The first botanical gardens in Geneva (c. 1750–1830): private initiative leading science

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Although botany has been practised since Antiquity and the existence of botanical gardens has been developing since the middle of the sixteenth century, it was not until the eighteenth century that botany acquired the status of an autonomous science, with some professional botanists earning their living as professors, garden directors or travelling explorers. The historical and sociological features of the rising 'Republic of botanists'[1] still remain to be studied in their entirety, because most of the existing researches on botany, as a social phenomenon, have focused either on one type of institution — usually the garden — or on the popularization of knowledge.[2] These and other studies on the history of botany have shown how that science became independent of its original medical purposes (and from faculties of medicine), how the 'natural methods' of classification gradually organized the arrangement of plants in the main gardens, and how public interest in exotic plants increased.

The aim of this paper is to describe the development of botany in a small city, Geneva, which cannot be considered as one of the major centres of research on plants in the eighteenth century, except for the field of plant physiology. Focusing on the genesis of the first private and public gardens, it examines the popularity of botany in the Age of Enlightenment and the kind of demands for knowledge and practical applications that it was supposed to meet and fulfil.

Botany and natural sciences in Geneva in the second half of the eighteenth century

In his *Mémoires et Souvenirs*,[3] Augustin Pyramus de Candolle (1778–1841) presents himself as the creator of modern botany in Geneva. This claim is largely justified, since after his return to his native town (1816) Candolle founded a school of systematic botany the aim of which was no less than to describe all the existing plants on earth.[4] This *Systema regni vegetabilis*, renamed *Prodromus systematis naturalis vegetabilis* after 1821, was to mobilize 35 fellow scholars in order to describe more than 58,000 species. When completed in 1873, the work totalled 17 volumes and 13,000 pages in folio. However, in a talk on the history of botany in Geneva delivered in 1830, Candolle recognized the part played by his fellow countrymen, especially Charles Bonnet, Jean Senebier and Nicolas Théodore de Saussure, in the development of plant physiology.[5] So, if taxonomic botany thus started rather late in Geneva, this is not the case for other aspects of plant science and agriculture, nor for the sciences as a whole. In fact, the interpretation of the history of botany depended largely on how the word 'botany' was understood. Had 'plant physics' and agricultural science to be included in botany, or not? Eighteenth-century scientists were divided on the question. But for Candolle's predecessors in Geneva, the answer was unquestionably yes.[6] In other words, local botany already had a substantial history before 1816.

As a city of modest size, with about 26,000 inhabitants at the end of the eighteenth century, Geneva could not compete with Paris, London, Berlin, Stockholm, St Petersburg, Bologna and the other scientific capitals of the time.[7] A small republic, allied to the Swiss cantons since the Reformation, it was a 'political atom' of about 65 patrician families ruling over the citizens and other inhabitants of the city, as well as over 10,000 rural subjects. As a stronghold of Calvinist Protestantism in the sixteenth and seventeenth

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centuries, it enjoyed a European reputation and Calvin's academy — the local institution of higher learning — strengthened its intellectual life in theology and philology, later in natural law as well as natural sciences. In fact, Calvinist Orthodoxy evolved at the very end of the seventeenth century towards a form of rational and liberal theology, so that the teaching at the academy was reshaped accordingly. From 1700 onwards, the principles of reason and the idea of nature guided the teaching of theology and law, so that modern science and philosophy played a key role in the training of the local elites, protestant ministers as well as civil magistrates. The acquisition of an '*esprit de géométrie*' and the expression of clear and correct ideas were considered crucial to the training of the mind of the students, and to the refutation of all deistic and atheistic sophisms.

By the middle of the eighteenth century, the French '*Philosophes*' looking for a republican model happened to consider Geneva as a symbol of Enlightenment. They thus created a new myth, in spite of the oligarchic character of the city-state.[8] In fact, the climate of intellectual tolerance that seemed to make the status of 'citizen of Geneva' so desirable was much less exotic for the Englishmen than it was for the Frenchmen. The natural theology advocated in Geneva by Jean-Robert Chouet and Jean-Alphonse Turrettini, two leading intellectuals of the late seventeenth century, had already been common in England since the Glorious Revolution of 1688, and even since the Restoration of 1661.[9] The idea that the study of nature is another way to look for God was a commonplace of the Boyle Lectures and was already in the minds of the founders of the Royal Society (1663). In Geneva, mathematics and mechanics were the first sciences to benefit from that new intellectual climate, but natural and experimental sciences, as well as astronomy, were to follow soon.[10]

Modern science made its way in Geneva with the introduction of Cartesian philosophy and science at the local Academy (1670), and with the experimental teaching of Jean-Robert Chouet, one of its philosophy professors.[11] The existence in the late seventeenth century of an important medical school, lead by Théophile Bonet, Jean-Jacques Manget and Daniel Le Clerc, also contributed to the emergence of modern science. However, the real beginning of an indigenous tradition of research in Geneva only came in the early 1720s, with the conversion to Newtonian science. That change of paradigm allowed mathematicians and physicists like Gabriel Cramer, Jean-Louis Calandrini (both disciples of Johann I and Niklaus I Bernoulli) and Georges-Louis Lesage to achieve a European fame. But from 1740 onwards, the major contributions of local scientists were in the experimental sciences, especially in the fields of animal and plant physiology (Charles Bonnet, Abraham Trembley and Jean Senebier), geology (Jean-André Deluc, Horace Bénédict de Saussure), electricity (Jean Jallabert) and meteorology (Marc-Auguste Pictet). Botany, especially systematics, was not among these privileged fields, despite the many local farmers' interest in agronomic improvements, and the growing popularity of Rousseau — a lover of nature and botany — among the craftsmen and the bourgeoisie.

Thus, the practice of botany started modestly in the 1750s with the scientific exploration of the neighbouring Savoy Alps. Much earlier, in the sixteenth century, Jean Bauhin had tried to establish the first botanical garden in the city, on the Petit Languedoc, in order to show the medicinal plants to his students (1568–1570).[12] But this attempt had few lasting results, except for a local botanist named Dominique Chabrey, who, in 1650–1651, decided to publish Bauhin's *Historia plantarum universalis* (3 vols). In 1666 followed a *Stirpium sciagraphica et icones* based on the specimens of Chabrey's collection, and perhaps of his own garden. In fact, the only botanical activity in Geneva until the middle of the eighteenth century happened to be herborizations by foreigners, besides the agronomical attempts undertaken by local gentlemen farmers. One of the few significant publications in that field was Nicolas Fatio de Duillier's *Fruit Walls Improved*, in 1699 (figure 2.1).

Half a century later, a few experiments carried out by Jean-Louis Calandrini and by his disciple Jacques-André Trembley on the generation of plants and the movements of leaves, inspired the larger investigations of Charles Bonnet (1720–1793) in the field of 'plant physics'.[13] In fact, Bonnet's well-known *Recherches sur l'usage des feuilles dans les plantes* (1754) shows the real beginning of plant science in Geneva. Walking in the steps of Stephen Hales and Duhamel du Monceau, Bonnet conducted various sets of systematic experiments on the absorption of sap by the leaves, on the different functions of their two surfaces, on the movements of leaves and stalks, and how heat and light influenced them.[14] He also described, with the help of coloured injections, the circulation of sap in the plants and the phenomenon of etiolation, caused by a lack of light, studied the role of cotyledons and showed, by rigorous experimentation, that the supposed degeneration of wheat in ryegrass was a legend.

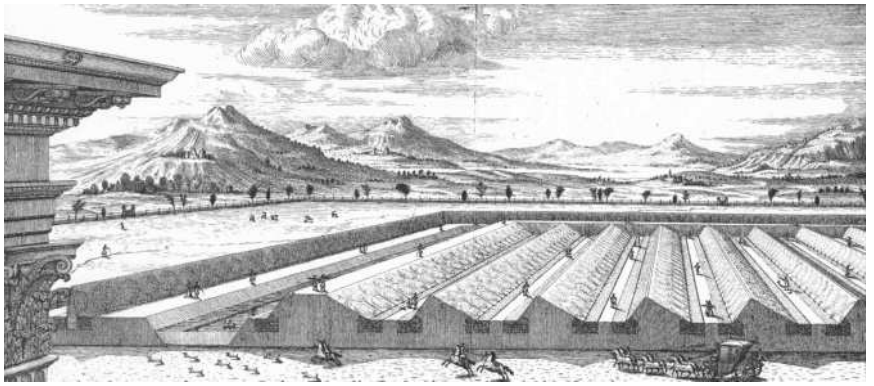

FIGURE 2.1. *One of the many solutions imagined by Nicolas Fatio de Duillier to improve horticulture (*Fruit Walls Improved*, 1699). This system of slopes facing south at an angle chosen for optimum year-round solar collection could easily be adopted in flat areas or even around cities which were, like Geneva, surrounded by large systems of bulwarks.*

In a completely different perspective, Horace Bénédict de Saussure (1740–1799), Bonnet's nephew, started his scientific career as one of the plant collectors for Albrecht von Haller. He also published his first treaty, entitled *Observations sur l'écorce des feuilles et des pétales* (1762), in the field of plant anatomy. This small book, describing the structure of leaves, was a supplementary study to Bonnet's *Recherches*.[15]

Another follower of Bonnet, called Jean Senebier (1742–1809), was the great plant physiologist in eighteenth-century Geneva and he is frequently considered to be the real founder of that discipline.[16] Working in the same field as Ingen-Housz and Priestley, he undertook many new experiments on the influence of carbonic gas and light on plants, studied the cycle of carbon and built the experimental and theoretical background leading to the understanding of photosynthesis. After Senebier, Nicolas Théodore de Saussure, Horace Bénédict's son, developed plant chemistry. He studied by exact chemical analysis of their ashes the nutrition of plants by the soil, showed the influence of the various mineral components of soil and plant moulds. Last but not least, he conceived the possibility of improving vegetable growth by the use of appropriate mineral fertilizers.[17]

The influence of Bonnet is also obvious in the work of Jean Pierre Vaucher (1763–1841). As a plant physiologist, he studied with great accuracy the reproduction of cryptogams, especially the algae. As the first taxonomist of some significance to practise in Geneva, he was interested in classifying species in natural families along the great chain of beings, and put a great emphasis on the physiological characteristics of the various groups of plants.

Summing up these developments in a discourse on Geneva botany in 1830, Augustin Pyramus de Candolle underlined that in the eighteenth century his fellow citizens' attention had been quite exclusively focused on plant physiology, so that they paid little attention to the field of descriptive botany.[18] He explained this trend by the interest of the local scientists for natural theology, most of them being — as mathematicians or physicists — 'more attracted by the stimulating but often disappointing study of causes than by the more modest, but more certain, observation of facts and of the links between them'.[19] Another explanation for that nearly exclusive trend was for Candolle the lack of anatomical teaching and training in the classification of living plants, combined with the absence of collections of natural specimens, such as herbaria. This statement, made by someone who was familiar with the important institutions and collections of Paris and Montpellier, is not absolutely true. In fact, various attempts, mostly private, had been carried out in Geneva since the middle of the eighteenth century to bridge this gap. An interest in botany was present among local scientists long before 1815 or 1830, although their various undertakings mostly failed to reach the level of Candolle's academic standards.

The age of private gardens (c. 1750–1800)

Half a century before Candolle, Horace Bénédict de Saussure opened his *Voyages dans les Alpes* (1779) with some sentences explaining that 'Geneva, by its natural situation, seems to be made to inspire a taste for natural history'.[20] The picturesque landscape stretching from Lake Geneva to Mont Blanc, Saussure writes, offers, through the most various sites and climates, an irresistible appeal to the study of natural history. The alpine surroundings of Geneva, he continues, are a paradise for the study of lithology, while the poorness of the soil does not prevent the region from being covered by a great number of interesting plants, growing in a range of various locations from the most meridional climate of the valleys to the Nordic conditions of the highest mountains. For Saussure, these extremely favourable conditions attracted to

Geneva such famous botanists as Jean Bauhin in 1564, John Ray in 1665 and Albrecht von Haller in 1728 and 1736. When in the late 1750s Haller started to prepare his monumental *Historia stirpium indigenarum Helvetia inchoata*, he appointed Daniel Le Clerc Jr (1728–1758) to be his plant collector for the Geneva region, from the Jura to the valley of Chamonix in the neighbouring Savoy. But when Le Clerc suddenly died, in 1758, it was the young Saussure who, at the age of eighteen, replaced him as one of Haller's collectors.[21]

For the flora of the natural region of Geneva, as of Switzerland as a whole, the publication in 1768 of Haller's monumental compendium ends a first stage of exploration. Another one started soon after, this time under the aegis of local botanists like Henri-Albert Gosse, Louis Jurine and Jean-Antoine Colladon. In the 1780s and 1790s, making a herbarium of alpine plants became almost fashionable, especially among middle-class amateurs inspired by Rousseau's conceptions of man and nature. The Linnean system of classification, already recommended by Saussure, gradually replaced Haller's nomenclature. In 1792, it was officially adopted by the newly founded Society of Physics and Natural History (SPHN).[22]

This society, immediately set under the patronage of Charles Bonnet, gave a handful of local scientists and amateurs the opportunity to contribute to a project of systematic description of the whole 'natural productions and resources' within a radius of about 12 to 15 leagues (i.e. some 55 to 70 km) around Geneva.[23] Among the founders of the Society of Natural History (later to be extended to Physics and Natural History), three at least (Horace Bénédict de Saussure, Henri-Albert Gosse and Isaac-Louis Gaudy) had their own botanical gardens. Two others (Jean Pierre Vaucher and Jacques Necker de Saussure) were to teach botany within a few years, and many more, like Louis Jurine or Jean-Antoine Colladon, owned a private herbarium. In other words, a good half of the twelve initial members of the society were involved in botany in one way or another.

Yet, the first owner of a botanical garden in the vicinity of Geneva was probably an amateur named Paul Gaussen (1720–1806), that is an 'outsider' who did not belong to the Society of Natural History.[24] He was apparently among the ten or twelve gentlemen farmers of the area who made use of their estates before 1800 to carry out experiments in agronomy or husbandry, and published some of their results in books or periodicals.[25] In any case, Gaussen was an enlightened amateur of natural history, who possessed a beautiful cabinet of shells as well as an important private library full of finely illustrated English books on botany and natural history.[26] However, the most important ornament of his estate of Bourdigny near Geneva was an arboretum with exotic species, in which he was able to grow the oldest female *Ginkgo biloba* in Europe. Up to the end of the eighteenth century, this specimen was used to provide all the ginkgos kept in the various gardens of the continent. Yet, Gaussen's garden, which may have been of an important size,[27] was little more than the illustration of a gentleman's passion for exotic trees.

In a completely reversed way, Charles Bonnet, Geneva's foremost scientist in the eighteenth century, used a rather modest garden located in the family estate of Thônex for various experimental purposes. In this first garden, conceived as an annexe to his research cabinet, he carried out most of the fundamental experiments on the functions of leaves described in the *Recherches sur l'usage des feuilles*. Later, after his marriage in 1756 to Jeanne-Marie de la Rive, Bonnet established another garden in Genthod. Located in very picturesque surroundings, above the lake of Geneva, with a magnificent view over the Alps of Savoy, it was surely a pleasure garden, an ideal place for a short walk in good company (figures 2.2, 2.3, and 2.4).

But it included also a kitchen garden, as well as a place to conduct experiments on trees and on plant growth. Some of these attempts are described in the two published '*Suppléments*' of Bonnet's *Recherches*. In the same way, entomological observations, notably on the reproduction of bees, which were carried out on experimental hives kept in the garden of Genthod, appear in the *Considérations sur les corps organisés* (1762) and in the *Contemplation de la nature* (1764).

Another private botanical garden used for scientific purposes was the one Horace Bénédict de Saussure shared with his father Nicolas (1709–1791) at Frontenex, just on the outskirts of the city. Before enjoying Europe-wide fame as a mountain explorer, geographer and geologist, Saussure was involved in botany and assisted Haller in his research on alpine plants. It is possible that his father Nicolas de Saussure, an agronomist himself, had already used the garden of Frontenex for some experiments on the growth of plants under specific conditions.[28] Anyway, the young Saussure collected there many alpine plants of the Geneva region, including the Jura and neighbouring Savoy. Because simply collecting specimens was not enough to study the flora of the region, and sometimes even to identify the species, Saussure felt the need of a garden to grow and to observe them more comfortably. This allowed him to study the newly discovered plants all year round, and to describe with accuracy

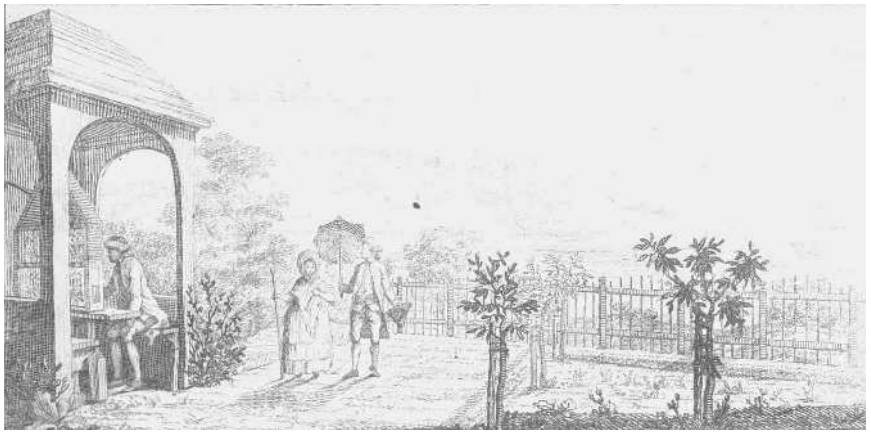

FIGURE 2.2. *The picturesque side of Bonnet's garden at Genthod, from Bonnet's* Oeuvres complètes*, ed. in-4°. This figure shows the romantic situation of the garden above the lake of Geneva and in front of the Savoy Alps. This scenery, very typical of the Swiss landscape, incites the study of nature in the garden as well as in its various surroundings. On the right of the picture, some trees under experiment, and on the left a small cabinet with an experimental hive for the study of bees.*

their organs, their vegetative cycle, etc. The garden was also a very useful tool to avoid classification mistakes, like taking a new variety for a species, or considering two similar specimens as belonging to different taxa.

Concretely, Saussure was able to send seeds, flowers, as well as fresh or dried samples of plants at different levels of growth, to Haller in order to allow him to study the influence of culture on their morphology and their characters.[29] These samples allowed Haller to compare plant growth under various conditions of soil, altitude and climate. In a letter to Allioni, Saussure explained that besides the culture of rare species of alpine plants, he also used his garden for the acclimatization of the exotic species that his mother loved so much.[30] His garden of Frontenex was probably also used to furnish study samples for his microscopic research on the structure of leaves. A last function of the garden was to furnish empirical data for the topic 'natural meteorology' published by Saussure and Senebier in the *Journal de Genève* between the years 1787 and 1791. This data, much appreciated by agronomists and farmers, consisted of observations on the phenological state of the plants at various times of the year (occurrence of leaves, flowering buds, etc.). Similar observations were made in Gaussen's garden at Bourdigny and in other places.[31]

Another private garden that achieved a kind of local fame was established by Isaac-Louis Gaudy (1757–1839), an amateur scientist, at his home village of Confignon not very distant from Geneva. Martinus van Marum, who visited it in 1802, judged it 'in no way outstanding, since it contained only some of the ordinary perennials and a few alpine plants'.[32] Although this garden disappointed the Dutch natural philosopher by its modest size, it nevertheless

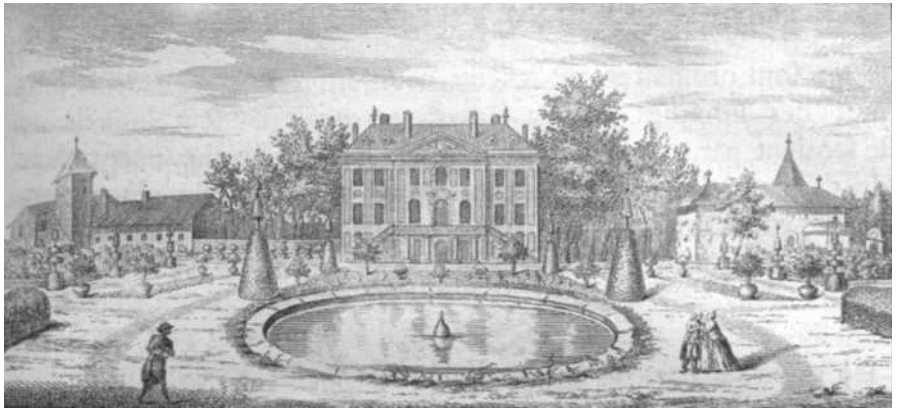

FIGURE 2.3. *Bonnet's house at Genthod, with a part of the French garden in the middle and two kitchen gardens on the right and on the left, from Bonnet's* Oeuvres complètes*, ed. in-4°.*

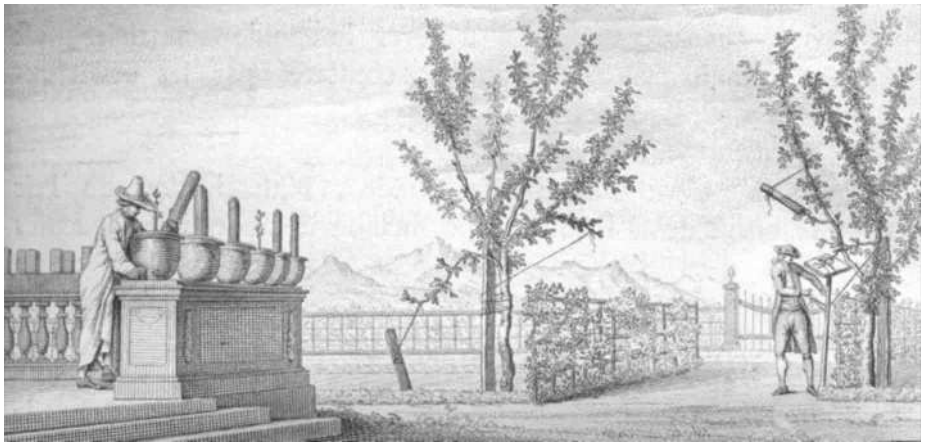

FIGURE 2.4. *Some experiments carried out in another part of Bonnet's garden at Genthod, from Bonnet's* Oeuvres complètes*, ed. in-4°. In the middle and on the right, boughs and stalks are diverted by an assistant from their natural positions in order to study their movements and their causes. On the left, Bonnet is observing the results of an experiment on the etiolation of plants, in order to understand the effect of solar light and heat on plant growth.*

represents a stage in the local development of systematic botany. When in 1792 the local naturalists debated on the usefulness of the Linnean classification, Gaudy was one of the few who wanted to restrict the use of this system to the description of genus and species. For the higher groups of plants, he defended the use of a 'natural method' allowing a better classification of the plant families according to their real affinities.[33] He was convinced that the use of the 'natural method' would made a systematic description of the flora of Geneva easier, because the number of families to consider for such work would not exceed 60, apart from about 50 isolated genera represented by only one or two species. Paradoxically, he saw in the production of such a limited flora according to the principle of natural affinities between plants the best opportunity to popularise botany among farmers and peasants of the region, because he was convinced that their good sense would be hurt by the use of an artificial method.[34] His garden was therefore conceived as a logistical basis for the study of local plants and their classification in natural families.

Another type of botanical garden, linked with a completely different scientific project, was created in the 1780s by Frédéric-Guillaume Maurice (1750–1826). That amateur of agriculture established a garden in Genthod where he developed a set of systematic 'botanico-meteorological observations' inspired by the work of Duhamel du Monceau. His method of taking observations on evaporation and on the temperature of the soil was presented in 1788 in a supplement to the *Journal de Genève*.[35] Among these measures, carried out three times a day, were the evaporation from ground and water, the temperature of ground and water, the temperature at 3 inches and 4 feet below the soil's surface, the temperature of water in a well and even the temperature inside the trunk of a big tree! To measure the ground's dampness, Maurice devised a special steelyard (called an 'atmidometer') consisting of a soil disk sliding in a well and hung on a lever arm regulated by a weight (figure 2.5). The degree of dryness or dampness was to be read at the end of the lever, on a graduated dial. That device, executed by Jacques and Nicolas Paul, instrument makers in Geneva, was supposed to indicate to the local farmers how much water they should give to their plants to get optimal growth.

Like Maurice and his close friend Marc-Auguste Pictet, many members of the Society for the Improvement of Arts and Agriculture, founded in 1776, hoped that agriculture might benefit from the development of these 'ground observations'.[36] Between 1787 and 1791, the *Journal de Genève*, the society's weekly paper, printed on its front page the evaporation for each day and the moisture of the ground at sunrise, at 2 p.m. and at sunset. A much more

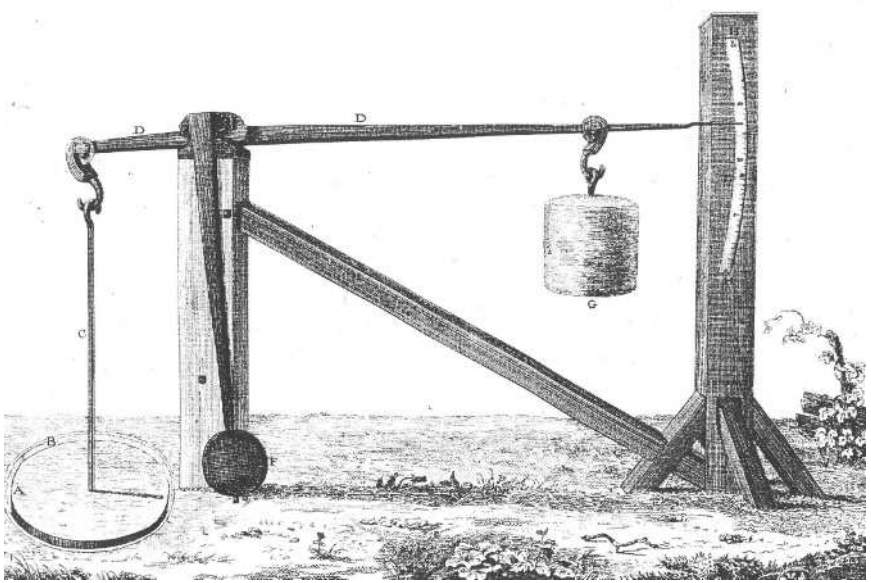

FIGURE 2.5. *'Atmidometer' conceived by Frédéric-Guillaume Maurice after an original idea of Horace-Bénédict de Saussure (1783) in order to measure the ground's dampness in his garden at Genthod. That large-sized device was executed in 1788 by Jacques and Nicolas Paul, instrument-makers in Geneva, and its description published in the* Journal de Genève.

detailed account of the various daily surveys conducted by Maurice was to be included in the monthly *Bibliothèque Britannique* from 1796 to 1800.

The last private botanical garden worthy of mention is the one established in 1788 by the naturalist and pharmacist Henri-Albert Gosse (1753–1816) in the dry ditches of the Geneva fortification system, more precisely in the outposts of the Bastion Bourgeois. The purpose of this garden was to grow medicinal plants — a common practice among apothecaries of the time — but most probably Gosse also used it to study the alpine flora.[37] In the absence of a medical faculty, Geneva was deprived of a medicinal garden, except for a short period at the time of Jean Bauhin, and apart from small parcels of land used by the local pharmacists to grow their herbals. Little information has been recorded about Gosse's garden, the first one to be located within the fortified belt of the city. As such, it was to serve as a model for all the subsequent public gardens, taking advantage of the enormous system of bastions and trenches that surrounded Geneva and offered an even greater surface than the city itself (figure 2.6).

The first attempt to create a collective garden was made in 1790, when Gosse suggested to the Society of Arts that they should rent the Bastion de Cornavin in order to develop the acclimatization of new species of useful plants on a larger scale.[38] This plan did not materialize until 1793, when it was taken over by the newly founded SPHN. But the choice of that society fell on another part of the city walls — the Bastion St-Léger, also called the 'Cavalier Micheli'.

The botanical garden of St-Léger (1793–1830)

Curiously enough, each of the six private gardens surrounding Geneva in the eighteenth century had its own rather specific character, linked to a different scientific and social function. One of the aims of the first public garden, founded in 1793 by the SPHN, was to join forces and to combine these different functions in a single place.

As mentioned above, the main reason for the foundation in 1791 of the Geneva SPHN (Société de Physique et d'Histoire naturelle) had been the systematic description of the neighbouring region from the point of view of its natural history. The development of a botanical garden was conceived in order to achieve this end. It became a reality early in 1793, when the society received permission from the government to establish a botanical garden on the Bastion St-Léger, a remnant of the sixteenth-century city walls. This small but well-situated garden had an effective area of some 1800 m^2. It was equipped with a fountain and had a small building that could be used to give botanical lessons and to store the herbarium of the society. The various flowerbeds, a first greenhouse and other required utensils were paid by the heritage of Charles Bonnet, who died on 20th May 1793.[39] The local scholars, who regarded themselves as his disciples in one way or another, decided to erect a monument to his memory in the middle of the garden (figure 2.7).

Built after drawings by Jean-Pierre Saint-Ours, the most famous local painter of the time, this monument symbolized the presence of the naturalists in the city. In the local Republic of eighteenth-century botanists, where the physiological school was absolutely dominant, Bonnet was the key figure in

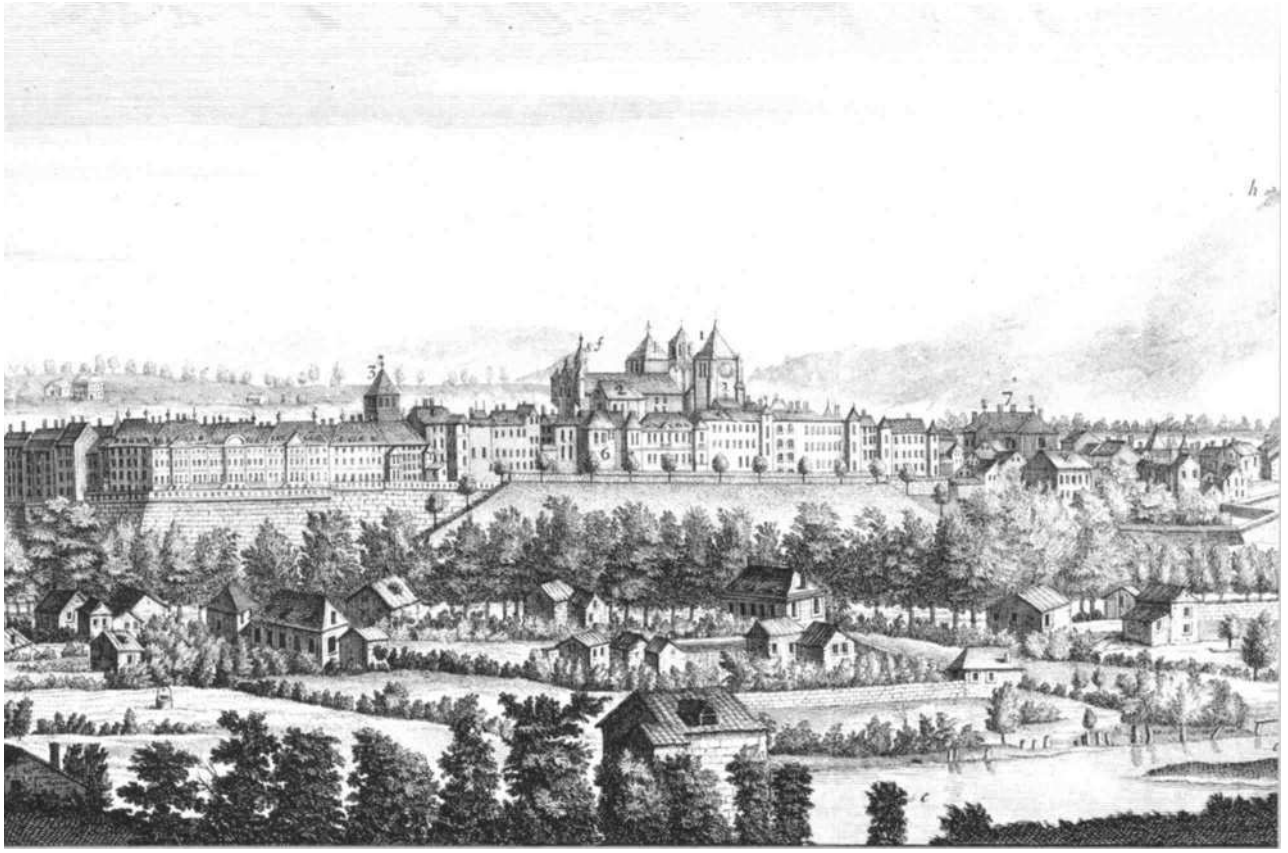

FIGURE 2.6. *View of Geneva from the south, showing the location of the city's first botanical gardens, part of an engraving after R. Gardelle (Icon. BGE). (1) In the middle of the picture, between the houses of the small village and the curtain of trees: Gosse's private garden. (2) On the small bastion at the extreme right of the picture: the Society of Physics's garden of St-Léger. (3) Again in the middle, between the curtain of trees and the city itself: the public garden of the Bastions.*

the same manner than Candolle would be later, after he established his own school of systematic botany.

For the Geneva Government, teaching had to be the main function of the garden. This consideration justified the donation of a piece of public space to the members of the Society of Physics. They were allowed to use it free of charge for scientific pursuits under the condition of caring themselves for all the transformations and repairs required. The garden of St-Léger was to function under the same conditions throughout the French period (1798–1813),[40] thanks to the special permission of the War Ministry. After 1817, the garden became *de facto* a private tenure of its director Michel Micheli de Chateauvieux and remained in use until his death in 1830.[41]

The teaching, to be given each year to the students of the 'Auditoire de Philosophie' for a rather modest price of one small ecu (a little more than six florins[42]), started in 1794 under the aegis of Jean Pierre Vaucher. Private attendants were also admitted, but not women. The lessons, followed among others by Candolle, aged 16, included a comprehensive survey of plant

FIGURE 2.7. *Monument to Charles Bonnet erected in the middle of the botanical garden of St-Léger (1794). It was realized by the sculptor Jean Jaquet and the architect Pierre-David Matthey, after drawings of Jean-Pierre Saint-Ours (Centre iconographique genèvois).*

physiology and of classification systems, especially the natural methods.[43] After four years, the number of subscribers decreased dramatically, and the course of botany was replaced by another one on mineralogy, given by Pictet and Gosse.[44] In 1802, Vaucher, being appointed an honorary professor of botany at the Academy, opened a public course in the garden, which apparently met with little success.[45] Neither Vaucher, who changed to the chair of ecclesiastical history in 1807, nor his associate professor Jacques Necker de Saussure (1757–1825) seem to have given many lessons in the following years. In 1811, the garden was used, three times a week, by Henri-Albert Gosse to give a course of botany and pharmaceutics which lasted 5 months and was followed by up to 16 philosophy and theology students.[46] After 1816, the teaching of botany was conferred on Candolle, now full professor at the Academy, and practical work transferred to the newly founded Jardin des Bastions. At that time, the Society of Physics abandoned the control of the garden of St-Léger and its director Micheli de Chateauvieux managed it as his private possession until his death in 1830 (figure 2.8).[47]

As noticed by some foreign travellers, this first (semi-) public botanical garden remained of a modest size.[48] Michel Micheli, its director, who served as an officer in the service of the King of France and barely escaped the massacre of the Tuileries on 10th August 1792, discovered botany rather late in life. He remained more of a horticulturist and agronomer than a genuine scientist.[49] He conceived the garden as being first of all a place to store as many useful plants as possible, in order to investigate their culture and their uses, a policy that was formally approved by his colleagues in 1794.[50] In the maintenance of the garden, Micheli was helped by other botanists of the society, especially Gosse and Vaucher, by a gardener working part-time, and sometimes by young students like Candolle or Jean-Pierre Pictet. In 1801, he decided to finance the construction of a new heated greenhouse himself.[51]

The first scientific aim of the garden was the study of the local flora, but the number of indigenous plants it kept is unknown. The study of exotic plants was also part of the scientific programme and justified the construction of a heated greenhouse designed for the keeping of southern species. In 1805, Micheli was proud to announce before the Society of Naturalists, another scientific society founded in Geneva in 1803, that the number of foreign species had reached 1200, all kept in good condition.[52] This statement was confirmed two years later to the Society of Physics by Gosse.[53]

Many specimens came from the local gardens, especially those of Paul Gaussen and Isaac-Louis Gaudy.[54] Various exchanges were made with other Swiss and French gardens like Bern (through Jacob Samuel Wyttenbach), Basel (Abel Socin), Yverdon (Edmund Davall) and Paris (André Thouin), as well

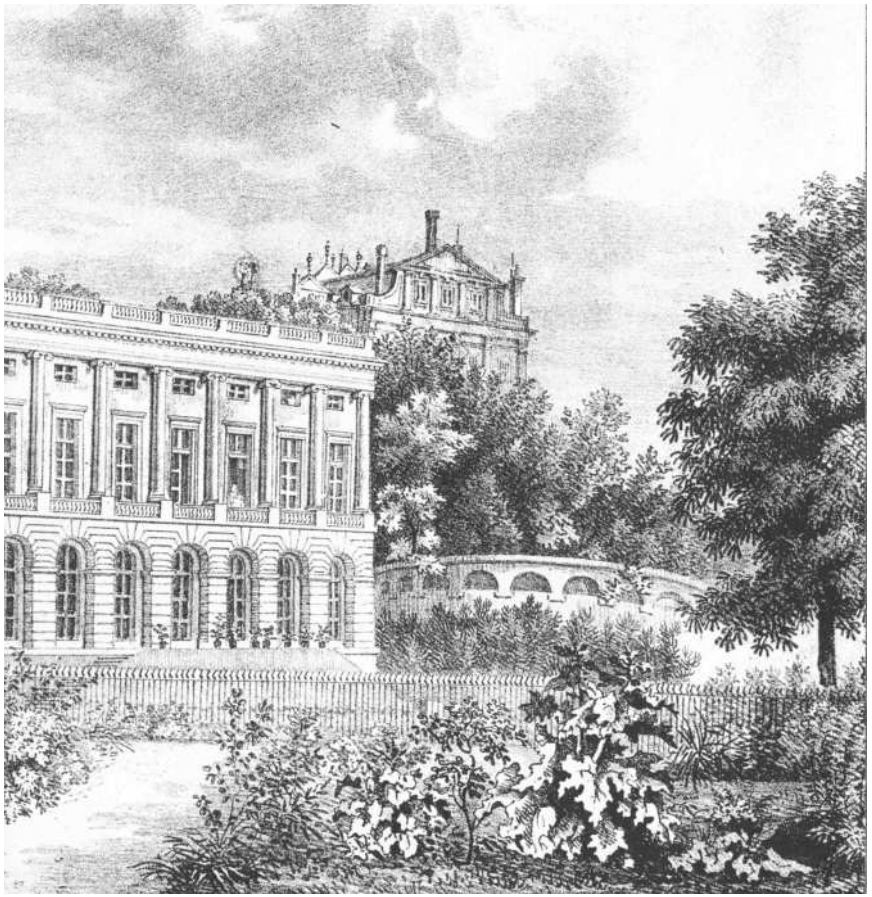

FIGURE 2.8. *A romantic view of the site of the Bastion St-Léger (on the right), soon after the loss of its function as a botanical garden. The luxuriance of the trees, especially over and behind the bastion, has been exaggerated, in conformity with the canon of romantic pictures.*

Versailles, London, Palermo and even Guadeloupe. Through these various exchanges, the local botanists were happy to receive seeds from remote areas like Russia, America and even Australia (the famous Botany Bay).[55]

All in all, the garden of St-Léger did little to promote the development of systematic botany in Geneva. The fact that the herbarium of the Society of Physics was classified according to the Linnean system — despite Gaudy's criticism — was a sign of conservatism.[56] Was the garden better equipped for research in plant physiology? In fact, the new heated greenhouse was used in 1801 by the young Jean-François Berger (1779–1833) to study the growth of a vegetable substance (called 'fleur de la tannée') used in tannery, and its dependence on the temperature of the soil and the surrounding air.[57] In 1808, further physiological research on a phenomenon linked with the growth of trees (called 'sève d'août') was carried out by Vaucher on some specimens in the botanic garden.

On a different scale, Frédéric-Guillaume Maurice's observations on ground moisture and evaporation were made in the garden of St-Léger from 1798 onwards, when the meteorological station used by the editors of the *Bibliothèque Britannique* was relocated there.[58] This contribution to 'terrestrial meteorology' (*météorologie terrestre*) may well have been the strongest contribution of the garden to science.

The acclimatization of useful plants was another function of the garden of St-Léger. Early in 1794, research on their culture had been defined as one of the main objectives of the new institution, with the perspective of diffusing new species in to the local gardens.[59] This goal was to be put in practice immediately, since Geneva suffered in 1794 from a serious food shortage, due to a drop in corn supplies. As a rich city, equipped with a well-functioning corn-supply system ('*chambre des blés*'), the eighteenth-century Geneva had encountered no problems with its food supply, although it depended on considerable imports from abroad. This explains why the potato, considered to be suitable nutrition for poor people or cattle, was virtually unknown in Geneva until the outbreak of the Revolution in 1792.[60] At that time, war and disorganization of international trade made the supply of corn a real problem, so that the potato appeared — for a short period — to be a suitable alternative. But little was known about how to grow and cook it, despite some investigations started a few years before by the Society of Arts. These investigations being stopped by political events, the Society of Physics decided to work on the potato problem in a thorough way and to use its garden to grow as many varieties as possible in order to find the best ones. Potato seeds were thus imported from other towns in Switzerland and from various foreign countries, especially France and England. In April 1794, a notice for the public was printed by the society on the best way to grow the precious tuber. Other experiments on potatoes were carried on in the garden of St-Léger until 1796, notably by Micheli, but their results, communicated to the Society of Physics, remained confidential.[61] The rapid end of the food shortage turned the

attention of Geneva botanists and agronomists to other themes of study, such as corn or vineyard diseases.[62]

The modest size of the infrastructure offered to the local botanists by the garden of St-Léger urged Henri-Albert Gosse to submit to the French and Geneva authorities an ambitious project for a new botanical garden on the Bastion Bourgeois, coupled with a scientific institute to be built on the Petit Languedoc (1803). This garden, divided into four enclosures, was conceived as an agronomical station, with a central part reserved for cultivation of foreign plants useful for medicine and arts. A second division was designed for the cultivation of indigenous plants. The third one served as teaching place for the cultivation of wheat and other edible vegetables, and the last was to host fruit, useful and beautiful trees.[63] Had the project been limited to the garden, it might have been accepted, although its estimated cost was 22,000 francs (45,833 florins!), or about five times the money invested by the Society of Physics in the garden of St-Léger. But Gosse wanted to couple it to a natural sciences institute that required the construction of not less than 11 small buildings, for the enormous sum of 120,000 francs![64] Neither the French authorities, nor the local ones, wanted to invest such an amount of money for purely scientific purposes. In Geneva, the development of botany was to remain above all a matter of private initiative.

The Jardin des Bastions under the direction of A. P. de Candolle (1816–1835)

The greatest leap in the history of local botany was achieved in 1816, when Augustin Pyramus de Candolle returned to Geneva. He had left the city for Paris in 1798, at the age of 20, in search of better career opportunities. He had had the good fortune to become a student of Cuvier and Desfontaines and to be offered the opportunity to produce a fully revised edition of Lamarck's *Flore française* (1805). In the meantime (1803), he was invited to give a course on plant physiology at the Collège de France. In Paris, Candolle adopted Antoine Laurent de Jussieu's natural system of classification. He soon had an invaluable opportunity to test it, when the Minister of the Interior entrusted him to establish a systematic description of the botanical resources of the great French Empire (1806–1811). One of the results of these missions was his *Elementary theory of botany* (1813), where he developed his own principles of natural classification of plants. Another result was the idea of establishing the principles of phytogeography, a pioneering intuition he shared with Alexander von Humboldt and with Ramond de Carbonnières.[65] These ideas, matured during an eight years' stay in Montpellier (1808–1816) as a professor of botany and director of the garden, were to become the basis of the subsequent work he undertook in Geneva as a mature man.

Called back home by the creation of a full academic chair of natural history encompassing botany and zoology (1816), Candolle did not imagine it possible to assume such teaching without the assistance of a good botanic garden. The creation of such a garden even became a kind of tacit condition for his return to Geneva.[66] However, neither the Academy nor the Society of Physics were able to give him the means he needed for this project. The State of Geneva agreed to offer him the larger field of the Promenade des Bastions as well as some money (35,000 florins) for the first plantings (figure 2.9). The rectangular garden had an enclosed surface of some 81,000 m^2 (or three Geneva 'poses'), equivalent to 4.5 times the area of the old garden of St-Léger. But for the greenhouses and other equipment, Candolle had to ask for the voluntary support of the public. In April 1818, he launched a public subscription with the help of the Society of Arts, arguing that Geneva needed to teach natural

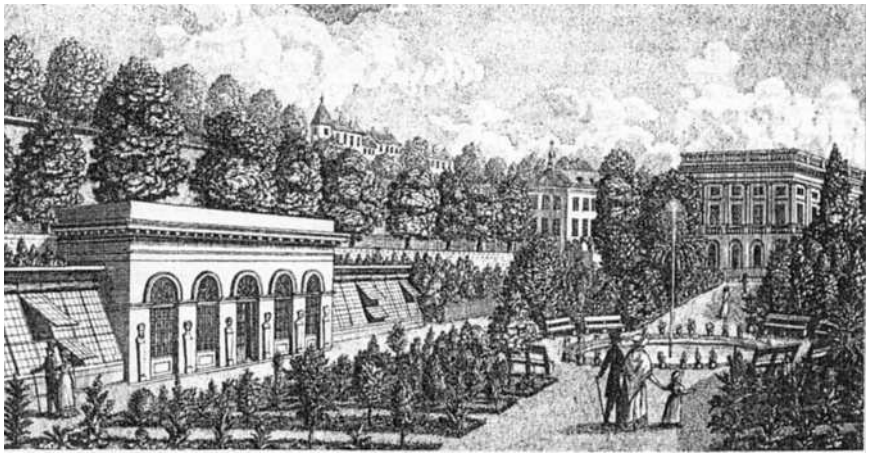

FIGURE 2.9. *Orangery, greenhouses and sprinkler-basin of the Jardin des Bastions after an engraving by Pierre Escuyer, 1824 (Icon. BGE).*

history at the level of its scientific tradition, to improve the culture of useful or beautiful species and to train a generation of skilled gardeners.[67] The result was rather impressive, since 58,240 florins and 600 species were immediately collected.[68] More were to follow later.[69]

The money raised was used for the construction of various buildings designed by Guillaume-Henri Dufour (1787–1875), Geneva's most famous engineer of the time. The central construction, along the Petit Languedoc (today the setting of the Reformation Wall), was a sober but monumental orangery decorated with the busts of the first local botanists Dominique Chabrey, Abraham Trembley, Charles Bonnet, Jean-Jacques Rousseau, Horace Bénédict de Saussure and Jean Senebier.

Each side of the orangery was extended by a long greenhouse of the Dutch type with a single inclined roof, a device inspired by the greenhouses conceived by Boerhaave at Leyden nearly one century earlier. They were to be replaced later by English-style greenhouses, with a two-sided roof, a model that spread from Great Britain after 1815. These greenhouses, one heated and one frost-free, were warmed through a system of hot-air ducts connected to a wood-burning stove of sandstone.[70] The remaining improvements were a circular fountain with a water jet and a tank placed in the middle of the garden (where the two central alleys crossed at right angles), and another basin for aquatic plants.

Circumstances happened to favour the quick realization of Candolle's plans, since a food shortage that occurred in 1816 (as a planetary consequence of the explosion of the Tambora volcano in Indonesia) gave him the opportunity to clear, with State support, the abandoned area of the Bastions in order to grow potatoes. In a way, the story of 1794 repeated itself with the same perspective of creating an experimental station for the study of useful plants. This time, however, public support was to go far beyond the small milieu of practising botanists and enlightened agronomists came from all the social classes. Some people of modest income even agreed to do volunteer work for the garden.

Candolle had the opportunity to measure the popularity of botany and himself in April 1817 when about 120 persons, mostly women, spontaneously offered their help to copy the 1200 original drawings of Mocino's *Flora of Mexico* within 10 days.[71] Women who were not allowed to attend the botanical teaching of Vaucher became a crucial factor in the success of Candolle's public teaching.[72] The popularity of botany was a powerful help to the realization of Candolle's plans for the garden. But it also compelled him to enlarge the functions of the new institution towards practical and less scientific aims.

According to Candolle's conception, analysed by the historian of science Jean-Marc Drouin,[73] a botanical garden can fulfil three different functions:

1. Teaching — a garden needs, says Candolle, to keep as many species as possible. The choice of species should not be limited to the plants useful for medicine or agriculture, and the specimens have to be arranged in the methodical order of natural families.
2. Research — the garden is a living collection where the botanist, if he accepts the limitation of his investigations to a specific group of plants, can observe the variability of species and make the classification progress. It is the best place to study the germination, the development of organs and all the phenomena linked to plant physiology.
3. Acclimatization — the transfer or introduction of useful or beautiful species growing in exotic countries (e.g. tomato, potato, coffee or the bread-tree) is another function of botanical gardens not supposed to compete with nursery gardens.

The first and the last of these functions, namely the teaching of botany (sometimes with agriculture and horticulture) and the encouragement of gardening (through various essays on the culture of useful and beautiful plants and the acclimatization of foreign plants) are always mentioned in the reports on the administration of the garden between 1823 and 1849, as well as in the academic talks related to the same topic.[74] Two other functions are sometimes added: botanical research and the possibility of Geneva citizens enjoying nice and potentially instructive walks. These different functions oriented the disposition of the garden.

Solemnly opened on 10th November 1817, the school of botany was located in the middle of the garden. The plant specimens were arranged in 50 flowerbeds sorted according to the principles of the natural classification in order to help the students to recognize the natural links between species.[75] The garden being conceived as a kind of living book open to anybody, the beginners could memorize the nomenclature of plants and study their structure in a more profitable way.[76] Among the students of the Geneva school of botany were Candolle's son Alphonse and other future botanists like Jean Étienne Duby, Jacques Denys Choisy, Jean-Pierre Dunant, Jacques Chanal, George François Reuter, Edmond Boissier and Charles Isaac Fauconnet. Some

of them were to contribute later to Candolle's *magnum opus*, the *Prodromus systematis naturalis vegetabilis*, or systematic description of all known plants.

The academic teaching of botany took place first in the old 'auditoire of philosophy' and the public lessons in the new Natural History Museum, created in 1818 in the former Residence of France. In 1827, the students had to move to the new botanical 'Conservatoire', where one year earlier Heyland had started to teach the drawing of flowers.[77] This move increased the students' interest for the garden and botanical observations made on the spot.[78] Yet, the community of botanists and of flower painters who asked for special permission to work in the garden (and the Conservatoire) or to receive samples on a regular basis remained remarkably stable, numbering 25 persons each year.

The school of agronomy was established at one end of the garden along the Palais Eynard. It was used for the acclimatization of foreign species but even more for the collecting of little-known indigenous varieties. Some of them were grown in the temperate greenhouse, which was considered by Candolle to be more important than the warm greenhouse.[79] The more important parcel was that of the 400 fruit trees, with varieties of pear trees (140), apple trees (130), plum trees (56), and peach trees (32), etc.[80] Another important enclosure was planted with 300 varieties of vines. The three remaining enclosures were for cereals and vegetables (potatoes, peas, cabbage, beans, lettuce), for fodders and for medicinal plants.

This aspect of the garden's activity interested many subscribers, especially the members of the agriculture class of the Society of Arts. A system of public distribution of seeds, plants, roots, grafts and even small trees was set up and met with considerable success. Each year, between 200 and 300 persons benefited from these distributions which introduced more variety into the private gardens of Geneva and opened a new market for the local nursery gardeners. It was above all these plant distributions that legitimized the botanical garden as a public and popular institution. But the system was more successful in spreading a taste for new flowers, like orchids, than in modifying the eating habits of the citizens, especially in fighting their prejudice against potatoes.[81]

The plants for experimental research and observations, as well as the specimen duplicates for sale and exchange, were placed at the other end of the garden, near the Place Neuve. Candolle's reputation made the exchanges more profitable for the garden. However, the prestige of the institution would have been lower if local botanists, agronomers and amateurs had not constantly offered seeds and plants to make these exchanges possible. Year after year, the gardeners were able to grow between 4000 and 5000 species, plus 400 to 500 varieties of ornamental flowers and ordinary vegetables, not to count the permanent 1000 varieties of fruit trees and vines. In his report for 1843, Alphonse de Candolle argued that to appreciate these numbers, it was necessary to remember that even the greatest botanical gardens of Europe, like those of Paris and Berlin, did not shelter more than 10,000 to 12,000 species. In other words, the Geneva garden, which had cost 15 times less, had nonetheless the ability to cultivate one third of their species.[82]

It is undoubted that the Geneva citizens were proud of their botanical garden. Many of them, including people of the lower classes who had no garden and no country house of their own, used it as a promenade, thanks to the large alleys that crossed and surrounded the place. In 1826, the rich banker Jean-Gabriel Eynard, whose house was contiguous with the garden, installed a fine iron grille to replace the ugly wooden fence that surrounded the area. Even though some damage occurred occasionally, the administration always maintained the public access to the garden.

The *Conservatoire botanique* and Candolle's herbarium

In 1824, five years after the official opening of the garden to the public (April 1819), a *Conservatoire botanique* could be added to the original institution thanks to the generosity of two anonymous donors (figure 2.10).[83]

Also designed by Dufour, this two-storey building housed the lodgings of the gardeners and the gate-keeper, a show-room for ploughing instruments and for temporary exhibitions of flowers, a great hall for the herbarium and teaching, a room to store the seeds, another for the drawers, and some more for the register of observations and the administration. From a scientific point of view, this building was to become the crucial part of the new institution, since it housed the collections of dry plants. The most important one was probably the herbarium of Albrecht von Haller, completed and given to Geneva in 1823 by his third son Albrecht Jr (1758–1823). This herbarium contained all the types used for the famous *Historia stirpium indigenarum Helvetias inchoata* of 1768.[84] Among the other herbaria of the *Conservatoire*, the majority came from local botanists like Jean-Antoine Colladon (1755–1830),

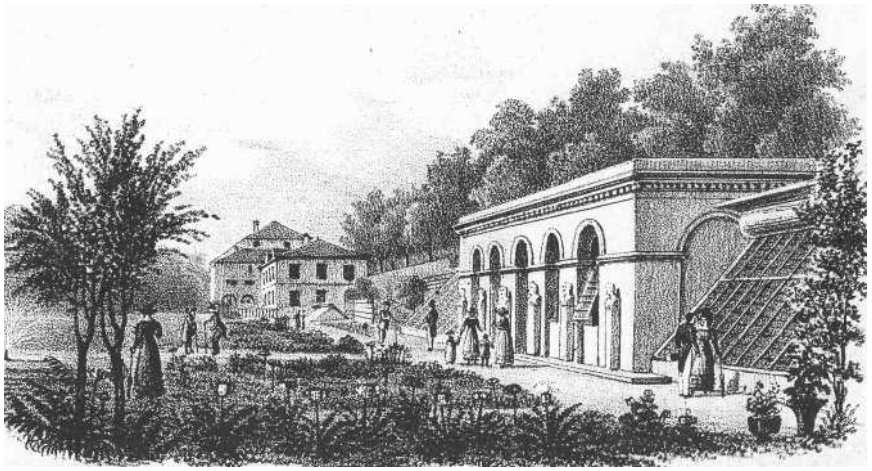

FIGURE 2.10. *Orangery and the rear of the* Conservatoire botanique*, after an engraving by Godefroy Engelmann, c. 1825 (Icon. BGE).*

Jacques Necker de Saussure (1757–1825), Jacques Roux (1773–1822) and Jacques Denys Choisy (1799–1859).[85]

In 1827, with the help of Nicolas Charles Seringe, a French botanist living for some time in Geneva, Choisy started to classify that collection of dry plants. A few years later, in 1831, this task was taken over by Alphonse de Candolle, the son of Augustin Pyramus, when he became vice-director of the garden.[86] He also classified the collections of woods, barks, gums and resins of the *Conservatoire*, as well as its modest specialized library.[87] From 1831 onwards, the *Conservatoire* was opened three times a week to persons wishing to work on its collections.

Despite all these improvements in the *Conservatoire*, the two most important botanical collections in Geneva remained the herbaria of Candolle and of Edmond Boissier (1810–1885) with its high quality printed *Bulletin*. Candolle's herbarium had been constituted in 1801 by the purchase of the 8000 specimen collection of the French botanist Charles Louis L'Héritier de Brutelle (1746–1800).[88] Soon after it was completed by the specimen duplicates of Louis Guillaume Le Monnier, given by Benjamin Delessert, and enriched by exchanges made with other botanists like Broussonet, Balbis, La Billardière, Humboldt, Bonpland, etc. Candolle himself collected many specimens during his systematic explorations of the French Empire (1806–1811). In Montpellier, he was fortunate enough to buy 1200 rare South American species coming from the herbaria of Cavanilles, Ruiz and Pavon, the famous scientific explorers of the Spanish colonies.

When Candolle returned to Geneva, his herbarium had already reached the number of 25,000 species (about 45,000 specimens[89]), that is more than three times the size of Carl von Linné's collection. In the two following decades, this herbarium was to grow at a rate of 5000 plants a year and reached about 135,000 specimens (75,000 species) in 1835 and even 164,750 specimens in 1841. Among the collections acquired during that period, one of 5000 plants from the Antilles was purchased through the botanist Balbis, 6000 came from East India (through Mr Wallich), 6000 were given by Marc Nicolas Puerari, Vahl's friend in Copenhagen, and 1400 more came from the Museum of Paris. Besides Puerari, other fellow countrymen gave their collections to Candolle, like François Delaroche and his father Daniel, who had been associated with Adriaan van Royen in Leyden, like Louis Perrot de Pourtalès, who explored the Pyrénées with Candolle, or like César Hippolyte Bacle, who collected plants from Senegal and Brazil. All these specimens were stored in four rooms of Candolle's house, near the St-Pierre Cathedral, and were completed by other collections of fruits, seeds, wood, barks, gums, resins and useful plant products. As a curator of these natural treasures, Candolle appointed Claude-Nicolas Seringe from 1820 to 1830, then Heinrich Wydler from 1830 to 1835 and finally George François Reuter, from 1835 to his death in 1841.[90] Besides the classification work, the main task of these curators was to receive and to guide the numerous botanists and students who wanted to work on Candolle's collections.

Another very useful working tool was Candolle's library, which filled a large part of the 40 boxes he brought back from Montpellier in 1816.[91] For him this library was a considerable financial burden at a time when the resources of the Public Library remained scarce. That is the reason why, in 1818, Candolle was engaged in the foundation of the Société de Lecture, whose aim was to bridge this gap in specialized literature.

When Candolle retired from the Academy in 1835,[92] he was proud to state that the lack of a suitable botanical institution, from which he had suffered as a young man, no longer existed. But for all these improvements, the most important institutions remained, throughout the nineteenth century, the chair of botany and the herbaria of Candolle and Boissier. It was not until the beginning of the twentieth century, when these collections reached the

Conservatoire botanique, that the public botanical institutions of Geneva took the lead over the private ones.[93]

We may end with a remark on the available information. It seems obvious that Augustin Pyramus de Candolle used the garden of Geneva for his two main scientific enterprises: the publication of a systematic description of all the known plants of the world (the *Prodromus*) and the foundation of phytogeography. But these undertakings are poorly documented, even in his *Mémoires et Souvenirs*. The printed and manuscript sources give a picture of the botanical garden as being mainly an agronomical station and a place for the teaching of botany, horticulture and gardening. Did the social, agronomic and symbolic functions of the institution really outweigh its purely scientific significance? Or is it an illusion produced by the expectations of the public, which oriented the contents of the administrative reports on the garden? Both hypotheses seem plausible. In any case, the Jardin des Bastions had major significance as a symbol for the botanists' insertion in the city in showing their usefulness to their fellow citizens. And this was a major point in a Republic deprived of any scientific academy, a faculty of medicine or even a prestigious faculty of science.

Acknowledgements

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European Institute of the University of Geneva, and
Conservatoire et Jardin botaniques de la Ville de Genève

Abbreviations

BGE = Bibliothèque de Genève (Public Library, Geneva).
SPHN = Société de Physique et d'Histoire Naturelle de Genève (Society of Physics and Natural History, Geneva).

NOTES

1. Modelled on the expressions 'Republic of Letters' (commonly used since the sixteenth century), 'Republic of Sciences' (that sometimes appeared in the eighteenth century) and even 'Republic of astronomers' (created by Johann III Bernoulli), the expression 'Republic of botanists' is meant to describe the emerging intellectual, relational and institutional field where botanists of all origins could work and exchange ideas in the Age of Enlightenment.
2. Examples of these two trends are included in Jardine, Nicholas, Secord, James A., and Spary, Emma C., eds, *Cultures of Natural History* (Cambridge, 1996), namely Cunningham, Andrew, 'The Culture of Gardens', pp. 38–56, and Drouin, Jean-Marc, and Bensaude-Vincent, Bernadette, 'Nature for the People', pp. 408–425.
3. Candolle, Augustin Pyramus, *Mémoires et Souvenirs*, Candaux, Jean-Daniel, *et al.*, eds (Genève, 2004).
4. See Naef, Jaques, 'La botanique', in Trembley, Jacques, ed., *Les savants genevois dans l'Europe intellectuelle* (Genève, 1987), pp. 329–375.
5. Candolle, Augustin Pyramus, 'Histoire de la botanique genevoise. Discours prononcé à la cérémonie académique des Promotions le 14 juin 1830', in *Mémoires de la Société de Physique et d'Histoire Naturelle de Genève*, 5, 1832, pp. 1–61.
6. See Bungener, Patrick, 'La botanique au service de l'agriculture: l'exemple des savants genevois', in Robin, Paul, Jean-Paul Aeschlimann, and Feller, Christian, eds, *Histoire et agronomie: entre ruptures et durée* (Paris: IRD Editions, 2007, collection Colloques et séminaires), pp. 285–302.
7. On the capital cities of eighteenth-century science, see Sigrist, René, Widmer, 'Les lieux de science de l'Europe moderne', in Ghervas, Stella, *et al.*, eds, *Lieux d'Europe. Une tentative d'inventaire* (Paris, 2007).
8. On that question see Porret, Michel, 'Genève républicaine au XVIIIe siècle: réalité des représentations et représentations de la réalité', in Buscaglia, Marino, *et al.*, eds, *Charles Bonnet, savant et philosophe (1720–1793)* (Geneva, 1994), pp. 3–17 (*Mémoires de la Société de Physique et d'Histoire Naturelle de Genève*, 47). That republican myth took its classical shape in a famous entry on Geneva published by d'Alembert in his *Encyclopédie* (1758).
9. For a concise survey on the development of natural theology in Geneva, see Pitassi, Maria Cristina, *De l'orthodoxie aux Lumières. Genève, 1670–1737* (Genève, 1992).
10. For a brief survey of the emergence of a local scientifc tradition, see Sigrist, René, *L'essor de la science moderne à Genève* (Lausanne, 2004) (coll. *Le savoir suisse*).
11. On the introduction of Cartesian science and philosophy at the Academy of Geneva, see Heyd, Michael, *Between Orthodoxy and the Enlightenment. Jean-Robert Chouet and the Introduction of Cartesian*

Science in the Academy of Geneva (Den Haag, 1982).

12. On Jean Bauhin and the first local botanists, see Candolle, Augustin Pyramus, op. cit. (1832), note 5, as well as Burdet, Hervé Maurice, Greppin, H., and Spichiger, R., 'Le développement de la botanique à Genève', in *Botanica Helvetica*, 100/3, 1990, pp. 273–292, especially pp. 273–275.
13. Trembley, Jacques A., *Theses de vegetatione et generatione plantarum* (Genevae, 1734); In the 1750s, Michel Lullin de Chateauvieux also carried out some experiments on the cultivation of plants that interested his nephew Charles Bonnet.
14. On these experiments, see Naef, Jaques, 'Charles Bonnet et les plantes', in Buscaglia, Marino, *et al.*, eds, op. cit. (1994), note 8, pp. 133–148, and Sigrist, René, 'Fonctions et formes de l'expérimentation chez Charles Bonnet: esquisse d'une typologie', in *Archives des Sciences*, 57/1, 2001, pp. 3–14.
15. On Saussure's contribution to botany, see Bungener, Patrick, 'Les rapports de Saussure avec la botanique', in Sigrist, René, ed., *H.-B. de Saussure (1740–1799). Un regard sur la Terre* (Genève, 2001), pp. 33–49.
16. On Senebier's contribution to plant physiology, see Kottler, Dorian B., *Jean Senebier and the emergence of plant physiology, 1775–1802. From natural history to chemical science* (Baltimore, 1973) [unpublished dissertation, Ann Arbor, UMI Dissertation Services, 1992].
17. On Nicolas Théodore de Saussure's work on the chemistry of vegetation, see Robin, Paul, and Blondel-Megrelis, Marika, '1800 et 1840. Physiologie végétale et chimie agricole. I. Saussure, une publication à ressusciter', in *Compte-rendus de l'Académie d'Agriculture de France*, 87/4, 2001, pp. 31–59.
18. See Candolle, Augustin Pyramus, op. cit. (1832), note 5, p. 32.
19. 'On a dû mettre toujours plus de prix parmi nous à cette recherche piquante, mais souvent trompeuse, des relations de la cause à l'effet, plutôt qu'à l'observation plus modeste, mais plus certaine, des faits et de leurs rapports de coexistence', Candolle, Augustin Pyramus, op. cit. (1832), note 5, p. 33.
20. 'Genève par sa situation naturelle semble faite pour inspirer le goût de l'Histoire Naturelle. La Nature s'y présente sous l'aspect le plus brillant: elle y étale une infinité de productions différentes, un Lac rempli d'une eau claire et azurée, un beau fleuve qui en sort, des collines charmantes qui le bordent et qui forment le premier degré d'un amphithéâtre de montagnes couronné par les cimes majestueuses des Alpes … ', Saussure, Horace Benédict de, *Voyages dans les Alpes: précédés d'un essai sur l'histoire naturelle des environs de Genève* (Neuchâtel, 1779), Vol. 1, pp. 1–2 (author's translation).
21. See Lienhard, Luc, 'Haller et la découverte botanique des Alpes', in Pont, Jean-Claude, and Lacki, Jan, eds, *Une cordée originale* (Genève, 2000), pp. 120–138. Haller's monumental work required the help of about 100 field collectors.
22. *Registres de la Société de Physique et d'Histoire Naturelle de Genève*, 16 February 1792 [*BGE*: *SP 13*]. On the early years of that Society, see Sigrist, René, *Les origines de la Société de Physique et d'Histoire naturelle (1790–1822). La science genevoise face au modèle français* (Genève, 1990) (*Mémoires de la Société de Physique et d'Histoire Naturelle de Genève*, 45/1).
23. Vaucher, Jean-Pierre, Notice sur la Société de Physique et d'Histoire naturelle', in *Mémoires de la Société de Physique et d'Histoire Naturelle de Genève*, 1/2, 1822, p. XXIII.
24. The physicist Jean Jallabert (1712–1768) was perhaps the first to own a private botanical garden. However, very little is known about this garden, probably a very simple one, where H.-B. de Saussure carried out some observations for Haller.
25. These first Genevan gentlemen farmers and horticulturists belonged to three different generations. Michel Lullin de Chateauvieux (1695–1781), François-Gratien Micheli du Crest (1705–1785), André Naville (1709–1780), Nicolas de Saussure (1709–1791) and Paul Gaussen (1720–1806) belong to the first one. The second included Guillaume-Antoine Maurice (1750–1826), Michel Micheli de Chateauvieux (1751–1830), Charles Jean Marc Lullin (1752–1833), Charles Pictet de Rochemont (1755–1824) and Michel Jean Louis Saladin (1756–1844). The last generation was illustrated by Jacob-Fédéric Lullin de Chateauvieux (1772–1851) and Marc-Antoine Fazy-Pasteur (1778–1856).
26. See Bernoulli, Jean (III), *Lettres sur différents sujets écrites pendant le cours d'un voyage par l'Allemagne, la Suisse, la France méridionale et l'Italie en 1774 et 1775* (Berlin, 1777), Vol. II, p. 41. Bernoulli took his own information from the published letters of Johann Gerhard Andreae, see Andreae, Johann Gerhard, 'Brief aus der Schweiz nach Hannover geschrieben in dem jahre 1763', in *Hannoversches Magazin* (1764–1765), reed. Zürich, 1776.
27. In any case, Gaussen was able to promise no less than 500 duplicates to the botanical garden that the Society of Natural History wanted to set up in 1792 on one of the city's bastions (*Registres de la Société de Physique et d'Histoire Naturelle de Genève*, 19 January 1792) [*BGE*: *SP 13*].
28. On Nicolas de Saussure, see Zumkeller, Dominique, 'Un père agronome: Nicolas de Saussure (1709–1791)', in Sigrist, René, ed., op. cit. (2001), note 15, pp. 395–408.
29. The rich correspondence between Haller and Saussure has been published by Otto Sonntag (Bern, 1990).
30. Letter to Allioni, 23 December 1761 [*Conservatoire et Jardin botaniques de Genève*].
31. See Bungener, Patrick, op. cit., note 6.
32. Forbes, Robert James, ed., *Martinus van Marum Life and Work* (Haarlem, 1970), Vol. II, p. 358.
33. Gaudy, Isaac-Louis, [*Abrégé de la Flore genevoise*] *lu à la Société des naturalistes le juil. 1792* [*Mss BGE: SP 19, envel. 2, no 8*]. Gaudy's taxonomic conceptions were influenced by Charles Bonnet's ideas on the 'chain of being'.
34. Gaudy thus reversed the usual belief that popular botany is better associated with the Linnean artificial system based on the sexual organs of plants, because it allows the establishment of clear-cut divisions between genus and species. See for instance Duris, Pascal, *Linné et la France (1780–1850)* (Genève, 1993).

35. Maurice, Frédéric-Guillaume, 'Nouvelles observations botanico-météorologiques', in *Journal de Genève* (1788).
36. One of the aims of meteorology in its first stage was to study the relation between atmospheric variations and agricultural production in order to find out their periodic variations, to ascertain their causes with a certain degree of precision and to be able to predict them. See Pictet, Marc-Auguste, 'Considérations sur la météorologie et résultats d'observations faites à Genève pendant l'année 1778', in *Mémoires de la Société des Arts*, 1/2, 1780, pp. 157–168, especially pp. 157–158.
37. As a matter of fact, Goss owned a herbarium besides a collection of medicinal plants. After his death both were given to Geneva botanical conservatory.
38. *Society for the Encouragement of Arts*, 'Registre de la Société familière', 24 April 1790.
39. This heritage amounted to a total of 6815 florins, which is slightly more than two times the (relatively modest) annual income of a Geneva Academy professor or of a skilled craftsman. Half of this sum was used to build a monument to Bonnet.
40. In 1798, Geneva was annexed to the French Republic and remained in that position during the Napoleonic Empire, until the very end of 1813.
41. Registre de la partie réglementaire de la *Société de Physique et d'Histoire Naturelle de Genève*, 16 December 1830, 6 and 20 January 1831 and 3 February 1831 [*SP 31, pp. 67–69*].
42. The price was later doubled to one 'ecu neuf' (about 12 florins), but still remained eight times lower than the 2 Louis (102 florins) paid to attend Pictet's lessons of experimental physics.
43. A manuscript copy of Vaucher's lessons is kept in the Library of the Botanical Garden of Geneva, under the reference [*Archives 091*].
44. Registres de la *Société de Physique et d'Histoire Naturelle de Genève*, 14 April 1798 [*SP 15*]. The year before (2 February 1797), Louis Jurine was asked to teach a course on entomology or mineralogy [*SP 14*].
45. [*SP 17*], 1 April 1802.
46. See Gosse's letters to Wyttenbach, 11 July and 26 December 1811 [*BGE: Ms. fr 2638, ff° 446–448*] and to his son, 17–18 November 1811 [*Ms. fr 2627, 1a*], as well as *Registres de la Société des Naturalistes*, 5 August 1811 [*SP 20B, envel. 3*].
47. In the beginning (1793), the *Society of Physics* appointed Gosse and Vaucher as directors of its garden [*SP 13*, 9 July 1793] but Michel Micheli, elected member on the 18 April 1793, took over the direction soon after, and paid most of the repairs and constructions from his own pocket.
48. The Italian chemist Luigi V. Brugnatelli noted for instance in his diary: 'Il Prof. di Botanica [sic] il Colonello Micheli de Chateau[vieux] ci condusse a vedere il piccolo Orto Botanico che il Prof. pensa dis sistemare quanto prima' (*Diario del viaggio compiuto in Svizzera e in Francia con Alessandro Volta nel 1801*, Pavia, 1953, 17 Sett. 1801).
49. None of his numerous papers on horticulture and agronomy read before the Society of Physics and the Society of Arts has been published, Candolle, Augustin Pyramus, op. cit. (1832), note 5, p. 46.
50. *Registres de la Société de Physique et d'Histoire Naturelle de Genève*, 6 March 1794 [*SP 13*].
51. This device had been described in an unpublished paper on greenhouses read before the Society of Physics on July 21 1803 (*Registres de la Société de Physique et d'Histoire Naturelle de Genève*: *SP 18*). Unfortunately, this paper has been lost.
52. *Registres de la Société des Naturalistes*, 13 September 1805 [*SP 20B, envel. 1*]. Given the modest size of the garden, this number seems rather high, and even more if it does not include the alpine plants.
53. *Registres de la Société de Physique et d'Histoire Naturelle de Genève*, 26 March 1807 [*SP 22*].
54. Gaussen alone seems to have offered no less than 500 plants to the new garden.
55. Letters from Wyttenbach to Gosse, 30 November 1793 and 20 November 1794 [*BGE: Ms fr 2638A, ff° 283–284 and 379–380*].
56. On the late Linneans, see Duris, Pascal, op. cit. (1993), note 34.
57. Berger, Jean-François, 'Observations sur la fleur de la tannée', in *Journal de Physique*, 55, 1802, pp. 117–127.
58. This meteorological station was transferred to the new *Jardin des Bastions* in 1822, and to the Observatory, on the bastion du Pin, in 1826.
59. *Registres de la Société de Physique et d'Histoire Naturelle de Genève*, 6 March 1794 [*SP 13*].
60. On the revolutionary plans for the introduction of potatoes in Geneva, see Hiler, David, 'La pomme de terre révolutionnaire', in Binz, Louis, *et al.*, eds, *Regards sur la Révolution genevoise, 1792–1798* (Genève, 1992), pp. 91–117.
61. See for instance Micheli's 'Description physiologique de la culture de la pomme de terre', delivered on 18 December 1794 and his 'Mémoire sur quelques semis' delivered on 17 March 1796.
62. See for instance Vaucher's paper 'Sur la maladie de la vigne appelée vulgairement la Touine', read on 16 August 1798.
63. *Registres de la Société des Naturalistes*, 12 April 1803 [*SP 20A, pp 1–6*].
64. Besides a central building for the public meetings, Gosse imagined smaller locations for experiments and practical work, for cabinets of physics, natural history and mechanical arts, for a library, etc.
65. Candolle exposed his conception of phytogeography under the item 'Géographie botanique' in Frédéric Cuvier's *Dictionary of Natural Sciences* (1820).
66. Candolle, Augustin Pyramus, op. cit. (2004), note 3, p. 340.
67. Candolle, Augustin Pyramus, *Prospectus d'une souscription en faveur du Jardin de botanique* (Genève, 1818), pp. 1–2.
68. Candolle, Augustin Pyramus, *Rapport sur la fondation du Jardin botanique de Genève* (Genève, 1819), pp. 8–9.
69. The privately raised funds finally amounted to 81,000 florins, to be added to the 3500 florins from the State and to 20,000 florins coming from the sale of a part of the garden to the banker Jean-Gabriel Eynard. The cost of the hothouses and the orangery

was nearly 60,000 florins. The ordinary costs were annually paid by the State.

70. Amsler, Christine, 'Le Jardin botanque des Bastions (1818–1824)', in Marquis, Jean-Marie, *et al.*, eds, *G. H. Dufour. L'homme, l'œuvre, la légende. Catalogue d'exposition de la maison Tavel* (Genève, 1987), pp. 112–113.
71. Candolle, Augustin Pyramus, op. cit. (2004), note 3, pp. 341–343.
72. This public teaching was given with no interruption from 1817 to 1828. The success of Marc-August Pictet's public lessons on experimental physics, attended by numerous women since the 1780s, had paved the way for the popularity of scientific culture among local elite and middle classes.
73. See Drouin, Jean-Marc, 'Une espèce de livre vivant: le rôle des jardins botaniques d'après Augustin Pyramus de Candolle', in *Saussurea*, 24, 1993, pp. 37–46, quoting Candolle, Augustin Pyramus, 'Jardins de botanique', in Cuvier, Frédéric, ed., *Dictionnaire des sciences naturelles*, 24 (1822), pp. 165–180.
74. See various *Compte rendu de l'Administration du Conseil d'Etat* for the years 1823 to 1849 (in *Registres du Conseil d'État*, kept in the State Archives of Geneva), and various *Rapport sur l'Etat de l'instruction publique. Prononcé aux Promotions* for the years 1831 to 1841.
75. Ideally, Candolle wished to show the affinities between families using a more creative way of arranging his plants, but the lack of space forced him to accept a classical orthogonal frame for his flower-beds.
76. Candolle, Augustin Pyramus, op. cit. (1822), note 73.
77. On Jean-Christian Kumpfler (1792–1866), nicknamed Heyland, see Briquet, John, *Biographie des botanistes à Genève de 1500 à 1930* (Genève, 1940).
78. *Compte rendu de l'Administraton du Conseil d'Etat pendant l'année 1842*, p. 50.
79. Candolle, Augustin Pyramus, op. cit. (1818), note 67, pp. 4–5.
80. Candolle, Augustin Pyramus, op. cit. (1819), note 68, p. 25, and Candolle, Augustin Pyramus, *Catalogue des arbres fruitiers et des vignes du jardin botanique de Genève* (Genève and Paris, 1820).
81. In his report for 1835 Candolle, who qualified the potato as a ''vegetable so superior to all others'', regretted that his countrymen's prejudice against it was hardly reduced after nearly one century.
82. *Compte rendu de l'Administration du Conseil d'Etat pendant l'année 1843*, p. 53.
83. Candolle, Augustin Pyramus, op. cit. (2004), note 3, pp. 352–353. These two anonymous donors gave 56,800 florins of the 74,000 that the building was to cost. Candolle thought they were nobody else than Jean-Louis Viollier (1778–1840), a banker, and François-Jules Micheli (1778–1861), owner of the 'Château du Crest' in Jussy near Geneva.
84. On the circumstances of this inheritance, see Burdet, Hervé Maurice, Greppin, H., and Spichiger, R., op. cit. (1990), note 12, pp. 279–281.
85. Candolle, Augustin Pyramus, op. cit. (2004), note 3, p. 353. To that list, see Briquet, John, op. cit. (1940), note 77, adds among those born before 1806, Louis Jurine (1751–1819), Henri-Albert Gosse (1753–1816), Jean Girod (1753–1841), Marc-Nicolas Puerari (1766–1841), Louis Perrot (1785–1865) and Jean-Pierre Dupin (1791–1865).
86. The specimen duplicates of the *Conservatoire's* collections were given to the city of Bern, and another set to the city of Lausanne.
87. The books of that library, created in 1830, came from the legacies of Michel Micheli (652 vols) and of Jean-Antoine Colladon (131 vols). But the total of monographs only amounted to 314 in 1832.
88. On Candolle's herbarium, see Candolle, Augustin Pyramus, op. cit. (2004), note 3, pp. 498–504.
89. When he started his *Prodromus*, a few years before 1818, Candolle's herbarium included exactly 47,200 specimens.
90. Reuter then became curator of the Boissier herbarium, and in 1849 director of the botanical garden of Geneva. He kept that position until his death in 1872.
91. Candolle, Augustin Pyramus, op. cit. (2004), note 3, p. 339.
92. He remained director of the botanical garden for some years in close association with his son Augustin.
93. In 1869, however, the botanical garden of Geneva acquired the important herbarium of Benjamin Delessert, which included, among other collections, the specimen duplicates of Lamarck.