view, as the juices would be consumed in perfecting the flowers, and the roots thus become useless. The planting of buds and runners for a new crop is done in the early part of April."

In Bentley and Trimen's *Medicinal Plants*, vol. ii., under plate 74, it is stated that "both Spanish and Russian licorice roots are usually imported in bales or bundles, or, rarely, in the case of that portion of the Spanish variety which is derived from Alicante, loose or in bags. The Spanish licorice root is in straight, unpeeled pieces, several feet in length, and varying in thickness from a quarter of an inch to about one inch. That from Alicante is frequently untrimmed and dirty in appearance, but that from Tortosa is usually clean and brighter looking. The Russian licorice root, which is imported from Hamburg, is either peeled or unpeeled. It is in pieces varying from twelve to eighteen inches in length, and from a quarter of an inch to an inch or more in diameter. Combined with the usual sweetness of licorice root, this variety has a feebly bitter taste."—*Kew Bulletin*.

CONSERVATORY CHAPEL AT LAEKEN.

In the grounds of the Palace of His Majesty the King of the Belgians, on high ground, with the lake beneath, and with the opposite bank richly clad with flowering shrubs, capped by the picturesque old windmill, which visiting artists always admire, stands the recently finished conservatory chapel, planned by His Majesty, and which, while being a novelty in its way, is a beautiful one. Wholly built of glass and ornamental iron-work, it is externally, and by its arrangement internally, in the nature of a gigantic conserva-

in the gardens as we pass. On the steps are vases filled with flowering plants, and on the roof the flowers of varieties of *Tropæolum Lobbianum* and of *Pelargonium peltatum*. At the bottom is a fine group, in which the center consisted at the time we write about of a grand plant of *Cattleya Trianaei*, with about sixty open flowers. Passing along the corridor, we remark the numerous plants of the useful *Coronilla glauca*, which are trained over the roof, and which it is intended to plant more extensively. Arriving at the first tropical house, filled with giant *Pandanus*, *Pritchardia pacifica*, and other species of palms, tree ferns, *Bromeliads*, and many large baskets suspended from the roof filled with grand plants of *Goniophlebium subauriculatum*, with fronds ten to twelve feet long, we continue along the corridors, the principal plants in flower in which were quantities of *Clianthus puniceus*, *Tacsonias*, and other climbers, and then we come to the great azalea house, a blaze of bloom in the season, with the flowers of the fine specimens of *Azalea indica* varieties, but brightened by the soft yellow, salmon, and red tints of the *Azalea mollis*, and the fragrant *mignonette*, which is grown remarkably well at Laeken. Continuing along the corridors, in this part brilliant with the bright trusses of some of the scarlet *pelargoniums*, which adapt themselves for training, we come to the orchid houses, where only showy species are grown, useful for cutting or decoration. In the next stretch of covered way the fuchsias depending from the roof and clothing the sides are very effective, and the *heliotropes* both pretty and fragrant. Here, too, *Brugmansia sanguinea* is covered with large flowers.

Descending the steps to reach the tunnel, here necessary to cross the roadway, we remark the fine effect of

THE GEOLOGICAL DEVELOPMENT OF THE UNITED STATES.

By RALPH S. TARR.

A STUDY of the fossils, and of the rocks themselves, has given geologists a basis for a chronology; and the history of the earth is, therefore, divided into periods which do not mean periods of time, but periods in the life history of the planet. Thus the Archean does not represent a period of years, but a period including those rocks which were laid down before the oldest known fossiliferous rocks. The Paleozoic, divided into Cambrian, Silurian, Devonian and Carboniferous, includes fossiliferous rocks which have certain definite fossils; and coming down toward the present, we have the Jura-Trias and Cretaceous as divisions of the Mesozoic, and Tertiary and Quaternary as divisions of the Cenozoic. Different text books adopt different names, but these are the ones used in this article. They cover a time incalculably long, amounting probably to millions of years; and from their pages the geologist is able to read a story with here and there a missing page, but with a sufficiently continuous record to enable him to place a correct interpretation upon the events of most importance in the history of the earth.

What the conditions were in this country during the earliest ages is only partly known. We believe that the planet was once a part of a nebula, and that it has assumed its present form by loss of heat and consequent solidification. Indeed, many of the changes of the past and present are apparently due to the continued loss of heat and contraction of a globe still hot within. The earth must have first of all become

THE CONSERVATORY CHAPEL AT LAEKEN.

tory, the only evidence of its being consecrated to divine service being the altar piece, which faces the entrance, and a few other less conspicuous objects. The width from the entrance to the altar on the opposite side is about 140 feet; the height of the dome 100 feet. The space beneath the dome has a mosaic floor, on which chairs are placed, leaving a walk up the middle. The dome is supported by ten pairs of polished red granite pillars on white pediments, and around each pair a space is laid out with tile edging, in which tall palms and tree ferns are planted, faced by flowering plants, which are removed as they go out of bloom, and are replaced by others in flower. Around the space beneath the dome is a circular walk, 20 feet in width, and beneath which the pipes for heating the structure are laid. On the outer side of the walk, and bordering the building, provision is made all around for palms and flowers, and lofty alcoves are arranged, in the front of each of which a white marble statue is placed, the alcove behind being filled with lofty palms and other foliage and flowering plants, some of which are permanent, and the others removable. It is altogether a beautiful structure, and artistically arranged, and one in which the hand of time will evolve still greater beauties, as the plants grow and adapt themselves to the positions in which they are placed. It is scarcely necessary to say that it is lighted by electric light, in the same way as the miles of the flower-planted corridors which connect all the conservatory-like buildings, in which state functions are held, the great palm houses, the orangery, etc.

Descending the steps at the side, and under the guidance of Mr. Knight, who has charge of the vast domain, we proceed to note a few of the more striking features

the standard *Polygalas* and *Genistas*. The board steps leading to the fine winter garden, palm house, and orangery, often alluded to in these pages, have a very pretty show of flowers, among which were some very effective orchids. Overhead were suspended large masses of *Oncidium pulvinatum*, with their long, pendent sprays of yellow flowers. Around the great palm house the planted out specimens of *Euphorbia jacquiniæflora* are perfectly charming, arching their pretty sprays of vermilion flowers over the side of the walk, each plant having twenty to thirty sprays, some of them with nearly two feet length of flower at their tips. Vases of *Cattleyas* and *Cypripediums*, too, give bright color, and the fine old palms are indescribably stately and picturesque in this gigantic structure, whose dome, supported by enormous white pillars, is about 140 feet in height. The orangery, with its rows of huge specimens, beautiful in the subdued light; the magnificent *camellia* house, filled with flowers; and the good show of greenhouse *rhododendrons*, were in that perfect order in which Mr. Knight keeps everything in this great garden. His office is no sinecure, for some hundred and forty regular men are employed under him, and the extent of the work under glass alone may be estimated when it is said that in a single year over £3,000 has been spent in fuel to heat the structures alone.—*The Gardeners' Chronicle*.

THE Spanish peasant works every day and dances half the night, and yet eats only his black bread, onion and watermelon. The Smyrna porter eats only a little fruit and some olives, yet he carries with ease his load of two hundred pounds.

liquid and then solid. We have no determined signs of the original crust of the earth, though some hold that the rocks of Archean age, the granitic gneisses of Canada and New England, are a part of this original crust. If this be the case, we have not yet learned to discover from these rocks any facts concerning the early history of the globe.

When we come down to the beginning of the Paleozoic, the time when the first well defined signs of life appear in the rocks, our history is more perfect. Just as the history of man becomes more and more obscure as we go backward from the present, so the history of the earth is more dimly recorded in early ages than at present. We have not yet learned whether life existed on the earth before the Paleozoic. Some have argued that the presence of graphite, phosphate deposits, limestone and iron, are of themselves proofs that there were organisms in the Archean. These are not, however, necessarily proofs of this, but are mere suggestions; for all of these may have been formed in a different way. Supposed evidences of fossils have been recorded from these rocks, some of them being apparently valid, others without foundation. To my mind, the strong argument in favor of the existence of Archean life is the fact that at the beginning of the Paleozoic there appears in the rocks a great assemblage of fossil forms. Ever since then these forms have been widening in development, and it seems fair to believe that they had done so before the Paleozoic. Still, the Archean reveals to us no definite evidence of organic life in variety. It is true that such signs would hardly be expected in these old rocks, which have been so altered that even their original character is masked, and from which it would seem

probable that all delicate organisms would be removed.

Concerning the physical geography of the Archean times in this country, we have a little more knowledge. The continent of North America seems to have been thus early outlined. There was in Canada a great land area, probably rising in mountainous heights, the remnants of which are seen in Labrador, central Canada and northern Canada. Along the present site of our western Cordilleras there appears to have been an archipelago, the Canadian land extended into the United States near Lake Superior, and there was an area extending from New England southwestward, along the eastern flank of the present Appalachians, down into the Southern States. The Adirondacks formed a land area, perhaps an island. How far eastward into the Atlantic this eastern mountain area extended we cannot say, but it certainly extended some distance. Nor are we able to estimate the height of the mountains; but all things appear to indicate that they were very high.

Where now is located the central plain of the United States, that is the Mississippi Valley, there was a great inland sea; but its shore lines are not traceable in all places. It impinged upon parts of the Cordilleran Archipelago, the Canadian Highlands, the Adirondacks and the Highlands of New Jersey. Connecting these points, it seems probable that we would have a rough idea of the shape of the inland sea; but the form and extent of the inclosing land areas may only be guessed. One fact brought out in several places is that there was a soil on the Archean land, derived from the disintegration of the rocks, just as is the case at present in the Southern States and in most southerly temperate and tropical latitudes. We are not without indication also that there was abundant volcanic activity in Archean times. The conditions, therefore, appear to have been in many respects like the present, although the physical geography was very different.

Along the margin of this land the early Paleozoic sediments, the Cambrian, were accumulated. The two great depressions of the land to-day, the Mississippi and the St. Lawrence valleys, were submerged, having their present condition thus early outlined, just as the present highlands were then outlined. In the mountains of the East, early Paleozoic eruptions occurred and volcanoes existed in many places, among others near Boston and in Maryland. We find to-day the lavas that flowed out in those times, and the volcanic ash that was thrown into the air. The volcanic cones have long since wasted away, as indeed have the very mountains themselves, and we have only here and there fragmentary records of these early Paleozoic volcanic episodes.

During nearly all of the Paleozoic, that is, through the long ages of the Cambrian, the Silurian, the Devonian and a part of the Carboniferous, the interior sea maintained its existence and was the gathering ground for the waste from the inclosing mountainous lands. Many thousands of feet of rocks, sandstones, shales, conglomerates and limestones were deposited in this sea, which slowly subsided as the sediments accumulated. Here were then formed the stores of building stones which we are now using, just as similar rocks are forming in existing oceans. For the gathering together of these quantities of rocks ages to be measured in hundreds of thousands of years must have elapsed.

Where now the Appalachians are situated there was then a shore line with a land area extending eastward beyond the present coastline. Large rivers entered the Mississippi sea, adding to the ocean bottom the sediments which they bore. The climate was then more equable than now, and there existed in favorable places, just as in the Bermudas of to-day, reefs of coral, which are now fossilized in some of the limestone beds. A warm current appears to have circulated in this interior sea, and different geologists have postulated a great Sargassum Sea in the swirl of this current. In this way attempts have been made to account for the bituminous shales of Kentucky, and also for the zinc-lead deposits of Missouri and neighboring States, the idea being that the constant decay of the floating seaweed in one case furnished carbonaceous matter, in the other disseminated lead and zinc, which were later gathered together just as flint in chalk is gathered into nodules, from a disseminated state, by a process of segregation or concretion.

Toward the close of the Paleozoic, that is in the Carboniferous time, the beginning of the Appalachians and central plains was made by an elevation, which transformed this part of the inland sea into a shallow water and marshy land. Here the coal vegetation grew, and we owe to this condition the supply of fuel upon which we are now depending. The conditions at this time were very peculiar, but we cannot at this time enter into their consideration. Suffice it to state that a luxuriant vegetation, resembling the present tropical flora, in many characteristics, grew upon a swampy land, perhaps upon a salt water swamp. The temperature was more equable than now, the moisture apparently greater and the land in an unstable condition. The latter point is indicated by the fact that coal beds were formed and then covered with marine sediments, upon which other coal-producing forests were accumulated. That is, there was an alternation of land and ocean several times repeated.

Immediately following this condition, which may be considered a premonition of what was to follow, came the formation of the Appalachian in the Permian period and the formation of the plains of the central States. Since that time these areas have been dry land continuously and the eastern part of the country was practically finished except for slight additions to the east coast and extensive erosion and sculpturing of the land areas into the present hills and valleys.

Elsewhere in the United States the Permian appears to have been a period of dryness. In at least one place, Texas, and perhaps elsewhere, as in Kansas, there existed in this period a condition of interior salt seas which eventually became dead seas. The red beds of central Texas, with their accompanying deposits of salt and gypsum, were formed during this time.

In the next period, which we may call the Jura-Trias, combining two periods, as recognized in Europe,

there came in the East the last period of volcanic activity, while in the West the Sierra Nevadas were formed into high mountains. The volcanic activity of the East was expressed along the entire Atlantic seaboard, from the Carolinas to Nova Scotia, by a series of intensions of a black trap rock and by volcanoes from which the same black basaltic lava flowed in great sheets. These intruded and extruded lavas still exist in remnants, and where they occur have produced striking features in the present topography. Among the more striking instances of this are the Palisades of the Hudson, the trap hills of Paterson and Orange, New Jersey, East and West Rocks of New Haven, Connecticut, Mts. Holyoke, Tom, the Hanging Hills of Meriden, and other prominent hills of the Connecticut Valley, etc. Since then there has been no volcanic action in the East. During the Jura-Trias there was an estuary where now the Connecticut Valley is situated and ocean waters extended as far northward as Northfield, Mass. The Atlantic coast was farther west than now and the waters of the ocean nearly bathed the eastern foot of the Appalachians.

During the Cretaceous period, which followed, the eastern coast of the country seems to have been nearly of the present form, although many of the finishing touches were wanting; but the western part of the country was very different from the present. A great arm of the sea extended, along the site of the present Rockies and the plateau of their eastern base, from the Gulf far northward into Canada. At times, and perhaps always during this period, there existed islands in this sea, but the main feature was that of water. Neither the Rockies nor the Coast Ranges existed then, and the Sierra Nevadas were bathed upon both their eastern and western bases by oceanic waters. Florida, Arkansas, Alabama and Texas were mostly beneath water, and here the sediments that were later built into these lands were accumulated.

At the close of the Cretaceous, much of this area was permanently transformed into land and the Rockies began to be formed. There was added to the east coast a strip of land, widening toward the south, and at present forming the inner or western part of the plains which lie between the Appalachians and the ocean. Florida was not formed and the low swampy plains from New Jersey southward were still beneath the ocean. An arm of the sea extended up the Mississippi Valley and the site of the Rocky Mountains and the present interior basin was occupied by a land dotted by many very large fresh water lakes.

The Tertiary period witnessed many interesting changes, which, being recent, are much more plainly recorded than those of earlier periods. In the East the land was much higher than the present. There are indications, in the existence of apparent river channels on the ocean bottom, that the coast line was then at the edge of the continental shelf, or from 75 to 100 miles farther seaward in our latitude. During the Tertiary, portions of the coastal plains were added to the east coast and Florida was formed partly by elevation and partly by the outward growth of the land, through the agency of reef-building corals.

The most stupendous event of this period, however, was the development of the Rocky Mountains. By these rock folds great lakes were destroyed and their sediments incorporated into the growing mountains, and other lake basins were formed, some of which have been destroyed and others of which remain. Most of these, owing to the aridity of the climate, are either dry, as in the case of the great continental basin, or are occupied by salt lakes, such as the Great Salt Lake. Immense flows of lava, destructive volcanoes, and intrusions of igneous rock accompanied this folding and faulting of the rocks, and we find in the West no more common phenomenon than that of partially destroyed volcanic cones and lava flows. They exist throughout the entire Cordilleras, from the eastern flank of the Rockies to the Pacific and from the Mexican boundary to Canada.

As a result of these changes we owe the formation of the wonderful mineral deposits of the West, while in the lakes there were formed vast stores of salt, gypsum, coal and other products. This, which is the most marvelous mineral region known in the world, owes its richness in this respect to its complicated history of folding, faulting, and volcanic eruption. For the present the Rockies seem to have nearly ceased growing, although there are many signs that the growth has not entirely ceased. Within extremely recent times, though not within the history of man, there have been volcanic eruptions, and recently formed lake shore lines have been tilted out of position. As one of the episodes of the Tertiary there was a regrowth of the Sierras and the formation of the Coast Ranges. This seems to have been a part of the great movements which produced the Rockies, but to have been somewhat more recent and, indeed, to be even now in progress of development.

In the Quaternary period one event of great importance occurred, as well as numerous minor changes. The land appears to have fallen and then risen again, and the finishing touches of the present land were made. A narrow coastal addition was made, particularly on the Gulf coast, where the Mississippi embayment was destroyed by the growth of the delta and the uplift of the land. On other parts of this coast low-lying swampy plains were also added.

A series of minor events occurred in the Cordilleras. Volcanic activity continued with constantly decreasing violence, the folding of the mountains approached its close and erosion made extensive breaches in the high mountains. The climate also suffered a change and the interior basin was changed from an arid to a moist region, then again arid and moist, followed by the present condition of aridity. During one of the moist periods great lakes existed in the present interior deserts and overflowed to the sea.

But by far the most important episode of the Quaternary was the oncoming of the glacial period, which followed closely upon the condition of high Tertiary elevation. Extending down to the latitude of New York this ice sheet transformed the northern part of the continent to a great ice plateau analogous to the present Greenland ice cap. How long it stayed and what its exact history has been are points that are still unsettled and under investigation. We know considerable about its effects, and it has been responsible for the great majority of the minor topographic features

of the glaciated belt. Our soils and clays, lakes and waterfalls and many interesting bits of scenery are due to this ice invasion, and even the harbors of the New England coast appear to be indirectly a result of the ice period.

To quote the last words of a paragraph upon the same subject in a recent work by the author,* "This is, briefly, and without entering into details or proofs, the general evolution of the continent. Its form was roughly sketched in the very earliest period and it has been slowly perfected, although undoubtedly many changes yet await it. No adequate mention has been made of the effect of erosion during all this time, but this is of prime importance. Old lands have been worn down, and the ruins deposited in the water, to afterward be again built into land and perhaps again transformed into sediment. Erosion and sculpturing have been ever acting, and the present form of the continent is the resultant of the conflict between the two opposing forces; the one tending to build up, the other to tear down."

* "Economic Geology of the United States."

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