distract the individual from his task. When the discomfort is sufficient to result in loss of sleep, individuals may be expected to become more irritable, and to adjust less readily to frustrating circumstances. Inter-personal relationships may deteriorate, and the efficiency on tasks requiring teamwork will suffer accordingly.

There are wide individual differences in psychological and physiological tolerance to hot climates. In general, the individuals who are expert at their jobs appear to show much less performance decrement in adverse environments than those who are only moderately skilled.

Apart from temperature and humidity effects, the intensity of direct and reflected sunlight in desert and beach areas is very likely to impair night vision unless protective measures are taken. Exposure of the retina to high-intensity light fields slows the rate of adaptation to darkness to such an extent that a measurable degree of night blindness may persist until morning. Subsequent exposure to bright sunlight will cause a repetition of this cycle, and troops may exhibit a degree of chronic night blindness as long as they remain in an area where the level of brightness is normally very high during the day.

This section of the report contains several maps and graphs from which prediction may be made (Figs 33-42) of water requirements, work limitations, survival time, and deterioration of operational effectiveness with inadequate water intake. The information contained in these maps and graphs is based on the following assumptions:

- (1) The individual soldier is of average size (150 pounds).
- (2) The individual is physically fit and acclimatized to heat.
- (3) Adequate clothing and equipment are available.
- (4) Eight hours constitute the normal period of sustained work and such work periods are suitably broken for meals and brief rests.

Throughout this section of the report, the adjectives "light", "moderate", and "hard" (or heavy) are used to describe different levels of work. Because these categories, in themselves, are so general, a table of energy expenditures for various activities is provided on the next page. The list of activities is not intended to be exhaustive, but only to serve as a reference, so that other military activities may be evaluated and placed in the proper category of work.

TABLE OF ENERGY EXPENDITURES FOR VARIOUS ACTIVITIES

<u>General Classification</u>	<u>Specific Activity</u>	<u>Energy Expenditure</u>	
		Cal./min	Cal/hr
<u>"Sedentary to Light"</u> (75-150 Cal/hr; 1.3-2.5 Cal/min)	Resting quietly	1.3	78
	Loaf in barracks	1.6	96
	Clerical, sitting	1.6	96
	Toilet	1.7	102
	Drilling	1.8	108
	Anti-gas drill	2.0	120
	Fatigue details	2.2	132
	Inspection	2.2	132
	Weapon Training	2.2	132
	Hand grenade drill	2.3	138
<u>"Moderate"</u> (150-300 Cal/hr; 2.5-5.0 Cal/min)	Gas mask drill	2.3	138
	Polishing brass	2.4	144
	Cleaning kit and rifle	2.7	162
	Driving car	2.8	168
	Manual of arms	2.8	168
	Rifle marksmanship	2.8	168
	Cleaning equipment	2.9	174
	Touch football	3.1	186
	Bayonet drill	3.3	198
	Sentry duty	3.5	210
	Driving tank over rough terrain	3.5	210
	March with 60 lb. pack at 2 mph	3.9	234
	Digging foxholes	4.0	240
<u>"Hard"</u> (over 300 cal/hr over 5.0 cal/min)	Close order drill	4.2	252
	Mass games	4.5	270
	Field march	4.8	288
	Cleaning artillery pieces	5.1	306
	Quick marching	5.6	336
	Obstacle course	5.6	336
	Digging trenches	6.0	360
	Snowshoeing	6.2	372
	Field march with rifle	6.5	390
	Marching (3 mph with 24-lb. pack and rifle)	6.6	396
Skating	6.6	396	
March over snow at 2.3 mph	6.7	402	
March on road at 3.4 mph	6.9	414	
Rifle exercises	7.5	450	
Creeping and crawling with full equipment	7.9	474	
Field march with rifle and 27 lb. pack at 3 mph	8.0	480	
March with 60 lb. pack at 4 mph	8.9	534	
Drill at double time	18.3	1098	

## DAILY WATER REQUIREMENTS FOR THREE LEVELS OF ACTIVITY

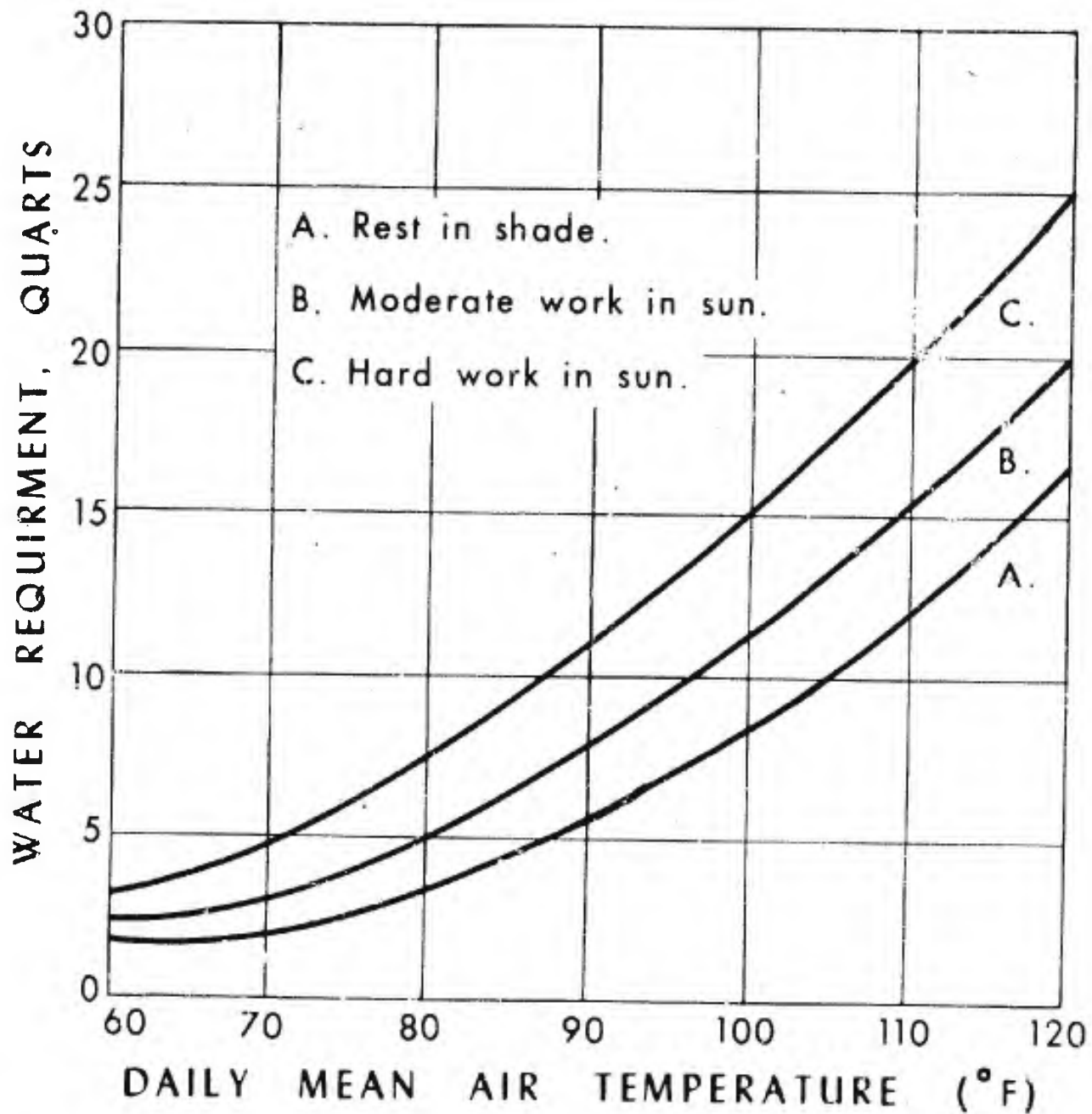


Fig. 33: This graph shows water needs, in quarts per day, for men at three activity levels in relation to the daily mean air temperature. For example, if one is doing 8 hours of hard work in the sun (Curve C) when the average temperature for the day is 100°F (Horizontal Scale) his water requirements for the day will be approximately 15 quarts (Vertical Scale).

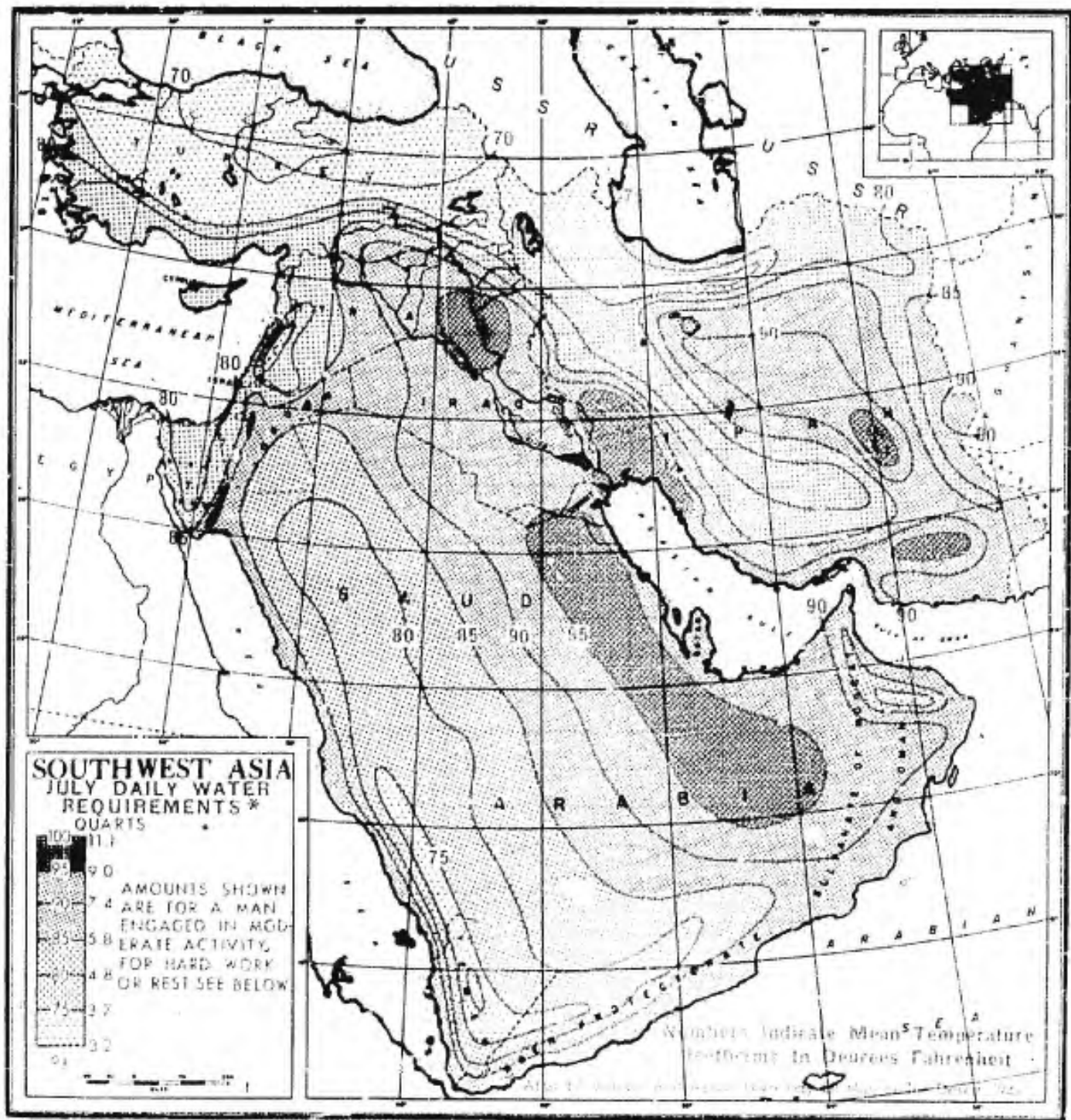


Fig. 34: This map of daily water requirements for men performing moderate work in July can be applied almost equally well in August. If one is interested in average July daily water requirements at a place where the map shows the mean temperature to be 95F (at the head of the Persian Gulf) he refers to the legend, which shows that the average daily requirement for the month is 9.0 quarts. To find the requirements for men resting or doing heavy work, refer to Figure 33. The intersections of Curves A and C with the 95F line (horizontal scale) show (on the vertical scale) the average water requirements for those activity levels.

### INSUFFICIENT WATER INTAKE AND IMPAIRMENT OF OPERATIONAL EFFECTIVENESS

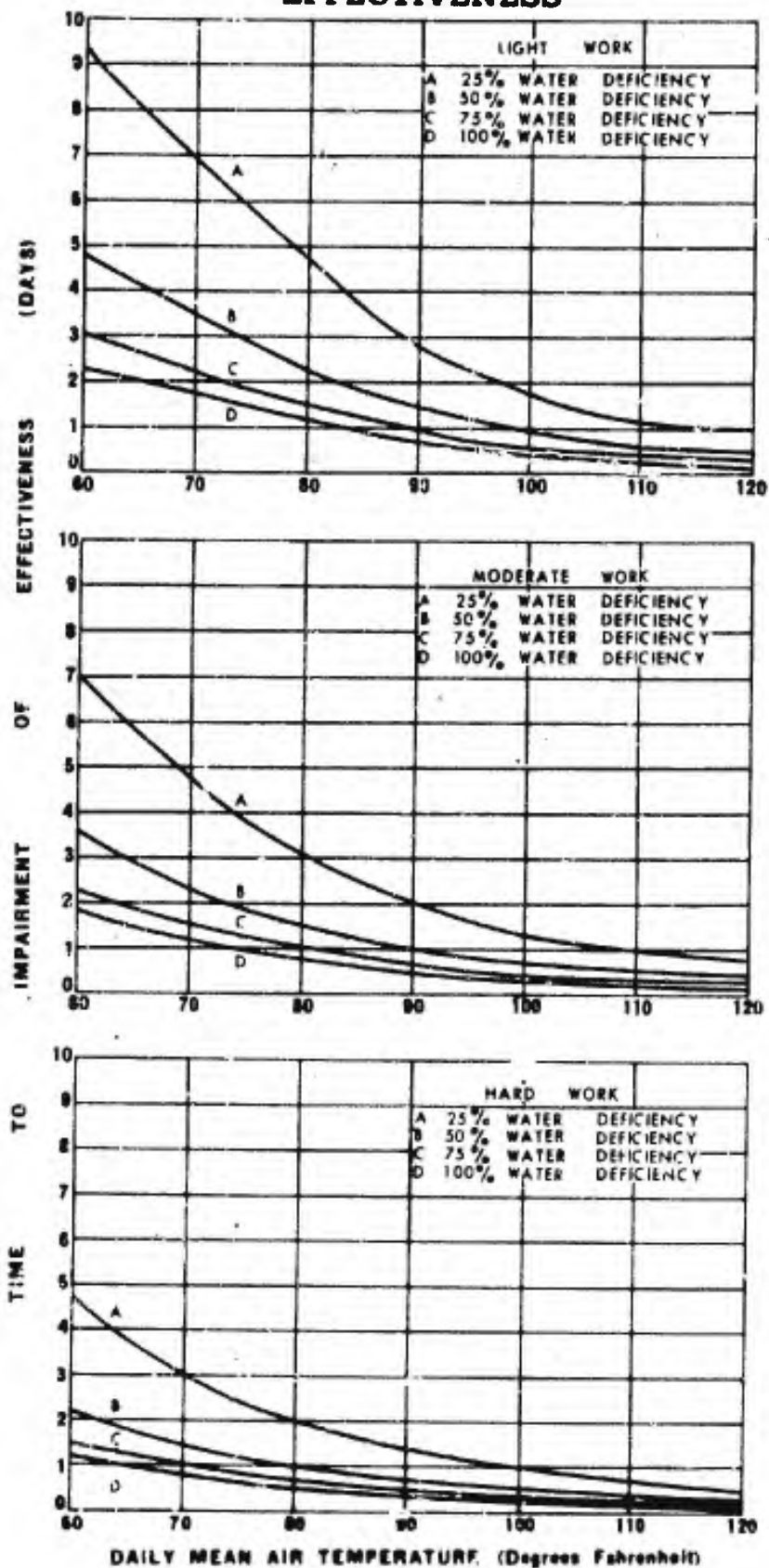


Fig. 35: (See Figure 36 for explanation)

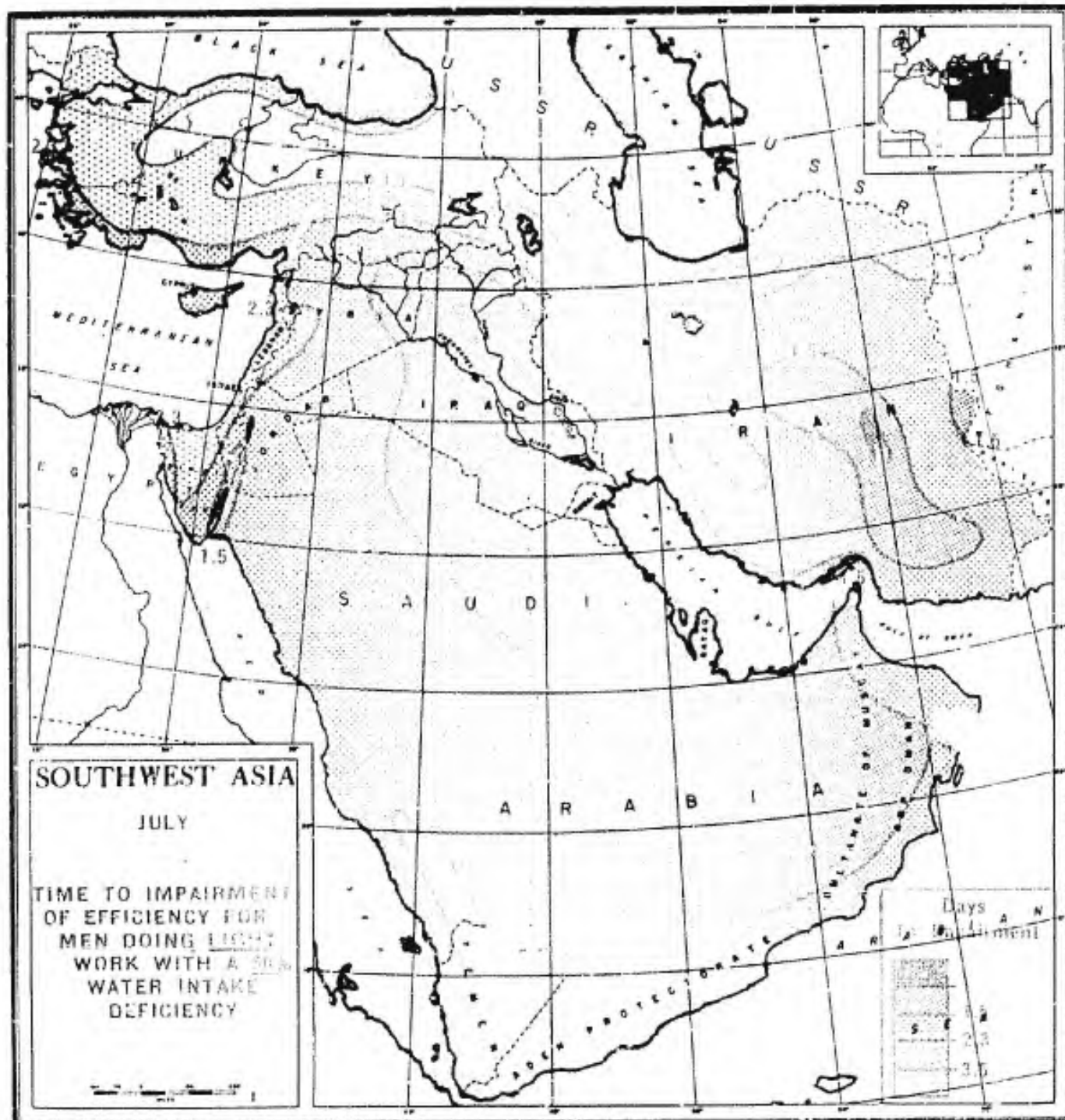


Fig. 36: When water intake is not adequate to replace the water lost from the body, dehydration occurs. When the amount of body water lost exceeds 5 percent of the body weight (about 3.5 quarts), operational effectiveness is impaired. The three graphs in Figure 35, for three levels of work, show the time (Vertical Scale) required for impairment of effectiveness at various average daily temperatures (Horizontal Scale). Each graph has four curves representing different levels of water deficiency. The three maps in Figures 36, 37 and 38 show the number of days to impairment in July for three different levels of work. As an example, Figure 36 shows that at the head of the Persian Gulf, the time to impairment for men doing light work with a 50 percent water deficiency is 1.5 days. By referring to the top graph in Figure 35, corresponding figures for 25, 75, and 100 percent water deficiencies can be determined. Similar procedures can be followed for the other two maps and graphs in the series.

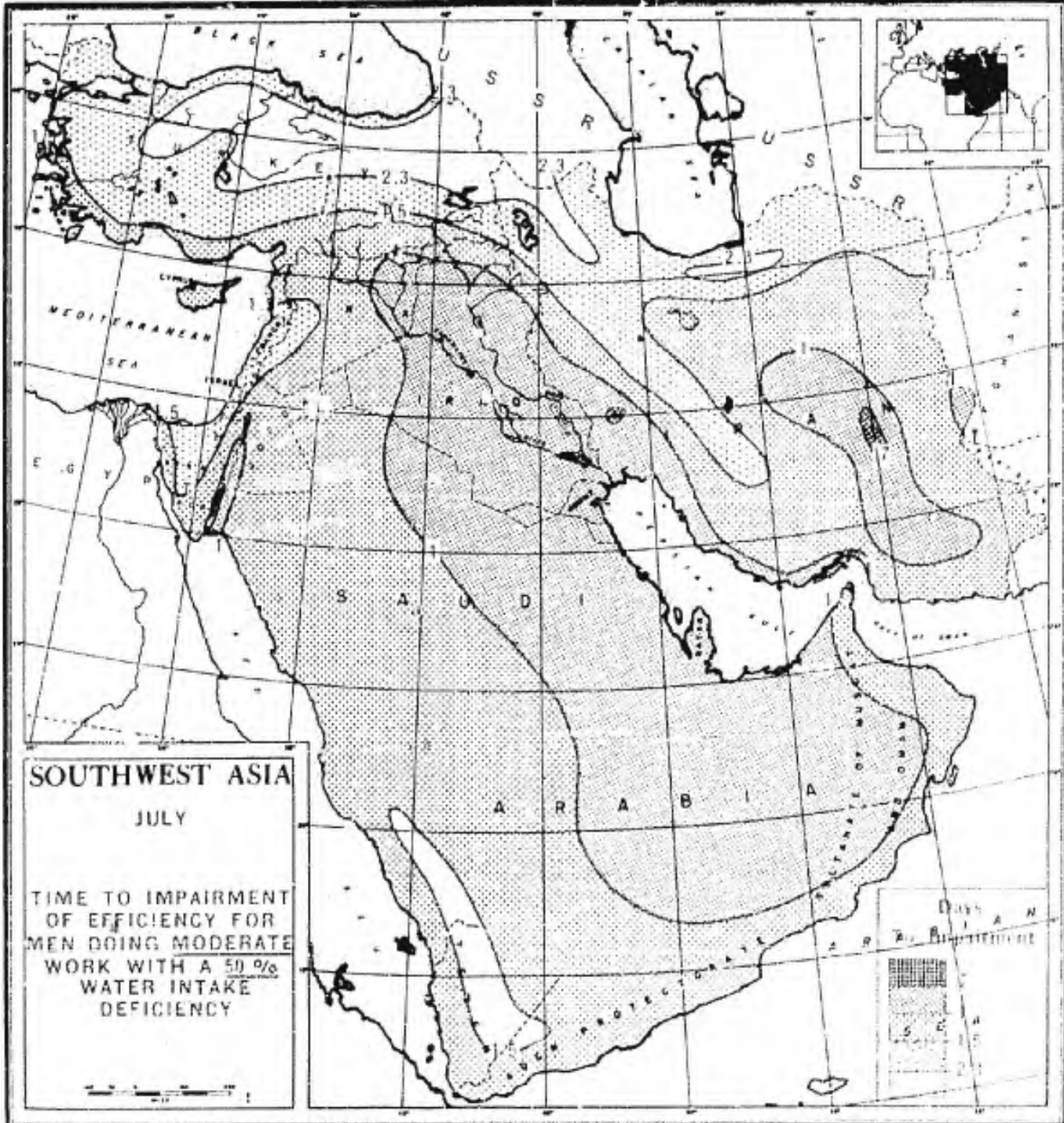


Fig. 37: (See Figure 36 for explanation.)

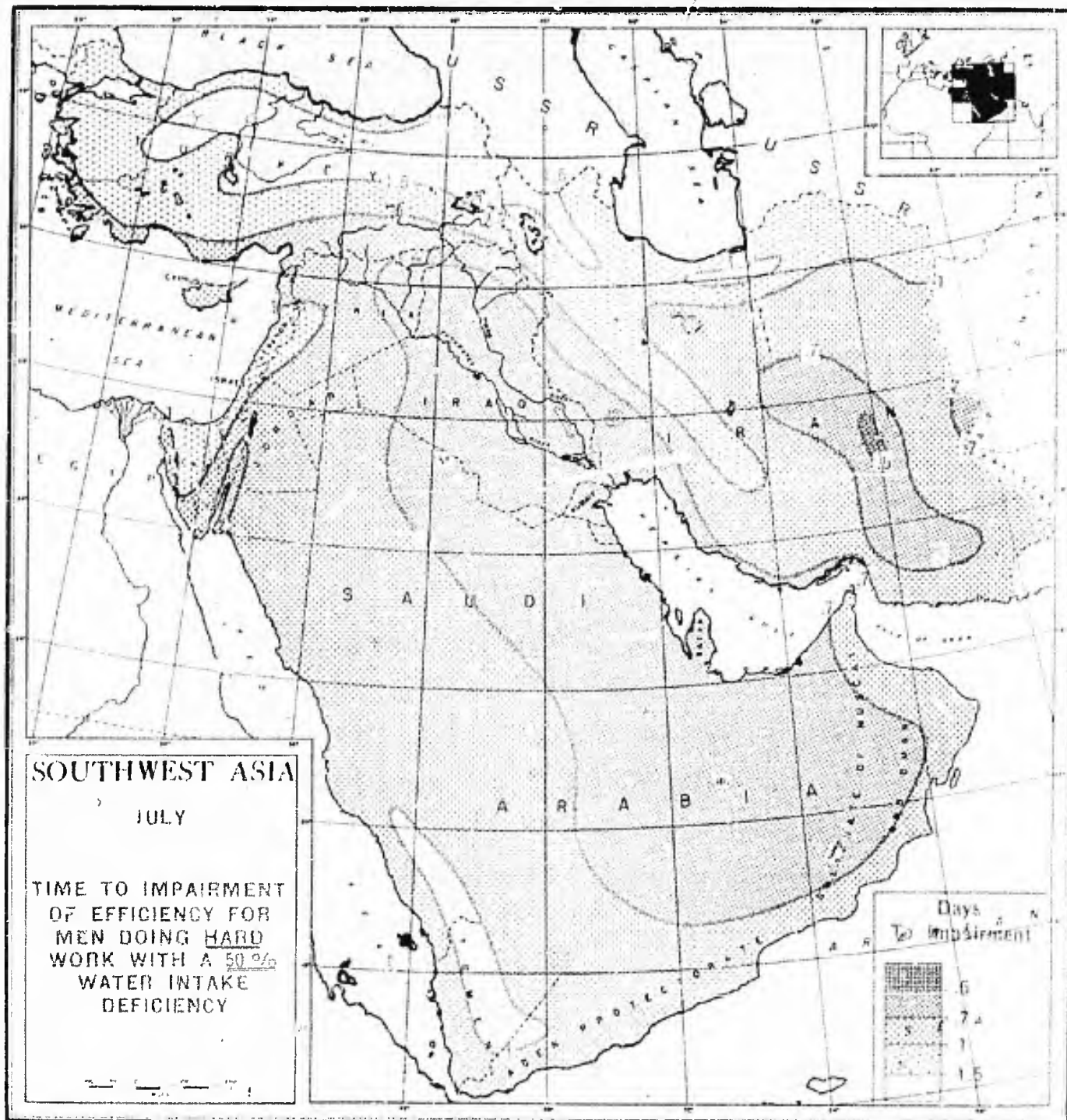
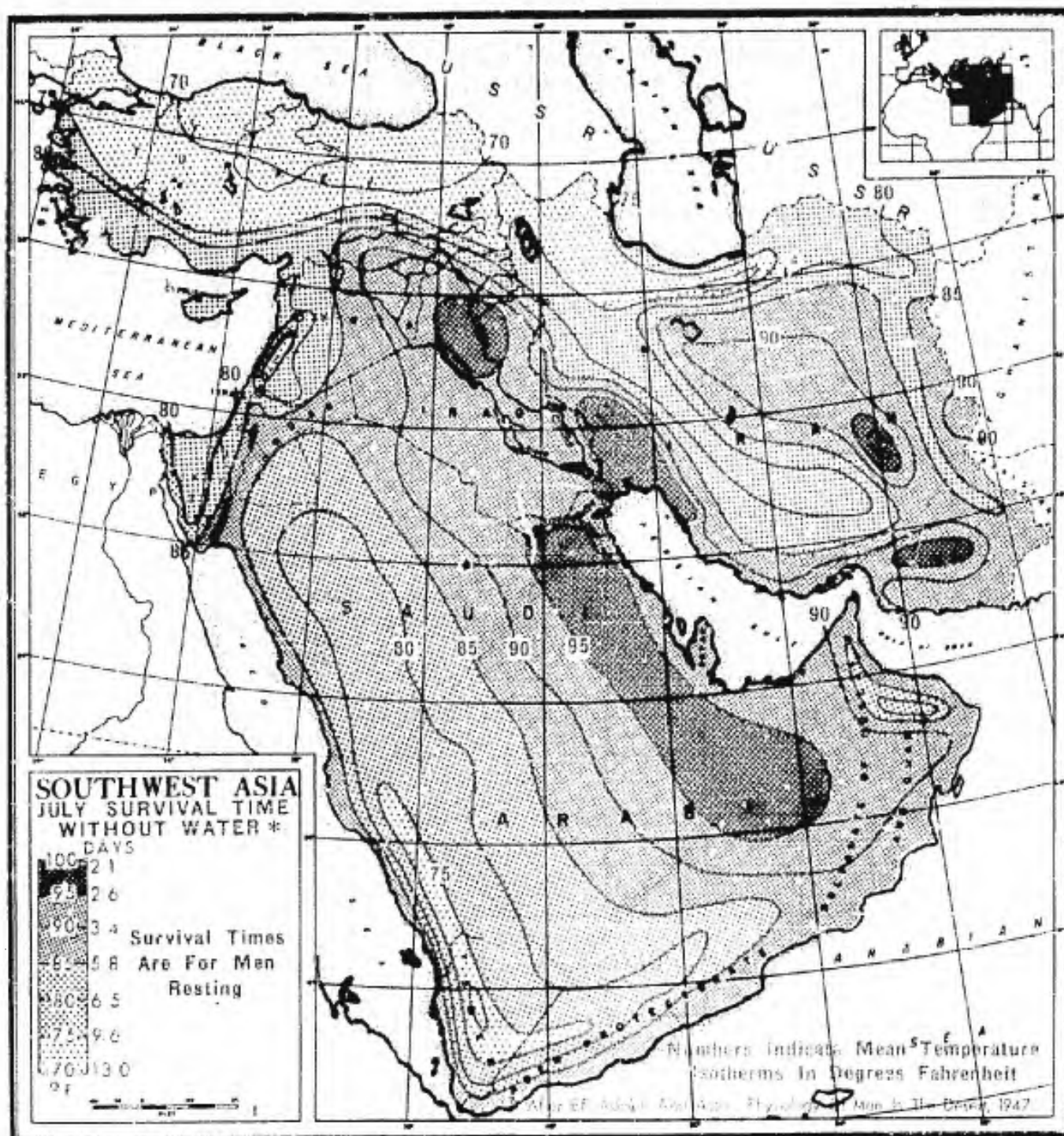


Fig. 38: (See Figure 36 for explanation.)



**Fig. 39:** This map shows the predicted survival time for resting men when drinking water is not available. Survival is not considered likely when body water loss exceeds 20 percent of body weight (about 1½ quarts). Because survival time is influenced both by the air temperature and by activity level, anyone involved in a survival situation should avoid all unnecessary physical activity and seek shade in the daytime. Necessary activities should be carried out at night.

### LIMITING ENVIRONMENTAL CONDITIONS FOR SUSTAINED WORK IN THE HEAT

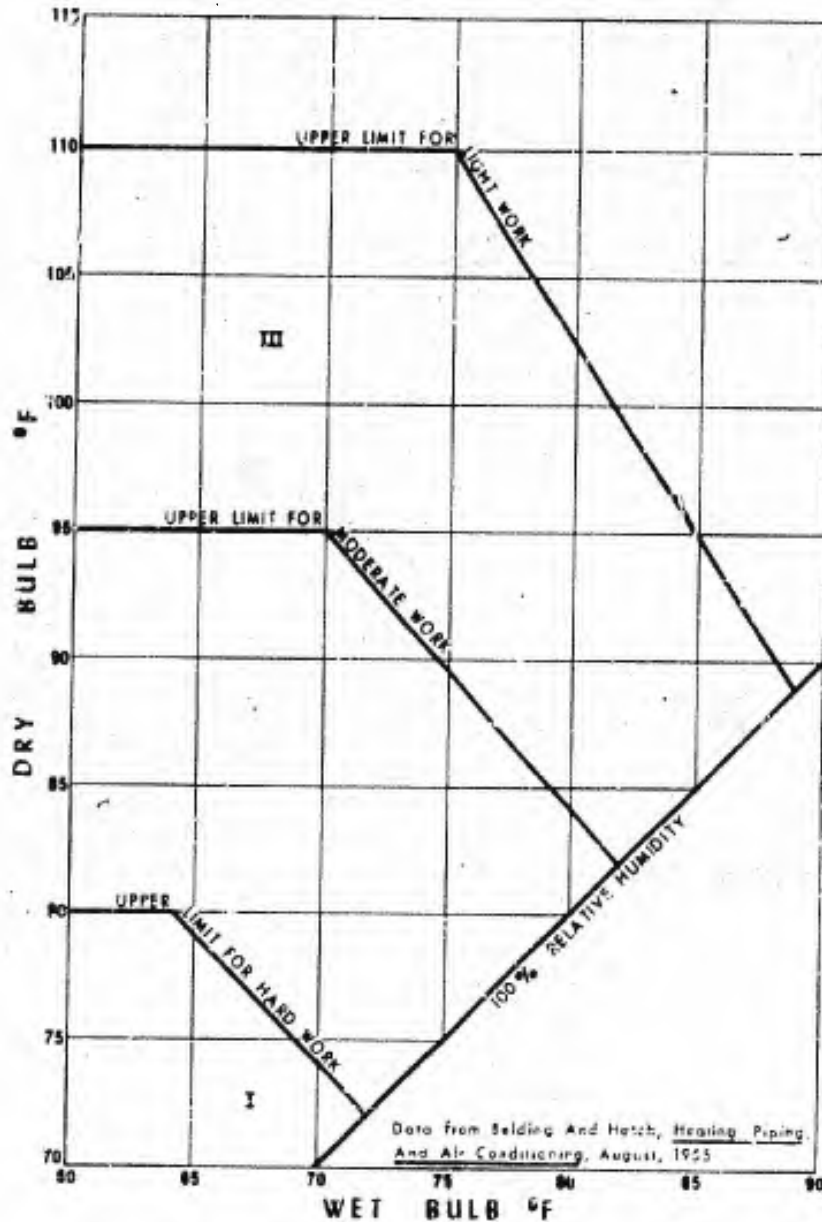
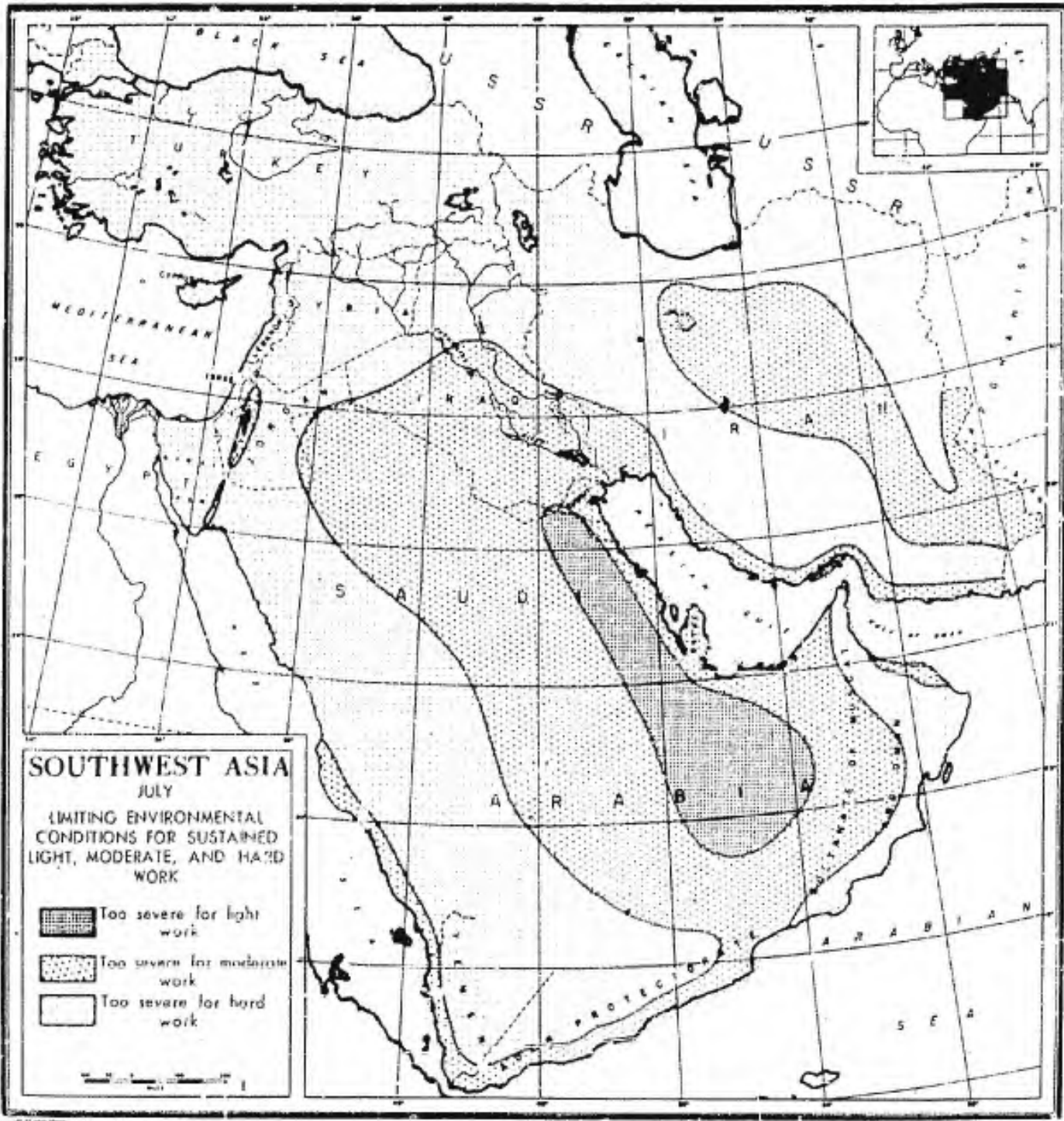


Fig. 40: Limits on sustained work are imposed by heat (dry bulb) and humidity (wet bulb) in combination. To determine the upper level of activity that can be maintained under various conditions, locate the point of intersection of dry bulb and wet bulb temperatures in Area I, II, or III, on the graph which indicates work capability in terms of maximum effort that can be sustained for 8 hours. For example, with a dry bulb of 90°F and wet bulb of 70°F, nothing more than moderate work can be performed on a sustained basis; with the same dry bulb and wet bulb of 80°F, only light work should be attempted. It should be kept in mind, however, that even hard work may be done for shorter periods. This method of estimating work capability necessarily presupposes constant conditions, although there is always variation over an 8-hour period.



**Fig. 41:** Heat stress conditions from the graph in Figure 40 are mapped above for July. Temperature and humidity data for the normal daytime working period were estimated from the mean values available and evaluated in terms of the graph. The map above shows that there is a sizable area where average conditions in July are too severe even for sustained light work. This should be interpreted as meaning that approximately half the days are less severe than the average, and on the most severe days, work can be done for periods somewhat shorter than 8 hours. Nevertheless, it would be advisable to have as much hard work as possible done at night during summer in order to take advantage of the less severe conditions.

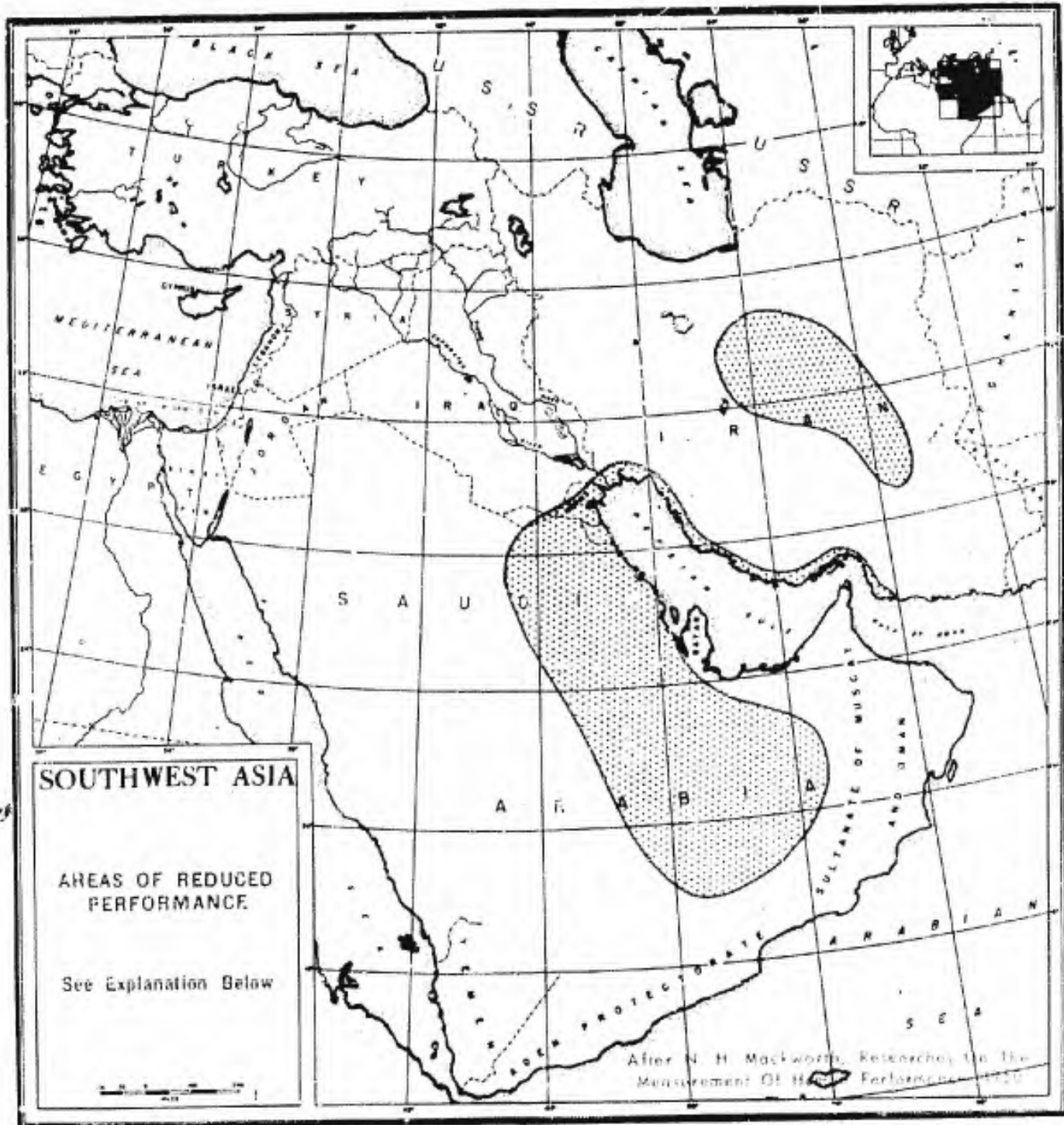


Fig. 42: This map shows areas where the performance of men doing light skilled tasks will be reduced by about 25 percent. This is not necessarily a decrease in the amount of work done, but rather an increase in number of errors. For example, a competent radio operator located in one of the stippled areas on an "average" day in July will make 25 percent more errors than he would if the temperature were 85° and the relative humidity 63 percent. If the operator, however, is highly skilled, he probably will suffer little or no performance decrement under the severe conditions. (Basic information on the performance of men under hot conditions was taken from N.H. Mackworth, Researches on the Measurement of Human Performance, Medical Research Council (Great Britain) Spec. Rpt. Ser. 468, 1950.)

### ENVIRONMENT AND MATERIEL

This section contains several maps predicting the performance or utility of several types of military items. It is considered that the kind of information presented herein is extremely important to the Army, but precise information about environmental limitations of equipment is scarce. The best known environmental effects on equipment are climatic limitations, particularly temperature. Among the temperature relationships, those best known involve the effects of cold.

Although there is great need for more and more precise information relating the performance of materials and equipment to environmental conditions, present knowledge permits presentation of some information of this type in a useful form. Reliable predictions can be made concerning the kind of clothing that is required in a given area during each season of the year. It is also possible to anticipate in a useful way the rate of deterioration of many food items in storage. The extent of growth of fungi and mold to be expected in a geographic area, with the accompanying deterioration of many kinds of materials, can be estimated and the environments beyond which certain types of equipment may not operate effectively can be mapped. All such predictions by their very nature involve certain assumptions (stated on maps), the use of available data, and professional judgments. Therefore, the boundaries on the maps and other aspects of these predictions should be accepted with the above points in mind.

## 1. Clothing Requirements

Because of the diversity of environmental conditions in Southwest Asia, the total range of Army clothing is required sometime during the year. Clothing needs are shown on the Clothing Requirement Areas map (Fig. 43) according to a newly developed (not yet adopted) system for specifying clothing needs on a world basis, usually referred to as the proposed World Guide to Field Clothing Requirements.\* Of the nine types of clothing requirement areas for the world, four are represented in Southwest Asia. The stippled areas on the map are the more northern highlands where some arctic clothing may be needed. For camouflage, over-white clothing may be needed in the higher mountains.

For the World Clothing Guide, Army clothing is grouped in four assortments, listed as A, B, C, and D in the clothing issue table below. Components of the assortments are as follows:

"A" - The lightweight tropical ensemble, consisting of cotton undershirt and drawers, cotton trousers, bush coat, wool knit shirt, tropical combat boots, wool socks with cushion soles, cotton cap, poncho, and headcloth. For lower nighttime temperatures, in desert areas, the wool shirt should be added to this assortment.

"B" - Same as Assortment "A", plus winter drawers, coat liner (jacket liner), single-breasted coat (jacket shell), glove inserts and shells. Leather combat boots are substituted for tropical combat boots.

"C" - The Army standard cold-wet ensemble, including: winter underwear; coat and coat liner (jacket shell and liner); wool shirt; cap, field, cotton; wool and cotton trousers; gloves and glove inserts; and boots, combat, rubber.

"D" - The Army standard cold-dry, or arctic ensemble, including: winter underwear; wool shirt; coat and coat liner; parka and liner; two cotton trousers and two liners; cap, field, pile; parka hood; arctic mittens; and boots, mukluk.

RECOMMENDED ISSUE OF CLOTHING ASSORTMENTS IN SOUTHWEST ASIA

	Clothing Assortment			
	A	B	C	D
Area 1	All Year			
Area 2	May - Oct			
Area 4	Jun - Aug	Sep-Oct, Apr-May	Nov - Mar	
Area 6		May - Sep	Oct - Apr	Optional in winter

\*Sprague, M. E. and C. W. Ross, World Guide to Field Clothing Requirements, July 1959, COM R&E Command, Technical Report, EP-115.

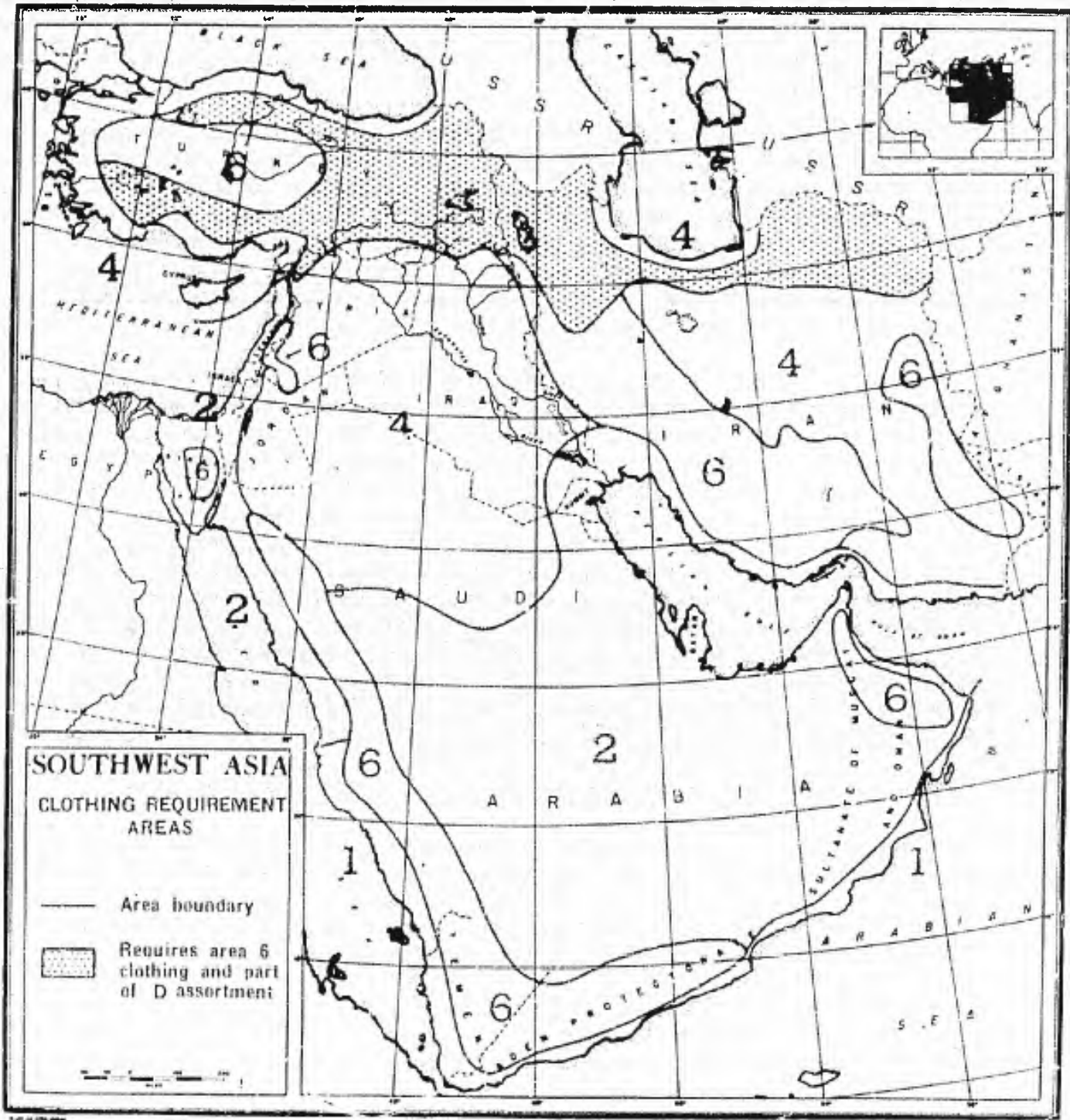


Fig. 43: Numbered clothing requirement areas were taken from "World Guide to Field Clothing Requirements". For clothing assortment requirements (A, B, C, D) for each season, and for item make-up of assortments, refer to "Recommended Issue" table on page 84.

## 2. Food Storage

A method has been devised for estimating the storage life of food items whose deterioration depends entirely on temperature. Storage life for most Quartermaster food items has been determined under constant temperature conditions, and it has been shown that for many foods the deterioration rate doubles for each 18°F. increase in food temperature. Because the deterioration rate varies with temperature, it is possible, by use of a weighted mean temperature (effective storage temperature), to show on a map the relative severity of different areas.

The maps for Long-Term and Short-Term Food Storage (Figs. 44 and 45) are based on effective storage temperatures computed for the year and for the hottest 3-month period in Southwest Asia. These maps, in conjunction with the Food Storage Table, give estimated storage life for the foods listed. Because the maps are based on yearly and 3-month means, storage life predictions close to these times are most dependable. Also, the maps are most dependable near the coasts and in the southern part of the region, and are least dependable in the mountains. All the figures are based on open dump or ventilated warehouse storage. If storage dumps are tightly covered with paulins or the warehouses tightly closed, storage life may be reduced to that corresponding to the adjacent more severe storage life area. The inherent error in laboratory storage life determinations is about  $\pm$  25 percent, and it must be remembered that part of the storage life of any item is spent before it arrives in the region.

### Step-by-step procedure for use of food storage maps and table.

- a. Locate place of interest on Long-Term Food Storage Map and determine the number of the Area in which it is located (I, II, III, or IV).
- b. Turn to the table and find safe storage time in months for the food of interest corresponding to the storage life area.
- c. If safe storage time is found to be less than 6 months, on the table, substitute the Short-Term Food Storage Map to determine storage life area (Is, IIs, IIIs, or IVs) and proceed as before, using the Short-Term columns in the table (Is, IIs, IIIs, IVs).

For example, if interested in the safe storage time for yeast at Basra (near Persian Gulf in Iraq), turn to Long-Term Food Storage map and find the number of the area involved (Area I). Turn back to Food Storage Table and find yeast under Column I (Long-Term Storage) which represents Area I on the map. Since the figure for yeast is 3 months (less than 6 months) repeat the procedure using the Short-Term Food Storage map and the Short-Term columns in the Table. The safe storage time for yeast at Basra is 1 month.

SAFE KEEPING TIME FOR NON-PERISHABLE FOODS IN OPEN STORAGE\*

PRODUCT	PACKAGING	SAFE STORAGE TIME IN MONTHS BY AREA				
		Long Term**	I	II	III	IV
		Short Term***	I <sub>s</sub>	II <sub>s</sub>	III <sub>s</sub>	IV <sub>s</sub>
<b>1. BEVERAGES:</b>						
Coffee, roasted, ground	Can, vacuum-packed	4	5	6	7	8
Tea, soluble product	Can		24	30	36	43
<b>2. CEREALS AND CEREAL PRODUCTS:</b>						
Cereals, breakfast, prepared	Carton w/inner bag		12	15	18	23
Cookies and Crackers (biscuits)	Special moisture-proof	4	6	8	12	16
Flour, wheat, bleached	Cotton and multi-wall bag	1	3	5	9	13
Macaroni, spaghetti, vermicelli	Corrugated fiberboard carton		10	15	18	23
Oversea PX items	Special moisture-proof	4	6	8	12	16
Prepared mixes (bread, cake, doughnut, pancake)	Can		12	17	24	34
<b>3. DAIRY FOODS, FATS, AND OILS:</b>						
Ice Cream mixes	Can	2	3	4	7	10
Milk, dry, whole	Can	3	5	7	10	12
Oleomargarine	Can	< 1	3	10	24	34
Eggs, whole, dehydrated	Can		12	17	24	34
<b>4. FOOD SPECIALTY PREPARATIONS:</b>						
Chocolate, cooking, unsweetened	Paper wrapped	2	3	4	6	10
<b>5. FRUITS:</b>						
Non-acid fruits	Can	6	9	14	20	29
Acid fruits (citrus, berries, sour cherries)	Can	1	2	3	6	11
Dried fruits, light	Carton	2	3	4	7	11
<b>6. MEAT, MEAT PRODUCTS, AND SEAFOOD:</b>						
Beef items	Can		24	30	36	43
<b>7. RATIONS, OPERATIONAL, PACKAGED:</b>						
Ration, Individual, Combat	Carton****		12	17	24	34
Ration, Small Detachment, 5-in-1	Carton****	6	9	12	18	24
<b>8. SOUPS:</b>						
Soup, bean or pea, precooked, dehydrated	Can	5	7	8	12	16
<b>9. SPREADS:</b>						
Apple butter, Jams, Jellies, and Marmalade	Can		10	13	18	24
<b>10. VEGETABLE ITEMS:</b>						
Low-acid vegetables	Can		12	20	24	31
High-acid vegetables (tomato products and sauerkraut)	Can	4	9	13	18	25
Dehydrated vegetables	Can	8	12	17	24	33

\*Table based on data supplied by QM Food and Container Institute for the Armed Forces (4/7/23/55)

\*\*Periods longer than 6 months

\*\*\*Periods shorter than 6 months

\*\*\*\*Individual items are packaged in cans, heat-sealed envelopes, and flexible bags

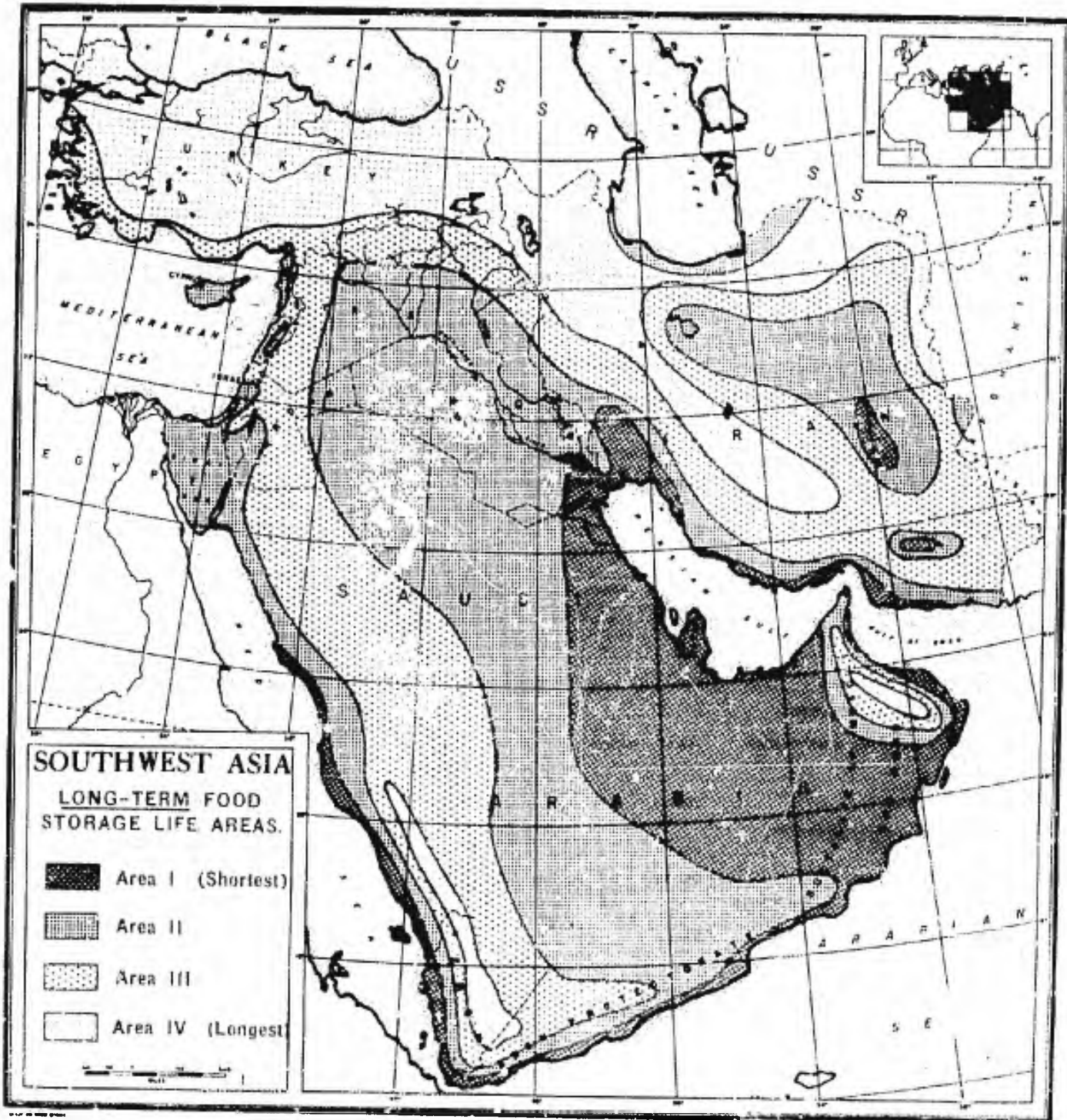
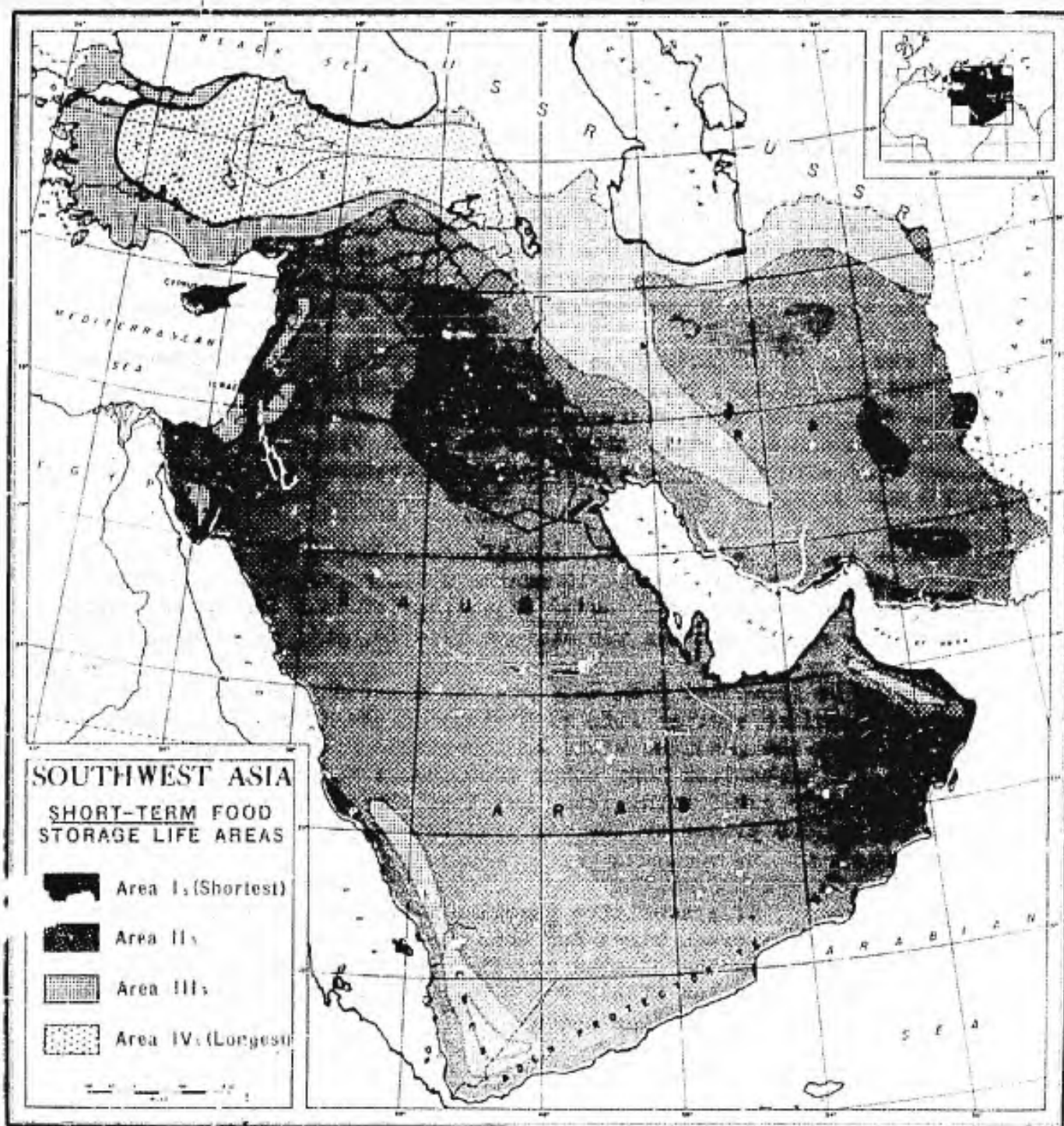


Fig. 44: Long-term for this map is more than 6 months. See text on page 86 for explanation and use.



**Fig. 45:** Short-term food storage is less than 6 months. See text on page 86 for explanation and use.

### 3. Gasoline Storage

Gasolines deteriorate largely through formation of gum which causes filter clogging and lowering of octane number. Although the initial gum content and the rate of gum formation differ widely, the effect of varying temperature on this rate is quite similar for all gasolines. The rate approximately quadruples for each 20F rise in temperature.

A map may be prepared from gasoline effective storage temperatures weighted so that they represent in gum degradation effect the whole series of cycling temperatures experienced in a field storage season in 55-gallon drums at various places on the map. Figure 46 is such a map, except that effective gasoline storage temperatures have been converted to storage life.

For a typical gasoline with inhibitors added, 5 mg. of gum per 100 ml. of gasoline might form in 12 months at 100F gasoline temperature. Since this is enough gum to cause rejection (if some gum were already present) 12 months becomes the storage life for this particular gasoline.

Figure 46 (computed from data for the 6 hottest months) shows comparative gasoline storage life at various points in Southwest Asia, assuming that the gasoline would be acceptable for 12 months at 100F. It should be emphasized that other gasolines with other inhibitors might differ in basic gum-forming rate, but that the proportionality between rates at various places on the map will be the same for almost all gasolines.

For example, if a sensitive gasoline were acceptable for only 4 months at 100F, storage times for this gasoline could be obtained from the map by dividing the plotted storage time by 3. Conversely, predictions for a gasoline stable for 2 years at 100F could be obtained by multiplying by 2 the time shown.



#### 4. Equipment Difficulty Caused by Heat

Some equipment may fail when it operates above a critical temperature, but be completely effective when the temperature drops to acceptable levels. For such equipment, a map showing frequency of occurrence of critical temperatures becomes an indicator of probability of equipment difficulty.

For example, in the operation of the Mobile Bakery, it has been found that yeast dies and dough dries out above about 115F. The Refrigerator, 25 cu. ft., maintains interior temperature with difficulty above 110F. Similarly, the Rough Terrain Fork Lift Truck is designed for temperatures below 110F and becomes less effective above that temperature.

Figure 46 shows where temperatures above 110F are common in July, and therefore, where the equipment mentioned above may give difficulty. Although the map is based on percentage of total hours above 110F (and gives information about the number of days of occurrence), it may be assumed that such temperatures will not prevail for more than 4 to 6 hours on any given day.

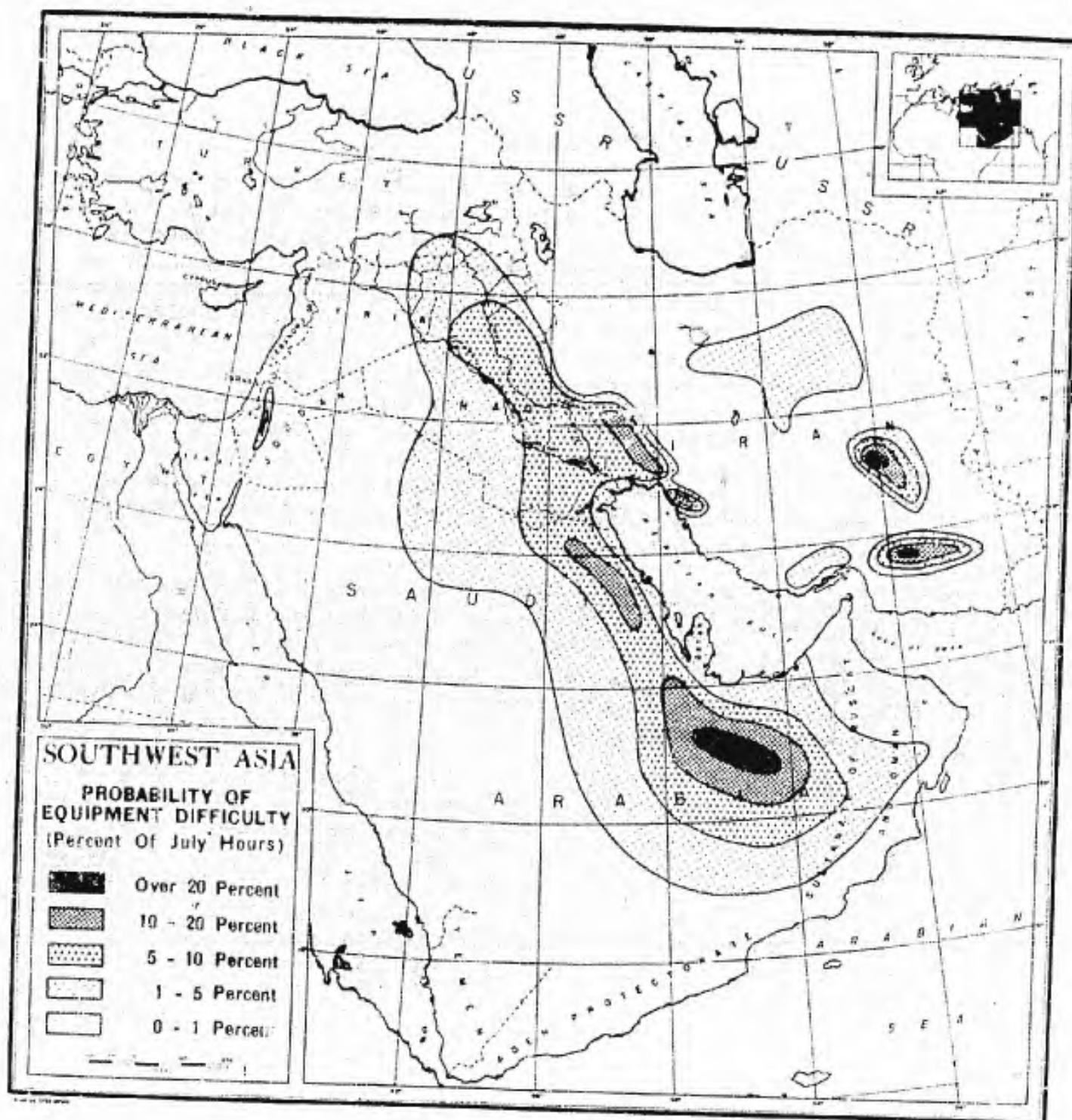


Fig. 47: This map shows the percent of July hours during which the Mobile Bakery; Refrigerator, 25 cu. ft.; and Rough Terrain Fork Lift Truck may be ineffective. These three items begin to fail at temperatures of about 110°F.

## 5. Microbiological Deterioration

Microbiological deterioration depends on a complex interaction of at least five factors including temperature, humidity, time, type of material, and the organism. In spite of the complicated nature of the action, however, the temperature and humidity conditions under which microbiological deterioration takes place are reasonably well known. Temperatures of 65 to 75F with relative humidities of 70 to 85% tend to produce moderate microbiological activity and temperatures of 75 to 90F with relative humidities over 85% tend to produce severe deterioration. Because different materials have different deterioration rates, the terms "moderate" and "severe" have no precise meanings. For example, severe microbiological deterioration can damage leather goods in approximately 10 days, whereas severe deterioration in tentage causes serious damage in approximately 6 months.

The map of microbiological deterioration (Fig 48) has two underlying assumptions: (1) the rate of deterioration for equipment in the open is closely related to mean monthly values of temperature and humidity as measured under standard conditions, and (2) poorly-ventilated places are more conducive to microbiological deterioration than well-ventilated places.

The seasons during which conditions are favorable for microbiological activity range from midsummer to midwinter within Southwest Asia. Along the shores of Turkey and along the Caspian Coast of Iran such conditions prevail from May through October. Along the coasts of Syria, Lebanon, and Israel suitable conditions exist in spring and autumn. In southern Iran and along the coasts of the Arabian Peninsula winter is the only season with a combination of temperature and humidity especially suited to microbiological activity.



**Fig. 48:** According to the criteria furnished on page 94, the areas of Southwest Asia favorable for microbiological deterioration are found only along the coasts; in most other areas the humidity is too low. This map of conditions favorable for microbiological activity should in no way be construed to suggest that such activity is confined to the areas shown; rather, it shows the areas that are especially favorable.

## 6. Anti-insect Equipment and Problems.

Many species of mosquitoes, including malaria-transmitting Anopheles, occur throughout Southwest Asia; in desert areas, they are found near irrigated plots, oases, and water holes. They are not found in mountain regions above 7,000 feet.

Numerous species of flies are annoyances in all countries of Southwest Asia. The common housefly and the stable fly are abundant wherever man and animals are present. Sandflies, which spread sandfly fever and oriental sore, occur in all countries. Buffalo gnats, midges, and other small flies, present chiefly in the upland areas, are extremely annoying, and their bites and resultant irritation can be very painful. The tsetse fly is present in southern Arabia near Aden.

Fleas, represented by several species, are common; some are capable of transmitting plague and typhus fever. Human lice, transmitters of typhus and relapsing fever, also are generally prevalent.

Other pests prevalent throughout Southwest Asia include ticks, mites, and bedbugs. Various species of ants, termites, beetles, moths, cockroaches, and centipedes occur in all countries. In some years locusts invade sections of Southwest Asia and cause serious destruction over wide areas.

Spiders and scorpions are common throughout this entire area. Their bites may be extremely painful, but they are rarely fatal to adults. These arachnids seek damp spots and may crawl into shoes, clothing, and baggage.

Quartermaster Corps anti-insect items, including personal protection items such as repellents and insect nets and items for insect control such as the various insecticides, provide effective protection against mosquitoes, sandflies, ticks, lice, mites, and fleas. Insect protection should be available throughout the year in all areas of Southwest Asia below 7,000 feet.

Three of the available insecticides that are emulsifiable concentrates should not be kept in storage at temperatures above 85°F for more than 9 months. These items are: Insecticide, DDT, Liquid, 25% DDT; Insecticide, Dieldrin, Liquid, 10%; and Insecticide, Lindane, Liquid, 12%. Because no part of Southwest Asia has mean temperatures above 85°F for periods as long as 9 months, it is considered that these items may be stored for one hot season in the warmest portions of Southwest Asia.

Three other insecticides, classed as wettable powders, should not be kept at temperatures above 85F for more than 18 months. They are: Insecticide, DDT, Powder, 75% DDT; Insecticide, Dieldrin, Powder, 50%; and Insecticide, Lindane, Powder, 75%. These items should be able to withstand storage anywhere in Southwest Asia for two summers. It is necessary, of course, that all of these items be stored in as cool and well-ventilated a location as possible, in order to achieve maximum storage life.

For a more thorough coverage of insect problems and control measures in Southwest Asia, reference can be made to Dept. of the Army TM 5-632, Insect and Rodent Control, and to the medical bulletins, published by the Office of the Surgeon General, for the individual countries in Southwest Asia.

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## GLOSSARY OF SPECIAL TERMS USED IN THIS REPORT

1. Mean Monthly Temperature: (Also used interchangeably with average monthly temperature) Average of the mean temperatures of each day within the month, averaged over a period of years. The mean temperature for the day is usually the average of the highest and lowest temperatures of the day.
2. Mean Daily Maximum Temperature: Average of the maximum temperatures of each day within a given period (in this case a month), established over a period of years.
3. Mean Daily Minimum Temperature: Average of the minimum temperatures for each day within a given period (in this case a month), established over a period of years.
4. Absolute Maximum Temperature: The highest temperature recorded during the period of record. Sometimes used to indicate the highest temperature for a given month during the period of record.
5. Mean Precipitation: Also called average precipitation. Average of the precipitation totals of each day within a given period (usually a month or year) averaged over a period of years. Precipitation is measured in linear units and the figure includes the water equivalent of snow and other frozen forms.
6. Temperature Analogy: Temperature statistics (in this case mean monthly temperatures) that bear a resemblance or similarity to those of another place.
7. Temperature Frequencies: Denotes the number of times a particular temperature occurs within a given period. May be expressed as occurrence frequency (days/month, hours/week, etc.) or percent frequency (percent of hourly observations) as in this report.
8. Dewpoint: The temperature to which air must be cooled in order for saturation to take place.
9. Dry Bulb Temperature: Same as air temperature (measured in a standard instrument shelter).
10. Wet Bulb Temperature: The lowest temperature to which air can be cooled by evaporating water into it. When used in conjunction with the air temperature (dry bulb), relative humidity, dewpoint, and absolute humidity can be calculated.
11. Nomadism: Description of a way of life, particularly in arid countries in which people are continuously on the move, camping temporarily in widely scattered locations.
12. Ethnic Groups: Term used to designate peoples on the basis of common customs, belief, and backgrounds.

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