from the still-active Baku field on the Azerbaijan coast. Prior to 1991, however, the Soviets were so negligent in protecting the environment in all their mineral industries that the entire Caspian Basin became frighteningly polluted.[5]

The focus of the very considerable geopolitical significance of the Caspian shifted after 1991 from a bilateral rivalry between the Soviet Union and Iran to more complex multilateral relationships among Russia, Iran, and three former Soviet Republics. The three newly independent littorals—Azerbaijan, Kazakhstan, and Turkmenistan—are now major players in the Great Oil Game of the Caspian Basin. One problem has been defining the complicated median lines that specify what areas of the seabed fall to the respective littorals for offshore oil drilling. Increasingly booming after the mid-1990s, the oil industry of the Caspian Basin–Central Asian states is noted in Chapter 6.

Rivers Great and Small

Extreme aridity in the southern and eastern sectors of the Middle East precludes any large-scale, local perennial runoff, and the major river systems in these regions rise in upstream highland areas of significant water surplus. Structural conditions in some of the more humid sectors interrupt drainage lines to divert a considerable percentage of the interior runoff into closed basins. Thus, the major river systems in the Middle East are limited both qualitatively and quantitatively.

The two largest stream systems in the core Middle East are the Nile in the southwest and the Tigris-Euphrates in the center, with all three rivers crossing deserts for hundreds of miles in their lower reaches but originating in highlands with a water surplus. Along with the Jordan, these most fabled streams in scriptures and ancient history have had renewed roles in current events, particularly the Tigris and Euphrates after the warring in Iraq after 2003. In addition, escalating disputes between the countries controlling the sources of the three streams and the downstream consuming countries are among the potentially serious confrontations faced by governments of the Middle East in the twenty-first century (see Chap. 8). Great streams in peripheral states also have rainy mountain origins: most notably, the Indus in the riverine state of Pakistan, as well as the Syr Darya and Amu Darya of "The Stans" and the Helmand in Afghanistan. In the Arabian Peninsula, not one perennial stream drains any part of the area—compelling confirmation of the stark aridity of this vast realm.

With the major exception of the Nile, virtually all Middle East rivers have a maximum runoff in late spring and a minimum flow in early fall. Most rivers at flood time are fed by runoff from snowmelt, which comes later than the actual precipitation maximum, November through February; their minimum flow after the hot, dry summer is supplied primarily by springs and other groundwater discharge. The Nile regime is precisely the reverse, as it floods in late summer and early fall, following the heavy summer monsoon rains in the river's source highlands, and is at its minimum in the spring.

Tigris and Euphrates Rivers. The Tigris (Arabic: Dijlah; Turkish: Dicle) and Euphrates (Arabic: al-Furat; Turkish: Firat) rivers enter the Gulf through a common 100-mile/160-km channel, the Shatt al-Arab, but each is otherwise a separate stream. Both rise in the snowy eastern Anatolian highlands hydrographic center of Turkey, with their headwaters only a few miles from each other (Map 2–1). In the highlands, additional tributaries augment their flow, but downstream, as they course across the flat desert, they lose water through evaporation and diversion for irrigation purposes. With diminished flow, they lose carrying capacity, drop some of their loads of silt, and continue to build up a common vast deltaic plain, with each channel also building natural levees.[6]

The longer of the two and the one with the greater drainage basin, the Euphrates, begins at the confluence of the Kara and Murat rivers near Keban, northeast of Malatya in eastern Turkey, and ends at its junction with the Tigris at Qurnah, at the head of the Shatt al-Arab. More than 1,700 miles/2,700 km long, it drains a basin of 171,430 miles^2/444,000 km^2. About 28 percent of the Euphrates basin is in Turkey, 17 percent in Syria, 40 percent in Iraq, and 15 percent in Saudi Arabia. However, more than 90 percent of the actual water flow is from runoff in Turkey. The Balikh and Khabur left-bank tributaries, rising in the Anti-Taurus foothills, join the Euphrates as it flows across Syria, but no tributaries enter it in Iraq. Mean annual flow at Hit, in central Iraq, was formerly 31,820 million cubic meters (m^3) per year; however, damming of the Euphrates at four places in Turkey and at al-Thawrah (formerly Tabaqah) in Syria has greatly diminished the river's mean flow, especially after the mid-1990s.

Although shorter than the Euphrates, the Tigris (1,150 miles/1,850 km) formerly carried an average 42,230 million m^3 of water per year, 25 percent more than the Euphrates, and since the Turkish and Syrian diversions of the Euphrates, the differential is even greater. To compensate for the dwindling lower Euphrates, water can be diverted by the Samarra barrage from the Tigris to the Euphrates by way of Lake Tharthar, a flood-control facility occupying a depression between the two rivers. Other aspects of water management have been enhanced with the completion in late 1992 of Iraq's so-called third river, a 350-mile/563-km canal that extends from Baghdad to Basrah.

Draining an area of more than 43,110 miles^2/111,655 km^2 above Samarra, the Tigris, unlike the Euphrates, receives significant contributions from tributaries in Iraq. Bringing snowmelt and rainwater from the high Zagros in northeastern Iraq, all the tributaries enter along the left bank; they include, from north to south, Great Zab, Little Zab, Udhaym, and Diyala. The Karkheh joins the Tigris at Amarah, upstream from Qurnah. More than the upper Tigris, the lower Tigris is subject to sudden flooding, especially when the Zab rivers flood simultaneously. However, flood-control measures, such as the Tharthar Project, have done much to alleviate the impact of floods. Neither river is satisfactory for regular navigation, although the Tigris carried shallow-draft boats in the early 1900s.

The building of the natural Tigris-Euphrates Delta has long been a subject of debate among geomorphologists, particularly regarding how much the head of the Gulf has been depressed by deltaic sediments and when this occurred during the delta's formation. The enormous load of silt carried by the Tigris (about 40 million m^3 annually past Baghdad), and formerly by the Euphrates (whose silt now largely settles in Turkish and Syrian reservoirs and in flood-control basins between Ramadi and Karbala in Iraq), has built a huge delta beyond Hit on the Euphrates and beyond Samarra on the Tigris. The rivers could logically be expected to continue steady construction of a contemporary common delta; however, building from the east, the much more rapidly advancing combined fan and delta of the Karun River has, in effect, dammed the outlet of the Tigris-Euphrates system into the Gulf. The Karun fan-delta barrier causes the Tigris-Euphrates streams to slow down and drop their silt load prior to overflowing the barrier.

The silting process created a maze of marshes and channels northwest of Basrah, many of which, after existing for thousands of years, were drained by the Saddam Husayn government for political reasons (see Map 13–2). Thus, the shoreline of the head of the Gulf during Sumerian times, for example, is uncertain. Whereas Ur seems to have been a port during its heyday, 3000 BCE, it may have been a river port, like modern Basrah. Problems regarding delta building and early coastlines at the head of the Gulf merit further investigation.

Nile River. With a length of 4,240 miles/ 6,825 km, the Nile is the world's longest river. Its drainage basin of 1.15 million miles^2/2.98 million km^2 is almost one-tenth the land area of Africa, although the Amazon, Mississippi, and Congo rivers have still larger watersheds. Seen anywhere along its lower course, the Nile, with an average annual flow at Aswan of 83,570 million m^3 per year, is an amazingly large stream to have traversed the full width of the eastern Sahara, yet thirty-two other major rivers carry more water than the Nile does in an average year. Completion of the Aswan High Dam in 1971 greatly altered the river's millennia-long regime and seasonal rhythm, and today's Nile is quite different from that famed in history.

The Nile's longest tributary, the White Nile, is born in the lake district of East Africa and channels the relatively uniform overflow from Lake Victoria. From this lake, whence the river's alternate name of Victoria Nile, the White Nile descends into the Sudd, the world's largest freshwater swamp, in southern Sudan. After dropping its silt load in and being regulated by the Sudd, the river flows northward and crosses progressively more desertic terrain to join the Blue Nile at Khartoum. Thus it has been the White Nile that has given the Nile its steady flow.

The Blue Nile is fed by heavy summer monsoon rains on the high Ethiopian Plateau and therefore has a different regime from that of the more uniform White Nile. It was the summer Blue Nile floods that, prior to the two Aswan dams, caused the famous annual Nile flood in Egypt, supplying about 80 percent of the river's water. From Khartoum, the Nile flows over a series of five cataracts (a sixth is drowned under Lake Nasser), numbered upstream from the first cataract at Aswan. Still in the Sudan, 200 miles/322 km below the Khartoum confluence, it receives the intermittent Atbara, the river's last tributary. Debouching into the Mediterranean 1,680 miles/2,705 km below the Atbara confluence, the Nile has for thousands of years dropped a great silt load to build up the extensive delta that is an integral part of the country. However, the Aswan High Dam has changed the river regime, and the Nile no longer brings silt to add significantly to its delta. Over the past 150 years, several barrages and major dams have been constructed to regulate the Nile flow, with the climactic structure the Aswan High Dam. Major political problems concerning the Nile are discussed in Chapter 8.

Fold Belt Rivers. Asia Minor and the western Iranian highlands have many perennial streams, only a limited number of which carry sufficient volume to be noteworthy. Clockwise, they include the Büyük Menderes in southwestern Anatolia; Gediz, debouching just north of Izmir; Sakarya, draining the highlands between Ankara and Istanbul and reaching the Black Sea west of Zonguldak; Kızıl, or Kızılırmak (Turkish: *ırmak* = river); the ancient Halys, with its basin comprising much of north-central Anatolia, making a broad loop before reaching its appreciable delta between Sinop and Samsun; and Yeşil, debouching across its delta east of Samsun. Most of these Anatolian rivers have been dammed for power generation.

Farther east is the Aras, which forms the Turkish-Armenian and Iranian-Azerbaijanian borders and empties into the Caspian Sea over the combined Kura-Aras delta south of Baku. In Iran, the Qezel Owzan-Safid drains a considerable area between Tehran and

Tabriz and then cuts through a steep-sided gorge in the western Elburz (where it has been dammed) to empty into the southwestern Caspian over an appreciable delta; the Zayandeh, or Zayandeh Rud (Persian *rud* = river), has an importance beyond its physical volume as it irrigates a considerable area around Esfahan before losing itself in a sump southeast of the city; and the Karun carries the largest volume of all Iranian rivers across a huge delta built jointly with its tributary, the Dez, and the nearby Karkheh. In Turkey, the two parallel Ceyhan and Seyhan rivers drain into the northeastern corner of the Mediterranean across the extensive Çukurova (Turkish *ova* = plain), the combined deltaic plain built by the two rivers.

Three Levant Rivers. Three modest rivers in the Levant have economic and political significance (see Chap. 8) far beyond their physical dimensions. The Jordan River (al-Urdunn) has several headwaters draining southeastern Lebanon, southwestern Syria, and northern Israel; its major tributary, the Yarmuk, enters on the east bank just south of the Sea of Galilee. The Zarqa enters from the plateau south of the Yarmuk. Meandering slowly along the rift valley floor, the Jordan has cut through old lake-bed deposits laid down in the late Pleistocene pluvial periods, when the ancestral Dead Sea was as much as 655 ft./200 m higher than at present (Fig. 2–5). Increased diversion of the Jordan and its tributary waters for irrigation purposes by Israel and the Kingdom of Jordan utilizes most of the river's water, except at flood time, before it reaches the Dead Sea. Thus, both the Jordan River and the Dead Sea are shrinking.

The two other Levant rivers of note, both fed by springs, arise within a few hundred meters of each other near Baalbak in the northern Bekaa of Lebanon and then flow in opposite directions. The Litani, the ancient Leontes, flows southward and below the Qirawn Dam enters a rapidly deepening and colorful gorge before turning sharply westward to the Mediterranean. Its course lies entirely within Lebanon. Israeli water planners have long sought methods by which to divert some of the Litani's water into the upper Jordan basin to increase irrigation supplies for Israel. The historic Orontes River (Arabic: Asi) flows northward along the bend in the Levant Rift into Syria and continues through Homs and Hamah, enters the reclaimed Ghab Marshes in a graben at the north end of the rift valley, and after flowing through Antakya (Antioch) in Turkey debouches into the Mediterranean.

Middle East Lakes

Few natural freshwater lakes of any considerable size and significance occur in the Middle East outside the Tigris and Euphrates valleys, where they tend to be shallow and where those in the south are in fact marshes. Large dams constructed on several major rivers during recent decades have impounded impressive freshwater reservoirs that are noted elsewhere. However, five lakes of the Middle East—only one with fresh water—are noteworthy here, and these and others are discussed in more detail in the relevant country chapters.

The two most familiar lakes in the region lie in the Jordan Trench. Although not large, the Sea of Galilee in Israel (also called Lake Tiberias and Lake Kinneret) has both religious-historical significance and crucial contemporary economic and political importance. Covering only 64 miles^2/165 km^2, the lake's surface varies between 685 and 710 ft./209 and 214 m below sea level, and its maximum depth is 138 ft./42 m. The lake occupies one of the enlarged basins in the Levant Rift System (see Fig. 2–2) and, fed mainly by and drained by the Jordan River, is now regulated as the control basin for Israel's national water system. Its generally fresh water is locally briny owing to underwater salt springs, especially near Tiberias on its west coast. Access by Syria to the northeast shore of the lake was an issue of sharp debate in the evolution of the borders of Israel.

Farther south in the Levant Rift lies the Middle East's most famous salt lake, the Dead Sea. The lowest water body on earth, its surface is more than 1,310 ft./400 m below sea level, and its maximum depth is an additional 1,300 ft./396 m lower. Like other inland lakes with no outlet, the Dead Sea has become increasingly saline because of the evaporation from its surface—roughly 96.8 million ft.^{3}/2.74 million m^3 per day—and because of the addition of salt from surrounding springs. Its water shows the highest salinity of all the world's water bodies, 35 percent, ten times that of average seawater. As a result, fish cannot survive in the water (hence the name of the lake), and the buoyancy is so great that people cannot sink while swimming in the Dead Sea.

Another result is that dissolved salts are present in such quantities that they are precipitated naturally or can be precipitated in evaporation pans, so that they are "mined" on a large scale in Israel and Jordan. This evaporation, and a steadily diminishing inflow of water from the Jordan River in the north—the lake's main supply of fresh water—owing to an increasing use of the river basin's water for irrigation, mean that the lake's surface is steadily dropping. The surface has fallen 35 ft./10.6 m since 1960. At present, the southern basin has shrunk to half its former size; completely separated from the larger and deeper northern basin by the sill extending from the Lisan Peninsula, it is now only a few feet deep.[7]

Numerous large saltwater lakes occupy closed tectonic basins in northwestern Iran and on the Anatolian Plateau. The two largest are Lake Van and Lake Urmia, the two lying on either side of the Turkish-Iranian boundary. Nestled in the rugged eastern Anatolian highlands, Lake Van, whose water is bitter because of several salts, is 82 ft./25 m deep, has a surface elevation of 5,400 ft./1,646 m, and covers 1,434 miles^2/3,714 km^2. Lake Urmia is shallower, not more than 66 ft./20 m deep, and very salty; it expands in size by one-third with the spring runoff to cover 2,317 miles^2/6,000 km^2.

The structurally and topographically complex southwestern part of Anatolia cradles a dozen salt lakes between Denizli on the west and Konya on the east. In northwestern Anatolia, lakes also occupy inland extensions of grabens both east and south of the Sea of Marmara. Tuz Gölü (Turkish: salt lake) is a shallow evaporation pan in the central Anatolian sump that expands and contracts markedly according to seasonal precipitation.

Groundwater

In addition to surface water, underground water is of vital significance in the Middle East and has been for thousands of years. Some groundwater comes to the surface in natural springs—artesian springs (*ayns* in the Arab lands), or contact springs—or emerges from caverns dissolved in limestone. Other water is tapped by hand-dug wells, familiar from biblical and Quranic accounts, many 50–100 ft./15–30 m deep. Some wells in desert areas, especially those sunk by nomads, may be only a few feet deep, dug into the sand and gravel of a broad wadi or an alluvial fan.

Especially in Iran, but also in other Middle Eastern areas, water in alluvial fans is tapped by a remarkable *qanat* system (also called *foggara, falaj, karez*), underground tunnels with spaced access wells reaching the surface (see Chap. 5). Thus, oases in the desert may be supplied by river water (Nile, Tigris, Euphrates), natural springs (in Egypt's Western Desert and in Saudi Arabia's Hofuf and Qatif oases), or dug wells (many in Iran and Saudi Arabia's Najd).

Rapidly growing populations, greatly increased supplies of capital, and increased exploitation of the environment in the Middle East have focused regional and national attention on water resources in general. Vast areas have no dependable surface runoff, but modern hydrogeological studies have discovered that some of them have surprisingly large underground water supplies, despite their desert character. The great alluvial fans of the UAE are a particular example of such an area. Especially since the 1950s, technology has been applied to the search for and exploitation of underground water, with the result that supplies beyond any earlier expectations have been found and are being pumped by electric or internal combustion engines from deep wells. It is now known that some of this water, usually in the deeper aquifers, is nonrenewable fossil water that was accumulated thousands of years ago, especially during the pluvial periods of the Pleistocene. Other aquifers are inexplicably recharged in the short term, even in areas that receive only minimum amounts of precipitation. The problem is that modern technology might permit such an overuse of these limited water supplies that critical shortages will develop within two or three decades.

In the central Arabian Peninsula, outcropping sedimentary strata of the Arabian Shelf contain aquifers that are recharged by the low annual rainfall in Najd and that then carry the water at increasing depths underground very slowly eastward toward the Gulf coast. Some of this water emerges in artesian springs in Hofuf, Qatif, and Bahrain, as well as from the Gulf bottom near Bahrain; some is tapped by wells. Some is pumped from wells drilled in the recharge area itself, and enormous amounts of fossil water in the Cretaceous Wasia and Biyadh aquifers are being heavily exploited, although recently in decreasing amounts, in central Saudi Arabia. In the Western Desert of Egypt, the widespread Nubian sandstone, which overlies the Nubian Shield, also contains huge amounts of fossil water that is being increasingly exploited. Some of this water emerges in the five oases of the area. Groundwater also plays a vital role in the water supplies of Mount Lebanon, western Jordan, the coastal plain of Israel, and, indeed, every country of the Middle East, as will be discussed in later chapters.

Thus, the significance of the patterns of physical features goes far beyond that of the landforms as such. Great importance attaches to the features' influence on and interaction with other patterns, cultural and biophysical. Topography has always influenced and will always influence where people cultivate their fields, build their settlements, align their transportation routes, construct their ports, fight their battles, and conduct their other activities. Similarly, landforms have interacted with climate, soils, and vegetation to create the infinitely varied natural environment. Above all, the utilization of water has been and is the single most critical aspect of the human experience in the Middle East. Economic and political aspects of the water problem are discussed further in Chapter 8.

Along with geomorphology, climate and its major effects play an important part in Middle East culture and regional developments.

THE SKIES AND THE WINDS: CLIMATE

Climate has as much direct and indirect impact on people and their activities as any other geographic factor. It affects the preferred places for human habitation, clothes people wear, the design of their houses, the vigor of their outdoor labor, the need for energy to cool or heat their homes, where various crops grow best, and many of their daily activities. In its interaction with other biophysical elements, the role of climate in a given environment is of pervasive significance. Temperature, precipitation, and winds, for example, influence other natural elements in the landscape—vegetation especially but also soils, landforms, and animal life. In turn, temperature and precipitation types and amounts are influenced by elevation and mountain barriers.

Factors of Middle East Climate

Whereas weather is the sum of day-to-day conditions of the atmosphere, climate is the long-term average of those conditions. Thus, climate may be thought of as "statistical weather." Six basic factors of climate in the Middle East, as elsewhere, control climates in general, although they have their own regional characteristics and balance. These six factors are latitude, seasonal pressure belts, passing pressure systems, land-water relationships, ocean currents, and landforms.[8] All of these except ocean currents, which are not of major importance in this area, are examined in their Middle East context.

Latitude. The latitudinal location of a place has two critical direct influences that in turn exercise major indirect influences. First, the latitude determines the angle at which the rays of the sun strike the earth and, thus, basically determines the amount of insolation, or solar radiation, a place receives. Second, as the vertical rays of the sun at noon shift latitudinally with the seasons, belts of atmospheric pressure and winds (and their effects on precipitation) shift accordingly. Located between 13° and 42° N Lat, the Middle East lies in the lower to middle latitudes. For comparison purposes, the lower 48 United States lie between 25° and 49° N Lat.

For general discussion purposes, the 35th parallel may be used as a rough dividing line between the more humid northern areas of the Middle East and the more arid southern three-fourths. The Levant coast and other highland areas are, of course, exceptions to this division.

Seasonal Pressure Belts. Atmospheric pressure, whether in a belt or in a "cell," influences whether air in a given belt is descending or rising, but far more significantly, pressure in adjacent belts or cells determines the strength, direction, duration, and other characteristics of winds in a given area. In general, two main pressure belts affect Middle East weather conditions.

First, most of the arid southern zone of the Middle East south of the 35th parallel lies much of the year under a subtropical high-pressure belt, a discontinuous east-west zone in which descending dry air heats adiabatically and desiccates by compression. The belt itself is marked by calms; however, once the subsiding air reaches the surface, it pours outward both northward and southward. The airflow toward the pole joins the belt of the westerlies, and the flow toward the equator veers counterclockwise to become the northeast trade winds. The dry high pressure and the dry northeast trades produce a desert belt that extends from the Atlantic Ocean eastward across North Africa, including the great Sahara (Arabic *sahra* = desert), then across Arabia and Iran to merge with the interior, midlatitude deserts of Central Asia (Figs. 2–1 and 2–8).

Second, the more humid areas north of 35°, extending from the Aegean and Mediterranean seas to northern Iran, are primarily a zone of transition between pressure belts and generally have a typical Mediterranean climate. In this climate type, conditions alternate between hot, dry summers and cool or cold, relatively moist, winters. In summer, this zone lies under dry continental trade winds or descending hot, dry air, a seasonal extension of the full desert conditions farther south. In winter, this same zone lies under a belt of stormy westerlies and passing atmospheric depressions that migrates southward during the low-sun season.

An added contrast between winter and summer conditions in the southernmost

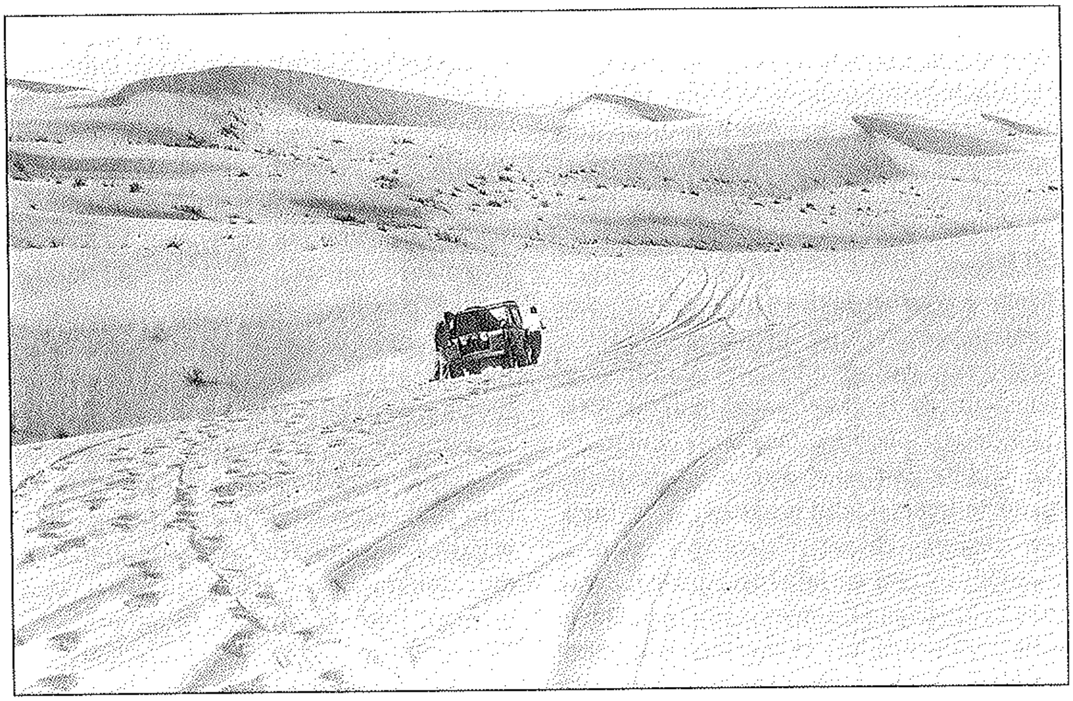

FIGURE 2–8 Giant sand dunes in vast dune field of al-Liwa in southwestern Abu Dhabi, UAE, indicating the extreme desert conditions of the lower Gulf region. Although surficially useless even for nomadic herding, the area has subsurface structures that contain huge petroleum and natural gas reservoirs.

Middle East results from the seasonal reversal of the great Asian pressure systems and the monsoons (from Arabic *mawsim* = seasons). Surface counterclockwise airflow out of the huge Asian high pressure streams northerly over the Middle East in winter ("northeast monsoon"), whereas in summer, deflected trade winds flow southwesterly over the Middle East into the deep Asian low ("southwest monsoon"). This seasonal pressure and wind reversal, with the migration of the vertical rays of the sun, involves the corresponding migration of the equatorial low-pressure belt, or doldrums, technically the Intertropical Convergence Zone (ITCZ). This belt is sometimes referred to as the Near-Equator Trade Wind Convergence (NETWC), or, more informally, the "monsoon trough," but all the names are indicative of the nature of the belt. Extending across the extreme southern Arabian Peninsula, the ITCZ breeds critical late spring and early fall precipitation in Asir and Yemen in the southwestern part of the peninsula and in Dhufar in southern Oman in the southeast. More discussion is given to this phenomenon under the "Precipitation" section below.

Passing Pressure Systems. Passing low-pressure systems—depressions, or "lows"—are the winter weather-makers for the northern and central parts of the Middle East. In autumn, as the vertical rays of the sun at noon shift southward, the belt of the stormy westerlies and the mean position of the polar front also shift southward over the northern sector of the region. Within that belt, in response to positioning of the jet stream, cyclonic depressions periodically move from west to east, following several regular tracks across the northern third of the Middle East.

These precipitation-producers pass near Cyprus and continue across Lebanon, Syria, and Iraq into Iran, although one track goes north of Asia Minor through the Black Sea. Less frequently, low-pressure systems cross Israel and Jordan and veer southeastward into the Arabian Peninsula. In most of the region, these weather-makers bring the winter precipitation that is characteristic of the Mediterranean climate. Similar patterns are found in southern California, Italy, Greece, and elsewhere.

Land-Water Relationships. The land-water patterns in the Middle East are major influences on climatic conditions in the region. Since the sea is the ultimate source of all moisture, the presence of water bodies, especially on the windward side, increases the potential for precipitation and humidity. Because of the high specific heat of water, large bodies of water also moderate the temperature of the air above them, warming onshore winds in winter and cooling them in summer in a heat exchange. This phenomenon influences coastal rims of all five Middle East seas, but it especially affects the more northern areas, along the Black Sea and Caspian coasts and along the eastern Mediterranean shores.

Landforms. Topography influences every aspect of climate. Highland areas have lower temperatures; mountain barriers intercept winds and wring moisture from them; mountain masses shunt storms to one side or the other; and open seas and plains give full play to prevailing winds. Highland masses such as the Anatolian Plateau divert passing storms to the north or south, influencing the storm tracks and other climatic elements. Since, in the normal lapse rate, temperature decreases 3.3°F/1.9°C for each 1,000 ft./305 m of elevation, highland areas enjoy temperatures lower than those of adjacent plains. Many favored mountain areas in the Middle East become bustling resort centers during the hot summers.

Highlands may also produce orographic (mountain-induced) precipitation from moisture-laden winds. Mount Lebanon is a classic example: Moist westerly winds from the Mediterranean blow against the windward slopes of the north-south mountain range behind Tripoli, Beirut, and Sidon. As the winds move upslope, they are rapidly cooled adiabatically at 5.5°F/3.1°C for each 1,000 ft./305 m, reach cloud stage and then dew point as they lose capacity to hold moisture, and precipitate rain at middle elevations and snow on the upper slopes (Fig. 2–9). Similar orographic influences operate on the windward slopes north and south of Mount Lebanon, as well as in the Anatolian, Zagros, Elburz, and Yemen mountains. Areas on the leeward side of mountain chains, by contrast, tend to be drier, or even arid.

Elements of Middle East Climate

The climate factors just reviewed combine to produce various climate characteristics, such as temperature, winds, precipitation, humidity, and evaporation, which in turn produce certain climate types in specific areas: deserts, steppes, and humid temperate zones. Temperature and precipitation patterns are shown in two maps (2–4 and 2–5), and data for those same elements at selected stations are listed in Table 2–1. The table also gives elevation, latitude and longitude, and climate type for each of the stations; the distributional patterns of the climate types are given in Map 2–6.

Temperature. The hallmarks of Middle East climate are without question heat and aridity. Thus, temperature is the premier element in this survey of the regional climate. Markedly high temperatures prevail more than half of the year in most of the lowland areas of the Middle East, especially interior areas or those subject to airflow from the

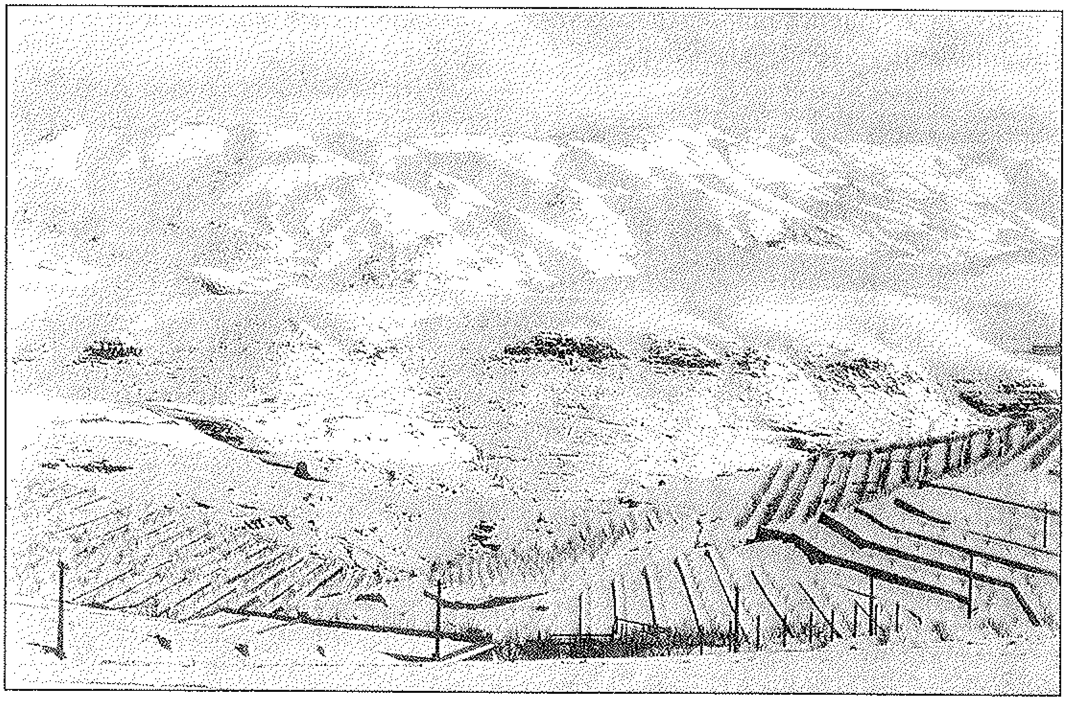

FIGURE 2–9 Dahr al-Baydar, pass in central Mount Lebanon, with its typical heavy winter snow cover. Moist winds blowing off the Mediterranean ascend the steep slopes and, during January to March, drop several feet of snow at upper elevations. Apple orchards are on the terraces in the foreground. Jabal Baruk is in the distance, with one of the remaining groves of Cedars of Lebanon.

interior (Map 2–4A). Although July and August are the hottest months, the period from April through October is warm to hot in most of the region. Afternoon temperatures of 100°F/38°C are registered in the middle Nile Valley and in the interior of Arabia by early March, and such temperatures may continue well into November. Averages of more than 90°F/32°C for the hottest months are common for extensive areas of Iraq (95°F/35°C for July in Baghdad), Iran, and especially the Arabian Peninsula. The cloudless summer skies, typical of desert and Mediterranean climate conditions, add to elevated daytime temperatures.

However, in data for desert stations, the averages mask the extremes of temperature. For example, at Abqaiq, an oil-production center in eastern Saudi Arabia, the mean daily temperature for July and August is a broiling 98°F/37°C—compared, for example, with 91°F/33°C for Yuma, Arizona, in July, one of the highest monthly means in the United States. But even more revealing is the average of Abqaiq's daily *maximum* temperatures (afternoon highs) for July, August, and October—112°F/44°C, 113°F/45°C, and 114°F/45.5°C, respectively. The station has recorded an absolute maximum of 125°F/52°C in July, and in many years fifteen or twenty consecutive weeks pass during which afternoon highs exceed 100°F/38°C. Baghdad, 600 miles farther north, records average maximum afternoon highs for July of 110°F/43°C, with the absolute July maximum reaching 125°F/52°C.

Before air-conditioning became common in the region, many older homes in the Middle East included an underground room (known as a *sirdab* in Iraq) in which the family sought relief from the summer heat. In the hotter areas, especially along the humid