CHAPTER V.

PLAINS, PLATEAUS, AND DESERTS.

PLAINS.

46. Continental Shelf Plains. — Off the coast of eastern North America there is a sea-bottom plain sloping out into deep water (Fig. 116). It attains a width of 50 or 100 miles, and its outer edge is covered by about 600 feet of water. The surface is a level expanse of sand near the coast, and of mud farther out. The plain is made of layer upon layer of sediment washed from the land, and the waves and currents are constantly adding to it. Other continents are bordered by similar sea-bottom plains, or continental shelves (Fig. 316).

Should this sea bottom be raised 600 feet, a broad strip of plain would be added to the American continent. It would slope at the rate of a few feet a mile, and the rain that fell upon it would find such difficulty in passing off that much of the surface would be swampy.

Summary. — *Continents are bordered by sea-bottom plains, or continental shelves, made of sediment from the land.*

47. Coastal Plains. — Uplifts have actually added such plains to the land (Figs. 122, 123). Some are narrow strips at the base of mountains, as in western South America (Fig. 117), where the land is still rising; others are many miles wide, like the plain that skirts the coast south of New York. Because they border the coast they are called *coastal plains.*

The coastal plain of the Atlantic and Gulf coasts extends from New Jersey to the Rio Grande, and includes the peninsula of Florida. Wells bored into it pass through hundreds of feet of gravel, sand, and clay, often finding water in the

FIG. 116. — Continental shelf off eastern United States. (Vertical scale greatly exaggerated.)

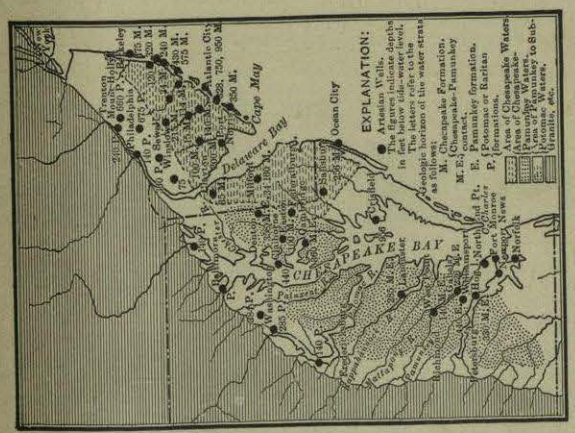

FIG. 115. — Location of artesian wells on the coastal plain from New Jersey to Virginia.

FIG. 117. — Narrow coastal plain of Western South America, a few miles wide.

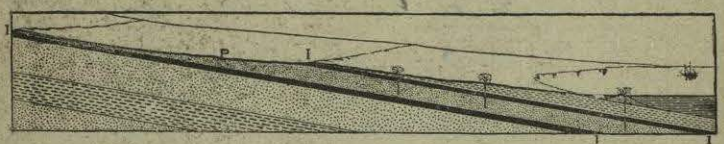

FIG. 118. — Diagram to illustrate the cause for artesian wells on a coastal plain. Water passes down the porous layer *P*, and is prevented from rising or going deeper by the impervious layers, *I*, *I*. When a well is bored down to the porous layer the water rises to the surface because it has entered higher than the outlet of the well, and is under pressure of the water in the porous layer, which, therefore, forces it out. Such a well may even be bored on a sand bar in the sea, finding water beneath the impervious layer.

FIG. 119. — The Florida plain along the St. John River.

FIG. 120. — A view of the palmettoes on the Florida plain.

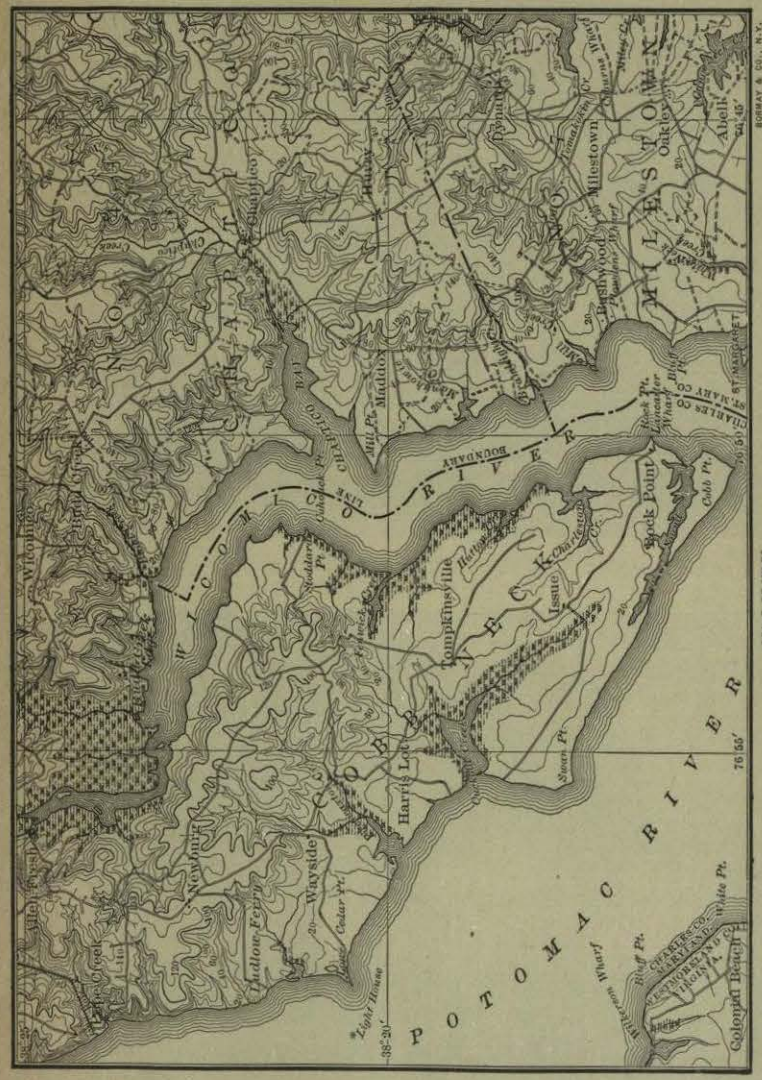

Fig. 121. — The coastal plain along the Potomac River. Notice how level it is; how branching the bay is; how swampy the lower courses of the rivers are; how flat-topped the divides are; and how the roads follow them. (The lines are contours.) (From Wicomico, Md., Sheet, U. S. Geological Survey.)

porous, sandy layers. Where the water rises to the surface, it is called an *artesian well* (Fig. 118). There are hundreds of such wells along the Atlantic coast (Fig. 115), and many cities, such as Galveston, obtain drinking water from them. Artesian water is pure and free from the germs that abound in surface drainage.

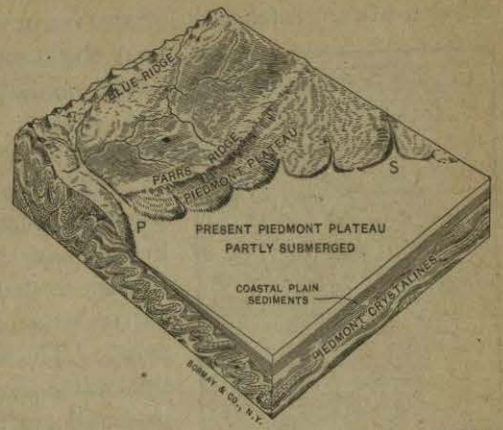

Fig. 122. — A sea-bottom plain being formed by the deposit of sediment on a submerged old land.

Fig. 123. — Same as Fig. 122, elevated to form a coastal plain. Rivers from the old land are extended out upon the coastal plain. This is the condition of the coastal plain southward from New York.

Much of the coastal plain is so sandy that it is poorly adapted to agriculture, and is still occupied by an open pine forest in which cattle roam, feeding on the scattered grass. The forest supplies valuable lumber, turpentine, tar, and other products. The higher and less sandy tracts are favorable to agriculture, producing fruit, grain, etc., in Maryland, Delaware, and other

states, and cotton, corn, and other products in the South. Along the coast and near the rivers the land is swampy, being useful in the South for rice culture.

FIG. 124. — The branching Chesapeake. The lines show the probable position of the rivers that formed this branching, submerged valley.

A slight sinking of this coastal plain has admitted the sea into the valleys, transforming their mouths to shallow bays (Figs. 121, 124), the seats of oyster and fishing industries. Some of the deeper bays have good harbors, though a fringe of sand bars partly cuts off the entrance to many. The shallower bays and tide-water rivers are navigable by small craft, thus opening up large areas of country to water transportation. This has helped greatly in carrying cotton and other products to the seaports for shipment. Chesapeake Bay, with its many branches, is the largest of the coastal plain bays.

For the most part the rivers of the coastal plain are sluggish, and, in some places, the slope of the plain is so gentle that water does not run off. This causes swamps, as in parts of Florida (Figs. 78, 79, 119), and the Dismal Swamp (Fig. 307). In Texas, south of Houston, the divides are so flat and swampy that there is no agriculture, and not even cattle can find support. The surface of the Florida plain is so young, and the streams have so little sediment, that the shallow lakes in depressions of the old sea bottom have not yet been filled. Where the streams have cut into this coastal plain they occupy shallow, steep-sided valleys, with broad, flat-topped divides (Fig. 121), along whose level surface the roads run.

Where streams pass from the older land to the coastal plain (Fig. 123), their slopes increase and their courses are interrupted by rapids and falls. The explanation of this fact is that the rivers have cut faster in the soft clays and sands of the plain than in the harder rocks of the old land. For this reason the boundary between the old land and the plain is called the *Fall Line* (Fig. 125). It has had a very important influence on settlement. Even in the days of the Indians, village sites on the rivers were located along this line, — the highest points to which canoes could go from the seaward side, and where portages were necessary to pass higher upstream. White men have located cities on these same spots, the farthest points to which boats from the sea can pass inland. Along the Fall Line are located Trenton, Philadelphia, Baltimore, Washington, Richmond, Raleigh, Columbia, and Augusta.

FIG. 125.—The Fall Line. Coastal plain dotted; cities printed in heavy type are located along the Fall Line.

Summary. — *Upraised sea bottoms form coastal plains skirting the coasts of continents. There is a well-defined one from New Jersey to Mexico, much of whose level surface is too sandy or swampy for agriculture, while in Florida there are many lakes still occupying the original depressions. A slight sinking has admitted the sea into the river mouths, transforming them to shallow bays. Where streams descend from the old land to the plain there is a line of rapids and falls, called the Fall Line.*

48. The Russian and Siberian Plains. — This, the greatest expanse of plains on any continent (Fig. 21), covers an area far greater than the entire United States. These plains extend from the Caspian region to the Arctic, including a large part of northern Asia and much of Russia, with a

western branch reaching to Holland. They are made of layers of sand, gravel, and clay, washed from the mountains of Asia and Europe into a sea which has been destroyed by uplift. The uplift of this sea-bottom plain has been so recent that the streams are young; there are many swamps; shallow lakes are yet unfilled; and the divides are flat-topped.

In the North there is barren *tundra*, inhabited by scattered tribes (Fig. 126) who use the reindeer as a domestic animal (Fig. 546). The soil, frozen to great depth, thaws in summer only at the surface, making the land a vast swamp; in winter the tundra is a bleak, frozen, snow-covered desert. Toward the south it grades into the forest region which is now being cleared and opened to agriculture as a result of the building of the Siberian railway. This forest section is destined to become one of the great farming regions of the world. On its southern side the forest belt grades into the open, grass-covered *steppes* (p. 285), a region too arid for farming, and, therefore, occupied by a nomadic, pastoral people.

Summary. — *Vast plains, caused by recent uplift of an ancient sea bottom, occupy a large part of northern Asia and Europe. There is barren, frozen tundra in the north, barren, arid steppe land in the south, and forest and farm land between.*

49. Plains and Prairies of Central United States. — In ancient geological times a sea bottom between the mountains of eastern and western North America was also raised above sea level. From time to time it has been reëlevated, and numerous additions have been made to its southern margin. Denudation has also been at work, lowering and sculpturing its surface, so that in places it is hilly. It forms one of the largest areas of plains in the world (Fig. 21).

Near the Appalachian Mountains the plains reach an elevation of 2000 to 3000 feet; near the Rocky Mountains they rise from 5000 to 6000 feet above sea level. From these higher portions, really plateaus, the surface slopes toward the Mississippi, making a broad valley which that river follows, receiving long tributaries down the slopes from either side.

FIG. 126. — A Laplander on the tundra.

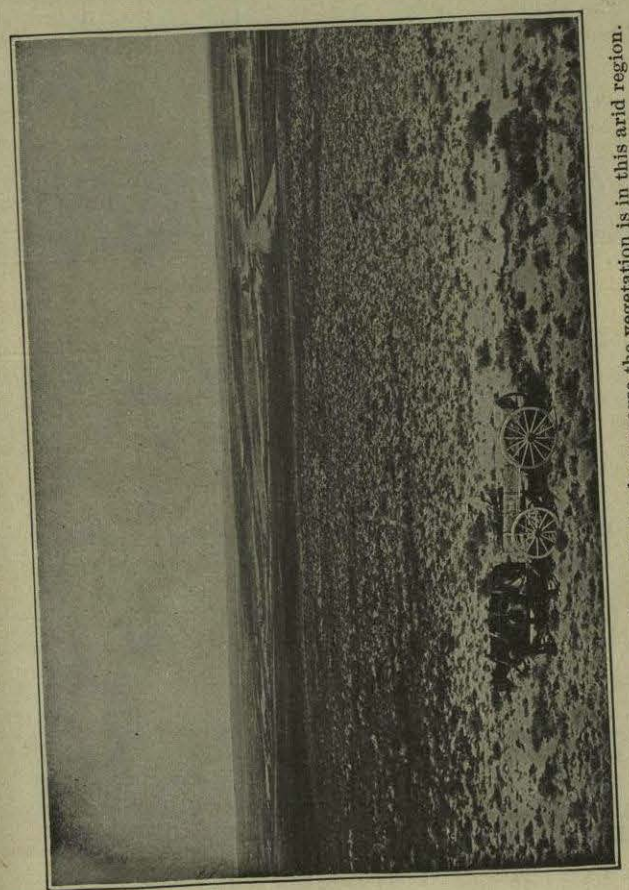

FIG. 127. — The Great Plains. Notice how sparse the vegetation is in this arid region.

FIG. 128. — Cattle on the Great Plains.

FIG. 129. — The great plains in Montana, near the base of the Crazy Mountains.

The plains west of the Mississippi are called the *Great Plains* (Figs. 127–129). In the eastern part they have rainfall enough for agriculture; but west of the 100th meridian they are suited only to grazing, though here and there rivers and artesian wells supply water for irrigation. Where the rainfall is light there is timber only along the streams. In early days, when Indians occupied them, crossing these vast plains was a difficult and dangerous undertaking.

East of the Mississippi are large areas of plain, called *prairies*, which, when discovered, were also free from forest. In some cases the treeless condition was due to fires, set by Indians in their buffalo hunts. In others the fine-grained soil seems to have been unfavorable to tree growth, but favorable to a luxuriant growth of prairie grass. These fertile, treeless prairies helped greatly in the settlement of the Middle West. A crop could be raised the first year, for there was no laborious work of clearing land for farming; and, when this was found out, settlers came rapidly and prospered.

Plains are not usually great mineral-producing regions, but are especially suited to agriculture when the climate is moist, and to grazing when arid. Yet, in the plains of central United States, beds of sandstone and limestone furnish abundant building stone; layers of salt are found; deposits of iron, lead, and zinc occur; and there are vast quantities of natural gas, petroleum, and coal. Where coal is present, busy manufacturing cities spring up, especially if agriculture flourishes, supplying materials for manufacture and a market for manufactured products. These conditions all exist on the plains of central United States.

Each of the continents has plains similar to those already described. The great plains of the Amazon, of Argentina, and of Venezuela are instances. A very large part of the land surface consists of plains (Fig. 21) that at one period or another have been raised from the sea.

Summary. — *The ancient and much worn plains of central United States slope from the mountains on each side, forming the great Mississippi valley. In the West the Great Plains are treeless, because arid; in the East, though the climate is moist, large areas, called prairies, were treeless because of the effect of fires and the compact soil. These plains, adapted to agriculture where humid, and grazing where arid, also contain mineral wealth, and, in the humid portion, have become a prosperous and busy manufacturing region.*

50. Lake Plains. — Sediment deposited in a lake levels its bottom. If the Caspian Sea or Lake Erie could be drained, their sites would become broad plains. There are places from which lakes have disappeared. Extinct lakes of this sort were formed by a great ice dam across north-flowing streams when the glacier was melting from North America (p. 149).

FIG. 130. — Extent of the extinct glacial Lake Agassiz, which occupied the valley of the Red River of the North.

An enormous lake of this kind, glacial Lake Agassiz (Fig. 130), larger than all the Great Lakes combined, existed in the valley of the Red River of the North. The fine-grained sediment that was deposited on the bottom of this extinct lake has made a fertile plain (Figs. 131, 132), one of the most famous wheat regions of the world. Its surface is so smooth that, after a rain, water stands on the ground in sheets.

A large lake also once existed in the Great Basin, round Great Salt Lake. When the climate became arid this lake was diminished by evaporation, leaving only small remnants, of which Great Salt Lake is the largest. These remnants occupy shallow depressions in the level lake-bottom plain (Figs. 133, 150, 301).

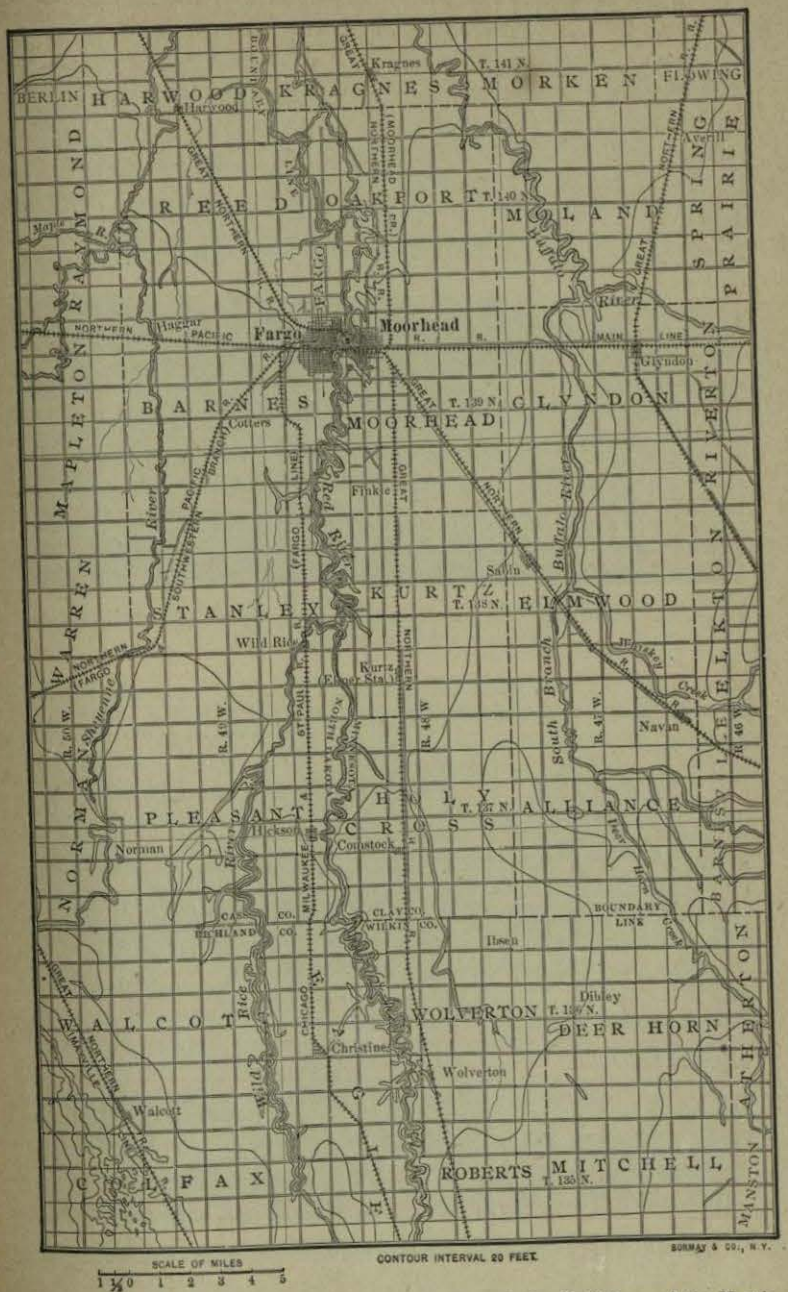

FIG. 131. — The lake-bottom plain of the valley of the Red River of the North. Notice how very level it is (see also Fig. 132). (Fargo Sheet, U. S. Geological Survey.)

FIG. 132. — Wheat fields on the Red River valley plains (Fig. 131). These plains are almost as level as the sea.

FIG. 133. — Salt Lake City, on the plain formed in the bottom of ancient Lake Bonneville (Fig. 301).

There are a number of other classes of plains. Some of these are described in the chapters on Glaciers (p. 149) and Lakes (p. 165). Others, formed by rivers, have already been described, — floodplains (p. 61), delta plains (p. 64), alluvial fan plains (p. 66), and filled valley plains (p. 67).

Summary. — *On lake bottoms sediment makes plains which may become dry land by the disappearance of the lakes, as in the valley of the Red River of the North, and the Great Basin.*

51. Life History of a Plain. — A *young plain* (p. 54) has a level surface, poorly defined and perhaps swampy divides, and

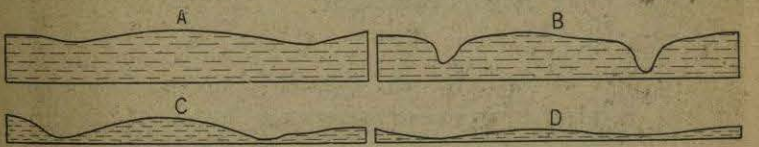

FIG. 134. — To illustrate the life history of a plain in uniform rock (*A*), through youth (*B*), to maturity (*C*), and old age (*D*).

shallow lakes. The consequent streams at first cut steep-sided valleys, with falls where differences in rock hardness are found.

In time the lakes are filled, grade is established, falls disappear, tributaries increase in number, divides narrow up, and the valleys broaden (p. 57). Such a *mature plain* has an undulating surface, and, if high, it may be so dissected as to become a hilly land (Fig. 134). In an *old plain* the valleys are so broadened that the surface again becomes nearly level.

The rock layers of a plain usually lie in sheets, gently inclined in the direction given them by uplift of the land (Fig. 118). As the surface of the plain is slowly worn down, durable layers, since they resist denudation better than weak ones, are left as uplands, possibly only a few feet, perhaps scores of feet, above the lower portions of the plain. Being in sheets, the durable layers form *belts* of hilly land bounded on either side by belts of lower land, where the weaker strata lie (Fig. 135). The plain is, therefore, sculptured into bands, or belts, of different level, corresponding

to the differences in the strata. Such a land surface, found both on recent coastal plains, as in eastern United States, and on older plains, as in central United States, is known as a *belted plain*.

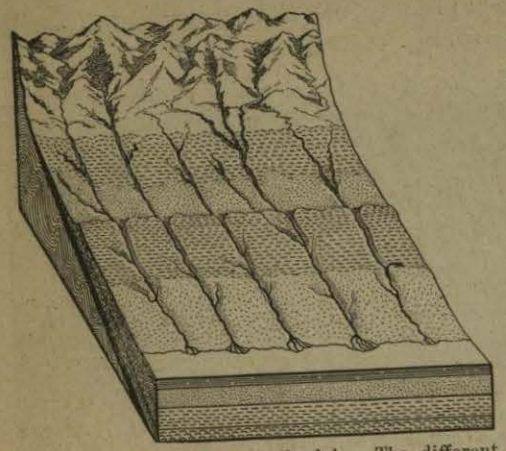

FIG. 135. — A belted coastal plain. The different symbols (dots and lines) represent different layers of rock, gently inclined toward us.

Summary. — *A young plain has a level surface and a young drainage system; a mature plain has broad valleys and a hilly surface; an old plain has a level surface again. A belted structure often results from the less rapid removal of the more resistant strata.*

PLATEAUS.

52. Nature of Plateaus. — When mountains are uplifted the country on either side is also raised, often without much folding of the strata. As the mountains rise higher the adjoining plains become more elevated, especially near the mountains and between the ranges. They may rise so high that they deserve the name plateaus, for a plateau is only an elevated plain. The plateau along the western base of the Appalachians (Fig. 146) is 2000 to 3000 feet above sea level; at the eastern base of the Rocky Mts. (Fig. 129), from 5000 to 6000 feet; between the Rockies and the Sierra Nevada, often 7000 to 8000 feet; north of the Himalayas (Fig. 136), over 10,000 feet.

Owing to the close relation between plateaus and mountains (Fig. 136), the strata of plateaus, though mostly horizontal, are sometimes broken and tilted; in fact, there is every

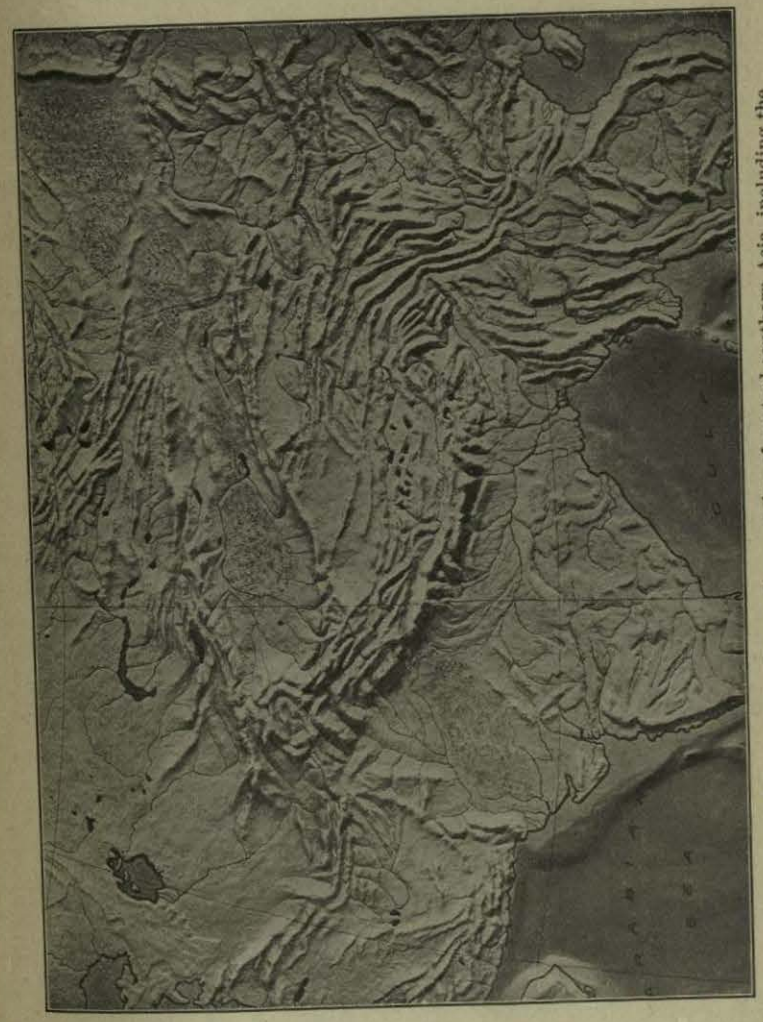

FIG. 136. — The high plateaus and mountains of central southern Asia, including the plateau of Tibet.

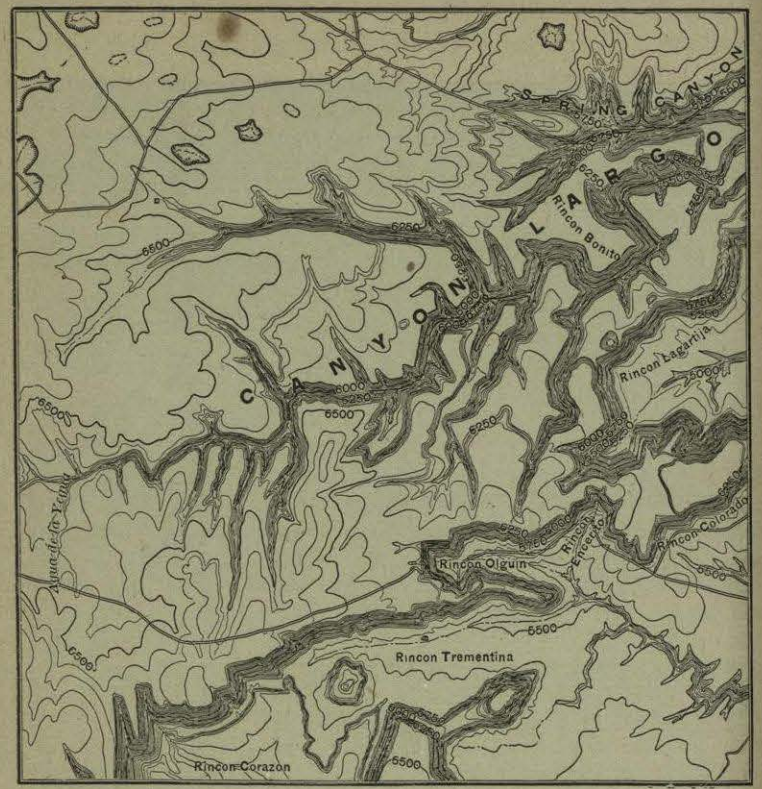

FIG. 137. — Map of a young river system on the plateau of northern New Mexico. (Part of Watrous Sheet, U. S. Geological Survey.)

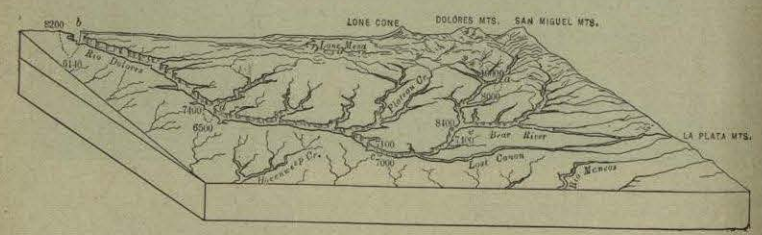

FIG. 138. — Canyon of the Dolores River, New Mexico, a young stream valley on an arid plateau.

gradation from slightly tilted plateau blocks (Fig. 155) to true mountains. Lava has often welled from the fissures, flooding large areas of country, as in the Columbia and Snake River valleys (Fig. 476).

Summary. — *Plateaus are elevated plains, raised during mountain uplift, with strata usually horizontal, though sometimes tilted.*

53. Sculpturing of Plateaus. — Rivers upon plateaus have much the same history as upon plains (p. 54); and the life history of a plateau is much the same as that of a plain (p. 79). But, being higher above base level, the streams have more work to perform, and this takes a longer time. Young streams sculpture plateaus into extremely rugged form, with flat-topped divides, and deep, steep-sided valleys, with falls and rapids. The valleys grow broader, the surface lower, and finally, in old age, the land is level again.

The sculpturing of plateaus is frequently retarded by the fact that the climate is arid and denudation therefore slow (p. 41). For this reason many arid land plateaus are still in the rugged stage of youth, even though in years they may be far older than maturely dissected plateaus of humid regions. For the same reason arid plateaus have an angular topography (Figs. 140, 148), while in moist climates denudation more commonly rounds the edges of the strata.

Summary. — *Plateaus, like plains, pass through stages of youth, maturity, and old age. But, since they are higher, the time required to lower them is longer, and the land forms produced are more rugged. The arid climate of many plateaus retards denudation and therefore prolongs youth.*

54. Canyons. — A canyon is the deep, steep-sided valley of a young plateau stream (Figs. 137, 138). Canyons are found on most plateaus, being a characteristic result of the early stages of river erosion in high plateaus. By far the best instance is the Grand Canyon of the Colorado. (Frontispiece; see also p. 322.)