

106° and 113° Fahr. These are at an elevation of about 6000 feet above the sea.

The metallic and mineral products which occur in the geological formations above described are very various. Diamonds were first discovered in the Serra do Espinhaço, in the vicinity of Diamantina, about 300 miles north of Rio, in 1786. In this neighbourhood there are shales, sandstones, and conglomerates; upon the sandstone there is or was a stratum of quartzite, still very distinct in many places, and among the sands created by the disintegration of this rock, diamonds are found. This district is named the *Chapada* of Diamantina, a term applied to small elevated plateaus, usually consisting of horizontal deposits, and separated by deeply eroded valleys. The diamond-producing soil extends along the Serra do Espinhaço as far as the northern borders of the province of Minas, along the valley of the upper Belmonte, and in the interior of the province of Bahia, as well as in the mountains that lie south-west of the sources of the São Francisco. Diamonds of smaller value have also been found in the province of Goyaz (on the Rio Claro); in Matto Grosso, where the valley of the Paraguay about Cuyabá and Diamantino has diamonds in considerable abundance; in Paraná, on the Rio Tibagy, a tributary of the Paraná-Panema; in São Pedro do Rio Grande do Sul; and in São Paulo;—but the area of their distribution is far from being well ascertained. The diamonds are generally obtained by washing; an excavation is made to reach the stratum called *cascalho*, a gravel composed principally of quartz and fragments of different rocks of the neighbourhood, and mixed with a reddish clay. The washers are seated either by a pond or running stream, and a portion of the gravel, being thrown into a large shallow wooden pan, is mixed with water and stirred about in the current, so that the muddy water escapes and the gravel and sand remain. This is now passed through a sieve, which separates the larger gravel from the smaller; the pebbles are then picked out, and the overseer examining the sand easily selects any diamonds that may be present. The diamonds are often of considerable size. Burton mentions one found in the *Chapada* of Bahia weighing 76½ carats, which when cut into a drop-shaped brilliant proved to possess extraordinary play and lustre. Emeralds, sapphires, rubies, topazes, beryls, tourmalines (black, blue, or green), and amethysts are found, especially in the provinces of Minas Geraes. Garnets occur in great profusion, though of inferior quality. Rock crystals, perfectly pure and of large size, are obtained in Minas, Goyaz, São Paulo, and Paraná; opals, chalcedonies, agates, and carnelians are found nearly throughout the country, but have become an article of export chiefly from the banks of the Uruguay, in the province of Rio Grande do Sul.

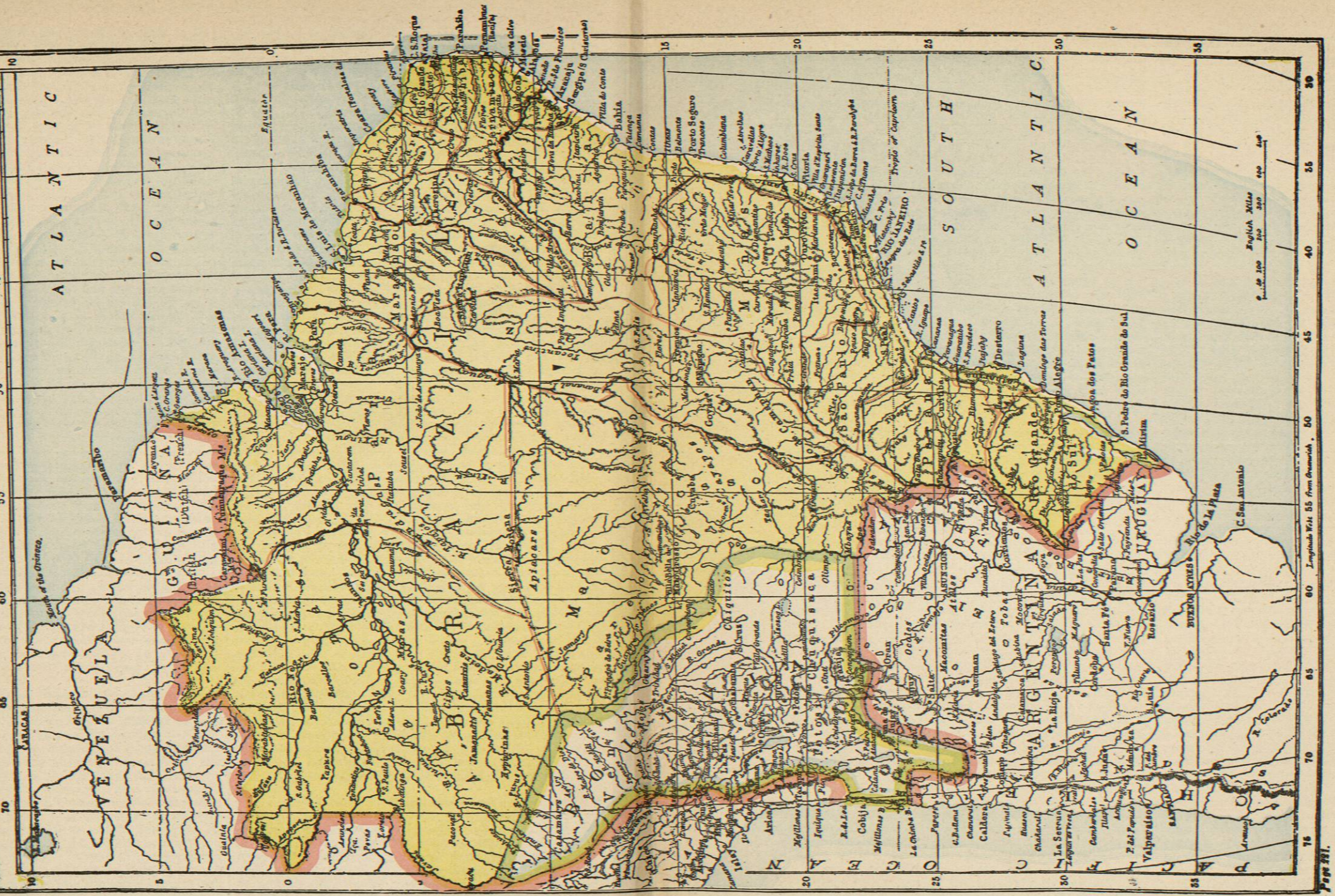
One of the Brazilian coal basins lies in the province of Santa Catharina, between the plateau and the sea; and along the banks of the Tubarão, beds of bituminous coal of fair quality are exposed, and were first noticed in 1841. Three separate coal-fields have been traced in the province of Rio Grande do Sul: the largest is situated in the valley of the Jaguarão (the boundary river with Uruguay), and in that of the Candiota, covering an area of about 50 miles by 30 miles; the second occurs in the valley of a tributary of the Rio Jacuaby, near the centre of the province; and a third near the village of São Jeronymo, on the bank of the Jacuaby. The Candiota field is now being worked by an English company. At the Arroyo dos Ratos in the same province, mines have been worked on a small scale; the coal from which is used by the steam-boats which ply on the Lagoa dos Patos, or on the rivers. Bitumen is found in most of the provinces, and is worked near the south coast of the province of Bahia.

Sulphur exists in a native state in the province of Rio

Grande do Norte, and in small quantity in Rio Grande do Sul, as well as at Furquim and Corrego do Ouro, in the district of Minas Novas in Minas Geraes. Saltpetre occurs with salt over a large area of Minas Geraes and Bahia, but is also abundantly formed in the floors of the calcareous caves of the Rio São Francisco valley from the city of Ouro Preto downwards. Saline efflorescence is observed at innumerable localities in the drier portions of the Brazilian plateau; efflorescences of nearly pure sulphate of magnesia are also to be found in the valley of the Rio das Velhas in the São Francisco basin, and in the province of Ceará, where chloride of sodium also appears.

Gold in Brazil is found in quartz veins traversing the old metamorphic rocks, such as clay-slate, mica-slate, or iron schist, in drift gravels and clays, and in alluvial sands and gravels derived from the wear of these. Most gold is afforded by the clay-slates traversed by auriferous quartz lodes, by the rock called Itacolomite (metamorphic rock of Lower Silurian age), and by certain iron-ores known as Itabirite and Jacutinga, the latter described by Burton as a substance composed of micaceous iron schist and friable quartz, mixed with specular iron oxide of manganese and fragments of talc. Over a very large area of the province of Minas Geraes, in the vicinity of Ouro Preto, the country is auriferous, and here are the richest gold mines of Brazil. The celebrated Morro Velho mine is situated on the western side of the valley of the Rio das Velhas, not far from Sabará, and was at first worked by native miners, but afterwards with great success by a company. The mines of Gongo Soco lie about 20 miles east of Morro Velho, on the opposite side of the Velhas, and were at one time very productive. Another company owns a tract of 21 square miles, not far from the Morro Velho. Other mines have been worked in this neighbourhood at the Morro de Sta Anna, at Maquiné near it, and in the Serra of Cata Branca, 2 miles east of the village of Corrego Seco. These mines with two exceptions have proved failures in working, after a period of success, and this notoriously from bad management. The mines, however, are very far from being exhausted; indeed the underground wealth of the country is as yet almost untouched. Much of the remaining portion of the province of Minas, and especially the upper basin of the São Francisco, is auriferous. In Northern Brazil the only gold mine yet opened is that of Tury-assú in the province of Maranhão; but concessions for working gold have been granted by Government in many parts of the provinces of Bahia, Pernambuco, Parahyba, Piahy, Goyaz, Ceará and S. Paulo. In southern Brazil gold is known at Capava, Rio Pardo, Sta. Maria, and Cruz Alta, in the province of Rio Grande do Sul; and at the first-named locality a Brazilian company is carrying on the work of mining. Gold washings occur in almost every province, but especially in the district of Minas Novas, 200 miles north of Ouro Preto, where the metal is found in grains or nuggets in a *cascalho* of quartz pebbles, often cemented into a conglomerate by iron oxide. They are carried on, however, in the rudest and most irregular way, and with more modern appliances might prove very remunerative.

The gold of Brazil is always alloyed with silver, and this metal is present in many of the galenic formations which are known in almost every province, as well as with the copper in the mines of Rio Grande do Sul. At the hill of Araçoiva, in the municipality of Sorocaba in São Paulo, silver was extracted nearly two centuries ago. Rich mines of mercury occur in the province of Paraná not far from the capital. Copper is abundant in the provinces of Matto Grosso, Goyaz, and Minas, near the capital of Bahia, in Maranhão and Ceará, but chiefly in Rio Grande do Sul, where at Santo Antonio das Lavras, in the municipality of



Caçapava, there are the richest copper mines of Brazil, the mineral from which yields 60 per cent. of pure metal.

Manganese exists in abundance in the vicinity of Nazareth, at the head of the estuary of the Jaguaripe, adjoining the bay of Bahia. Galena mines are in operation in many parts of the empire; the chief are those of Iporanga, Sorocaba, Iguapé in the province of São Paulo, and those of the Rio Abaeté and Sete Lagôas, the most productive of all, in the province of Minas. Lead mines also exist along the whole coastal region from Santa Catharina to Maranhão, those of the hill chain of Ibiapaba on the borders of Ceará and Piahy being important.

Every part of Brazil contains iron, in ore or in other forms, and an almost unlimited quantity appears to exist in the mountains of Minas Geraes. At São João de Ipanéma, in S. Paulo, there are heavy deposits of magnetic iron, which are mined and smelted almost on the spot; and other seams of like character appear in the provinces of Alagoas, Ceará, Rio Grande do Norte, and Parahyba. Some of the Brazilian mines are quite free from pyrites. In 1810 a company of Swedish miners and founders settled at Ipanéma, and erected two small refining furnaces. In 1817 they produced nearly 4000 arrobas of iron, which was manufactured on the spot into horses' shoes, nails, locks, and other articles. There is now a very considerable establishment, at which moulding and refining is carried on, the woods of the neighbourhood furnishing an abundant supply of charcoal. A railway is projected to unite the works with S. Paulo and its port. Not far from these mines there are extensive quarries of marble of valuable sorts.

A country so extensive as Brazil, and so diversified in its surface, necessarily exhibits a considerable variety of climate. The great northern lowland lying entirely within the tropics has great heat, and its year is divided between the simple wet and dry seasons. The elevation of the central and southern highland of Brazil introduces great variety in the seasons and climates of the intertropical portion of that region; and towards the south beyond the tropic a temperate zone is reached in which four seasons are marked, though not so distinctly as in central Europe. The whole wide plain of the Amazon basin has its rainy season from January or December till May or June, the remaining half of the year being dry, though intervals of fine weather may occur within the wet period, and of showers in the dry season. The fall during the rainy months is excessive, raising the level of the great river full 40 feet, and much thunder and lightning always accompanies the heavy rain. This belt of single rainy and dry season appears to terminate about the line of the River Paranahyba, between the provinces of Maranhão and Piahy; at the town of Maranhão the annual fall has been found to be on an average 280 inches. Inland, across the higher southern watershed of the Amazon, from the interior of the provinces of Maranhão and Piahy, over Goyaz and northern Matto Grosso as far as the falls of the Madeira, the rainy seasons follow the passage of the sun towards and away from the southern tropic, and occur from October or November to March or April, with more or less marked intervals of drier weather.

In lower Maranhão showers also occur in October, and are called the 'Cashew rains.' On the north-east coast slope, in the provinces of Ceará, Rio Grande do Norte, and northern Bahia, the rains appear to be governed by the prevalence of the north-east winds from the Atlantic, and occur from March or April to June, July, or August. The coastal region from southern Bahia to São Paulo and the São Francisco valley have again a more or less marked double rainy season between October and April or May; the heaviest rains occur in the São Francisco valley from January to May, the highest freshets of the river being in

March; the coast rivers, such as the Rio Doce, rise first in December, and again to an almost equal swelling in March. At Pernambuco the amount of the annual rainfall is upwards of 100 inches; at Rio de Janeiro it has decreased to 59 inches, and a gradual diminution of the quantity is observed from the Amazon southward. In São Paulo the rainy season is, in summer, from November till April, the greatest quantity of rain falling in January. In Sta. Catharina the rains begin to be irregular, and from this to the southward over Rio Grande do Sul the four seasons of the temperate zone begin to be distinguishable. The whole country is, as a rule, abundantly watered, the only portion which may suffer from drought being that of the interior between the São Francisco and the Paranahyba, where extraordinary dryness has sometimes prevailed.

In temperature the vast Amazon basin is remarkable for the small seasonal variation of heat, accounted for by its equatorial position and immense surface of water and forest; within its limits the thermometer at its highest readings averages 90° and the lowest 75°. At Pará the register kept by Costa Azevedo between 1861 and 1867 gave a mean temperature of 80°, a maximum of 95°, and a minimum of 68°. Observations are very deficient for the greater portion of the empire. About the Falls of the Madeira, Keller estimates the mean annual temperature at 77°, with but small variation in the seasons. In the latitude of Rio de Janeiro the summer or January temperature near the sea-level has an average of about 75°, that of July descending to about 65°; and in the extreme southern provinces the corresponding figures may fall to 70° and 50° Fahr. in summer and winter. But an immense variety of temperature and climatic condition are found on the central and southern table-lands and mountain ranges of Brazil, from the hot and humid air of the coast to the mountains where in winter it frequently snows, and where lakes may be covered with a coating of ice. In the high plains of Rio Grande and São Paulo the thermometer may also fall to below the freezing point.

The prevalent winds of the greater portion of Brazil are <sup>Winds.</sup> the trade-winds from the east, which, gathering the vapours from the whole breadth of the equatorial Atlantic, give out their excessive moisture over the northern forest plains of the Amazon, reaching inland as far as the high wall of the Andes. The east winds are strongest in the Amazon valley from July till November, mitigating the heat of the dry season. On the maritime regions of central Brazil the north-east or south-east trades prevail according to season. In the far interior the general winds take a more north and south direction, blowing usually from the south when the sun is in the northern tropic and from the north during summer. Land and sea breezes are very constant along the coasts. At the mouth of the São Francisco, for example, the morning is still and calm; about nine o'clock a breeze steals over the water, rippling its surface and gradually increasing to a stiff wind about noon; the breeze continues steadily till night-fall, when it again falls calm.

With the exception of the marshy banks of some of the rivers and the lowlands and swamps, where intermittent fevers are very prevalent, the country is generally healthy. On the sea-coast and inland in some of the maritime provinces, epidemics of yellow fever and cholera morbus have been experienced since 1850. The mortality in the most populous towns of Brazil is not, however, above but rather below that of the large cities of Europe.

The broadly-marked features given to the landscape by the vegetations of different characters in Brazil are distinguished by several names. *Mattas* or heavy forests cover the immense northern lowland which is watered by excessive rains, and these occur also in belts of greater or less width over the lower portions of the central and southern