ART. VII.—1. *Origin of Cultivated Plants.* By ALPHONSE DE CANDOLLE. London: 1884.

2. *The Wanderings of Plants and Animals from their first Home.* By VICTOR HEHN. Edited by JAMES STEVEN STALLYBRASS. London: 1885.

3. *Report of the Fifty-third Meeting of the British Association for the Advancement of Science, held at York,* 1881. *Address on Geographical Distribution.* By Sir J. D. HOOKER. London: 1882.

4. *Island Life; or, the Phenomena and Causes of Insular Faunas and Floras, including a Revision and attempted Solution of the Problem of Geological Climates.* By ALFRED RUSSEL WALLACE. London: 1880.

ALTHOUGH the origin of the most useful plants is, as Humboldt observed, lost in obscurity, great advances have been made within the past thirty years in our knowledge of the history of plants and of those natural migrations by which they have been distributed over the surface of the globe.

We can strongly recommend Sir Joseph D. Hooker's presidential address to the geographical section of the British Association in 1881 as a capital *résumé* of the successful labours by which the history of plant distribution and the botany of the various countries of the world have been step by step unfolded. With the exception of De Candolle's latest book, all the leading modern works on the origin of species and the alliances of widely separated families of plants had been published in 1881, including the whole of Darwin's and Wallace's books. Sir Joseph Hooker's own work as a distinguished explorer of plant life in several extensive countries had been accomplished, and the lapse of eight more years would hardly have put him in a better position for delivering an address on botanical geography.

The science of the subject just named seems to have had its germ in the ingenious ideas of the learned French botanist and traveller, Tournefort, who first observed in ascending the mountains of Armenia in the interest of the Jardin des Plantes that the vegetations met with in such ascents represent those of successive higher latitudes. This idea of Tournefort's was further developed by Linnæus in his 'Stationes et Coloniæ Plantarum,' and it formed the first step in botanical geography. Linnæus, who was, like all

discoverers in this department, a traveller, was the first who gave attention to the topography of plants, defining, in the two books just named, their habitats and their stations, or the physical nature of their habitats, and even sketching pretty accurately an outline of the distribution of various plants as determined by climate, latitude, &c., as well as indicating the means of transport by wind, birds, and various other agencies—a kind of knowledge which has constantly increased at the hands of numerous observers, and to which Darwin devoted many pages in his chapters on geographical distribution in the 'Origin of Species.'

The next great generaliser was the indefatigable and ever attractive Humboldt, who in one of the earlier works from his prolific pen dwelt on the floras he had met with in advancing from the equator to the poles, and in ascending mountains. He had found that some kinds of plants increase in numbers relatively to others in proceeding from the equator to the poles, as ferns, grasses, and trees bearing catkins, such as the alder, birch, and willow; others decrease, as Rubiaceæ, Malvaceæ, and Compositæ; whilst others, such as Labiatæ and Cruciferæ, are most abundant in temperate regions, and decrease in both directions. As the result of his researches, pursued with astonishing powers of observation and reflection and extraordinary industry and sagacity, Humboldt was enabled to lay down those isothermal lines which students of botanical distribution owe to him, and to become substantially the founder of a new department of geographical science.

Little further progress could now be made so long as the old ideas of the unalterable character of the surfaces and climates of the globe prevailed. Sir Charles Lyell's works, however, were destined to disperse these old beliefs. In his 'Principles of Geology' he showed that the fauna of Sicily was older than the island it inhabits, having migrated thither before its separation from the continent of Italy. Darwin had made the same discovery when he recorded in his 'Journal of Researches,' 1839, the migration of animals into America in prehistoric times. 'We may safely look,' he says, 'at this quarter [Behring's Strait] as the line of 'communication (now interrupted by the steady pro-'gress of geological change) by which the elephant, the 'ox, and the horse entered America, and peopled its wide 'extent.'

Edward Forbes was another naturalist of genius who aided the work of these early pioneers. In several papers and

memoirs written more than fifty years ago he demonstrated that our British flora consisted of several assemblages of plants which had immigrated at periods when these islands were united to the adjacent continent, and which had still remained more or less localised. The oldest of these assemblages he described as the Pyrenean group, peculiar to the west of Ireland, which it entered along a chain of now submerged mountains that extended across the Atlantic from Spain to Ireland. A second assemblage characteristic of the south-west of France now prevails in Devon, Cornwall, and the Channel Islands; a third belongs to the north-east of France, whence it passed into our south-eastern counties in the era of the mammaliferous crag; a fourth was introduced from Scandinavia by the floating ice of the glacial period, when the mountain tops of our submerged country formed part of a chain of islands in the glacial sea connecting us with Norway. This assemblage consists of the alpine plants of Scotch, English, and Welsh mountains. Besides these there is the Germanic group of plants which entered these islands before their separation from the continent and during their upheaval from the glacial ocean, when the temperature was increasing, and which are still more abundant on the eastern side though spread throughout the kingdom.

At these stages of investigation, when the modes of dispersion of species, genera, and families had been traced, the representation of species, and the alliances which exist between groups of plants widely and effectually separated, were mysteries which had not been accounted for. Species being permanent and special creations in the popular belief, it was maintained that the different localities in which they were found must have presented conditions so similar that they favoured the creation of similar organisms. Unfortunately for this theory, it was found that in numerous cases no such similarity of physical conditions existed.

It is needless to dwell on pre-Darwinian theories formed in the dark. In remarking on the doctrine of the orderly evolution of species under known laws, and on those recognised principles of the science of geographical distribution which must guide all who enter on its pursuit, Sir Joseph Hooker mentions the three greatest names in this department in the following apt sentence: 'As Humboldt was its founder, and 'Forbes its reformer, so we must regard Darwin as its latest 'and greatest lawgiver.' In showing that the modification of species after migration and isolation is only a question

of time and changed physical conditions, he explained the leading facts of distribution—

'such as the multiplication of new forms, the importance of barriers in forming and separating zoological and botanical provinces, the concentration of related species in the same area, the linking together under different latitudes of the inhabitants of the plains and mountains, of the forests, marshes, and deserts, and the linking of these with the extinct beings which formerly inhabited the same areas; and the fact of different forms of life occurring in areas having nearly the same physical conditions.'

In 'Island Life' Mr. A. Russel Wallace endeavours to determine those conditions of the globe which existed anterior to our epoch, and which affected the distribution both of plants and animals over its surface. That Ireland was united with Britain, and Britain with the Continent, is proved by a variety of evidence; by the shallowness of the intervening seas, the submerged forests of the coasts of Devonshire and Cornwall, of the Bristol Channel, and at Cromer in Norfolk; and by the evidence of caves containing antlers of the reindeer, and the remains of animals which had been devoured by bears and hyænas on the face of the high sea cliffs of Glamorganshire. An interesting chapter in 'Island Life' is devoted to evidence of this kind, and to the effect of a former union with the Continent on the migration of plants. It is remarkable that there are no species of plants accepted by botanists as good species peculiar to the British Isles. The half-dozen good species of brambles of Professor Babington's British Rubi are not accepted by other botanists as true species; while the few flowering plants peculiar to these islands are either varieties or subspecies, such as *Helianthemum Breweri*, an annual rock rose, found only in Anglesea and Holyhead Island; *Rosa hibernica*, found only in North Britain and Ireland; *Œnanthe fluviatilis*, a water dropwort, found only in the south of England and in one locality in Ireland; and *Hieracium iricum*, a hawkweed of North Britain and Ireland.

There are, however, two species of plants found respectively in the north-west and west of Ireland, which do not occur in the European flora, and are natives of North America, and with these we may class the Irish filmy fern, *Trichomanes radicans*, which is found in the south-west of Ireland and Wales, was formerly extant in Yorkshire, and has no station in Continental Europe, except, perhaps, the south-west of Spain, though it is common in the Azores, Madeira, and the Canary Islands, and in many tropical countries. As these

plants are truly indigenous, and were not introduced by human agency, we have named them as conspicuous examples of natural migration, and of the difficulties attending our subject. Even in the case of twenty species or subspecies of flowering plants named by Mr. Wallace, and chiefly continental, it is not easy to explain why they should be found in Ireland and not in Britain. Mr. Wallace's explanation is that 'they probably had a wider range in mild preglacial 'times, and have been preserved in the south and west of 'Ireland owing to its milder climate. It must be remem- 'bered that during the height of the glacial epoch Ireland 'was continental, so that these plants may have followed the 'retreating ice to their present stations, and survived the 'subsequent depression. This seems more probable than 'that so many species should have reached Ireland for the 'first time during the last union with the continent, subse- 'quent to the glacial epoch.'

As an isolated volcanic mass built up from the edge of a profound oceanic gulf 17,160 feet deep, St. Helena owes none of its indigenous vegetation to a former union with any continent, and its characteristics must be precisely the opposite to those of Britain. We should expect to find a native flora of a very ancient type, and accordingly Sir Joseph Hooker tells us that forty of the fifty indigenous flowering plants of St. Helena, and ten of the twenty-six ferns, are absolutely peculiar to the island, and, 'with scarcely an exception, 'cannot be regarded as very close specific allies of any other 'plants at all. Seventeen of them belong to peculiar genera, 'and of the others all differ so markedly as species from 'their congeners that not one comes under the category of 'being an insular form of a continental species.' As to the original source of the vegetation of St. Helena we can only suggest the route of the earliest migration of some species of the ferns. Sixteen of these are not peculiar to the island, but are common either to Africa, India, or America; and this suggests migration of species carried by the wind. The identity of species of ferns found in countries widely separated from St. Helena does not imply a recent origin of the island, for such is the great stability of some of the generic and specific forms of ferns that many of those which have been fossilised and preserved in miocene strata of Switzerland were found by the surprised botanist who first compared them to present the slightest possible divergence from living species.

Sir Joseph Hooker believes that the affinities of the flora

of St. Helena generally are mainly African; and when we consider that in spite of ocean currents and of large seeds which have been stranded on the shores of St. Helena, and have germinated there after floating round the Cape of Good Hope from Madagascar or Mauritius, no existing or known method of migration can be suggested to account for the earliest evergreen mantle which covered this luxuriant island, we are borne to the conclusion that there must have been earlier mutations of the globe's surface than those which the geological maps of the world make us acquainted with. Moderate changes, however, might have sufficed, and especially that which geologic evidence confirms, the existence of intermediary islands which have now disappeared, though their sites are indicated by the presence of shoals in deep oceans.

It is evident that the earliest distribution of animal and vegetable life in a country must have been determined by geological changes, and on this hypothesis it is no longer mysterious that some plants should be natives alike of North America and of Europe, and of Europe and Australia, though they are absent from all the intervening countries. It ceases to surprise us that some of the Alpine species, primulas and saxifrages, are common both to the Arctic and Antarctic regions, having the wide world and its tropics between them, that the aquatic plants should be so widely dispersed although one system of water is as completely isolated from another as those various areas of land which are separated by barriers that appear insurmountable, that three cedars growing in English shrubberies now side by side, the Deodar, the Cedar of Lebanon, and the African Silver Cedar, which, according to Dr. Hooker, are but forms of one species, should have their original stations as far apart as the slopes of the mountains of Northern India, Syria, and the upper plateaus of the Atlas mountains.

The presence of Arctic plants in southern floras is one of those wonders of the plant world which are due to migrations that have left no trace of their history. By what route could plants have travelled by their own volition so that fifty-eight species should be identical in New Zealand and Europe? By what means was an interchange effected between South America and New Zealand, so that eleven species are identical in the two countries besides thirty-two which are closely allied? That great authority on the flora of Australia, Sir Joseph Hooker, states that thirty-eight species of the plants of Europe and Northern Asia are not found in the warmer

and intermediate regions, though they reappear in Australia. The same authority makes the following remarks, in his introductory essay on the 'Flora of Australia,' on the capacity for migration which the hardy plants of Scandinavia possess in common with the human population of that strength-imparting region.

'When I take a comprehensive view of the vegetation of the Old World, I am struck with the appearance it presents of there being a continuous current of vegetation (if I may so fancifully express myself) from Scandinavia to Tasmania; along, in short, the whole extent of that arc of the terrestrial sphere which presents the greatest continuity of land. In the first place Scandinavian genera, and even species, reappear everywhere from Lapland and Ireland to the tops of the Tasmanian Alps, in rapidly diminishing numbers it is true, but in vigorous developement throughout. They abound on the Alps and Pyrenees, pass on to the Caucasus and Himalayas, thence they extend along the Khasia mountains and those of the peninsula of India to those of Ceylon and the Malayan Archipelago (Java and Borneo), and after a hiatus of thirty degrees they appear on the alps of New South Wales, Victoria, and Tasmania, and beyond these again are those of New Zealand and the Antarctic Islands, many of the species remaining unchanged throughout. It matters not what the vegetation of the bases and flanks of these mountains may be; the northern species may be associated with alpine forms of Germanic, Siberian, Oriental, Chinese, American, Malayan, and finally Australian and Antarctic types; but whereas these are all, more or less, local assemblages, the Scandinavian asserts his prerogative of ubiquity from Britain to beyond its antipodes.'

The remarkable fact thus strikingly conveyed may be attributed to what Mr. Wallace calls that 'aggressive and 'colonising power of the Scandinavian flora' which has enabled 150 species to settle successfully in New Zealand, about as many in Australia, and nearly as many in the Atlantic States of America, while half the European species which have colonised Australia have also established themselves in those deep-sea islands, the Azores, 800 miles from Europe across an ocean so deep that the existence at any time of intermediate islands is not suspected.

If speculation may be hazarded on such a subject, it would seem that the immigrants in question must have found the antipodes less completely clothed with vegetation than it is at present, for plants do not readily win their way on ground that is already occupied. This is a law which may possibly not apply to the hardy denizens of the north, whose powers of competition may enable them to do battle with established rivals successfully. But such capacity for aggression is given to few, and Sir Joseph Hooker gives an interesting

example when he states, 'I am informed that the late Mr. 'Bidwell habitually scattered Australian seeds during his 'extensive travels in New Zealand,' but they failed to take possession, and such characteristic groups as those which furnish the wellknown eucalyptus and acacia of Australia are not found in the indigenous flora of New Zealand. The Scandinavian flora, on the contrary, has established itself in every temperate country to which it has had access, and its powers of migration are as remarkable as its powers of aggression.

The natural migration of plants, that is, the extension of species beyond the limits of their former homes without human agency, may be effected by various means, by rivers or ocean currents, by wind, which may waft the spores and light seeds of plants to immense distances, or by birds, which may transport them either as fruits which they have swallowed or as seeds clinging to the dirt adhering to their feet. The wind is a very common agent in the dissemination of species, especially in mountainous countries, where light seeds are readily transported from the higher levels to those which are lower. In Switzerland, when the valleys are torn by the force of the north wind, seeds are often driven to a great height, together with snow and dust. M. Boussingault has witnessed the driving of seeds to a height of 5,400 feet during such storms, and one can easily see that valleys and ravines would be crossed by such seeds, and that the same agency of wind might also plant the crevices of the most lofty and inaccessible cliffs. The spores of cryptogamic plants might cross the English Channel, the Mediterranean, and even the Atlantic, since they are lighter even than ashes, and it is known that the ashes of volcanoes have been driven by wind 290 leagues, or as far as from Vesuvius to Constantinople, during an eruption, and in 1845 from Hecla in Iceland to the Faroe Islands and the Orkneys, and even as far as Ireland and England.

Among his wonderful experiments Mr. Darwin found that the small portions of earth attaching to the feet of migrating birds contained seed. Nine grains of earth on the leg of a woodcock contained a seed of the toad rush. From 6½ ounces of earth rolled into a ball and adhering to the leg of a wounded partridge he raised eighty-two separate plants of five species. Migrating birds often frequent the edges of ponds ere their departure, and in 6¾ ounces of such mud he raised under glass 537 plants. Seeds furnished with crowns, hooks, or prickles readily stick to the plumage of birds,

which all such birds, and especially such wanderers as the albatross, might carry long distances.

Applying these facts to the case of the Azores, Mr. Wallace found that most of the plants of the Azorean flora are well adapted to be carried by the methods just suggested—forty-five of the 439 flowering plants belonging to genera that have either pappus or winged seeds, sixty-five to such as have minute seeds, thirty to those with fleshy fruits which are greedily eaten by birds, some have hispid seeds, and eighty-four are glumaceous plants well suited to conveyance by winds and currents. The only trees and shrubs of this isolated group are bearers of small berries, such as the Portugal laurel, myrtle, laurustinus, and elder, while those with heavy berries, which could not be conveyed by the means suggested, oaks, chestnuts, hazels, apples, beeches, alders, firs, are absent, common as they are in Europe. The character of the flora is that of the south-western peninsula of Europe, and, if we assume that one half of its species is indigenous, the other introduced by European settlers, there is still a rich and varied flora which Mr. Wallace thinks has been recently carried over 900 miles of ocean by the means just indicated. There is probably no better example of ocean migration than that offered by the Azores, and it is believed that the phenomena in question are still in progress, and that 900 miles do not form the limit of the distance to which this same ocean carriage of plants extends.

An interesting assortment of drift fruits collected in the spit of land enclosing Kingston Harbour in Jamaica, by Mr. D. Morris, may be seen in the museums at Kew. The character of these fruits indicates that they were brought by the Gulf Stream current from the mouths of the Amazon and Orinoco—a long migration on the part of these windfalls from the central parts of South America, but not so long as that effected by numerous specimens of the same kinds of living and yet waterproof drift which have found their way across the Atlantic to our south-western coasts. The active part played by the sea in aiding migration has been made more prominent since the publication of the 'Botany of the 'Challenger,' which contains* a summary, in which Mr. Hemsley brings to light some interesting facts bearing on our subject.

Since the publication of Darwin's personal observations on the methods of migration, and of Hooker's account of the

* Appendix, vol. i. pp. 277–304.

vegetation of the Falkland, Kerguelen, Auckland, and other islands, and of Wallace's 'Island Life,' the origin and composition of the vegetation of remote islands has engaged the attention of many botanists and travellers. But we have not met with a more interesting contribution to the literature of insular floras than a letter of Mr. Hemsley's, on the new vegetation of a surface destroyed by volcanic action, which appeared in the 'Field,' September 29, 1888. Five years ago the island of Krakatoa, in the Sunda Strait, was the scene of a most violent volcanic eruption, in the course of which that part of the island which did not totally disappear was covered with a deep deposit of cinders and pumice-stone. The intense heat must alone have been sufficient to destroy every germ of life, and therefore this island, covered as it now is with new vegetation, offers a perfect example of the unaided immigration of its several existing plants, the sole agents of the movement having been in this case winds, waves, and birds. The account of what has happened may best be given in Mr. Hemsley's own words. After stating that Krakatoa is situated twenty miles from both Java and Sumatra, and half that distance from the nearest spot—a small island only—where terrestrial vegetation existed, he says:—

'The first phase of the new vegetation was a thin film of microscopic freshwater algæ, forming a green, slimy coating, such as may often be seen on damp rocks, and furnishing a hygroscopic condition, in the absence of which it is doubtful whether the ferns by which they were followed could have established themselves. Both algæ and ferns are reproduced from microscopic spores, which are readily conveyed long distances by winds. Eleven species of fern were found, all of very wide distribution, and some of them had already become common the fourth year after the eruption. Scattered here and there among the ferns were isolated individuals of flowering plants, belonging to such kinds as have succulent seed vessels eaten by birds, or such as have a light, feathery seed vessel like the dandelion, and a host of others, and are wafted from place to place by the winds.

'On the seashore there were young plants and seeds (or seed vessels containing seeds) of upwards of a dozen other herbs, shrubs, and trees, all of them common on coral islands and on the seashore of the Malayan islands, and all known to have seeds capable of bearing long immersion in sea water without injury. Among the established seedlings were those of several large trees, and a convolvulus that grows on almost all tropical coasts, often forming runners one hundred yards in length. There were cocoanuts also, though none had germinated.'

It is evident from the rapid advance of a new and exotic vegetation that the winds, and other agents we have named,

had all been busy in the performance of their allotted tasks; and as growth and decay are alike rapid in the tropics, we may imagine that the increasing attractions of the spot and the larger production of food plants will induce an increased number of winged visitants to alight on the island, and some of these probably will add to the variety of the vegetation. In the end man himself will come with more seeds in his pocket, and thenceforward the plants of culture introduced or at least protected by him will dominate over those planted by Nature.

It cannot often have happened—and only in the near neighbourhood of other shores—that any island denuded of its vegetation, or rising naked from the waters, could have received a large number of species in the course of only five years. The floras of more distant islands would be far longer in their arrival, and they would be poorer. The seeds of flowering plants could seldom reach a distant island with unimpaired germinating powers. But a single vagrant seed arriving and taking hold in a hundred years would people the island in time. Mr. Hemsley, who is quite at home with drift seeds at Kew, points out that the Keeling Islands are a case in point. Darwin found the native vegetation contained only about twenty kinds of flowering plants, some of them very rare; but they had spread all over the islands, and now the islands are covered with profitable plantations of cocoa-nut trees.

We have now dealt very briefly with the prehistoric period of our short history of distribution, showing by sufficiently clear evidence the slow action of natural forces in spreading, and sometimes destroying and redispersing, the vegetation of the globe over its surface, from island to island, and continent to continent. But within the comparatively short period of his history, man has been an active agent in dispersing plants. A paper was read last autumn by a local botanist at Penzance, in which he described a number of foreign plants which he had found growing in the neighbourhood of that town. It seems that all these plants were strangers to Cornwall till recently, when their seeds were introduced with the imports of foreign corn. The same phenomenon has been observed in many other parts of the country, and in many other countries where seeds from suitable climates have, one way or another, been introduced unintentionally by way of the sea. The story has been often told of imported weeds, which have proved as noxious in Australia as those terrible pests the rabbits; and in another

hemisphere, the American naturalist, the late Asa Gray, gave a pathetic account in one of his works of the most troublesome weeds of the United States, which he declared to have been 'mostly of British origin.'

There are certain weeds which possess great colonising tact. The shepherd's purse, for instance, has dispersed itself throughout the world, succeeding everywhere, and a British grass, *Poa annua*, one of the commonest of weeds, thriving often in the less used streets of towns, has been observed by a recent traveller, Mr. John Ball, in the Andes, the Straits of Magellan, and within the tropics of Brazil.

These are examples of accidental, or rather of incidental, migrations. There are others in which the most useful plants known to man have followed his steps in his various excursions and rambles. We learn from the earliest history of mankind that certain dominant nations, having first taken advantage of the susceptibility of some plants to useful developement in the places where Nature had planted them, have, in the course of their various migrations, trading voyages, travels, and conquests, taken their cultures with them. Those who are interested in records of this kind will find, probably, all that is known on the subject in the delightful volumes on the 'Origin of Cultivated Plants' and the 'Wanderings of Plants and Animals,' respectively written by M. de Candolle and Professor Hehn, the last-named work having been edited by Mr. J. S. Stallybrass.

Since the publication of M. de Candolle's 'Géographie 'Botanique,'* more than thirty years ago, the work of exploring habitats and tracing migrations, the discoveries in botanical and archæological science, and the labours of Mr. Darwin and others, have, as already indicated, considerably increased our knowledge of the history of plants. M. de Candolle, therefore, had no difficulty in finding materials for compiling substantially a new work. In the present volume he has applied himself, with the aid of great knowledge and unwearied industry, to the task of determining the period during which each species has been in cultivation, and how its culture spread in different directions, limiting his attention to those plants which are cultivated for economic purposes, and leaving both wild plants and plants of ornament unnoticed. His first aim has been, he says, to discover the condition and habitat of each species before it was cultivated, and in making this attempt the method of proceeding has been to deter-

* This work was reviewed by Mr. Bentham in this Journal in 1856.

mine which of the numerous varieties of a species is probably the most ancient, and whence it came. That is the task which M. de Candolle has undertaken, confining his inquiries, as he himself says, 'to the examination of each 'species since its cultivation, or in the time immediately 'before it.' Until a very recent period—perhaps we may say until the publication of M. de Candolle's 'Géographie 'Botanique'—little progress had been made in tracing plants to their original homes. Three out of four of the guesses of Linnæus on this subject are now known to have been about as accurate as the legends of those older writers who attributed the olive to Minerva, the vine to Osiris, and the rose to the goddess of love. A great advance has certainly been accomplished, but one would still like to be assured whether the cereals and certain other important plants were modified by culture and the art of early plant improvers, or whether such plants were conferred by Nature on favoured countries, whence they were afterwards distributed. In either case the original wildings, or rather their original forms, may not now exist in the neighbourhood which gave them birth. During the present century, a Frenchman named Olivier imagined that he had discovered wild wheat on the banks of the Euphrates. But the general belief now is that his wildings were merely specimens of cultivated wheat, which had escaped from their fields.

'The lentil and chick pea probably no longer exist in 'nature,' says our author; and when he adds that 'other 'species, as wheat, maize, the broad bean, carthamus, very 'rarely found wild, appear to be in course of extinction,' we feel bound to remark that if Mr. Darwin, the most impartial of inquirers, shows at any time the slightest anxiety to discover examples of evolution, attributing wheat and other cereals to the gradual improvement of uncultivated grasses, our author is assuredly a little over-sanguine as to his discovery of original forms. Wheat, he thinks, may have been indigenous in Mesopotamia, and in his account of maize he says, 'Settled populations can only have been 'formed where nutritious species existed naturally in soil 'of easy cultivation.' The potato, the sweet potato, and maize, according to our author, fulfilled these conditions in America; 'and as the great populations of this part of the 'world existed first in the high grounds of Chili and 'Mexico, it is there probably that wild maize existed.'

It is singular that the name of Darwin is only once or

twice mentioned in the volume before us. But this shows the limited character of the task its author has undertaken, and some persons probably would have thought his work more satisfactory if he had altogether avoided the abstruse inquiries of that naturalist, confining himself entirely to the department of the botanist and man of letters.

M. de Candolle says that 'selection, that great factor 'which Darwin had the merit of introducing so happily 'into science, plays an important part when agriculture is 'established; but in every epoch, and especially in its 'earliest stage, the choice of species is more important than 'the selection of varieties.' In accordance with this view, he adds that 'the lowest savages know the plants of their 'country; but the example of the Australians and Pata-'gonians shows that if they do not consider them productive 'and easy to rear, they do not entertain the idea of culti-'vating them.'

Accordingly, M. de Candolle makes the distribution of the populations of the globe dependent on the spontaneous character of the food plants of various regions. Australia was thinly populated because, in spite of its favourable climate, Nature had not endowed it with productive species of plants. 'There must be valuable qualities in a wild 'plant in order to lead to its cultivation,' and the indigenous flora was so poor, as regards its capability of improvement by culture, that, although Sir Joseph Hooker has enumerated more than a hundred species which may be used in some way, they were not, as a matter of fact, cultivated by the natives; and, in spite of the improved methods of the colonists, no one does cultivate them. So says M. de Candolle, and he applies the same reasoning to the plants of South Africa and of Patagonia, countries which were naturally poor, he says, in the productive species, while their isolation from regions which Nature had treated more liberally, and their unfortunate exclusion due to distance, drought, or deserts, prevented the migrations of useful plants from reaching them. On the contrary, in other countries a number of useful species easily cultivated were found from the beginning — rice and the several leguminous plants of Southern Asia, and barley and wheat in their native land of Mesopotamia. M. de Candolle thinks that the earliest empires of the world with their enormous populations were reared in certain districts to which Nature had granted as a special gift productive species of plants, together with a favourable climate. In

America the maize, the potato, the sweet potato, and manioc take the place of the earliest food plants of the East; but these productive species were not improved by the hand of man as population grew, or at any rate not so much so as to have lost their original forms; they were the cause which enabled these regions to support that population. Consistently with this view he finds wheat and maize growing spontaneously in their respective centres from which these useful species were diffused.

M. de Candolle does not appear to have abandoned the opinion expressed in 'Géographie Botanique raisonnée,' that plants have rarely been so much modified by culture that they cannot be identified with their wild prototypes. We need scarcely observe that such a theory is diametrically opposed to the teaching of Mr. Darwin. M. de Candolle holds that our most prolific cereals, as well as other plants, were the gift of Nature to certain regions, and that the great populations of the world accumulated in particular sites in consequence of these gifts; while Darwin thought that the varying forms of florists' flowers and garden vegetables must convince us that selection is everything, and the choice of the particular species to be operated upon is by comparison nothing. You can convert such common subjects as pelargoniums and potatoes, turnips, radishes, and carnations to every size, shape, and colour by a few years' breeding and selection. In accordance with this view, the most useful food plants may have been developed from obscure grasses and other unproductive forms of plants, and great populations may have been everywhere founded on plant improvement. Mr. Darwin himself, in referring to the theory which De Candolle had avowed in his 'Géographie 'Botanique,' remarks that

'on this view, considering that savages would not have chosen rare plants for cultivation, that useful plants are generally conspicuous, and that they could not have been the inhabitants of deserts or of remote and recently discovered islands, it appears to me strange that so many of our cultivated plants should be still unknown, or only doubtfully known in the wild state.'

But if they have been profoundly modified by culture, the difficulty disappears, as it does provided they had been exterminated during the progress of civilisation, which M. de Candolle himself states can have rarely happened, for the earliest earth-tillers in any country having selected one of M. de Candolle's highly endowed species, its growth would then be carried on within the boundaries of cultivation, and

its extirpation from the waste lands would be less likely to occur, as it would cease to be an object of search. It seems to us that our author has not given due weight to the fact that the earliest cultivators were savages waging war with Nature with tools rudely pointed with flints, or at a still earlier date with finger-nails only. Mr. Darwin has recited in 'Animals and Plants under Domestication' the accounts of travellers of the wretched food collected by savages in Australia, Sikhim, South Africa, and other places. As to the cereals, if the present size of the grains was not acquired under cultivation, some countries were greatly blessed compared with others. Barth's 'Travels in Central Africa' is cited by Mr. Darwin for the account of several tribes in the central region who collect the seeds of wild grasses for food. Livingstone described the natives near Tete as collecting the seeds of a wild grass. There are numerous kinds of grasses with seeds of small size which are used as food—for example, in the deserts of the Punjaub, where the seeds of four genera are so used, namely, of Agrostis, Panicum, Cenchrus, and Pennisetum—as well as the seeds of four other genera belonging to distinct families.

As to the absence of any useful plant in Australia, the Cape of Good Hope, New Zealand, or America, south of La Plata, as also from all uninhabited islands, these are facts entirely opposed to M. de Candolle's view that nearly all our useful plants, natives of Europe, Asia, and South America, had originally existed in their present condition. As the various introduced plants find in these countries a suitable soil and climate, it is astonishing that nothing useful should have been naturally produced under such favourable circumstances. We are, in fact, driven by a process of logical exhaustion to conclude that the chief food plants were not created as we find them, and that non-improvement of natural species indicates the absence of population or of motive for improvement. The inhabitants of Australia and the Cape of Good Hope did not cultivate the ground at all, and in those particular parts of America which have been referred to as originally barren of useful plants, the ground was very imperfectly cultivated, the inhabitants being hunters or fishermen. In the case of New Zealand, Mr. Darwin explains that the Polynesian colonists brought with them seeds and roots as well as the dog, so that the early colonists, like the later European migrants, had no particular inducement to cultivate and improve the aboriginal plants, which could not possibly compete with

those which they brought with them, and which had been for ages grown and perfected in the more populous and civilised parts of the world.

The same reasoning applies to the seats of ancient empires, which were both civilised and thickly peopled; as, for example, Mexico, Peru, Chili, and Brazil, where cultivation and other arts were practised before the arrival of the Spanish and Portuguese voyagers. As in the Old World, so in the New, there was no want of native food plants; and, says Mr. Darwin—

'Had North America been civilised for as long a period and as thickly peopled as Asia or Europe, it is probable that the native vines, mulberries, crabs, and plums, would have given rise after a long course of cultivation to a multitude of varieties, some extremely different from their parent stocks; and escaped seedlings would have caused in the New as in the Old World much perplexity with respect to their specific distinctness and parentage.'

Having already suggested the methods of the prehistoric dispersal of plants, our next and chief concern is to render an account of their subsequent movements. This is, in fact, the task which M. de Candolle has undertaken, and with all his great resources of learning, diligence, and care he has found it sufficiently involved. The history of the introduced plants of a country is often as obscure as that of its people. We know historically that neither the Scotch, nor English, nor Welsh are indigenous races, and we know something of the nations that preceded them. In like manner we know the history of most of our cultivated plants, whether Roman generals brought them, or the explorers of the New World, or the collectors of the great nursery firms who are ransacking the globe at the present time and importing novelties every day. But some of the more ancient travels of plants are far more obscure.

It is easy to conceive that the earliest colonists of the world carried with them in their migrations those species of their own cultivated plants, as well as domestic animals, which suited the new regions, and in proportion to the want of civilisation among them would be the small number of the introductions. As population became more dense, and agriculture and art improved, the introduction of a larger number would be accomplished. So long as people lived by the chase, or by depasturing their flocks and herds throughout an extensive country, they would require few cultivated plants; but as the population became more dense and civilised, their wants in this respect would necessarily be

increased. It is easy to imagine what would happen when an energetic race had established a great empire having communications, as the Romans had, with the whole world so far as it was known. Such a race in their earlier period would be collectors of useful plants for the support of their increasing population, and later on they would be distributors. It is evident, therefore, that two great civilisers of the ancient world—war and commerce—must have spread the most useful plants wherever their influence extended.

In his present work M. de Candolle includes 247 species of plants of utility most commonly cultivated, of which the Old World has furnished 199, America 45, while three are still uncertain. He thinks it surprising that the United States with their vast territory, which will soon support hundreds of millions of inhabitants, only yielded two native species of food plants—the Jerusalem artichoke and the gourds. Within the past two thousand years there has been no discovery, not even to the extent of a single species, which can rival the older food plants—maize, rice, the potato, sweet potato, bread fruit, date, cereals, millets, sorghums, the banana, and the soy bean of China and Japan—which have all been cultivated from three to five thousand years.

After all, the plants of utility are few. About one hundred thousand species of flowering plants are known to botanists, and only 247 of these render direct and important services, or are in any degree indispensable, to man. About forty-four species, however, have been made the special subjects of man's care, and have accompanied his migrations from an unknown period of history. Very few useful plants were common to both hemispheres till their distribution by man had made them so. None were indigenous to the Arctic or Antarctic region, nor to Patagonia or the Cape of Good Hope, nor to Australia, if we except that very indifferent vegetable *Tetragona expansa* and the blue gum, *Eucalyptus globulus*.

It may be accepted as a general conclusion that the most essential plants come on the stage first, so that their history includes that of the earliest agriculture and of the most ancient people of the world. At a later stage we may presume that other plants were found useful, such as the artificial fodder plants which began to be cultivated for cattle when the purely pastoral system of husbandry by nomad tribes came to an end, just as cattle ranchings will do in America at no distant date, it is said. The cultivation of medicinal plants would follow, in the course of time,

with that of edible fruits and garden vegetables, and of aromatic leaves and seeds, such as tea and coffee. Tea, it is true, is so old in Chinese history that no record exists of the earliest cultivation of the plant, and the only account of its origin is purely legendary. If tea and coffee had been more essential to us in this country, they would have been here before the seventeenth century.

Among the plants of prehistoric cultivation, rice perhaps should take precedence, since it has probably supplied the means of subsistence to a greater number of the human race than any other cereal. It is conjectured that the earliest agriculture originated in dry eastern countries, and therefore for the most part on the banks of rivers where irrigation could be easily supplied. As an aquatic plant, rice may have grown spontaneously on the numerous river banks of China and of India; at any rate, the Chinese emperor, Chinnong, sowed it ceremoniously with his own hands at a festival instituted by him 2800 B.C. It was cultivated in the valley of the Euphrates 400 B.C., and was transported a thousand years later to the irrigated parts of Syria, thence to Egypt, and thence, in comparatively modern times, and by routes which will occur to the reader, to Spain and to America.

The oldest agriculture was that of China, Egypt, and the adjacent countries of Asia, and notwithstanding the advanced state of the agriculture of China as far back as 2700 B.C., the earliest migration of a number of useful plants from Western Asia, their original home perhaps, into the Celestial Empire, only occurred in the second century before the Christian era, at the period of the mission of Chang-Kien. That famous ambassador, who is said to have remained two years in the West, carried home with him the bean, cucumber, lucern, saffron, sesame, the walnut, pea, spinach, water melon, and other plants. The Mongolians could hardly have introduced many new and useful plants into China, since their immigration was from the wrong quarter, that is, from a country too cold to have originated them.

M. de Candolle discusses the migrations between China and the West with much learning. In his detailed account of the peach and apricot, in another part of the work, he states that the Chinese knew the latter plant 'two or three 'thousand years before the Christian era,' and that Chang-Kien, who went as far as Bactriana, first made the West known to the Celestials, and that 'it was then, perhaps, 'that the apricot was introduced to Western Asia.' In

treating of the peach he says, 'I formerly attributed a 'Chinese origin to the peach, a contrary opinion to that 'which prevailed at the time, and which people who are not 'on a par with modern science continue to reproduce.' He then proceeds to enforce his view that different varieties of the peach, besides two wild forms, had certainly been known in China 'for thousands of years' before the Christian era, before its introduction into the Greco-Roman world, and for a thousand years, perhaps, before its introduction into the lands of the Sanskrit-speaking race.

The history of the peach, like that of the apricot, is particularly interesting. They both came from a part of the interior of Asia more distant than the city of Cerasus, the earliest home of the cherry, which, at the triumph of Lucullus, heralded the arrival of other fruits from further inland, Rome proving always a halfway station from which Western Europe received them. Neither Cato, Varro, Cicero, nor any author of Republican Rome, nor poet of the Augustan age, nor the elder Greeks whose works have been preserved, mention the peach or apricot. We have already noticed conquest as an impulse of migration, and accordingly the extension of the 'Roman world' eastward formed an epoch in the history of plant migration. As Professor Hehn observes, 'It was only when the Roman Empire, 'after the overthrow of Mithridates, began to extend, directly 'or indirectly, to the valleys of Armenia and the southern 'margin of the Caspian Sea, that the natural treasures of 'these strange and fertile regions were gradually disclosed, 'and bit by bit conveyed to Italy.' Towards the middle of the first century of the Christian era the gardeners of Italy had planted for profit 'the Persian apple' and Armenian plum, i.e. the peach, *Amygdalus persica* and *Prunus armeniaca*. M. de Candolle's ingenious theory of the Chinese origin of the peach is entirely at variance with the explanation suggested by Mr. Darwin and adopted by his followers. The peach, he says, is not mentioned by Xenophon, though it must have been heard of about the time of the retreat of the ten thousand, and possibly became known by report after the expedition of Alexander, for Theophrastus mentions it as a Persian fruit 332 B.C. It is not mentioned in the Hebrew writings, and has no Sanskrit name, and as the Sanskrit-speaking peoples, as well as the early Greeks and Hebrews, all migrated from the upper part of the Euphrates valley, M. de Candolle concludes that it could not have been an aboriginal of Western Asia, and that it came from China. The

Chinese, he says, had early discovered the route over the mountains to Kashmir, Bokhara, and Persia, and by this road the first peach stones may have travelled. M. de Candolle refers to the fact that the peach has been found wild in different parts of Asia, and he observes very justly that this does not prove it to be indigenous, since the wildings may have sprung from the stones of cultivated fruit. The same remark applies to wheat, maize, and many other plants for which M. de Candolle is inclined sometimes to claim an indigenous as well as spontaneous existence. Mr. Darwin,* on the contrary, accepts the opinion of T. A. Knight and other horticulturists that the peach is a modified almond, which acquired its present character at a comparatively late period. This, Mr. Darwin believes, would account for the several facts brought forward by our author, 'on the same 'principle that the nectarine, the offspring of the peach, has 'few native names, and became known in Europe at a still 'later period.'

It is evident that however ancient the agriculture of China may have been, and whatever improvements were effected by culture in its food plants or fruits, the isolation of the country must have checked their migration. It was not so, however, with the plants of that vast region which stretches from the Ganges to Armenia and the Nile. History has placed in this part of the world the cradle of the human race, and if the plants of chief utility and ornament were originated, as we believe they were, by selection and the long-exerted skill of early plant improvers—of whom Ceres may have been a successful prototype—then this part of Asia must have been the birthplace of the best plants as well as of the most civilised nations. We approach now to historic times, when the Turanian, Aryan, and Semitic races engaged in constant wars, with frequent great migrations of men, and no doubt of plants, when the first Assyrian and Egyptian empires were founded, and when the Aryan tribes migrated to the west and south, carrying, no doubt, some of their best plants with them.

Wheat, which is now the bread corn of twelve European nations, and is fast supplanting maize in America and several inferior grains in India, was no doubt widely grown in the prehistoric world. The Chinese cultivated it 2700 B.C. as a gift direct from heaven, the Egyptians attributed its origin

* Animals and Plants under Domestication, vol. i. p. 357.

to Isis, and the Greeks to Ceres. A classic account of the distribution of wheat over the primeval world shows that Ceres, having taught her favourite Triptolemus agriculture and the art of breadmaking, gave him her chariot, a celestial vehicle which he used in useful travels for the purpose of distributing corn to all nations. Ancient monuments show that the cultivation of wheat had been established in Egypt before the invasion of the shepherds, and there is evidence that more productive varieties of wheat have taken the place of one, at least, of the ancient sorts.

Innumerable varieties exist of common wheat. Colonel Le Couteur, of Jersey, cultivated 150 varieties, Mr. Darwin mentions a French gentleman who had collected 322 varieties, and the great firm of French seed merchants, Vilmorin-Andrieux et Cie., cultivate about twice as many in their trial grounds near Paris. In their recent work on 'Les Meilleurs 'Blés,' M. Henry L. de Vilmorin has described sixty-eight varieties of best wheat, which he has classed into seven groups, though these groups can hardly be called distinct species, since M. Henry L. de Vilmorin has crossbred three of them, *Triticum vulgare*, *T. turgidum*, and *T. durum*, and has found the offspring fertile.

Three smallgrained varieties of common wheat were cultivated by the first lake dwellers of Switzerland (time of Trojan war) as well as by the less ancient lake dwellers of Western Switzerland and of Italy, by the people of Hungary in the stone age, and by the Egyptians on the evidence of a brick of a pyramid in which a grain was embedded, and to which the date of 3359 B.C. has been assigned. The existence of names for wheat in the most ancient languages confirms this evidence of the antiquity of its culture in all the more temperate parts of Europe, Asia, and Africa, but it seems improbable that wheat has ever been found growing persistently in a wild state, although the fact has often been asserted by poets, travellers, and historians. In the Odyssey, for example, we are told that wheat grew in Sicily without the aid of man, but a blind poet could not have seen this himself, and a botanical fact can hardly be accepted from a writer whose own existence has been contested. Diodorus repeats the tradition that Osiris found wheat and barley growing promiscuously in Palestine, but neither this nor other discoveries of persistent wild wheat seem to us to be credible, seeing that wheat does not appear to be endowed with a power of persistency except under culture. Sir John

Lawes has shown at Rothamsted that wheat, like other domesticated plants, does not survive many years when exposed to the rivalry of wild competitors. He left the upper end of a wheat field uncut and uncropped, and allowed the grain to fall when ripe; and in three years there was hardly a single ear of corn left, while those which could be found were short in the stalk, with perhaps a single grain, instead of thirty or forty, in the ear. In the struggle for existence on untilled ground weeds invariably destroy wheat. Cultivated plants are dominant only when protected. Our food plants, in short, are artificial in their present forms, and in a state of nature they would rapidly disappear. The fittest survivals in nature are the hardiest and most robust—that is, the weeds; and cereals, selected and modified as they were with the object of attaining size and prolificacy, could not win their way amongst such competitors without a great deal of help, hoeing, and manure.

The agriculture of the Euphrates was probably as ancient as that of the Nile, and although the history of the Dravidian and the Malay peoples does not reach far back, M. de Candolle assigns as old an agriculture to India and the Malay Archipelago. Possessing as we do evidence of Egyptian and Phœnician visits to various stations in the Mediterranean regions and even to countries far beyond, we may be sure that they carried useful plants with them, but we have no historical record of the actual arrival of any of the cereals in England or the northern coasts of Europe, and the kitchen middens of the Danish dwellings in the age before metals had reached Denmark have exhibited no sign of the practice of agriculture at that time. The age may not have been more remote than that of Pericles or of the palmy days of the Roman Republic, and the Scandinavians of the period may have subsisted on the animal food obtained by fishing and hunting, with cabbages and other indigenous vegetables which would not require cultivation. The Aryan nations, whose migrations to Europe began from 2,500 to 2,000 years B.C., probably increased the list of European plants, though we learn from names occurring in tongues older than these migrations, such as Finn, Basque, Berber, and the language of the Guanchos of the Canary Islands, that several plants from the East must have been cultivated in Europe prior to those migrations. In later times, when the use of bronze had reached as far north as Sweden, we meet with the first evidence of agriculture at that period in the carving

of a cart drawn by two oxen, among the remains of the inhabitants.

In other parts of Europe an earlier agriculture existed. Professor Heer has described the seeds of cereals found in the midden heaps of the lake dwellers of Eastern Switzerland, showing that plants had been imported as early as the stone age or the siege of Troy from the countries south of the Alps. M. de Candolle adds that they may have received plants cultivated by the Iberians who occupied Gaul before the Kelts. At a later period, when these same lake dwellers of Switzerland and Savoy possessed bronze, their agriculture was more varied, and they then cultivated a larger number of species than the lake dwellers of Italy when in possession of the same metal, but this might have been due to a greater antiquity or to local circumstances. In continuing this analysis M. de Candolle adds:—

'The remains of the lake dwellers of Laybach and of the Mondsee in Austria prove likewise a completely primitive agriculture; no cereals have been found at Laybach, and but a single grain of wheat at the Mondsee. The backward condition of agriculture in this eastern part of Europe is contrary to the hypothesis based on a few words used by ancient historians, that the Aryans sojourned first in the region of the Danube, and that Thrace was civilised before Greece. In spite of this example, agriculture appears in general to have been more ancient in the temperate parts of Europe than we should be inclined to believe from the Greeks, who were disposed, like certain modern writers, to attribute all progress to their own nation.'

The agriculture of the New World coincides with its name, the earliest civilisation of Mexico and Peru being subsequent to the Christian era; still we may argue from the widespread cultivation of the most useful plants of America at the time of its discovery that M. de Candolle is not mistaken in claiming at least two thousand years as the period of their domestication. The clearest evidence exists that cultivated and other plants have travelled very widely, and also that they have sometimes flourished better in their new homes than they had done in the older ones, so that, however suitable soil and climate may be for particular plants in any given country, it does not follow that they ever grew there in a state of nature. On the contrary, some productive regions, such as Australia, only received the gift of useful plants in modern times. Our own history is older, still none of our most useful plants are native, and, in fact, most of the vegetation seen in the course of a stroll on a summer's day is actually of foreign origin. All our cultivated crops are

so, as, for instance, the cereals and turnips, most of the clovers, the cattle cabbage, and the mangold wurzel, which were all introduced either from Europe, or, perhaps in the case of the cereals and flax, direct from the far East by one of the early Aryan races, who appear to have taught Europe her first steps in agriculture.

In the hedgerows several of the so-called native trees and shrubs are really foreign in their origin. The discovery of the submerged forest off Cromer, stretching away under the shallow waters of the German Ocean towards the opposite coast, has brought to light prehistoric and yet visible evidence as to the trees which are native, and at the same time it has suggested routes by which we now know that some of our so-called native plants reached these islands in a former order of the world. Plants, as already said, are not necessarily native because they flourish and seem at home. The oak, yew, beech, and Scotch fir were undoubtedly among the trees of our prehistoric forests, but our 'hedgerow elms' are not all native, and the commonest of the several sorts growing south of the Trent, the old English elm, is not an indigenous species. The aspect of our own country must have been almost as much changed by the introduction of the elm and plane, the spruce, larch, silver fir, and other foreign conifers, as well as the laurel and numerous shrubs grown in the precincts of dwellings, as that of Portugal has been in recent times by the introduction of camellias, oranges, the Australian gum tree, and the loquat from China, a tree which has proved particularly acceptable in a sunny climate, since as a giver of shade it surpasses even the fig.*

Europe seems to have been originally bare both of cereals and of other useful plants. Her native fruits were merely nuts and poor berries, masts, sorbs, and crabs; the rest came from the East by various routes, which have been already indicated. Within the historic period Rome was the great emporium, and owing to her conquests in the earliest cultivated countries of the East, the cradle of the oldest and best plants, her generals became the chief introducers of vegetable novelties. They conferred on France, for example, the means of producing her exquisite wines and the best of her cognac, and they planted the vine even in England. Cæsar found in Britain, according to his 'Commentaries,' apples of indifferent quality, and a very poor catalogue of other fruits, such as the hazel, bullace, wild raspberry, sloe, elder, and blackberry.

* Crawford's 'Portugal Old and New,' 1880, p. 127.

The generals who succeeded him left us, at quitting, the pear, peach, cherry, vine, fig, mulberry, damson, medlar, and walnut, with many ornamental shrubs. They were men of taste and luxury, and some of those who resided long in this country sent to Rome for any novelty suited to the climate, planted probably the first orchards—at least, of superior fruits—the earliest rose gardens, and among other trees the bay, the English elm, the plane, which had passed from Asia into Italy, and had reached the northern shores of Gaul, as Pliny states, about A.D. 79.

Among similar examples of what pioneers and conquerors have done, the Moors brought to Western Europe that most valuable milk and butter making forage plant, lucern, and the sugarcane, as well as many flowers and other plants of Arabia. The most remarkable gifts of this kind are conferred from an instinctive desire to render the earth more productive, as when Sir Walter Raleigh planted at Youghal the American tuber, which has proved at once a blessing and a curse, the food plant of millions, but unfortunately a lamentable agent of improvidence.

It is, of course, by the activity of man—the explorer of every corner of the world—that the migrations of useful plants have been effected, so that the history of man's migrations would include that of the plants he has taken with him. We have already referred to some of the older wanderings of nations, and to their work in distributing plants throughout the world. As examples of more modern wanderings we may take the rice plant and maize, one of them the most important food plant of the New World, the other holding a similar position among the most populous countries of the East. In the time of Columbus maize was confined to America. It travelled into several old countries by routes which need not be given in detail. It will suffice to say that it travelled on its merits, as the most productive of all cereals, quickly, and that seeds were sown early in the sixteenth century in Spanish, Italian, French, German, and English gardens. Soon afterwards it spread into the fields of various countries. The Venetians transported it to the East, and it became naturalised in Turkey, the Danubian countries, Hungary, and in the Levant and South Europe generally, where it now forms the principal bread corn of the people. Following the routes of commerce, it has travelled to China and Japan, and it has even penetrated to the heart of Africa in company with missionaries or with persons engaged in trade—the slave trade perhaps.

Rice being an Old World plant has an ancient history and a Sanskrit name, *vrîhi*, which became in the Iranic languages *hrîzi*, a root, whence came the Greek name for rice, and the Latin *oryza*. Herodotus, who had heard of the wool which grew on trees (cotton), had also heard of rice as a food plant of India. The Macedonian conquest of Asia made the plant known to the Greeks, but it was during the Persian dominion that it first migrated as a useful plant from the banks of the Indus to the Oxus and Euphrates. The Arabs brought it to Europe. Having been long acquainted with the grain through their Indo-Ethiopian trade, they introduced its cultivation in the delta of the Nile after their conquest of Egypt; and the Moors afterwards pursued the same kind of farming, with the aid of irrigation, in the lowlands of Spain, especially in the basins of the Guadalquivir and Guadiana, and in the rich marshlands of Valencia. Spain proved a halfway station in the passage of this grain from Asia to America, and rice and maize were soon growing side by side in both hemispheres.

Tea, sugar, coffee, and cotton have all travelled far from home. The first-named plant was transported in Wardian cases from China to Assam, where, within British possessions, the plant and its culture have become naturalised. As to sugar our story must be brief. Its primitive range, M. de Candolle thinks, extended from Bengal to Cochin China, and perhaps included the Sunda Isles and the Moluccas, whose climate is similar. Its extension from India westwards is not difficult to trace. The Greco-Roman world was only slightly acquainted with the sugarcane, and the Hebrew writings do not mention it. The cultivation of the plant probably did not exist west of the Indus at the time of the Jewish captivity at Babylon. Egypt, Sicily, and the south of Spain owed it to the Moors in the Middle Ages, and it flourished in those countries till its great success in the new colonies of Spain caused the abandonment of its culture in Europe. From Sicily the sugarcane was transported to Madeira by Don Henriquez; it accompanied the Portuguese into Brazil, the English into Barbadoes and Jamaica in the seventeenth century, and the French into Bourbon and Mauritius.

Returning to the Old World, we find the use of coffee unknown in Arabia, its indigenous country, till a mufti of Aden acquired a taste for it in Persia, and made known its use to his countrymen at home. It had reached Constantinople in 1550, and there after a while it was for political

and economical reasons forbidden, tolerated, and taxed in turn. The Venetians brought the berry westwards in 1615, and the cafés of Paris and establishments of the same class in London were opened soon afterwards. But in these cases the berry only wandered, while its culture remained behind. A touching story has been told of the travels and dangers of a coffee plant. The first specimen of the plant rooted in French soil in a hothouse in the Royal Gardens of Versailles in 1703, but it died from ill-treatment. A little later another plant was received at the same gardens as a present from Amsterdam, the Dutch being then great traders with the East. It flourished, and was propagated by cuttings, one of which was given by Antoine de Jussieu to the Chevalier Déclieux, a naval officer, who undertook to convey it to the French colony at Martinique, where it was hoped coffee might become a commercial product. Aided by gods and men we know how plants have travelled and survived great dangers, sometimes encountering a latitude too cold for them, and sometimes, like the bread fruit on board the 'Bounty,' surviving the dangers of a mutiny. M. Déclieux's coffee plant was nearly lost through a failure in the store of water during the voyage. Only one glassful daily could be spared for each person on board, and none for the coffee plant, which must inevitably have perished but for the Chevalier's devotion to it. Anxious that the valuable plant entrusted to him should be landed in safety, he bestowed upon it daily half his allowance of water, and, at the cost of much suffering to himself, saved its life.

There are several species of cotton, some of them indigenous to the New, some to the Old World. On the discovery of America, the Spaniards found Barbadoes cotton, *Gossypium barbadense*, in cultivation and in use from the West India Islands to Peru and from Mexico to Brazil. Seeds of this sort have since been scattered in India, Java, and other hot countries of the East, where their offspring have increased the confusion arising from the existence of several species, and the difficulty of distinguishing between them. *Gossypium herbaceum* is, however, an ancient species in Asiatic plantations, indigenous in Burma and the Indian Archipelago, but not identical with the tree cotton, *G. arboreum*, of Upper Egypt, mentioned by Herodotus, Dioscorides, and Theophrastus. Even in the time of Pliny it does not appear that any kind of cotton was cultivated in Lower Egypt, though a hundred years later it had migrated into that part of the country. Pliny was mistaken in

supposing that the dress of the Egyptian priests and the grave-clothes of the mummies were of cotton. In modern times the microscope has shown them to be of linen, as were the priestly robes of the Jews, in accordance with divine behests received not long after their departure from Egypt. The commonest cultivated cotton now in all countries, including the United States, is *G. herbaceum*, a native of this hemisphere, which followed the migration of men and plants to America in company with sugar.

There is no trailing plant which has entwined itself more persistently into the affections of numerous nations than the vine, whose native country seems to be between the Black and Caspian Seas, where immense quantities of wild vines grow to this day, and where in ancient times Noah made wine. In Egypt it is probable that the arts of grape growing and wine making were practised five or six thousand years ago, but in China and the east of Asia only two thousand years ago. M. de Candolle believes that both Semitic and Aryan nations knew the use of wine, and distributed the vine in all the countries into which they migrated, including India, Egypt, and Europe. Its further distribution by Greeks and Romans is well known, and we shall pass over those classic travels, as well as the more modern movements into America and into our several colonies. Professor Hehn's essay on the vine is a long one, full of interest and curious research.

The common cabbage, *Brassica oleracea* of Linnæus, exists in the wild state in two distinct regions of Europe—the Mediterranean coast near Nice, Genoa, and Lucca, and those of the United Kingdom and Denmark and some other spots. It is not quite certain whether the plant is indigenous in these sites or the result of self-sowing from cultivation, so that the facts of geographical botany are rather bare with regard to this useful plant. On the contrary, historical and philological data afford clear evidence of the comparatively modern and European origin of the countless varieties of cabbage which cultivation has produced. Most of these modifications have been effected since the days of the ancient Greeks. Theophrastus distinguished three forms of the cabbage; Pliny, double that number; Tournefort, twenty; De Candolle, more than thirty. That these 'improvements' of the tough and hardy straggler of Shakespeare's Cliff and many similar seaside stations were effected by European cultivators seems certain, inasmuch as their common names are numerous in European languages and rare or modern in

those of Asia. There are five or six ancient roots from which the European names are derived. (1) *Kap* or *kab* in several Keltic or Slav names, which with the French name *cabus* clearly owns the same origin as *caput*, a term derived from the head-shaped form of the cabbage. (2) *Caul*, *kohl*, in several Latin, German, and Keltic languages (*caulis*, stem or cabbage); *choli* in old German, *kohl* in modern German, *kaal* in Danish, *kaol* and *kol* in Breton, *cal* in Irish. (3) *Bresic*, *bresych*, *brassic* of the Keltic and Latin languages, from which perhaps were derived *berza* and *verza* of the Spaniards and Portuguese, and *varza* of the Roumanians. (4) *Aza* of the Basques (Iberians) differs little from the preceding.

After showing that the various names of the cabbage in the Keltic languages prove the existence of the species on the west coast of Europe, M. de Candolle says:—

'If the Aryan Kelts had brought the plant from Asia, they would probably not have invented names taken from three different sources. It is easy to admit, on the contrary, that the Aryan nations, seeing the cabbage wild, and perhaps already used in Europe by the Iberians or the Ligurians, either invented names or adopted those of the earlier inhabitants.'

M. de Candolle has no doubt that the wild plant was gathered before it was cultivated, and that the period of its earliest cultivation is more ancient than that of the Aryan invasions.

Unlike the cabbage, the beetroot (*Beta maritima*) does exist in western temperate Asia; but the nations of the Aryan race do not appear to have brought it with them, as there is no name for it common to the Indo-European languages. No Hebrew name is known for it; and however indispensable sugar beet and mangold may be at the present time in the agriculture respectively of France and England, the improvement and cultivation of the plant commenced probably three or four centuries before the Christian era.

In 'Wanderings of Plants and Animals,' Professor Hehn treats his subject as a scholar, not as a naturalist, and solely in relation to European civilisation. He takes his stand on philology, as his editor, Mr. Stallybrass, intimates in the following sentence:—

'If he [the scientific man] finds a plant flourishing pretty abundantly in Greece or Italy now, and knows of no climatic or geological changes that would exclude its having flourished there 5,000 years ago, he will

at once pronounce it indigenous, and scout the notion of its having been imported. But now listen to the scholar, and he may tell you that Homer never mentions such a plant; that later poets speak of it in a vague way, as something very choice and very holy, and always in connexion with some particular deity; they may have tasted its fruit, may have seen the figure of its flowers (probably conventional) in emblematic painting or carving, but have not the faintest notion of its shape or size, whether it be a grass, a shrub, or a tree; till at last, in the time of Alexander or Darius, the plant itself emerges into clear visibility. Your inference will be that it came to Greece within historic times.'

We are convinced that Mr. Stallybrass's 'scientific man' would not plead guilty to the charge of jumping to conclusions in the manner he suggests. The botanist is quite accustomed to the finding of plants flourishing amazingly a long way from their native home, and he has his own method of deciding whether they are foreign or not. For example, all the fruits and vegetables of temperate and subtropical countries have been planted in Australia and New Zealand, and many of them thrive—as the watercress does in the last-named island—better in their new homes than in the older countries. But the botanist finds no alliance between the immigrants and the indigenous vegetation, and he can detect each imported species by the aid of science alone, without the help of history. He does not mistake the Mexican agave, the American opuntias, and the African palms, for plants indigenous to the neighbourhood of Monaco, though they grow there freely. Numberless examples of this kind might be cited, and in fact the botanist is as often puzzled to account for the absence of a particular plant in spots where the soil and climate seem suitable for it, as he is to explain the appearance of one where the conditions do not appear favourable.

Professor Hehn's method of treatment is exemplified in his account of the edible chestnut, which could not, as he shows, be indigenous to Europe, since 'neither Greeks nor 'Romans had an individual name for the chestnut tree and 'its fruit.'

'If,' he continues, 'the Greeks had found the chestnut tree existing in their future country when they first arrived, they would certainly have mentioned the fruit in their legends. But we only hear of the acorns of the *drus*, the esculent oak; and the aborigines, such as the wild Arcadians in their mountains and woods, are always called acorn eaters even by the oracles. When Hesiod describes the blessings of peace and justice, the earth bringing forth fruits, the oak bearing acorns, the bees furnishing honey, and the sheep yielding its fleece, would he have

forgotten to mention the chestnut if it had then grown on the mountains, bestowing sweet fruits on mankind?'

He then proceeds to trace the migration of the chestnut from Castania, the place in Asia Minor from which it derives its name.

Under the circumstances we have mentioned it is not surprising to meet with a few technical errors in Professor Hehn's work. Among these, the prickly *Ruscus aculeatus* is mentioned as the Alexandrian laurel, instead of *Ruscus racemosus*; the cytisus of the ancients, a shrub largely used as fodder for cattle, and identified correctly as *Medicago arborea*, is confounded with the laburnum; and the Virginian creeper (*Ampelopsis hederacea*) with the fox grape, with which it has no connexion, except that both are plants of the New World; while the native habitat of the Lombardy poplar, a tree of Western Asia, is relegated to the Mississippi valley.

The blemishes of this very learned and attractive volume are, however, not considerable. A more systematic arrangement of subjects might, perhaps, have been desirable. It is rather a shock to lovers of natural history to find the several chapters on the horse, mule, and ass intermixed with accounts of the vine, fig, and olive, and to find in the table of contents cats, poultry, and fruit trees in close proximity with the buffalo, hop, and other subjects of an incongruous character. These remarks, after all, only show that Professor Hehn has not attempted a work on natural history. But he has certainly accomplished a most delightful volume of essays, in which the history and migrations of cultivated plants and domestic animals are traced by the philologic method. He has himself called his book very modestly an historico-linguistic sketch. His editor may fairly claim that 'sketch' is a light word for the stores of learning he has collected. Moreover, those readers whose appetite for philology is not satisfied in the body of the work will find at the end nearly a hundred pages of 'notes,' which will certainly content them.

We have already noticed the poor character of the indigenous fruits of Europe, and the introductions of the Romans, who made their famous city the rendezvous of foreign plants. Apples, pears, and plums, destined to replace their sour predecessors in European gardens, reached Rome from Armenia, the damson (*Damascena*) from Damascus, the chestnut from Castania in Asia Minor, the pomegranate from Africa, the peach and walnut from Persia. The fig tree, crossing from Syria to its halting-place in Greece, must have reached the

site of Rome early, since it sheltered the wolf which suckled the founders of the city. This is a kind of evidence, however, which M. de Candolle avoids, and he does not mention that Bacchus grew fat on the succulent fig, and that the same heathen deity promised a crown to a maiden, whose confidence he afterwards abused by twisting the hard calyx of the pomegranate into 'the likeness of a kingly crown,' and then changing the poor girl, who had died of grief, into a pomegranate tree.

In the time of Cæsar most of the houses in Rome had gardens attached to them, in which grew, for the sake of their beauty, shade, or fame, such trees and shrubs as the pine, plane, box, and bay. The influx of plants into England at that time included, besides those already named, the vine, peach, medlar, fig, walnut, and others, including the mulberry. If we may indulge in a brief historical narrative, the plants which the civilised Romans introduced to our shores were afterwards destroyed and trodden under foot by the tribes of northmen which followed them. It is probable that the country was not much richer in plants of utility and beauty during great part of the Middle Ages than it had been more than a thousand years before. War has proved a great distributor, and we owed to the crusades a considerable influx of plants, which were preserved with others from other sources in the gardens of the religious houses. At the close of the Middle Ages, when the era of great houses such as Hampton Court, Nonsuch, and Hatfield succeeded that of the fortresses in which the great barons and landowners had previously resided, a greater immigration of foreign plants took place than we have space to record in detail. Names of famous gardeners and planters will occur to the reader, such as that of Gerrard, of the Physic Garden in Holborn; Lord Bacon, of Gorhambury; Henry VIII. and his fruiterer, who commenced the Kentish orchards, and trained grapes, peaches, and apricots to a fourteen-feet wall at Nonsuch; Evelyn, who 'first taught 'gardeners to speak proper English;' Tradescant, the traveller, one of Charles II.'s gardeners, who cultivated for his majesty the queen pine from Barbadoes; Bishop Compton, who grew at Fulham Palace the tulip tree, magnolia, deciduous cypress, and cedar of Lebanon; Sir Hans Sloane, of the Chelsea Botanic Garden; the Duchess of Beaufort, of Badminton; and Jeanie Deans's Duke of Argyll, called by Horace Walpole the 'treemonger,' who planted his exotics at Whitton, near Hounslow.

It is singular that the most useful of our conifers, the larch, whose durability Pliny mentions, and which was used for many buildings and bridges at Rome, only reached this country early in the seventeenth century, and it remained practically unknown till the Duke of Athole used it for covering his hilltops between Blair Athol and Dunkeld. The story of more recent introductions would be a long one, since innumerable plants have reached this country in turn from the Mediterranean, North America, India, and elsewhere. Most of those we refer to were brought hither by the travellers of the last century, but besides these immigrations others on a far larger scale have since been due to the horticultural collectors who in quite recent years have filled our woods and shrubberies and flower borders, as well as our hothouses, with plants of all descriptions—hardy shrubs from the uplands of China and Japan, or of California and the Cape, as well as flowers and fruits from the tropics. The enormous sums spent upon the orchis alone assure us that this kind of immigration is not likely to abate, since wealth and good taste alike encourage it.