assertion deserves no particular refutation. Streams, indeed, can carry down seeds; and plants from those higher regions through which the streams flow are accordingly often found growing on their banks. But the Flora on the banks of one and the same stream, is very different in the different districts through which it passes, as is seen in the clearest manner upon the shores of the Elbe; for in Bohemia very different plants appear from those which spring in the neighbourhood of Dresden,—others, again, make their appearance near Wittenberg and Barby,—and a yet different set near Lauenburgh and Hamburgh.

These considerations lead us to conclude, that the vegetable world has neither descended from one common birthplace, nor diffused itself from one country into another; but that vegetation is in every case the product of the joint influence of temperature, soil, and the particular composition of the moisture of the earth.

Nor is the conclusion of Brown (on Congo, p. 50.), that the native country of a genus is always where the greatest variety of species is found, by any means to be admitted, since the example of Nicotiana shews the contrary. The greatest number of its species are found in South America; yet the *Nicotiana Chinensis*, Lehm. and *fruticosa* are certainly indigenous to Eastern Asia.

CHAP. VI.

ON MALFORMATIONS AND DISEASES OF PLANTS.

[illegible], S. 119–131.
[illegible] der Gewächse.
[illegible] der vegetabilischen Reproduction.
Keith's System of Physiological Botany.

PAPER 5

From *Essay on the Geography of Plants*

Alexander von Humboldt

Foreword

Having been away from Europe these past five years, and having wandered through countries of which many had never been visited by naturalists, I should perhaps have hastened to publish the abridged account of my travel to the tropics and the series of phenomena that occurred successively before me over the course of my investigations. I would have been flattered by public appreciation of such haste as part of it has shown a generous interest in my own survival and in my expedition. However I thought that, before speaking about myself, and the obstacles I overcame during my expedition, I had better draw the attention of physicists to the major phenomena that Nature displays in the regions I visited. It is their whole that I consider in this essay where I present the results of the observations that will be published in greater detail in further works I am preparing for the public.

I include all the phenomena that one can observe on the surface of the globe, as well as in the surrounding atmosphere. The physicist familiar with the present state of science, primarily that of meteorology, will not be surprised to see such a large number of topics being touched upon in so few pages. Had I been able to work for a longer time on their drafting, my book would have been even shorter for an overview should only depict major views on physics, i.e., undisputed results that can be expressed as precise numbers.

I already conceived the idea of this work in my early youth and presented the first outline of a Geography of Plants in 1790 to the famous companion of Cook, M. Georges Forster, to whom friendship and gratitude attach me closely. Since then, my studies in several fields of the physical sciences have helped expand these initial ideas further. My travel to the tropics provided me with invaluable material for the physical history of the globe. It was when I actually saw the great objects I had to describe, at the foot of the Chimborozo, on the hillsides of the southern sea, that I wrote most of this work. I thought that I had to retain the title "Essay on the Geography of Plants," because, when considering the imperfection of my work, any less modest title would have made it less worthy of public indulgence.

It is primarily for its style that I beg such indulgence. Having expressed myself for such a long time in several languages which are no more my mother tongue than is French, I dare not hope to now always maintain the purity of style that one would expect from a work written in my own language.

The overview presented here is based on my own observations and on those of M. Bonpland. United by the bonds of a most intimate friendship, having worked together for six years, and having shared the sufferings which travelers are necessarily exposed to in uneducated countries, we agreed that work on the results of our expedition will be co-authored under both our names.

It is in preparation of these works, which have been my main occupation since my return from Philadelphia, that I had to ask for help from renowned men who have honored me with every kindness. M. Laplace, whose name is far above my praise, was kind enough to show a most flattering interest in the work I brought back as well as in that completed since my return to Europe. Enlightening and refreshing, as if through the power of his wit and all that surrounds him, his help has become as useful to me as it generally is to all young men who approach him.

If it is a joy for me to pay friendship the tribute of my admiration and gratitude, this commits me to fulfill no less sacred duties. M. Biot was kind enough to honor me with his advice in the drafting of this work. Combining a physicist's perspicacity with a geometrician's profound knowledge, his company became a fertile source of instruction to me. Despite his numerous occupations, he was kind enough to calculate the tables of horizontal refraction and of light extinction in my table.

The facts I present on the history of fruit trees are

Translations by Francesca Kern and Philippe Janvier from Alexander von Humboldt, *Essai sur la Géographie des Plantes* (Paris: Levrault, Schoell et Cie., 1805).

taken from the work of M. Sickler, who combines—and this is rare—great erudition with much philosophical insight.

M. De Candolle provided me with interesting data on the Geography of Plants from the high Alps. M. Ramond provided me with information on the flora of the Pyrennées, and extracted data from the classical works of M. Willdenow. I regarded it as important to compare the phenomena of equinoctial vegetation with those of our European soil. M. Delambre was kind enough to enrich my overview with the measurements of summits never previously published. A large number of my barometric observations were calculated by M. de Prony (according to M. Laplace's formula and taking gravity into consideration). This honorable scientist was even kind enough to have four hundreds of my altitude measurements calculated under his supervision.

I am currently drafting the astronomical observations made during my expeditions, part of which have been submitted to the Bureau des Longitudes to have their accuracy checked.[1] It would have been imprudent to publish either the maps I made inland of the continent, or the account proper of my travels, before these were submitted because the position of the localities and their altitude have bearing on all the phenomena of the regions I visited. I am especially proud that the longitudinal observations I made during my trip on the Orinoco, the Cassiquiaré, and the Rio-Negro will be of interest to those concerned with the geography of southern America. Despite Father Caulin's precise description of the Cassiquiaré, more modern geographers doubt the accepted communication between the Orinoco and Amazon. Having worked there, I could not expect that some would reproach me bitterly[2] for discovering in Nature river courses and mountain directions completely at odds with what is shown on La Cruz's map; however, it is the fate of travelers to displease some when they observe facts that contradict received views.

After drafting the volume on astronomy, that of my other works will soon follow, and it will only be after my last voyage is published that I shall deal with a newly planned endeavor to throw the brightest light on meteorology and magnetic phenomena.

I cannot publish this first essay, this first result of my researches, without expressing my profound and respectful gratitude to the government which has honored me with such generous protection during my travels. Being granted a protection hitherto not granted to any individual, and having lived for five years in a frank and loyal nation, I was never confronted in the Spanish colonies with any other obstacle than those of physical Nature. The memory of this government's benevolence will remain in my soul, as deeply engraved as the expression of affection and interest that all classes of inhabitants honored me with during my stay in both Americas.

Alex. De Humboldt.

Essay on the Geography of Plants

Read to the physical sciences and mathematics classes of the Institut National, the 17 Nivôse[3] of the year 13.

Botanists' research is generally directed toward objects that only encompass a minute area of their science. They occupy themselves almost exclusively with the discovery of new plant species, their exterior structure, the characters that distinguish them, and the analogies that group them into classes and families

The knowledge of forms under which organisms present themselves is, without a doubt, the principal basis of descriptive natural history. One must view it as indispensable for the advancement of sciences which touch upon the medical properties of plants, their cultivation, or their application in the arts: if worthy of exclusively occupying a large number of botanists, although also capable of being considered philosophically, it is not any less important to target the Geography of Plants. This science as yet only exists as a name, and yet is an essential part of general physics.

The Geography of Plants considers plants by the relationships of their local association in different climates. As vast as the object it embraces, it broadly outlines the immense expanse covered by plants from regions with perpetual snow to the depths of the oceans, to the interior of the globe where—in obscure grottoes—cryptogams grow as unfamiliar to us as the insects which they nourish.

The superior limit of vegetation varies, like that of perpetual ice, according to its distance from a pole or the obliquity of solar rays. We ignore the extent of the inferior limit of plants: precise observations made in both hemispheres of subterranean vegetation prove that the interior of the globe is animated everywhere that organic germs have found the appropriate space for their development, and nourishment similar to their own constitution. The rocky and icy peaks which our eyes can hardly distinguish above the clouds are exclusively covered by mosses and lichenous plants; analogous cryptogams—sometimes studded, sometimes colored—ramify themselves in the vaults of mines and subterranean grottoes. In this way, two opposite limits of vegetation produce beings similar in structure, and whose physiology remain equally unfamiliar to us.

The Geography of Plants does not only arrange plants according to the zones and altitudes they are found in, nor is it content to consider plants according to the degrees of atmospheric pressure, temperature, humidity, and electric tension under which they live: it distinguishes among plants, as among animals, two classes which have very different ways of life and—dare one say it?—habits.

Some plants grow isolated and scattered: for example, in Europe *Solanum dulcamara, Lychnis dioica, Polygonum bistorta, Anthericum liliago, Crataegus aria, Weissia paludosa, Polytrichum piliferum, Fucus saccharinus, Clavaria pistillaris, Agaricus procerus,* or in the tropics *Theophrasta americana, Lysianthus longifolius, Cinchona, Hevea.* Other plants, gathered in societies like ants or bees, cover immense ground from which they exclude any hetergenous species: for example, strawberries [*Fragaria vesca*], bilberries [*Vaccinium myrtillus*], *Polygonum aviculare, Cyperus fuscus, Aria canescens, Pinus sylvestris, Sesuvium portulacastrum, Rhizophora mangle, Croton argenteum, Convolvulus brasiliensis, Brathys juniperina, Escallonia myrtilloides, Bromelia karatas, Sphagnum palustre, Polytrichum commune, Fucus natans, Sphaeria digitata, Lichen haematomma, Cladonia paschalis, Thelephora hirsuta.*

Plant associations are more common in temperate rather than tropical zones whose less uniform vegetation is all the more picturesque for this. From the banks of the Orinoco to those of the Amazon and the Ucayale, the entire surface of more than five leagues of soil is covered by thick forests; and if the rivers did not interrupt its continuity, monkeys—almost the only inhabitants of these solitudes—could swing from branch to branch from the boreal to the austral hemisphere. However, these immense forests do not offer a uniform view of social plants: every part produces diverse forms. Here we find mimosas, Psychotria or *Melastomas,* there baytrees, brasiletos, *Ficus, Carolinea,* and *Hevea,* all of which intertwine their branches with no plant exerting its authority over the others. However, this is not the case for the tropical region neighboring New Mexico and Canada. The plateau (1,500–3,000 m above sea level) from 17° to 22° latitude—the entire county of Anahuac [Chambers County, Texas]—is covered by oak trees and a species resembling *Pinus strobus.* On the eastern slope of the Cordillera, in the Xalapa valley, we find a vast forest of sweet gum: the soil, vegetation, and climate all take on the characteristics of temperate regions, a circumstance which has not been found elsewhere at the same altitudes in southern America.

The cause of this phenomenon appears to depend on the structure of the American continent: it stretches toward the North Pole, extending itself further in this direction than Europe. This makes the Mexican climate colder than it should be for its latitude and elevation from sea level. The plants of Canada and more northern regions have flooded back toward the south, and the volcanic mountains of Mexico are covered by the same fir trees which only appear to also be found at the sources of Gila and Missouri rivers.

By contrast, the great catastrophe in Europe that opened the Strait of Gibraltar and hollowed out the bed of the Mediterranean prevented African plants from migrating into southern Europe: we also find far fewer species to the north of the Pyrennées. However, the fir trees crowning the heights of the Tenochtitlan valley are species identical to those at the 45th parallel, and any painter traveling in the countries situated beneath the tropics to study the character of the vegetation there will not encounter the beauty and variety of forms found in equinoctial plants. In the parallel of Jamaica, they would find oak forests, fir trees, *Cupressus distichia,* and *Arbutus madronno:* indeed, forests that present all the characters and monotony of social plants in Canada, Europe, and northern Asia.

It would be interesting to designate on botanical maps the ground on which assemblages of same

1. The Bureau des Longitudes, which still exists in France, is a special office in charge of checking the accuracy of all geometrical measurements. TRANS.

2. *Géographie moderne,* by Pinkerton, translated by Walkenaer; vol. 6, pp. 174–77.

3. The fourth month of the French Republican calendar. (The equivalent date in the Gregorian calendar is 7 January 1805.) TRANS.

Copyrighted material

plants grow. They would appear as long bands whose compelling expansion diminished the population of states, separated neighboring nations, and put in place greater obstacles to their communication and commerce than mountains and seas. Heathland, this association of *Erica vulgaris* and *Erica tetralix*, of *Lichen icmadophila* and *Haematomma*, is scattered from the most northern extremity of Jutland, through Holstein and Lunebourg, to the 52nd parallel. From there, it turns toward the west, by the granitic sands of Munster and Breda, to the hillsides of the Ocean.

For many centuries, these plants caused widespread sterility of the soil, and thus exerted an absolute empire on these regions: despite his best efforts, man struggles against an almost untameable Nature and has secured only a small portion of ground for cultivation. These cultivated fields, small conquests of industry and charity for humanity, form small islands so to speak among the heathland: they remind the traveler of Lybya's oases, where ever-fresh greenery contrasts the desert sands.

A moss common to tropical and European swamps, *Sphagnum palustre*, covers a large part of Germania. This moss renders vast terrain inhabitable to the nomadic people whose customs Tacite described. A geological fact supports this phenomenon. The most ancient peat bogs mix MURIATE DE SOUDE [muriate of soda?] and marine shells and owe their origins to *Ulves* and *Fucus;* by contrast, more recently formed and more scattered peat bogs arose from *Sphagnum* and *Mnium serpillifolium*, and their existence proves to what extent cryptogams previously covered the globe. By cutting down forests, agricultural people diminished the humidity of the climate, dried swamps, and economic plants gradually conquered plains previously dominated by cryptogams adverse to cultivation.

Although the phenomenon of plant associations seems to appear predominantly in temperate zones, the tropics also offer several examples. At 3,000 m, on the back of the Andes range, there grow *Brathis juniperina*, *Jarava* (a grass genus neighboring *Papporophorum*), *Escallonia myrtilloides*, several species of *Molina*, and primarily *Tourrettia*, whose pith provides food for which indigenous Indians compete with bears. In the plains that separate the Amazon and Chinchipe rivers, we find a combination of *Croton argenteum*, *Bougainvillea*, and *Godoya*, and, as in the savannahs of Orinoco, the palm *Mauritia*, the herbaceous sensitive plants, and *Kyllingia*. In the kingdom of New Grenada, Bambusa and *Heliconia* offer uniform bands uninterrupted by other plants: but these plant associations of same species are invariably less spread out and less numerous than in more temperate climates.

Geology pronounces on the ancient relationship of neighboring continents based on analogous hillsides, shallows of the Ocean, and the identity of animals which inhabit these. The Geography of Plants provides invaluable material for this sort of research: it can, to a certain extent, recognize the islands which—previously united—separated from one another, thus announcing that the separation of Africa from southern America occurred before the development of organisms. This science also shows which plants are common to both eastern Asia and the hillsides of Mexico and California. There are plants which exist in all zones and at every elevation above sea level. The Geography of Plants can help back up with some certitude the first physical state of the globe: it can decide whether, after the retreat of the waters whose abundant and agitated traces remain on conchiferous rocks, the whole surface of the world was immediately covered by a diversity of plants, or if—conforming to the traditions of different peoples—the globe at rest only produced plants in one region which sea currents then transported over the centuries to progressively more remote zones.

It is this science which examines if, across the immense variety of vegetative forms, one can recognize some primitive forms and if species diversity should be considered an effect of a degeneration which—with time—rendered the initially accidental forms constant.

If I dared to draw general conclusions on the phenomena I observed in the two hemispheres, the germs of cryptogams struck me as the only ones which Nature develops spontaneously in all climates. *Dicranum scoparium* and *Polytrichum commune*, *Verrucaria sanguinea* and *Verrucaria limitata* of Scopoli grow at all latitudes in Europe as at the equator, on the highest mountain ranges as at sea level: anywhere with shade and humidity.

On the banks of the Madeleine, between Honda and Egyptiaca, on a plain where the thermometer invariably indicates 28 to 30°C, at the base of *Macrocnemum* and *Ochroma*, mosses form a cover as beautiful and green as any found in Norway. If other travelers have asserted that cryptogams are very rare in the tropics, their assertions are doubtless based on the fact that they only visited the arid coasts and the cultivated islands without penetrating to the inland

of continents. Lichenous plants of the same species can be found at all latitudes: their form appears as independent of the influence of climate as Nature is of the rocks it inhabits.

We do not yet know of a phanerogam whose organs are flexible enough to adjust to all zones and altitudes. In vain we pretended that *Alsine media*, *Fragaria vesca*, and *Solanum nigrum* enjoyed this flexibility reserved for man and the mammals surrounding him. The American and Canadian strawberry differs from the European. M. Bonpland and I believe we discovered several feet of the latter on the Andean cordillera, in passing the valley running from the Madeleine to the Cauca, by the snows of Quindiu. The solitude of the forests, composed of *Styrax*, passifloras growing on trees, wax palms, the absence of cultivation in the surroundings, and other circumstances seem to exclude any suspicion that these strawberry plants were spread by man's hand or by birds; but, had we perhaps discovered this plant in flower, we would have found it specifically different to *Fragaria vesca*, in the same way that subtle nuances differentiate *Fragaria elatior* from *Fragaria virginiana*. During the five years that we botanized the two hemispheres, we—at the very least—never collected a European plant spontaneously produced by the southern American soil. We limit ourselves to believe that *Alsine media*, *Solanum nigrum*, *Sonchus oleraceus*, *Apium graveolens*, and *Portulaca oleracea* are plants which, like the Caucasian race, are very scattered in the northern part of the ancient continent. As we still know so little of the productions of the interior of soils, we must abstain from all general conclusions: I might add, otherwise, that we risk falling into the same trap as geologists who construct the entire globe according to the model of hills which surround them.

To decide on the big problem of plant migration, the Geography of Plants descends into the interior of the globe: it consults the ancient monuments Nature left behind as petrifications, in the fossil wood, and in the tombs of the first vegetation of our planet that are the carbon layers. It discovers the petrified fruits of the Indies, palms, tree ferns, Scitaminaea, and tropical bamboo all buried in the frozen ground of the north; it considers whether the equinoctial productions such the bones of elephants, tapirs, crocodiles, and marsupials recently unearthed in Europe could have been transported to temperate climates by the strength of submerged currents, or if these same climates previously sustained palms and tapirs, crocodiles and bamboo. We are inclined toward the latter opinion when we consider the local circumstances that accompanied the petrifications in the Indies. But can we admit to such great changes in atmospheric temperature without recourse to a shift in the stars, or a change in the axis of the Earth, which current astronomical knowledge claims unlikely? If the most striking geological phenomena tell us that in the past the entire crust of the planet was in a liquid state, and if stratification and differing rocks indicate to us that the formation of mountains and the crystallization of great masses around a common core were not completed at the same time on the entire surface of the globe, then we can conceive that the passage from a liquid to a solid state must have released an immense quantity of heat, and increased for a time the temperature of a region independently of solar heat: but would this local temperature increase have lasted Nature's required time to explain such phenomena?

Changes observed in the light of stars caused us to suspect that our sun endures analogous variations. Would an increase in the intensity of solar rays at particular times have spread tropical heat to the regions neighboring the poles? Are these variations which render Lapland habitable for equinoctial plants, elephants, and tapirs periodical? Or are they the effect of some passing and perturbing causes of our planetary system?

These discussions link the Geography of Plants to geology. It is its spread since the beginning of the primitive history of the globe that the Geography of Plants offers man's imagination so rich and interesting a field to cultivate.

Plants, if indeed analogues of animals by the irritability of their fibers and the stimulants which excite them, are essentially different in their mobility. The majority of animals do not leave their mother until adult. On the other hand, plants are fixed in place after their development and can only travel when still contained in an egg whose structure favors mobility. However, it is not only winds, currents, and birds that aid the migration of plants; man primarily takes care of this.

Once he abandoned the wandering life, he gathered around him animals and plants useful in clothing and feeding him. This transition from a nomadic to an agricultural lifestyle was belated with the people of the North. In equinoctial regions, between Orinoco and Amazon, the thickness of the forests prevents the savage from sustaining himself from hunting alone: he is forced to take care of some plants for subsistence such as several feet of *Jat-*

ropha, banana, and *Solanum*. Fishing, fruits, palms, and these small cultivated plots (if I dare call such a small collection of plants a plot), constitute the basis of the southern American's food. A savage's state is primarily modified by the Nature of the climate and soil he inhabits. It is these modifications alone that distinguish the first inhabitants of Greece from shepherd Bedouins, and from Canadian Indians.

Some plants which have been central to gardening and agriculture since the earliest times, have accompanied man from one end of the globe to another. In Europe, this is how the vine followed the Greeks, wheat the Romans, and cotton the Arabs. In America, the Tulteques [Toltecs, of Mexico] brought maize with them, and potatoes and quinoa are found everywhere where the inhabitants of the ancient Condinamarca passed. The migration of these plants is evident, but their homeland remains as unknown as that of the different races of man which we already find on every part of the globe since the beginning of their respective traditions. To the south and east of the Caspian Sea, to the banks of the Oxus [Amu Darya River], in the ancient Colchis [an area in Georgia, Asia], and particularly in the province of Curdistan [Kurdistan], where the high mountains are perpetually covered by snow as consequence of being 3,000 m above sea level, the soil is covered by lemon, pomegranate, cherry, pear, and all the other fruit trees found in our gardens. We ignore whether this is their natal site, or—if cultivated in the past—they have become wild and their existence confirms ancient agriculture of a region. It is these fertile countries between the Euphrates and the Indus, between the Caspian Sea, Pont-Euxine, and the Persian Gulf, which have provided the most precious produce in Europe. Persia sent us the walnut and peach; Armenia the apricot; Asia Minor the cherry and chestnut; Syria the fig, pear, pomegranate, olive, prune, and blackberry. In the time of Canto, the Romans knew not of cherries, peaches, or blackberries.

Hesiod and Homer already mentioned the cultivated olive in Greece and the island of the Archipelago. Under the reign of Tarquin the Elder, this tree only existed in Italy, Spain, and Africa. Under the consul of Appius Claudius olive oil was still very rare in Rome, but in the time of Pliny, olive trees had already reached France and Spain. The vine that we cultivate today did not originate in Europe: it appears wild on the hillsides of the Caspian Sea, Armenia, and Kerman. From Asia, it passed to Greece and, from there, to Sicily. The Phoenicians carried it to southern France, and the Romans planted it on the banks of the Rhine. The species of *Vites* that we find wild in northern America, and which gave the name of land of wine (Winenland) to the first part of the new continent the Europeans discovered, are very different to our *Vitis vinifera*.

A cherry-laden tree decorated the triumph of Lucullus; this was the first tree of this species to be seen in Italy. The dictator had removed it from the province of Pontus, and after the victory he carried it off to Mithridates. In less than a century, the cherry tree was common in France, Germany, and England. This is how man changes the surface of the globe to his liking, and gathers around him plants from the most remote climates. In the European colonies of both Indies, a small cultivated plot introduced coffee of Arabia, sugar cane of China, indigo of Africa, and a multitude of other plants belonging to both hemispheres. This variety of produce becomes all the more interesting when it recalls to the observer's imagination the series of events which spread the human race across the whole surface of the globe, and of which it appropriated all the produce.

This is how man—anxious and laboring, traveling to the various parts of the world—forced a certain number of plants to inhabit all climates and all altitudes; but this empire exerted on organisms has hardly de-Natured their primitive structure. The potato, cultivated in Chile at 3,000 m (1,936 fathoms) elevation, has the same flower of that plant introduced to the plains of Siberia. The barley that nourished the horses of Achilles was doubtless the same we sow today. The characteristic forms of plants and animals presented on the current surface of the globe do not appear to have been subjected to any changes since those ancient times. The ibis buried in the catacombs of Egypt, a bird whose antiquity goes almost as far back as the pyramids, is identical to that which fishes on the shores of the Nile today; its identity evidently proves that the enormous casts of fossil animals held in the bosom of the earth, not belonging to the variety of current species, in fact belong to a very different order of things than we currently live under, far too ancient for our traditions to include them.

Man, favoring the cultivation of newly introduced plants, has caused these to dominate over wild species; but this preponderance, which makes the appearance of European soil so monotone, and of which the botanist despairs during his excursions, only belongs to that small part of the globe where civilization has become perfect and, within which, by a necessary series of events, the population has increased

the most. In the countries neighboring the equator, man is too weak to tame a vegetation which hides the soil from sight and leaves nothing free except the Ocean and rivers. Nature carries this wild and majestic characteristic before which all efforts at cultivation flounder.

The origin, the first homeland of the economic plants which have followed man since the most distant eras, is a secret and impenetrable as the first residence of all domestic animals. We ignore the homeland of grasses which provide the principal nourishment to the people of the Mongolian and Caucasian races; we do not know which region spontaneously produced the cereals, wheat, barley, oats, and rye. Rye does not even appear to have been cultivated by the Romans. We claimed to have found wild barley on the shores of Samara in Tartary, *Triticum spelta* in Armenia, rye in Crete, wheat in Baschiros in Asia: but these facts do not appear to be based on sufficient observation; it is very easy to mistake plants produced spontaneously, for plants—fleeing man's empire—have regained their former liberty. By devouring the grains of cereals, birds easily disseminate them in the woods. Plants which constitute the natural wealth of all inhabitants of the tropics, the banana tree, Caric *papaya*, Jatropha *manihot*, and maize have never been found in a wild state. I saw several feet of these on the shores of the Cassiquiaré and Rio-Negro, but the savage of these of regions, as melancholy as he is distrustful, cultivates small plots in the most solitary places; he abandons them shortly afterwards, and the plants left behind soon look natural to the soil that produced them. The potato, this beneficial plant upon which a large part of the population of the more barren countries in Europe subsists on, presents the same phenomenon as the banana tree, maize, and wheat. From the little research I could undertake in the field, I never learnt of any traveler who found potato in the wild, neither on the summit of the cordillera of Peru, nor in the kingdom of New Grenada where this plant is cultivated with *Chenopodium quinoa*.

These are some of the considerations agriculture presents, and its various produce depends on the latitude, origin, and needs of people. The influence of food, more or less stimulating the character and energy of passions, naval history, and wars undertaken for the dispute of produce of the vegetable kingdom; these all link the Geography of Plants to the political and moral history of man.

Without a doubt, these connections sufficiently demonstrate the area of science I am trying to delimit; but man's sensitivity to the beauties of Nature also explains the influence vegetation's appearance has on the taste and imagination of people. Man would be advised to examine what the character of vegetation consists of, and the variety of sensations vegetation produces in the soul of those who contemplate it. These considerations are all the more important because they touch upon the means by which the arts of imitation and descriptive poetry act on us. The simple appearance of Nature, the sight of fields and woods, cause a rejoicing that differs essentially from the impression a particular study of the structure of an organized being provides. Here, it is the detail that interests us and excites our curiosity; there, it is the whole, whole masses, that agitate our imagination. What more differing impressions between the appearance of a vast prairie bordered by a few trees, and the appearance of a thick and sombre wood mixed of oak and fir trees? What more striking a contrast than that between the forests of temperate zones, and those of the equator, where the naked and entwined trunks of palms lift themselves above flowering mahogany to form majestic porticos in the air above? What is the moral cause of these sensations? Are they produced by Nature, by the grandeur of masses, the contour of forms, or the haven of plants? How can this haven, this view of Nature more or less rich, more or less pleasant, influence the mores and, primarily, the sensitivities of peoples? Of what consists the character of the vegetation of the tropics? What difference in physiognomy distinguishes plants from Africa from those of the New Continent? What analogy of forms unites Andean alpine plants with those found on the summits of the Pyrennées? These are questions little broached to at present, and doubtless deserve to occupy the physicist.

Among the variety of plants that cover the framework of our planet, we can distinguish without hesitation some general forms to which the majority of the others can be reduced, and which present as many analogous families or groups between them. I limit myself to naming fifteen of these groups whose physiognomy offer an important study to the landscape painter: 1. the form of the Scitaminae (*Musa, Heliconia, Strelitzia*); 2. those of palms; 3. tree ferns; 4. the form of *Arum, Pothos, and Dracontium;* 5. that of fir trees (*Taxus, Pinus*); 6. all the *Folia acerosa;* 7. that of tamarins (*Mimosa, Gleditsia, Porlieria*); 8. the form of the Malvaceae *(Sterculia, Hibiscus, Ochroma, Cavanillesia*); 9. those of lianas (*Vitis, Paullina*); 10. those of orchids (*Epidendrum,* *Serapias*); 11. those of prickly pears (*Cactus*); 12. the Casuarinaceae (*Equisetum*); 13. those of grasses; 14. those of mosses; 15. and finally, those of lichens.

These physiognomic divisions have almost nothing in common with those that botanists make to this day along very different principles. Here, all we mean are the larger contours that determine the physiognomy of vegetation and the analogy of impressions on the observer of Nature, whereas descriptive botany groups plants according to the affinity presented by the different smaller, but most essential, parts for fructification. It would be an undertaking worthy of a distinguished artist to study the physiognomy of the plant groups in Nature I have enumerated here, and not in glasshouses and botanical volumes. What more interesting a subject for a painting than the trunk of a palm balancing its variegated leaves above a group of *Heliconia* and banana trees? What more picturesque a contrast than ferns in a tree surrounded by Mexican oak trees?

It is in the absolute beauty of forms, in harmony and contrast, that the assemblages are created of what we call the "natural character" of this or that region. Some forms, often the most beautiful (Scitaminae, palms, and bamboos), are entirely absent in temperate zones; others, for example trees with pinnate leaves, are very rare and less elegant. Arborescent species are low in number, smaller, and less weighed down by visually pleasing flowers. Also, the frequency of social plants mentioned earlier, and man's culture, make the soil's appearance less monotonous. By contrast, in the tropics Nature has contented itself to assemble all forms. Pines appear to be missing at first glance, but in the Andes of Quindiu, and in the temperate forests of Oxa and Mexico, there are cypress, fir, and juniper trees.

Plant forms closer to the equator are generally more majestic and imposing; the veneer of leaves is more brilliant, the tissue of the parenchyma more lax and succulent. The tallest trees are constantly adorned by larger, more beautiful and odoriferous flowers than in temperate zones. The weathered bark of their ancient trunks forms the most pleasant contrast against the young foliage of lianas, *Pothos*, and particularly orchids whose flowers imitate the form and plumage of the birds feeding on their nectar. However the tropics never offer our eyes the green expanse of prairies bordering rivers in the countries of the north: one hardly ever has the gentle sensation of spring awakening vegetation. Nature, beneficial to all beings, has reserved for each region particular gifts. A tissue of fibers more or less lax, vegetable colors more or less brash depending on the chemical mixture of elements and the stimulating strength of solar rays: these are just some of the causes that give each zone of the globe's vegetation its particular character. The great heights to which the soil near the equator elevates itself give the inhabitants of the tropics the curious spectacle of plants whose forms are the same as the plants in Europe.

The Andean valleys are adorned with banana and palm trees. Higher up grows that beneficial tree whose bark is a most efficient and rapid febrifuge. In this temperate region of the cinchona, and higher up toward that of the *Escallonia*, grow oak trees, fir trees, *Berberis*, *Alnus*, *Rubus*, and a mass of genera which we believe only belong to northern countries. Any inhabitant of the equinoctial regions also knows of all the plant forms Nature surrounds him with: the earth displays before his eyes as varied a spectacle as does the azure-colored vault of the sky which cannot hide any constellation from his sight.

Europeans do not enjoy this same advantage. Languid plants cultivated by love of science or refined luxury in glasshouses only hint at the shadow of the majesty of the equinoctial plants: many forms remain unknown to them forever, but perhaps the richness and perfection of their languages, the imagination and sensitivity of their poets and painters compensate for this. It is the arts of imitation which reproduce before our eyes the varied image of the equatorial regions. In Europe, an isolated man living on an arid coast can enjoy in his mind the scenery of the remote regions. If his soul is receptive to the production of art, and if his cultured mind is broad enough to reach for the great concepts of general physics, he is able—from the bottom of his loneliness, and without leaving his home—to appropriate all that the intrepid naturalist has discovered traveling through the air and ocean, penetrating subterranean caves, or climbing icy summits. It is probably in this way that the lights of civilization have the greatest influence on our individual happiness. They make us live in both past and present times, gathering around us all what Nature has produced in the various climates, bringing us into communication with all the peoples on Earth. Thanks to the discoveries we have already made, we can project ourselves into the future and, by foreseeing the consequences of the phenomena, we can erect forever the laws to which Nature submits. It is in undertaking these researches that we prepare ourselves for an intellectual delight, a moral freedom that strengthens us against the blows of destiny, and which no external power could possibly destroy.

	east of the Alleghanies		west of the Alleghanies
Aesculus flava can be found from	36° latitude	to	42° latitude.
Juglans nigra	41°		44°
Aristolochia sypho	38°		41°
Nelumbium luteum	40°		44°
Gleditsia triacanthos	38°		41°
Gleditsia monosperma	36°		39°
Glycine frutescens	36°		40°

Additions to the Geography of Plants

In mentioning measures made by Spanish surveyors in this work, we made use of a reduction of vare of Castille in meters and fathoms which was not rigorous enough.[4] The vare is to the fathom 0.513074 : 1.196307, and instead of reducing by 2.3, one assumed one fathom = 2.3316 vares. Don Jorge Juan only accommodated for 2.32. However, consult the excellent work of M. Gabriel Ciscar *Sorba los nuevos pesos y medidas decimales* (1800). The 7,496 vares that the beautiful maps of Madrid's Deposito Hydrografico give to Chimborazo are, as a consequence, only 3,217 fathoms, which is the same number Bouguer published in his illustration of the world. The mountain from S. Elie is 6,507 vares, or 2,792 fathoms (5,441 m). That of Beau-Temps is 5,368 vares, or 2,304 fathoms (4,489 m). See *Viaje al Estrecho de Fuca hecho por las Goletas sutil y Mexicana* (1792), p. cxx–cxv.

II

In 1800, M. Barton read a memoir on the Geography of Plants of the United States to the Society of Philadelphia; it has not yet been published, but contains the most interesting ideas. He observed that *Mitchella repens* is the most scattered plant in North America. It occupies all the ground from 28° to 69° latitude. *Arbutus uva ursi* can also be found from New Jersey to 72° latitude where M. Hearne observed it.[5] On the contrary, Gordonia *Franklinia*, and *Dionaea muscipuls* are very isolated on a small terrain. M. Barton remarked that, in general, the same species of plants spread further north in countries situated to the west of the Alleghany Mountains than to the east where the climate is colder. Cotton is cultivated in Tennessee at a latitude that it is not found in North Carolina. The eastern hillsides of Hudson Bay are devoid of vegetation, whereas its western hillsides are covered. [See table above.]

M. Barton observed that: even *Crotalus horridus* (timber rattlesnake) can be found to the east of the Alleghanys until 44° latitude, whereas it spreads toward the north to the west of the mountains until 47° latitude. Also compare the excellent work of M. Volney on the soil and climate of the United States.[6]

4. The length of the meridian degree at latitude 45° was calculated to be 57,027 fathoms. Eds.

5. Here, Humboldt refers to the botanist, Benjamin Smith Barton (1766–1815) and Samuel Hearne, the author of *A Journey from Prince of Wales Fort in Hudson's Bay to the North Ocean . . . in the Years 1979, 1770, 1771, and 1772* (London: A. Strahan & T. Cadell, 1795). Eds.

6. Constantin François de Chasseboeuf, compte de Volney's *View of the Climate and Soil of the United States* (1804), is based on travels during 1795 and 1796. Eds.