HUNTIA

A Journal of Botanical History

VOLUME 13 NUMBER 1
2006

Hunt Institute for Botanical Documentation
Carnegie Mellon University

Pittsburgh

The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Huntia publishes articles on all aspects of the history of botany, including exploration, art, literature, biography, iconography, and bibliography. The journal is published irregularly in one or more numbers per volume of approximately 200 pages by the Hunt Institute for Botanical Documentation. External contributions to *Huntia* are welcomed. Page charges have been eliminated. All manuscripts are subject to external peer review. Before submitting manuscripts for consideration, please review the "Guidelines for Contributors," which are available on our Web site or by request. Direct editorial correspondence to the Editor. Send books for announcement or review to the Book Reviews and Announcements Editor. The subscription rate is $60.00 per volume. Send orders for subscriptions and back issues to the Institute. Hunt Institute Associates may elect to receive *Huntia* as a benefit of membership; contact the Institute for more information.

Hunt Institute for Botanical Documentation
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213-3890
Telephone: 412-268-2434
Email: huntinst@andrew.cmu.edu
Web site: http://huntbot.andrew.cmu.edu/
HIBD/Publications/HI-Pubs/Pub-Huntia.shtml

Printed and bound by Hoechstetter Printing,
an RR Donnelley Company, Pittsburgh, PA

ISSN 0073-4071

HUNTIA 13(1) 2006

Claude-Joseph Geoffroy's 1711 lecture on the structure and uses of flowers

Paul Bernasconi and Lincoln Taiz

Abstract

In 1711 Claude-Joseph Geoffroy, newly elected *associé botaniste* in the Académie Royale des Sciences, presented a lecture titled "Observations on the Structure and Uses of the Principal Parts of Flowers" in which he rejected the asexualist views of his former mentor, Joseph Pitton de Tournefort, and embraced the new sexual theory of plant reproduction. To bolster his arguments, Geoffroy claimed to have carried out several observations and experiments that: (1) demonstrated, for the first time, the necessity of pollination for seed production; and (2) supported the spermist side in the debate between spermism and ovism. Based on these findings, Geoffroy was hailed for having provided the first definitive proof of the sexual theory of plants. Six years later, however, Geoffroy was publicly ridiculed by Sébastien Vaillant for "augmenting" his arguments with certain "details" and "beautiful facts" that he "gleaned … from various authors" — a veiled charge of plagiarism. Modern scholars have established that Claude-Joseph Geoffroy paraphrased a key passage from Rudolph Jacob Camerarius' 1694 *Sexu Plantarum Epistola* without citing it. Other observations Geoffroy reported in support of spermism appear to have been inspired by a paper by the British botanist Samuel Morland. Questions also have been raised over whether Geoffroy actually performed the emasculation experiments he reported or plagiarized them from Camerarius. In response to Vaillant's accusations, Geoffroy wrote two drafts of a letter of rebuttal in which he strenuously defended himself against the charge of plagiarism. Focusing narrowly on the issue of terminology, he cited the 1704 thesis of his brother, Étienne-François, as the original source of the terms he had used in his 1711 lecture. Geoffroy then leveled the countercharge that it was Vaillant, not he, who had plagiarized his brother's thesis, but Geoffroy failed to mention that his older brother's 1704 thesis also contained the same unattributed experiments of Camerarius that he, himself, claimed to have performed in 1711. Although the younger Geoffroy's alleged plagiarism has been well documented, the role of Étienne-François in the imbroglio has not yet been addressed. Geoffroy's 1711 lecture and subsequent letters to the Académie provide an intriguing window onto the ethical conflicts that could and did arise in the absence of strict rules of citation in the early 18th century. The fact that it took nearly 40 years for Geoffroy's plagiarism of Camerarius to come to light suggests that botanists of the Holy Roman Empire were relatively isolated from their European colleagues. The prolonged war with France plus the lack of a centralized scientific society probably served as barriers to the dissemination of works by German botanists to other European countries. These barriers ensured the obscurity of Camerarius' groundbreaking experiments in the *Epistola*.

Introduction

In his 1717 lecture opening the annual course in botany at the Jardin du Roi in Paris, Sébastien Vaillant chose as his topic the new sexual theory of flowers, entertaining the medical students in attendance with eroticized descriptions of stamens and pistils "engaged in their frolic" on their "nuptial beds" (Bernasconi and Taiz 2002). In attempting to place his own stamp on the sexual theory, Vaillant touted his own novel system of classification based on the sexual organs of flowers and harshly criticized the widely used identification method of Joseph Pitton de Tournefort for failing to take floral sexual organs into account. Vaillant also attacked another former colleague in the Botany Department at the Académie, Claude-Joseph Geoffroy. In 1711 Geoffroy, a newly elected *associé botaniste*, had presented a

Chapel Hill, NC, U.S.A. [PB]

Department of Molecular, Cellular, and Developmental Biology, University of California, Santa Cruz, CA 95064 U.S.A. Email: taiz@biology.ucsc.edu [LT]

paper titled "Observations on the Structure and Uses of the Principal Parts of Flowers" in which he embraced the sexual theory of plants and presented new observations supporting it. Vaillant was especially irked that Geoffroy had, in his view, stolen Vaillant's terminology for male, female, and hermaphroditic flowers, and, in addition, had taken credit for experimental work done by others:

> I return to the different sexes of plants. Since everyone in the whole world knows that they are not always assembled in the same flower and that to the contrary, one is often separated from the other, either on the same individual or on different plants, I thought it convenient to establish three types of flowers: Males, Females and Androgynous (or hermaphrodite), names that a sweet and officious Echo (The Author of the Observations on the Structure and Uses of the Main Parts of Flowers) cared to repeat (at least the first two) in front of a Royal Assembly in order to transmit them to posterity, as well as some details which he did not report so faithfully, since he believed them to be simply a case of the fabled crow dressing itself up with the feathers of a jay. But as it would displease God if I were to take away from him these details and envy even the smallest of the pretty facts he harvested here and there from various authors to augment his observations, I abandon them to him with a light heart. The other details I take directly from pure Nature, the only book one must peruse in order to avoid making mistakes by trying to impress others (Bernasconi and Taiz 2002, pp. 110–111).

Although Vaillant refrained from using the term, this passage was tantamount to a charge of plagiarism.[1] Curiously, Vaillant never specified whose work, other than his own, Geoffroy was supposed to have "gleaned." His reticence on this score made him all the more vulnerable to a strongly worded rebuttal by Geoffroy the following year. In two scathing letters addressed to the Académie, only one of which was presented orally, Geoffroy strenuously defended himself against the charge of plagiarism and, perhaps employing the strategy of "the best defense is a good offense," leveled the countercharge that Vaillant had plagiarized the 1704 thesis of his brother, Étienne-François Geoffroy. The upshot of the exchange was that the irascible Vaillant was taken to task by a special disciplinary committee of the Académie and forced to write a perfunctory letter of apology (Rousseau 1970).

As late as 1714, Claude-Joseph Geoffroy was still being hailed in the Académie *Mémoires* for having provided the first definitive proof of sex in plants and for having overturned the asexualist doctrine of his predecessor, the great Joseph Pitton de Tournefort. Yet despite his auspicious debut as an *associé botaniste*, Claude-Joseph Geoffroy abruptly abandoned his work on the sexual theory after 1712 and in 1715 seized the first opportunity to switch departments from Botany to Chemistry. Thereafter, he published papers only on chemical and pharmacological topics.

Precisely when Geoffroy's colleagues first became aware that there was some truth in Vaillant's charges is difficult to say. The first person to revive the issue in print was Johann Georg Gmelin of the University of Tübingen, who, in 1749, republished Rudolph Jacob Camerarius' 1694 *Sexu Plantarum Epistola*. In his commentary, Gmelin noted the striking resemblance of sections of Geoffroy's 1711 lecture to passages in the *Epistola* published 17 years earlier, although Geoffroy had not cited Camerarius. At Geoffroy's funeral only three years later, Grandjean de Fouchy (1707–1788), longtime Académie Secretary, seemed to handle the subject of Geoffroy's scientific contributions somewhat delicately: "It is not our intention to give the details of all the *Mémoires* which M. Geoffroy presented to the Académie; … suffice it to say that no other Academician fulfilled that duty more dutifully" (Plantefol 1965). Thus, with a sardonic turn of phrase, Geoffroy's once-celebrated lecture was quietly swept under the rug.

Gmelin's revelation notwithstanding, Geoffroy's paper continued to be cited as an original contribution to the sexual theory, independent of Camerarius, for two more centuries. In the late 19th century, Julius von Sachs, the great German plant physiologist and botanical historian, took pains, in his comprehensive *History of Botany* (1875), to give Camerarius priority for the first definitive experimental evidence for the sexual theory. He also expressed strong doubts that Claude-Joseph Geoffroy had actually performed the experiments he claimed to have done in his 1711 lecture.

> The only proof offered for the fact that the seeds are infertile if deprived of the cooperation of pollen is a very hasty account of some experiments with maize and *Mercurialis*. The result of these experiments, as well as some other remarks of Geoffroy, remind us of the text of Camerarius' letter to an extent which mere accident will hardly account for. If Geoffroy really made these experiments, which is open to some doubt, yet they were made fifteen years later than those of Camerarius, who did make the same experiments among others and has described them better (Sachs 1906, p. 396).

Despite Sach's caveat, the 1911 edition of the *Encyclopaedia Britannica*, in its article on botany, continued to attribute Camerarius' experiments to Geoffroy (incorrectly referred to as "E. F. Geoffroy"):

> In 1694 R. J. Camerarius, professor of botany and medicine at Tubingen, published a letter on the sexes of plants, in which he refers to the stamens and pistils as the organs of reproduction, and states the difficulties he had encountered in determining the organs of Cryptogamic plants. In 1703 Samuel Morland, in a paper read before the Royal Society, stated that the farina (pollen) is a congeries of seminal plants, one of which must be conveyed into every ovum or seed before it can become prolific. In this remarkable statement he seems to anticipate in part the discoveries afterwards made as to pollen tubes, and more particularly the peculiar views promulgated by Schieiden [*sic*]. In 1711 E. F. Geoffroy, in a memoir presented to the Royal Academy at Paris, supported the views of Grew and others as to the sexes of plants. He states that the germ is never to be seen in the seed till the apices (anthers) shed their dust; and that if the stamina be cut out before the apices open, the seed will either not ripen, or be barren if it ripens. He mentions two experiments made by him to prove this—one by cutting off the staminal flowers in Maize, and the other by rearing the female plant of *Mercurialis* apart from the male. In these instances most of the flowers were abortive, but a few were fertile, which he attributes to the dust of the apices having been wafted by the wind from other plants (Rendle 1910, p. 301).

Note that Camerarius was credited only for calling stamens and pistils "organs of reproduction," while Geoffroy was credited with Camerarius' emasculation and sexual isolation experiments.

And there the matter stood until 1965, when Anne-Marie Prévost of the Laboratoire de Botanique de la Sorbonne in Paris presented a side-by-side comparison of a paragraph from Camerarius' *Epistola* on embryo development in legume seeds and a parallel paragraph from Geoffroy's lecture. The multiple parallels between the two paragraphs led her to conclude that Geoffroy had indeed committed literary theft, or plagiarism. Prévost also questioned, as Sachs had done, whether Geoffroy had actually performed the maize and *Mercurialis* experiments he described. In an accompanying paper, Plantefol (1965) concurred with Prévost's conclusion but sought to mitigate the offence by placing Geoffroy's action in the context of his life, both professional and personal. Jacques Rousseau (1970) provided further details about the scandal, including Geoffroy's 1718 letters to the Académie in which he cited his older brother's 1704 thesis as his original source. Camerarius was never mentioned in the older Geoffroy's thesis either. The younger Geoffroy brother also never addressed the chronological problem of how his brother could have described emasculation studies in 1704 that he, himself, claimed to have performed seven years later.

In his book *On the Shoulders of Giants*, Robert Merton describes the tense atmosphere that existed in scientific circles during the 17th and early 18th centuries because of the frequent charges of plagiarism, both real and imagined:

> …it is quite in keeping with the practice of the time to charge, and be charged with, plagiarism. Can you think of any one of consequence in that energetic age who escaped unscathed, either as victim or alleged perpetrator of literary or scientific theft, and typically, as both filcher and filchee? I cannot (1965, p. 68).

Among the "plaintiffs and defendants," as Thomas Mallon (1989) calls them, were Descartes, Leibniz, Hooke, Halley, Newton, and Pascal. The acrimonious exchanges between Geoffroy and Vaillant are in keeping with this grand 17th- and early 18th-century tradition. Although much has been written about the dispute, many questions yet remain. For example, Claude-Joseph cited his older brother's thesis as his original source for his terminology. What was Étienne-François' role in the whole affair? Did Geoffroy's failure to cite Camerarius (as well as Samuel Morland and other contributors to the sexual theory) rise to the level of "plagiarism?" Were the rules of citation in the 18th century different from those of today? Several decades were to pass before Geoffroy's debt to Camerarius was recognized. What were the obstacles that kept Camerarius' historic contribution to the sexual theory in obscurity for so long? And what roles did the newly formed scientific societies play in protecting scientific priority and guarding against plagiarism? Although we may never have definitive answers to any of these questions, we will attempt to reconstruct a plausible scenario based on the fragmentary information available.

The brothers Geoffroy

A useful discussion of the Geoffroy family dynasty can be found in David Sturdy's *Science and Social Status* (1995), and brief accounts of the chronology of events leading up to Claude-Joseph's 1711 lecture have been provided by Lucien Plantefol (1965) and Jacques Rousseau (1970).

Claude-Joseph Geoffroy was the younger son of Matthieu-François Geoffroy, a fourth-generation pharmacist, and Louise de Vaux, the daughter of a prominent surgeon. The Geoffroy family was one of the most important pharmaceutical dynasties in Paris. In addition to running the family business on Rue Bourgtibourg, Matthieu-François held a variety of civic offices and was a high official ("Prévost des Marchants") in the Apothecaries' Guild. Matthieu-François Geoffroy was also in close contact with members of the newly formed Académie des Sciences and regularly hosted scientific meetings at his home (Stroup 1990). These intellectual soirées were attended by leading members of the Académie. According to Stroup (1990, p. 196), "Du Verney dissected and Homberg demonstrated chemical operations; Cassini brought his planispheres, Sébastien Truchet his machines, and Joblot some lodestones." Claude-Joseph was thus privileged to grow up in the company of many of the leading scientific lights of his day.

Claude-Joseph's brother, Étienne-François (1672–1731), was 13 years his senior. As the eldest son, Étienne-François was expected by his father to succeed him as head of the family business; Claude-Joseph was slated to become a doctor. Étienne-François initially went along with his father's plan, earning the title of master apothecary in 1694, after which he helped run the family business for several years. However, the scientific meetings to which he had been exposed as a child had made a deep impression on Étienne-François, and he, in turn, was greatly admired for his intellect by Académie scientists. His scientific interests were further piqued by a trip to England in 1698, where he met with Sir Hans Sloane and other members of the Royal Society. In 1699 he was accepted by Wilhelm Homberg (1652–1715) as an *élève* at the Académie, an apprenticeship that allowed him to assist Homberg in his experiments, and later in the same year he was promoted to the rank of associate chemist. Then, in 1700, during a trip to Italy to purchase books for the royal library, Étienne-François made the momentous decision to abandon pharmacy in favor of a career in medicine. In so doing, Étienne-François was forfeiting his claim to the highly profitable Geoffroy family business in order to pursue a far less lucrative career in science. Upon returning to Paris, Étienne-François immediately enrolled as a medical student and received his M.D. in 1704. The subject of his thesis was "Is a Worm the Origin of Man?," in which Étienne-François argued in favor of the spermist view of sexual reproduction.

Étienne-François' rise up the academic ladder was swift and unproblematical. In 1709 he succeeded Tournefort as professor of medicine, chemistry, and botany at the Collège Royal, as well as professor of chemistry and "démonstrateur de l'intérieur des plantes" at the Jardin du Roi. Étienne-François' primary contribution to the history of chemistry was his "tables of affinities," the earliest attempt to arrange in tabular form pure substances according to their physicochemical properties. Toward the end of his career, he was elected dean of the medical school, a post he held until his death (Sturdy 1995).

Given Étienne-François' scientific proclivities, which were evident from an early age, it must have come as no surprise to Matthieu-François when his oldest son surrendered his claim to the family business by abandoning pharmacy. He could afford to be supportive of Étienne-François' decision because his younger son, Claude-Joseph, was quite agreeable to switching careers with his older brother by becoming a pharmacist. Later in life Claude-Joseph was to prove himself to be a shrewd businessman who greatly expanded the family fortune. In keeping with his social position as head of the highly successful business, he was to be an active participant in civic affairs and a leader in the pharmacy guild throughout his life. In contrast, Étienne-François, led a more scholarly existence, shunning all outside activities other than science, even avoiding positions as court physician that might have profited him financially (Sturdy 1995). It appears that Matthieu-François understood his two sons well. He had already surmised that Claude-Joseph was temperamentally better suited to run the family business than Étienne-François, so Matthieu-François could afford to be generous and bestow his blessing on the older son's decision to attend medical school.

Claude-Joseph seems to have gone along with his father's new plan without objection. He became a master apothecary in 1703 at the age of 18 and began working at the family pharmacy. At that time botany was considered an essential part of the ongoing education of a pharmacist. He and his brother had earlier attended classes taught by Tournefort at the Jardin du Roi. In 1707 Claude-Joseph was sent on a trip to southern France to study the local flora. Perhaps inspired by his brother's epiphany in Italy, Claude-Joseph chose this occasion to make the decision to follow in his brother's footsteps by entering the Académie, where he was already regarded as a promising academic prospect.[2] Unlike his brother, however, Claude-Joseph had no intention of abandoning pharmacy, and upon his return he was permitted to enter the Académie as Tournefort's *élève*. Plantefol (1965) has noted that Claude-Joseph shared his older brother's preference for chemistry over botany. His decision to enter the Académie as a botanist seems to have been based on a simple calculation. Since there were fewer senior *élèves* in botany than in chemistry (and thus fewer competitors for any *associé* positions that might open up in the future), his chances of advancing to *associé* were better in botany than in chemistry.

Plant research at the Académie Royale des Sciences in the early 18th century

Research in plant biology at the Académie during the early 18th century had both experimental and descriptive components. Physiological experiments by Mariotte, La Hire, Perrault, Huygens, and Tournefort had focused primarily on the problem of the ascent of sap, inspired by Harvey's model for the circulation of the blood. Their studies anticipated Stephen Hales' classic *Vegetable Staticks* published in 1727. As in England, experiments were also conducted on the question of spontaneous generation, especially by Tournefort (Stroup 1990). Tournefort correctly pointed out that mushrooms arose from spores, contradicting the British naturalist Robert Morison who thought they arose spontaneously from the soil. Tournefort drew a parallel between the "seeds" of mushrooms and those of plants but was unable to find a true ovary in the mushroom. Claude-Joseph Geoffroy (1714a) expanded on Tournefort's observations in a paper he presented in February 1711, the same year of his lecture to the Académie, on the truffle fungus.

Significant experimental work was also being conducted on reproduction in cryptogams. Tournefort himself had examined the spores of ferns, bryophytes, and fungi, erroneously equating them with seeds. Tournefort's successor at the Jardin du Roi, Antoine de Jussieu (1686–1758), was studying fossil ferns and subsequently was the first to propose the establishment of the Fungi as a new class of plants. René-Antoine Ferchault de Réaumur (1683–1757) was investigating sexual reproduction in the marine alga, *Fucus*, identifying both male and female "flowers" as well as "seeds." Jean Marchant (1650–1738) was carrying out parallel studies on the liverwort species that later would be named in his honor: *Marchantia*.

Botanists at the Académie were well aware of Nehemiah Grew's (Fig. 1) new sexual theory of flowers, first published in 1682. Since both Réaumur and Marchant were identifying male and female structures in cryptogams, we can assume that they would have accepted the sexual theory of flowers based on the belief that nature's laws should be universal. Geoffroy noted in his unpublished letter of 1718 (see Appendix) that in 1683, the year after Grew's conjecture was published, Marchant had described the pistil as a female structure analogous to the womb: "the style is to the flowers what the tubes of the womb are to the animals, and it contains in its membranes the siliques that take the place of the chorion and the amnios, providing the air that is necessary for perfecting the seed that links to the placenta through its umbilical cord" (Memoirs of the Academy, 1693, p. 32). Thus, Marchant was already primed to accept the sexual theory even before Grew's proposal appeared. However, Tournefort rejected the sexual theory, and this had a chilling effect on research on this problem at the Académie.

Tournefort's opposition to the sexual theory arose from two main sources: (1) the authority of Malpighi, whose own experiments had led him to conclude that pollen was a waste product produced by flowers during the refinement of the sap for the developing seed; and (2) his belief, based on anatomical observations, that fungi produced spores without apparent sexual structures. Nevertheless, Tournefort

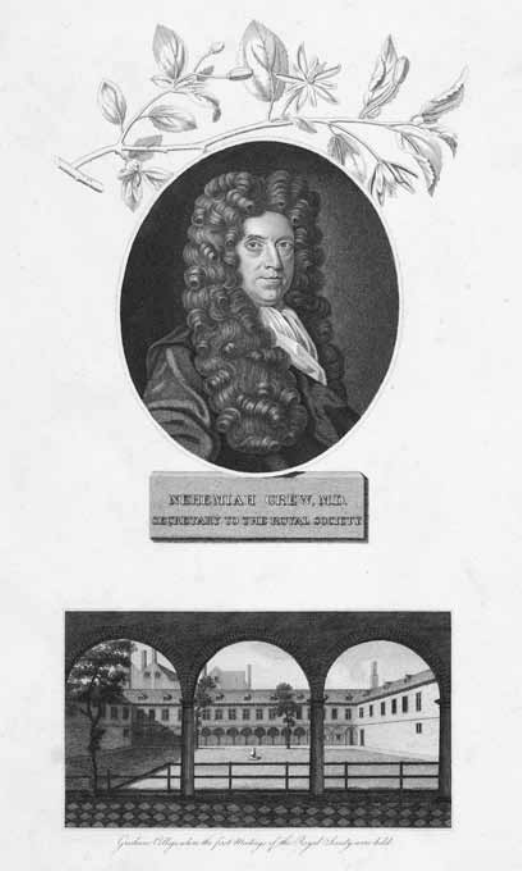

Figure 1. Nehemiah Grew (1641–1712), stipple engraving by James Newton, 1804, after Robert White, 1701, with vignette of Gresham College below. Plate for Robert John Thornton's *New Illustration of the Sexual System of Carolus von Linnaeus* (London, Printed for the publisher by T. Bensley, 1807). Courtesy of Hunt Institute for Botanical Documentation.

recognized that in the date palm, at least, pollen did play a fertilizing role in fruit development. Soon after he was appointed professor of botany at the Jardin du Roi in 1683, Tournefort traveled to Andalusia, Spain, famous for its palm trees, where he attempted to investigate the ancient reports of the effect of pollen from the male trees on fruit development in the female trees. This seems to have been Tournefort's only experiments concerning the sexual theory, but we are not aware of any published account. According to Greene (1983, pt. 2, p. 941), "…he made unsuccessful efforts to either establish or disprove the reputation the palms had long had with some botanists of being endowed with sexuality; but he came away knowing no more about the matter than Theophrastus had known two thousand years before." Nevertheless, Geoffroy, in his 1711 lecture, cites Tournefort's "Institutions Botaniques"[3] in support of the sexuality of date palms:

> For these fruits to ripen and to render them good to eat and fertile, one needs either to plant a male palm in the vicinity or to cut branches of a male tree loaded with anthers in full bloom and to bind them above the branches of the female palm tree, and it produces an abundance of good fruits. This observation was confirmed to M. Tournefort in 1697 by Adgi Mustapha Aga, a spirited and inquisitive man, Tripoli's Ambassador to the King, as this learned botanist reports in his *Institutions Botaniques*.

In 1712, the year after Geoffroy's lecture, a note also appeared in *Histoire de l'Académie Royale des Sciences, Année 1712* further attesting to Tournefort's belief in the fecundating role of pollen in date palms:

> Mr. Jeaugon found among the manuscripts of the Embassy of Mr. de Nointel in Constantinople confirmation of what Mr. Tournefort had advanced in the foreword of his *Institutions* regarding the report of the Ambassador of Tripoli in France about the palm tree. At the time that the female palm tree produces the first stems that are referred to as *swords*, that is to say, in April or at the beginning of May, one places in each of these swords a small branch of the flower of the male palm tree, & unless one does this the dates of the female palm tree do not mature, have an unpleasant taste, and do not form a seed. Only one male palm tree is needed to fecundate two or three females (Anonymous 1731, p. 52).

Perhaps botanists at the Académie wished to emphasize Tournefort's acceptance of the fecundating role of pollen in date palms to soften the blow to his reputation for having opposed the sexual theory.

Finally, an early goal of the Académie had been to publish a definitive natural history of plants, and considerable time and energy had been poured into this project. According to Stroup (1990), "This study was old-fashioned and stressed descriptions, lists of synonyms and sources, explanations of medical uses, tips on cultivation, and illustrations, all reminiscent of Bauhin." The one new element introduced was chemical analysis: the chemical composition of each plant was to be included along with its anatomical descriptions and uses.

Interestingly, Tournefort published his three-volume *Élémens de Botanique* in 1694 and his *Histoire des Plantes* in 1698, ostensibly as preliminary versions of the larger *Histoire* of the Académie. However, when the Académie's multi-authored *Histoire* failed to materialize, Tournefort's work effectively functioned as its substitute. According to Sturdy (1995), this raised the hackles of some of Tournefort's botanical colleagues who felt he had improperly appropriated the researches of various Académie members without giving them proper credit. One critic went so far as to state that the *Élémens* was merely a rehash of John Ray's writings (Sturdy 1995). Indeed, the controversies that surrounded the publication of Tournefort's *Élémens* and *Histoire* seem to foreshadow those of his *élève*, Claude-Joseph Geoffroy, after his 1711 lecture.

The spermist/ovist debate: Étienne-François' 1704 thesis

During the 17th century, ovism was firmly entrenched at both the Royal Society in London and the Académie Royale in Paris. Then, in 1700, Nicolas Andry du Bois-Regard, a physician, published a book titled *On the Generation of Worms*, an exhaustive study of human parasites. In the penultimate chapter, Andry discussed the observations of Leeuwenhoek and Hartsoeker regarding the presence of "worms" in spermatic fluid, and he enthusiastically embraced the spermist view of sexual reproduction. The book was widely read and stimulated spirited debate among academicians (Roger 1997).

Étienne-François Geoffroy appears to have been among those who were inspired by Andry. On Thursday, 13 November 1704, on the completion of his medical degree, Étienne-François presided over a debate between ovists and spermists at the medical school. As was customary, the older Geoffroy began the evening by presenting his thesis, titled "Does Man Originate from a Worm?" Written in Latin, the thesis is said to have aroused so much interest "among the ladies" (Dorveaux 1931) that "Mr. Andry … was kindly asked by Mr. Boudin, State Counsel and first doctor for Monseignor" to prepare a French translation.[4]

Medical school theses in the 17th and 18th centuries differed from doctoral theses of today in that they did not necessarily contain original data. Rather, a thesis consisted of a set of arguments supporting a particular point of view. Its function was both to present an overview of a specific topic and to stimulate discussion of a specific aspect of the topic afterwards. Senior members of the faculty often presented theses, but medical students were also expected to present a thesis as part of their graduation requirements. In this case the student usually "defended the views of his professor, and some theses may have been written by the professor for his student to defend publicly" (Stroup, pers. comm., 2005).

Andry was listed on the cover page of the translation as "Lecturer, and Royal Professor, Doctor Regent of the Faculty of Medicine of Paris." The fact that Andry was the translator of Geoffroy's thesis hints of a possible mentor-student relationship. If so, Andry may have had a hand in writing the thesis as well. On the other hand, Geoffroy, a former apothecary, brought an entirely new dimension to the problem that Andry, as a medical doctor, couldn't provide: a strong background in botany and a familiarity with the botanical literature. Indeed, what distinguished Geoffroy's thesis from previous arguments in favor of spermism was his support for the spermist doctrine in plants as well as animals. The parts of the 1704 thesis that are most likely to have been Étienne-François' own contributions are his discussions of sexuality in plants.

Tournefort was also listed at the end of the thesis as one of the "Disputants," and presumably he was present at the lecture. This did not prevent Étienne-François, in his introduction, from completely ignoring Tournefort's longstanding objections to the sexual theory:

> Generation, apparently so varied in the different species of living organisms, essentially follows the same laws. One observes in all diverse parts that constitute the sexes and without which generation is impossible. These parts are found equally in Man, in four legged animals, in birds, in fishes, in the insects, and in plants…

Étienne-François specifically defines stamens as male sexual structures:

> The male parts of the plants are the "stamens," decorated by their anthers: and the female parts are the "pistils." One understands by stamen, these little filaments usually placed in the middle of the flower: by anthers that which terminates the top of the filaments: and by pistils, a little green stem which rises between the aforementioned filaments.

While Étienne-François cites no source for this characterization, it is ultimately derived from Nehemiah Grew's famous conjecture, which he attributed to Sir Thomas Millington, in the 1682 edition of his *Anatomy of Plants*. In keeping with the spermist position, Geoffroy asserts that pollen contains the embryonic plant. Using lily as an example, he writes:

> The yellow powder which comes away from these anthers, and which sticks to the fingers when one touches them, contains the **germs** of the lily.

Geoffroy then characterizes the pistil as the female sexual structure of the flower. To explain how the "germ" finds its way to the egg, he cites the pistil's hollow neck as the conduit, using lily as an example:

> The thin green stem which appears among these little yellow bodies is what one calls the pistil. This stem is hollow and ends at the top by three rounded and slit corners: it receives the germs coming away from the anthers of the lily, and it guides them to the seed reservoir since the bottom of this pistil hides small eggs, or in other words, seminal vesicles, which are the seeds of the plant. The seeds become fertile by the intromission of the germs they receive; and the whole part which contains the top and the bottom of the pistil is the female part of the lily.

Here he deviates from the ovist Grew, who believed that fertilization was achieved by means of a vaporous "prolific virtue" emanating from the pollen. Although Geoffroy cites no sources anywhere in his thesis, his description of lily styles is strikingly similar to that contained in Samuel Morland's 1703 paper in *Philosophical Transactions*. Morland also disagreed with Grew's concept of "spirituous emanations" from pollen, arguing instead:

> That this *Farina* is a *Congeries* of Seminal Plants, one of which must be convey'd into every *Ovum* before it can become prolifick; That the *Stylus* in Mr. *Ray's* language, the upper part of the *Pistillum* in Mr. *Tournefort's*, is a Tube designed to convey these Seminal Plants into their Nest in the *Ova* (Morland 1703, p. 1475).

Morland had made his observations on the flowers of *Corona imperialis* (*Fritillaria imperialis*), a member of the lily family. Since the vast majority of styles are solid rather than hollow, was it mere coincidence that Geoffroy just happened to use the same plant family as Morland did? The timing of Geoffroy's thesis just one year after Morland's paper was published is very suggestive. It seems likely, therefore, that Geoffroy derived much of his description of pollination and fertilization from Morland's 1703 paper. Later in the chapter, however, Geoffroy makes an astonishing statement that goes well beyond Morland. He claims to have observed pollen grains *in transit* down the hollow tube of the style:

> Let's add that when the flowers are perfect, not only the extremities of the pistil become covered by the dust escaping from the anthers but, upon opening their styles, one finds a large amount of these dust particles inside, including near the seeds or seminal vesicles.

Where did Étienne-François obtain this description, which is completely erroneous? Morland had only *inferred* that pollen grains migrated down hollow styles to the ovule based on logic, not visible evidence. If by "one finds a large amount of dust…" Geoffroy means that the observation is based on his own microscope studies, it is simply a case of the triumph of hope over reality.

We now come to the crucial passage in which Étienne-François Geoffroy describes experiments that demonstrate that pollen is required for the production of fertile seed. He begins by pointing out that in "double flowers" lacking stamens no true seeds are ever produced. Significantly, Camerarius also prefaces the discussion of his emasculation experiments by citing the phenomenon of double flowers. Geoffroy then proceeds with a description of the experiments with dioecious and monoecious species.

> We will add that, if one removes from a flower its anthers, one removes at the same time all its means to procreate: this is easily demonstrated on the corn plant and on the castor bean, by cutting off the stamens before they ripen; since then the pistils, rather than bearing fecund seeds, only carry a couple of empty seed coats which soon dry up. If, among the plants of the same species with fruits and flowers growing on separated plants, one grows a singular female plant, in such a way that it cannot receive any dust particle coming from the male, this solitary plant either will not bring fruits to maturity, or will produce only sterile ones which will look like these eggs produced by hens without the help of a rooster and in which there is no germ. This observation can easily be made with *Mercurialis*, hemp and other similar plants.

The above passage is central to our understanding of the younger Geoffroy's 1711 lecture, so it is worth taking a moment to consider its significance. Although not explicitly stated, Étienne-François Geoffroy gives the clear impression that he, himself, has performed the emasculation experiments in the monoecious species, corn and castor bean, as well as the female plant isolation experiments with dioecious species: "*Mercurialis*, hemp and other similar plants." Yet there is no evidence that the older Geoffroy ever performed such experiments. Alternatively, it could be argued that he is merely reporting the results of someone else's experiments with which he is familiar. In that case, whose experiments was he reporting? Not those of his younger brother, who only began his research at the Académie with Tournefort in 1707 and did not begin his work on flowers until 1711. No one in England, France, or Italy was then engaged in such studies. The most likely source for the pollination experiments Geoffroy the Elder described so matter-of-factly in his thesis is Camerarius' *De Sexu Plantarum Epistola*, published in 1694.

Let us compare sentences from the above paragraph with parallel sentences in Camerarius' *Epistola* (Table 1). In the first example, both sentences concern the removal of the male flowers from the monoecious plant, castor bean. The concluding descriptions of the sterile fruit that develop without pollination is nearly identical in the two versions. The second example is based on experiments with dioecious species in which the female plant is

Table 1. Comparison of Étienne-François Geoffroy's thesis and Camerarius' *Epistola*.

Étienne-François Geoffroy's thesis	Camerarius' *Epistola*
1. … if one removes from a flower its anthers, one removes at the same all its means to procreate: this is easily demonstrated on the corn plant and on the castor bean, by cutting off the stamens before they ripen; since then the pistils, rather than bearing fecund seeds, only carry a couple of empty seed coats which soon dry up.	… I have learned in two cases how detrimental to the plants is the loss of stamina. When I took away, in the *Ricinus* [castor bean], the round flower buds before the unfolding of the stamina and prevented carefully the appearance of new ones, I never obtained from the remaining intact seed buds complete seeds, but only the empty seed-coats suspended, wilting, and drying (Bodenheimer 1958, p. 285).
2. If, among the plants of the same species with fruits and flowers [i.e., staminate flowers] growing on separated plants, one grows a singular female plant, in such a way that it cannot receive any dust particle coming from the male, this solitary plant either will not bring fruits to maturity, or will produce only sterile ones …	… the third group of plants, where fruits and flowers [i.e., staminate flowers] occur on separate plants. A mulberry tree which has none other in its neighborhood with flowers, yielded berries which however, did not contain a single seed (Bodenheimer 1958, p. 285)

grown separately from the male. Camerarius uses the rather unsatisfactory terms "fruits and flowers" to distinguish between the female flowers ("fruits") and the male flowers ("flowers"). Note that Geoffroy uses the same awkward terms to distinguish between the female and male flowers. These examples of parallelism, plus the absence of any other known source for Geoffroy's data, argues strongly that the older Geoffroy was basing his discussion on Camerarius' *Epistola*.

As we will see, the *Epistola* performed double duty for the Geoffroy brothers when Claude-Joseph claimed to have performed the very same experiments *again* in his 1711 lecture.

Étienne-François also noted microscopic observations of legume seeds in his 1704 thesis, which demonstrated that an embryo only appeared in the seed after "fecundation" by pollen:

> By carefully observing the seeds or seminal vesicles prior to their fecundation, one will see that they are filled by a clear liquor, and the opaque body will never be seen, which since it develops as the seed grows, easily shows that it itself is the principle of the plant or the plant itself even if it is a shortened version of it.

Microscope studies on legume seeds had been performed by various members of the Académie, although none specifically addressing the problem of the timing of embryo formation (Stroup 1990). It is therefore possible that the older Geoffroy had either made these observations himself or was describing the observations of one of his colleagues. However, as will be discussed later, the identical anatomical observations were also available in the *Epistola*, and this is the precise section of the younger Geoffroy's 1711 lecture that Prévost (1965) has shown was plagiarized from Camerarius. Thus, it seems likely that this, too, was borrowed from Camerarius by Étienne-François, setting a pattern of "Epistola-envy" that his younger brother would follow.

Étienne-François cited no references in his thesis, either in the French translation or the original version in Latin. Although unacceptable by modern standards, medical school theses in Geoffroy's day typically contained no references. On the other hand, a perusal of the theses presented to the medical school in Paris between 1690 and 1720 revealed that there were exceptions to the rule.[5] These exceptions fell into two classes.

The first class of exceptions consisted of theses citing relatively few references, usually from classical sources. (Where present, references were always listed in the margins and were cited as letters (*a*, *b*, *c*, etc.) within the text.) The second class of exceptions cited copious references, both classical and contemporary, often filling the margins completely. Indeed, such theses referenced nearly every sentence in the text.[6]

Why a small minority of medical theses were so thoroughly referenced while the vast majority contained no references at all, remains an intriguing question. The presence of these exceptions, however, suggests that while it may have been customary not to cite references, some authors were scrupulous to a fault about documenting their sources. Étienne-François thus had the example and the option of citing his sources in his discussion of plant sexuality. On the other hand, his failure to do so cannot be interpreted as an attempt to conceal his sources in this particular case since he also cited no references in an unrelated second thesis he presented in 1708 (Bodenheimer 1958).

The fact that Tournefort was listed as one of the "disputants" suggests that he was probably present during Étienne-François' thesis presentation. While Tournefort took the spermist side of the spermist/ovist debate for animals, he would have rejected the idea that pollen performs the office of the male sperm in plants. Tournefort would have put on a brave face during Geoffroy's presentation, but he may have begun to fear that his monumental *Institutiones Rei Herbariae*, published only four years earlier, was already obsolete because it had not been based on the sexual theory. This raises the question whether Tournefort, himself, had read Camerarius' *Epistola* by 1704. If Étienne-François had read it, wouldn't he have passed the information on to the Académie's foremost botanist? Perhaps by 1704 Tournefort had come to realize that the times had passed him by. His silence in the wake of Geoffroy's thesis can be interpreted as resignation to, if not agreement with, his colleagues' acceptance of the sexual theory. We are aware of no evidence that he ever changed his own mind.

Claude-Joseph Geoffroy: Early career

Claude-Joseph's first project as an *élève* with Tournefort was an analysis of plant essential oils, and he must have been quite productive since the work was read before the Académie on 12 November 1707 and was included in *Année 1707*, which was published the next year. Then, in 1708, two events were to shake Claude-Joseph's world: both his father, Matthieu-François Geoffroy, and his supervisor at the Académie, Joseph Pitton de Tournefort, passed away. Such a double blow could easily have had an unsettling effect on Claude-Joseph's mind, cutting him adrift from his moorings. On the other hand, it must have been a heady experience to realize that he was now free to chart his own course. In agreeing to take over the family business, he had deferred to his father's wishes, but, like his brother, he was drawn to the intellectual excitement of the Académie.

The decision to follow in his brother's footsteps at the Académie suggests that Claude-Joseph regarded Étienne-François as a role model, a habit probably begun early in childhood. Given the 13-year gap in their ages, Étienne-François would always have seemed to occupy an exalted position in the family hierarchy. By 1708 Étienne-François had already been a member of the Académie for nine years as an associate chemist, was serving his second year as demonstrator at the Jardin du Roi, and was on the verge of being given a faculty position as professor of medicine at the Collège Royal. Claude-Joseph, on the other hand, was only a second-year *élève* in botany. With father and scientific mentor dead, Claude-Joseph would now have looked to his older brother for guidance.

Between 1707 and 1711, Claude-Joseph presented two more papers on plants: a short paper (1709) on the growth, chemistry, and medicinal properties of the filamentous cyanobacterium, *Nostoc* (showing that it was a "plant"), and an article (1714a) on the structure and mode of reproduction of the truffle fungus. As was customary in this period, Geoffroy identified the spores of the truffle fungus as "seeds" and the sporangia as "flowers":

> If these dots are the truffle seeds, I would suspect that the white plaques surrounding these seeds, are, in fact, like flowers, since flowers should be included in the truffles, together with the seeds.

The distinction between spores and seeds did not become clear until William Hofmeister's discovery of "alternation of generations" in 1851.

A new research direction

Upon completing his analysis of truffles, which was read before the Académie on 25 February 1711, Geoffroy once again found himself looking for a new research project. His previous work with cryptogams had been quotidian efforts that had not led to anything interesting or noteworthy. As pragmatic as he was, he would have understood that to compete successfully for the next available *associé* position he would have to be doing significant research on an important problem.

Preformationism was then one of the hottest topics at the Académie. Participants in the debate were divided into two camps, ovists and spermists. Etienne-François was a major spokesman for the spermist position. In 1704 he had published his medical thesis on the topic, "Is a Worm the Origin of Man?"[7] Etienne-François' main argument in favor of the spermist view of animal reproduction was that no one, not even Malpighi, had ever seen an embryo in an unfertilized hen's egg.[8] Hence, he argued, the embryo had to be supplied by the sperm from the rooster. The centerpiece of Étienne-François' case for spermism, however, was a series of observations and experiments on plants.

As a former apothecary and demonstrator at the Jardin du Roi, the older Geoffroy had a strong background in botany. Additionally, having entered the Académie as a chemist, Étienne-François had never been hindered by Tournefort's bias against the sexual theory. Quite the opposite, he was surrounded by colleagues like Nicolas Andry who welcomed the new evidence from plants that appeared to support the spermist view. As will be discussed more fully later, it appears that Étienne-François was also familiar with Camerarius' 1694 *Epistola* as well as Samuel Morland's 1703 paper in *Philosophical Transactions*. Given Étienne-François' active involvement in the ovist/spermist debate, it is no surprise that the younger Geoffroy decided to enter the fray. We even have this on Claude-Joseph's own authority, for he stated in his 1718 letter (see Appendix):

> My brother embraced the ... [spermist position] in a thesis he defended at the School of Medicine the 13th November 1704, when he presided for the first time ... It is therefore not surprising that, profiting from my brother's reflections, I agreed with his sentiments ... etc.

Clearly, with Tournefort no longer in the picture, the time was ripe for someone at the Académie to conduct original research on the new sexual theory of plants. Accordingly, in 1711 Claude-Joseph chose as his new research project the sexual function of flowers. Réaumur and Marchant, and many others, must have breathed a sigh of relief that the sexual theory was finally getting the attention it deserved.

Another academician at the Jardin du Roi who took an active interest in the younger Geoffroy's new research topic was Sébastien Vaillant. Vaillant, who held the position of *sous-démonstrateur de l'extérieur des plantes*, had been seething for years over Tournefort's stubborn resistance to the sexual theory. Indeed, Vaillant was then in the process of developing a radical new classification method based on the sexual structures of flowers, a method now recognized as the precursor of the sexual system of Linnaeus. In retrospect, the mutual ambition of Geoffroy and Vaillant to use the new sexual theory of plants as a springboard for their own careers set them on a collision course.

Election to the Académie

Less than two months later, on 20 April 1711, Bourdelin Claude II, an *associé botaniste* in the Académie since 1699, died unexpectedly at the age of 44, and his position suddenly became available.[9] According to Plantefol (1965), there were only two other *élèves* in botany at the garden competing with Claude-Joseph Geoffroy for the new position: Daniel Vieussens and Jean-Nicolas de la Hire. Vieussens, who had been an *élève* for three years (one year less than Geoffroy), had held the post of associate anatomist since 1699 and spent much of his time away from the Jardin du Roi.[10] La Hire, who already held the position of *pensionnaire*[11] in astronomy, had only been an *élève* in botany since 1710. Plantefol summed up the field as follows: "surrounded by two newcomers, Vieussens who was rarely seen at the Académie and La Hire who was just getting started, Geoffroy was the obvious choice to succeed Bourdelin Claude II. . . ." We can further speculate that Geoffroy's new research topic on the sexuality of flowers was already stirring up interest, giving him the edge in the competition.

Claude-Joseph Geoffroy was elected as *associé botaniste* in May, less than a month after the position became available. His decision to enter the Académie as a botanist rather than a chemist, as he would have preferred, now seemed like a prescient career move. As if to seal his new-found status, the date for his wedding to his fiancé, Marie-Elisabeth Ruel,[12] the daughter of a respected Parisian merchant, was set for 11 August (Sturdy 1995, p. 333). Now he could look forward to becoming the patriarch of his own family. These must have seemed like heady times for Claude-Joseph Geoffroy. In addition to being head of the highly lucrative family pharmacy, he could now boast membership in the Académie, a highly visible research topic, and an impending wedding. In short, everything seemed to be going Claude-Joseph's way.

An invitation to speak

Perhaps Claude-Joseph's fortunes were rising too rapidly. Shortly after his election to the position of *associé botaniste*, he was approached by Jean Paul Bignon (1662–1743), the current vice president of the Académie, and asked to present a paper at the public meeting scheduled for 14 November. According to Plantefol (1965), it was customary for newly elected members of the Académie to present a talk on their research after being elected. However, Sturdy regarded the invitation, not as a routine procedure, but as a high compliment to Geoffroy:

> This was a considerable honour, for Bignon—mindful that lectures had to strike a balance between scientific seriousness and

> comprehensibility when guests from the royal court or elsewhere were present—chose the lecturers only after much reflection and consultation with other academicians. Given the nature of the audience, the topics of the public lectures normally were general. The speaker would present the principal problems, hypotheses and theories associated with his subject; he would discuss those scholars whose studies had contributed most to its elucidation; and he would expound, with appropriate expressions of modesty, his own insights and interpretations (Sturdy 1995, p. 332).

Assuming Sturdy is correct, why did Bignon and the Académie choose Geoffroy? Having just elected Geoffroy as a member, academicians would have been intimately familiar with his scientific output thus far. It is difficult to believe that his work on *Nostoc*, an obscure microorganism, would have been considered sufficiently scintillating or significant to serve as a showcase for the scientific accomplishments of the Académie. And although guests from the royal court may have revered the truffle fungus as a culinary treasure, a dissertation on the internal anatomy of the truffle fungus would hardly have excited much scientific interest. In fact, none of Geoffroy's previous papers lent themselves to the type of general explication that Sturdy describes.

On the other hand, Geoffroy's new research project on the sexual theory was an ideal topic for such a venue. Étienne-François' thesis seven years earlier had been a great success, but he had presented only a summary review of the problem. A full elucidation of the sexual role of pollen in flowers was not only of great theoretical interest to biologists but also of potential practical interest to horticulturalists and an aesthetically appealing subject to the layperson as well. In fact, it was probably a measure of just how delighted members of the Académie were to finally be able to present the sexual theory to the French public that they chose the somewhat bland Claude-Joseph Geoffroy over other potential speakers. Thus, even without Bignon's specifying the topic of his lecture, Geoffroy would have known exactly what the Académie wished to hear.

However honorific, the invitation to present a lecture on 14 November put Geoffroy in a bind. Although he was familiar with the history and literature of the sexual theory through his brother, his own research on the problem was just getting underway. And with less than six months to prepare, it would be difficult for him to generate enough data to allow him to add his own insights and interpretations to the problem, as was expected. Ideally he would have preferred to have more time, but there was no way he could turn down Bignon's invitation. All things considered, however, Geoffroy probably realized that he had nothing to lose and everything to gain by accepting Bignon's invitation to speak.

Geoffroy's 1711 lecture takes shape

Fortunately for Geoffroy, the problem of sex in plants had a long and romantic history going back to Theophrastus, who first discussed the use of the "dust" of male date palm trees to induce fruit production in the female trees. Nehemiah Grew and John Ray (Fig. 2) had previously reviewed the history in their writings, as had Camerarius in his *Epistola*. Geoffroy could also include in his lecture various anatomical drawings of the parts of flowers, most of which had already been published by Tournefort, Grew, Malpighi, and Ray. He may already have begun his own microscope studies of pollen, and he planned to supplement the observations of Grew with his own drawings of pollen structures.

One set of experiments Geoffroy knew he could complete in time for the lecture was a chemical analysis of pollen from various flowers, using the categories of sulfur, salt, and oil—the elements thought to comprise living things. Grew had already commented

Figure 2. John Ray (1627–1705), stipple engraving by William Holl, 1804, from a painting by Mary Beale with vignette below of Britannia crowning Ray as the prince of English botanists after design by Thomas Uwins. Plate for Robert John Thornton's *New Illustration of the Sexual System of Carolus von Linnaeus* (London, Printed for the publisher by T. Bensley, 1807). Courtesy of Hunt Institute for Botanical Documentation.

on these constituents briefly in his *Anatomy of Plants*. Geoffroy, whose first love was chemistry anyway, would have no difficulty completing a full set of experiments of this type, igniting the pollen of various species in a flame or treating them with various solvents and noting the effects.

Geoffroy would also be able to draw on the extensive literature on cryptogams (ferns, mosses, liverworts, seaweeds), supplementing the observations of Tournefort, Marchant, Réaumur, Vaillant, and Marsigli with his own published observations of the truffle fungus. There was also Morland's 1703 paper, with its strong defense of spermism. In all, Geoffroy might have anticipated that he could fill up at least three quarters of his talk with information already in the literature or results that were easily obtainable in the laboratory.

The centerpiece of the lecture was to be a description of his own experiments, patterned after those of Camerarius, providing proof of the sexual theory of plants. But how could he possibly hope to complete these experiments in less than six months? Camerarius had conducted his studies over the course of several years. But as will be detailed later, Geoffroy had one major advantage over Camerarius: he already knew what the results of his experiments should be.

Geoffroy had three choices: (1) he could cite and describe both Morland's 1703 paper and Camerarius' 1694 *Epistola*, supplementing these authors' work with his own observations and preliminary experiments; (2) he could initiate his own independent experiments, patterned after Morland and Camerarius, and present his own *preliminary results* as a progress report without ever discussing or citing Morland's or Camerarius' work; or (3) he could try to repeat the experiments of Morland and Camerarius in six months. He may have reasoned that even if he ran out of time, he could fall back on Morland's or Camerarius' results as long as he made a good faith effort to complete his own studies. After all, if Étienne-François had used Camerarius' data without citing him, why couldn't Claude-Joseph do the same?

The first option, citing Camerarius' openly, apparently did not appeal to Geoffroy, presumably because it would not enhance his own career prospects sufficiently. The second option, to present his own preliminary results only, without being able to draw any firm conclusions, would have probably ended the lecture on an unsatisfying note. Besides, Étienne-François had already summarized Camerarius' main experiments seven years earlier. Claude-Joseph's presentation would have to advance the story beyond where his brother had left it. Presenting anything less than a full confirmation of the sexual theory was simply not a viable option. Thus, the third alternative seemed to be the best plan for him personally since it would both provide a fitting climax to the lecture and serve to advance his career. Camerarius' thoughtful and scrupulously honest *Epistola* appeared to be entirely reliable. The book itself was exceedingly scarce. As long as the younger Geoffroy faithfully conducted his own preliminary experiments in the Jardin du Roi, who would know that he padded his lecture with results from the exhaustively repeated experiments of Camerarius?

The only wrinkle in his plan was that anyone familiar with Étienne-François' 1704 thesis would probably remember that it already contained the results of pollination studies strikingly similar to those that Claude-Joseph now intended to report as his own. Doubtless it was to avoid such a temporal contradiction that Geoffroy failed to cite his own brother's thesis in his lecture. Perhaps he hoped that if Académie members noticed the overlap at all, they would treat it as a collaboration between the two brothers.

Claude-Joseph's citation strategy

In the final version of his lecture Geoffroy the Younger cited six contemporary botanists: fellow Académicians Tournefort, Marchant, and Vaillant; the Italians Malpighi and Marsigli; and Nehemiah Grew from England. In addition, Geoffroy cited four 15th- and 16th-century sources: Jovianus Pontanus, Prosper Alpino, Valerius Cordus, and Andrea Cesalpino. Conspicuously absent from the list are two British botanists, John Ray and Samuel Morland; Rudolph Jacob Camerarius from Tübingen; and Geoffroy's own brother, Étienne-François Geoffroy.

John Ray in his *Historia Plantarum* (1686) had listed various dioecious and monoecious species and had pointed out their significance for the sexual theory. Ray had strongly influenced Camerarius and was cited prominently by him in the *Epistola*. Tournefort and Ray had visited each other, so Ray would have been an obvious person to cite. Ray, in turn, had credited Grew for first suggesting the sexual function of pollen in 1682. Yet the only reference to Grew in Geoffroy's lecture is a condescending correction of a supposed error:

> Those [pollen grains] from *Geum* with red flowers are also red, even if Mr. Grew claims never to have seen any of that color.

Geoffroy thus cited Grew only in the context of a trivial detail about pollen color, omitting any mention of his having been the first to propose the sexual theory of flowers.

Overall, a pattern emerges from Geoffroy's list of citations. Geoffroy recognized only those authors who had either opposed the sexual theory (Malpighi and Tournefort) or who worked on the cryptogams (Marchant and Marsigli). Geoffroy cited Vaillant only in the context of his observations on mosses, completely ignoring any mention of the new classification system he was in the process of developing, which was based on the sexual parts of flowers. Geoffroy also failed to cite the relevant work of authors who either accepted the sexual theory in principle (Ray, Grew, and Étienne-François) or who had actually published experimental work on the sexual theory (Morland and Camerarius). In short, any author who might have upstaged Geoffroy in any way was either not cited or cited for some insignificant detail.

Was such a self-serving presentation of the relevant literature considered normal and acceptable by his colleagues at the Académie? On the contrary, speakers at the Académie's public meetings were, according to Sturdy (1995), expected to discuss the works of those scientists who had contributed the most to the elucidation of their topic. By this criterion, Geoffroy's citation strategy sharply deviated from the ethical code of the Académie.

Geoffroy's debt to Morland

In his 1703 paper in *Philosophical Transactions*, a publication readily available to Académie members,[13] Samuel Morland had taken issue with Nehemiah Grew's conclusion that the pollen contributes nothing materially to the formation of the embryonic plant during fertilization. According to Morland, Grew erred in believing that pollen need only fall onto the outside of the ovary and touch it in order to "impregnate the included seed by some spirituous emanations or energetical impress" (1703, p. 1475). Morland countered Grew's hypothesis, which is essentially the ovist view, with a spermist interpretation: Seeds "are at first like unimpregnated ova of animals; that is farina is a congeries of seminal plants,[14] one of which must be conveyed into every ovum before it can be prolific."

Morland based his ideas about fertilization primarily on an examination of a single species, *Corona imperialis* (*Fritillaria imperialis*), a member of the lily family. Several anatomical features of *Fritillaria* pistils that appeared to support the spermist model were cited. First, the stamens are "artfully" positioned around the style to allow them to "turn every way with the least wind," and the heights of the anthers are "almost exactly equal" to the height of the stigmas. Second, the stigmas are covered with "tufts" that serve to trap the pollen. Third, the style consists of a hollow tube, open at the top, "designed to convey these seminal plants into their nest in the ova." Morland hypothesized that the pollen is first carried by the wind and then caught by the sticky hairs of the stigma, after which it is either washed down the tube to the ovum by rain or blown down by the wind. He neglects the problem of hanging flowers, and he simply assumes that all styles of all flowers are hollow.

Étienne-François had merely summarized Morland's results. Claude-Joseph took Morland's basic observations, extended them to several other species, and embellished them with a few additional observations and experiments of his own. For example, he demonstrated the hollow nature of lily styles by sucking water through them:

> All these pistils, whatever their appearances, have some opening at their extremity, or some slits that continue down their whole length to their base, or to the embryos of the seeds. This is what one readily sees in the lily, narcissus, pomegranate, and particularly in pumpkin, by splitting these pistils lengthwise or by cutting them transversely.
>
> If, after having cut the pistil of lily, one plunges its end in water, and sucks from the other end, one can draw up water in the same manner as one would by using a very fine straw.

Like Morland, Geoffroy made the mistake of generalizing this phenomenon of hollow styles to all flowers.[15] However, unlike Morland, Claude-Joseph did acknowledge the problem posed by hanging flowers. If the pollen falls or is washed down the tube of an upright style, what happens when the style is pointing downward, and the pollen must rise vertically to reach the ovum? Geoffroy anticipated this problem and suggested several possible mechanisms for pollen entry in hanging flowers[16]:

> I realize that in the flowers that bend down, like the one from the Crown Imperial, Cyclamen and *Acanthus*, the location of the pistils does not seem favorable for the intromission of the dust particles that leave the anthers; but is it not sufficient that the dust

> particles attach to the pistil, and that its tip is thus covered, to speculate that it insinuates itself little by little, with the aid of the viscous sap that coats them, the outside air that pushes them in, and perhaps also by the particular morphology of these pistils?

Unlike his older brother, the younger Geoffroy did not claim to have observed pollen grains in transit down the hollow style on their way to the ovule. Instead, he based his argument on logic and deduction:

> When one considers the presence in most flowers of all this apparatus of anthers filled with dust, placed around or above the pistil, which, for its part, is open, decorated with hair, or covered with a sticky material for retaining these dusts particles, which are themselves hairy and viscous, how could one not conclude that all this artifice is designed for the sole purpose of making sure that the dust, as it leaves the anthers, sticks to the pistils and slips inside their cavity?
>
> Whatever mechanisms this dust uses to enter the pistil, it is so essential to the fecundity of plants that without it the seeds abort or are incapable of reproducing the species…

In his 1703 paper, Morland, while conceding that he had not been able to directly demonstrate that pollen delivers the embryo physically to the ovum, proposed an experiment that he believed would provide such evidence:

> If I could now show that the ova, or unimpregnated seed, are ever to be observed without the seminal plant, the proof would arise to a demonstration; but having not been so happy as to discern this, I shall recommend the enquiry to those gentlemen who are masters of the best microscopes… (p. 1477).

Morland was completely unaware of Camerarius' 1694 *Epistola*, which contained a detailed description of this very experiment! In fact, as will be shown later, Geoffroy appears to have taken his own version of the experiment directly from the *Epistola*.

Finally, although he lacked any direct proof, Morland believed he had found strong circumstantial evidence for the physical entry of pollen into the ovum: a small opening in the seed leading to the embryo:

> For… the seminal plant always lies in that part of the seed which is nearest to the insertion of the stylus, or some propagation of it into the seed vessel; I have discovered in beans and peas and phaseoli, just under one end of what we call the eye, a manifest perforation (discernible by the grosser sort of magnifying glasses) which leads directly to the seminal plant, and at which I suppose the seminal plant did enter; and I am apt to think that the beans or peas which don't thrive, will be found destitute of it (p. 1477).

The "eye" in this case is the scar left from the funiculus, the stalk that connects the ovule to the placenta. The "perforation" is the micropyle, through which the pollen tube grows on its way to the embryo sac. Thus, Morland deserves some credit for correctly identifying the micropyle as the point of entry of the sperm, although not in the way he imagines.

Without citing Morland for this idea, Geoffroy devotes a significant portion of his lecture to the hypothesis that pollen enters the ovum via the micropyle:

> Following this hypothesis, it is not difficult to determine the way in which the germ gets into this vesicle, for besides the fact that the cavity of the pistil extends from its tip to the ovules, these vesicles [ovules] also have a tiny opening near their attachment point that is located at the tip of the pistil conduit, in such a way that the little dust particle can naturally fall through this opening in the cavity of the vesicle, which is the ovule. This cavity leaves a tiny scar that is easily seen in the majority of seeds: one can see it very easily without recourse to a microscope in peas, fava beans and *Phaseolus*.

Although not in the identical order, nearly every sentence in Geoffroy's paragraph has a homologue in Morland's. At the very least, the similarity between the two paragraphs strongly suggests that Geoffroy had a copy of Morland's paper in front of him while he was preparing his lecture yet failed to cite it. Did this amount to plagiarism? Before deciding, let's compare the omission of Morland's paper to the omission of Camerarius' *Epistola*.

Geoffroy's debt to Camerarius

We now turn to Geoffroy's second uncited source, the *Epistola*, which appears to have provided Geoffroy with the two crucial elements he needed for his lecture: (1) microscope studies showing that embryos only appear in the seed after pollination; and (2) emasculation studies in maize and *Mercurialis* showing that pollen is required for viable seed production.[17]

The *Epistola* begins with a review of various types of circumstantial evidence in favor of the sexual theory, including the presence in most flowers of both stamens and pistils. Camerarius (Fig. 3) points out that pollen grains exit the anthers and powder the surfaces of the stigmas and that the stamens and pistils are arranged in the flower in a way that seems to promote fertilization.[18] He also cites the phenomenon of "doubling" in some flowers, in which the number of petals doubles and the stamens disappear, noting that such flowers never produce seeds. Camerarius concludes that most flowers are hermaphroditic, and, like Grew, he cites Jan Swammerdam's (1637–1680) demonstration of hermaphrodism in snails in support of this idea.

In the spirit of Grew and Malpighi, Camerarius begins the experimental section of the *Epistola* with a series of microscope studies. First he examines pollen grains. He notes that the shapes of pollen grains vary with different species and sometimes have a rough or spiny outer coat.

He then carries out a developmental study on the origin of the embryo in "a large flower of the Papilionaceae," that is, the legumes — probably pea or bean. His goal was to determine whether an embryo is present in the seed prior to pollination, the same experiment Samuel Morland had proposed to prove that pollen brings the embryo to the seed. Camerarius states that at the earliest stage of floral development, before the pollen had been released from the anthers, he is only able to see green transparent vesicles (the ovules) filled with a clear liquid lining the young pod. Later in development, after the pollen had been released from the anthers, Camerarius could detect a new structure in the ovule, which he described as an undifferentiated "green dot." At later stages of development, the globule increased in size and developed cotyledons and a radicle (embryonic root). This microscope study on the "Papilionaceae" was cited by A.-M. Prévost (1965) as the passage that Geoffroy lifted from the *Epistola* almost verbatim. (Prévost's comparison is reproduced in Table 2 with the phrases believed to have been plagiarized underlined.)[19] Although it

Figure 3. Rudolph Jacob Camerarius (Camerer) (1665–1721), line engraving by John C. Dehne, no date. Courtesy of Hunt Institute for Botanical Documentation.

Table 2. Comparison of Camerarius' *Epistola* and Claude-Joseph Geoffroy's lecture.

Camerarius' *Epistola*	Claude-Joseph Geoffroy's lecture
As this remark attracted my attention, I chose to examine a fairly large Papilionacea flower, before it had opened, and before it had attained its normal size and color; having removed the petals and the filaments, I wished to see in the young silique, which normally swells after the withering of the flower, what phenomenon was taking place at that time. And it is there in truth, through the delicate membranous silique, facing the sun and more clearly, observing it under the microscope, I was able to recognize the little green transparent vesicles already placed in their order along the median; I found, after a prolonged observation over the next several days, that these vesicles were none other than the external envelope or skin of the future seed. Indeed, after the pollen sacs of the anthers, already emptied of their pollen, withered with the petals, and the silique had developed further, I started to notice a green dot in the cavity of the vesicles, in the middle of a clear liquid, that I had not seen before. It was an extremely small ball, swimming freely, in which one couldn't recognize, or at least I couldn't see, anything organized or differentiated. But at a later moment during the growth, dissection revealed that two small leaves were becoming distinct, that the liquid was getting used up little by little, and finally that the seminal plantlet, perfect with respect to its lobes, its germ, and its radicle, filled the interior of the skin entirely.	Indeed, if one examines in the leguminous plants the pistil, or that part that becomes the pod, before the flower opens, after having freed it of its petals and stamens, and if one looks at it in sunlight under a microscope, one can very easily see the little green and transparent vesicles which will become the seeds placed in their natural order, and in which one distinguishes nothing else besides the envelope or skin. If one continues to observe it during several successive days in other flowers, as they develop, one notices that these vesicles grow and fill up with a clear liquor in which, once the dust has been dispersed and once the petals have fallen, one begins to see a small, freely floating dot or greenish globule. One cannot see anything organized in this small body, but with time and as it grows, one distinguishes little by little two small leaves like two horns. The liquor is consumed slowly as the small body enlarges and the seed becomes completely opaque. If one opens it, one finds the cavity filled with the little plant made up of the germ or plumule, the radicle, and the lobes of the fava bean or the pea.

is possible that Geoffroy repeated some of Camerarius' observations himself, the parallels between the two paragraphs are too numerous to be merely coincidental, indicating that he had Camerarius' paper in his possession.

After presenting the results of his embryological study in legume seeds, Camerarius observes that flowers fall into three classes: hermaphrodites, monoecious plants, and dioecious plants.[20] Pollination in hermaphrodite plants is promoted by the close proximity of the pistils and stamens. In contrast, Camerarius suggested that wind served as the vector for transferring pollen from male to female flowers in monoecious and dioecious species.

All of the preceding was preliminary to the centerpiece of the *Epistola*: Camerarius' historic appeal to experiment using monoecious and dioecious species. Ray in his *Historia Plantarum* (1684) had provided a list of various herbaceous species possessing unisexual flowers. Herbaceous species are, of course, much easier to manipulate experimentally than trees, an advantage that Camerarius was quick to exploit. Camerarius tested three herbaceous dioecious plants—*Mercurialis* (dog's mercury), *Spinacia* (spinach), and *Cannabis* (hemp)—by separating the females from the males. In the case of *Mercurialis* and *Spinacia*, female plants grown in the absence of male plants produced seeds, but the seeds were sterile when planted in soil. On the other hand, the results with *Cannabis* were less clear. Camerarius carefully removed all the male plants from a plot of field-grown hemp, but the female plants nevertheless produced a few fertile seeds, "at which," states Camerarius most endearingly, "I must admit I was quite upset."

Camerarius did not stop there, however, but went on to try to identify the cause of the failure. After investigating the ability of pollen from other species to substitute for hemp pollen, he concluded that only hemp pollen could fertilize female hemp flowers. He then carefully repeated the original experiment with hemp and obtained the same result as before. Most of the seeds were sterile, but a few seeds were fertile.

Although Camerarius was unable to determine the cause of the few fertile hemp seeds in time to include the results in the *Epistola*, he had already solved the problem in an earlier publication according to Julius von Sachs (1906). Sachs states that in 1692 Camerarius published a short article in the *Ephemerides* reporting that in spinach, nettle, and three other dioecious species, hermaphroditic flowers occasionally appeared on female plants.[21] The presence of a few hermaphroditic flowers on the female hemp plants would thus explain the few fertile seeds he found in the experiments with hemp.

Camerarius next reported experiments with two monoecious species, *Ricinus* (castor bean) and *Zea mays* (maize). In *Ricinus* he removed all the male flower buds before they opened, with the result that no seeds formed and the fruits all withered. In maize he describes his experiment thusly:

> In this cereal the protruding panicle at the end of the stalk is too well known to need a detailed description. After the wilting and drying of this panicle without seed formation, farther down those thick cylindrical spadices are taking shape, which with their grains are covered by some leaves and protruding from each grain a long thread, which spread like a tail and which receive the pollen …
>
> … When the unfolding tufts [male panicles] were cut early, two ears appeared which were devoid of any seed, and only a great number of empty seed-capsules appeared (Bodenheimer 1958, p. 285).

Here again Camerarius honestly reported a result that contradicted his expectations. A third ear was found that contained eleven fertile seeds, although the vast majority were sterile. Camerarius speculated that since he had carefully removed all the male flowers and there were no other intact maize plants nearby, the eleven fertile seeds on the third ear must have been caused by wind-borne pollen from a distant plant.

Recall that Étienne-François had already summarized the results of Camerarius' emasculation studies in his 1704 thesis (see page 11). Yet, in his 1711 lecture, Claude-Joseph claimed to have performed essentially the same experiment with maize:

> I have raised several plants of corn, which, as we know, bears at the top of its stem stamens loaded with anthers and the fruits or ears along the stem in some axils of the leaves. I have cut the stamens with as much care as it has been possible, as soon as they were visible, and before the anthers blossomed.

The results that Geoffroy reports are quite similar to those of Camerarius, including the presence of a few fertile seeds among the mostly aborted ones:

> On some of the plants the ears, after they reached a certain size, dried up completely without the ovules having profited, and on some other plants there were some grains along the ear that grew considerably and looked as if they contained germs and were therefore fertile, while all the others aborted; but no ear developed in its entirety.

Geoffroy's seemingly honest reporting of results inconsistent with his expectations lends an aura of authenticity to his presentation, but did he actually perform this experiment?

According to Prévost (1966), Geoffroy's method of emasculation (i.e., cutting the stamens *individually* before the anthers opened) is simply not feasible in maize. In maize the anthers mature and become loaded with pollen while still inside the closed male floret. Once the floret opens, it takes only 30–45 minutes for the filaments to elongate and for the anthers to begin shedding their pollen. A single maize plant might produce up to 10,000 stamens, each capable of releasing 2,000 pollen grains. Shedding typically begins shortly after dawn and is nonsynchronous. At each position along the tassel there are "flowers" — each consisting of two florets, each containing three anthers. On the first day, one floret opens in the flowers along the central axis; on day two, the second floret opens from these same flowers, and the first wave of florets opens on the major side branches. In a healthy maize plant, anthers emerge continually for five to seven days, making it extremely difficult to avoid the shedding of some pollen using Geoffroy's approach (Virginia Walbot, Stanford University, pers. comm.).

However, in the opinion of Dr. M. Gerald Neuffer, a distinguished corn geneticist at the University of Missouri,

> The experiment *could* have been done by tediously removing the stamens (qua stamens), albeit with considerable effort and dedication, by visiting the plants perhaps twice a day. If I were doing it that way, I would have removed each spikelet, containing two florets with six anthers, leaving a bare stem … ,[but] if [Geoffroy] were a plant biologist with common sense … he would not likely have done it that way or by opening the spikelets and removing the six anthers (M. G. Neuffer, pers. comm.).

Thus, in Neuffer's opinion, the experiment *could* have been done as Geoffroy described but only with great effort and dedication. If Geoffroy had any common sense at all, he would not have done it this way.

But can we be certain that 18th-century French varieties of maize behaved the same as modern varieties? Perhaps the stamens of 18th-century maize matured at the same time. Again, according to Professor Neuffer, the sequential maturation of stamens in the tassel was first observed in Europe over a century ago, and 18th-century French maize varieties would have had similar flowering habits (M. G. Neuffer, pers. comm.). Thus, we can be reasonably certain that the maize varieties Geoffroy was using exhibited the same type of nonsynchronous opening of the male flowers as modern varieties do.

The only other possibility is that Geoffroy mistakenly used the term "stamens" when he actually meant "tassels." If so, when he stated, "I have cut the stamens with as much care as it has been possible, as soon as they were visible," he actually meant that he removed the entire tassel, exactly as Camerarius had done.

Yet Geoffroy gives a precise definition of stamens in the opening paragraph of his lecture: "some filaments called stamens, terminating with small bodies of a different structure, which are called anthers." Moreover, in a subsequent report on Geoffroy's studies with maize published in *Histoire de l'Académie Royale des Sciences, Année 1712*, we find the following description of male flowers:

> Maize … is a plant in which the flower is separated from the fruit. The flower is at the top of the stem, and forms a *bouquet* which contains stamens (Anonymous 1731, p. 50).

In this account, the author, presumably Bernard Le Bouyer de Fontenelle (1657–1757), refers to the stems bearing male flowers as a "bouquet" that *contains* "stamens." Had Geoffroy meant to say that he removed the emerging tassels from the maize plants, he probably would have used the term "bouquets." Taken together, the evidence strongly suggests that Geoffroy was *not* confusing the term "stamens" with "tassels" in his experiments with maize.

A possible clue to the reason for Geoffroy's choice of the word "stamens" can be found in the following quote from Étienne-François' thesis:

> …this is easily demonstrated on the corn plant and on the castor bean by cutting off the stamens before they ripen.

Here Étienne-François also used the term "stamens" to refer to the tassels of maize because maize is grouped with castor bean, which does not have tassels. Perhaps Claude-Joseph used his brother's terminology without proper reflection, even though it was inappropriate for the experiment with maize. If he had actually tried to conduct the experiment in this way, it would have been immediately apparent that the method was impractical. We therefore agree with Prévost's assessment that Geoffroy's maize experiment could not have been successfully performed as described.

The question remains, why didn't Geoffroy simply copy Camerarius' method since he apparently copied his results? The most generous interpretation is that Geoffroy described the method he had *planned* to use if he had had enough time to do the experiment. It is possible that the version of Camerarius' results he had read was an excerpt without any detailed methods. (As will be discussed later, Geoffroy's first reading of the *Epistola* was most likely as a summary in the German scientific journal, *Ephemerides*.) Perhaps removal of individual stamens sounded more precise and less destructive than removing the entire tassel—an *improvement* on Camerarius' method!

Geoffroy also reported carrying out a sexual isolation experiment identical to Camerarius' with the dioecious plant, *Mercurialis*, in which he obtains the same results Camerarius did, even down to the few inexplicably fertile seeds. Regarding these additional studies for which Geoffroy provided no specifics, Prévost (1965) remarked, "We have no reason to believe that the experimental results announced by Geoffroy… are any more real than the ones with maize."

Were Geoffroy's results entirely fabricated, as Prévost suggests, or did he genuinely try to repeat the experiments of Camerarius? An account of how he proceeded with his research is given in the first draft of his 1718 letter to the Académie:

> As you can see, I predate Mr. Vaillant, when it comes to criticizing what Mr. Tournefort has to say, unless he pretends to betray the trust I put in him when, telling him about the memoir I was planning, I asked him for plants to conduct my observations. I asked him since he lived at the Royal Gardens where, thanks to the efforts of Mr. Tournefort first and his excellent successor Mr. Jussieu next, the plants were grown in such abundance that one can call upon them at any moment.
>
> If it were true that I stole from him, he could have claimed it then, and he would probably have done it without doubt, without letting several years pass by.
>
> …There was nothing he could sink his teeth in about my observations, some of which were made with him as he was present, nothing, I am saying, since he himself admits that *"[I] pride [myself] in making the dust fly,"* speaking of these stamens, *"without getting a single grain in our eyes."*

A similar narrative is given in the presented version of the 1718 letter:

> During the time I was working on my memoir, I knew that it would not be sufficient that I "*made precise observations in the Laboratory,*" an ironic praise that Mr. Vaillant could have done without bestowing me (p. 24). I went to the Royal Gardens where the plants of all species are always in abundance. There I had the opportunity to discuss my project and my observations with Mr. Vaillant and even to make some observations while he was present. He admits as much in his memoir: *"making the dust fly without getting a single grain in our eyes"* (p. 22).

In both accounts, Geoffroy affirms that he did indeed go to the Royal Gardens where all the plants he needed were "always in abundance" and that he not only discussed his proposed experiments with Vaillant but also actually performed some of them with Vaillant standing by as a witness. According to Geoffroy, Vaillant's sarcastic remark that Geoffroy was *"making the dust fly without getting a single grain in our eyes"* is a direct reference to Geoffroy's pollination studies. It seems doubtful that Geoffroy would have made such a claim if it were blatantly false since Vaillant could easily refute it. It therefore appears that Geoffroy did indeed attempt to repeat Camerarius' pollination studies in the Jardin du Roi and that Vaillant was a witness. How far he got in his experiments is a matter of conjecture, but it seems unlikely that he could have arrived at any firm conclusions in such a short time without resorting to Camerarius' *Epistola*. It is unlikely, for example, that the method of stamen removal he claims to have used in maize would have yielded results as clean as those he reports. From the amount of detail he presents, Geoffroy also seems to have repeated Morland's observations on the hollow styles of lily, and he may have attempted to repeat Camerarius' microscope observations on legume embryogenesis as well.

That Geoffroy was indeed carrying out observations on maize is also attested to by his last botanical effort, as described in a note in *Histoire de l'Académie Royale des Sciences, Année 1712* (Anonymous 1731).[22] Here it was reported that Geoffroy "le cadet" noticed the presence of apparently normal pistils developing on the tassels of several maize plants. Over time the pistils developed into normal kernels, without any ill effects on the rest of the plant. The feminization of tassels is a well-known phenomenon in maize and is caused by a hormone imbalance, a fact Geoffroy had no way of knowing. Geoffroy mistakenly concluded that the seed had developed from a pollen grain. According to his spermist interpretation of the sexual theory, each pollen grain contained an embryonic plant and was therefore capable of producing a seed. However, as the author of the article (Fontenelle?) commented:

> It is, however, not easy to imagine how this dust, which is made only to fertilize seeds and which must be extremely different, becomes a seed itself. Moreover, what are we to make of ordinary seeds that came to maturity without being fertilized by the dust of stamens (Anonymous 1731, p. 51)?

Nevertheless, it is clear that Geoffroy had been actively engaged in observing maize plants, even if he borrowed heavily from Camerarius' results.

The *Epistola*'s obscure journey to Paris

Camerarius published *De Sexu Plantarum Epistola* in 1694 as an open letter, written in Latin, to his friend, Michael Bernhard Valentini (Fig. 4), a professor in Giessen.[23] It was privately printed in book form at Camerarius' own expense.[24] The number of copies of the first and only printing was very small, and it does not appear to have been picked up by the book-trade. As a private impression it was probably not available to the larger libraries. Only six copies of the *Epistola* are known to be extant. The only surviving copy at the University of Tübingen library was bequeathed by the estate of a Tübingen physician, Johann Heinrich Ferdinand of Autenrieth (1772–1835). A second copy, now missing, is believed to have been donated by Camerarius himself (Gerd Brinkhus, University of Tübingen Library, pers. comm.).

Camerarius probably sent out other copies of the palm-sized book to selected friends and colleagues at various German academies and universities, but international distribution was probably adversely affected by the War of the League of Augsburg (Sturdy 2002). Tübingen citizens periodically were forced to flee approaching French armies with their belongings, which must have been extremely

Figure 4. Michael Bernhard Valentini (1657–1729), portion of the engraving by A. M. Wolffgang, 1701, after C. Labert. Courtesy of Hunt Institute for Botanical Documentation.

disruptive to university researchers. At the end of the *Epistola*, Camerarius laments the unjust war then underway: "a time of war, turbulence, and public calamity in the fatherland."[25] The Camerers, a prominent pharmacy family, were no doubt fully engaged in the political situation. Camerarius' younger sister, Agnes Susanna, was married to Johannes Osiander, a theology professor at the university, who became a hero for successfully negotiating an agreement (involving ransom) with French officers to spare the city from destruction.[26]

Given Camerarius' bitterness over the war, it seems unlikely that he would have sent copies to members of the French Academy. Although England was an ally of the German states, Camerarius does not seem to have sent any copies of the *Epistola* to British scientists either. The British Library has two copies of the *Epistola*, but these were purchased long after publication: one from the collection of Sir Joseph Banks (1743–1820) and the other bearing the stamp of the King's Library of George III (reign: 1760–1820). Significantly, there is no copy of the *Epistola* in the collection of Sir Hans Sloane (1660–1753). If Sloane, a prominent botanist, passionate bibliophile, and contemporary of Camerarius[27] didn't have a copy, it is unlikely that the *Epistola* made its way to England during Camerarius' lifetime.

Although the 1694 edition had an extremely small circulation, Camerarius' friend to whom the *Epistola* was addressed, Michael Bernhard Valentini, published extracts of the book, along with his own responses, in the periodical *Miscellanea Curiosa, sive Ephemeridum Medico-Physicarum Germanicarum Academiae Caesarea-Leopoldinae Naturae-Curiosorum* (also known as *Ephemerides*) (Camerarius 1696). The *Ephemerides* was the publication of the Academia Naturae Curiosorum, centered in the city of Schweinfurt. Members of the Academia Naturae Curiosorum had named the journal after Emperor Leopold I (1640–1705) in an attempt to gain his support. In 1677 Leopold rewarded them by conferring on the society the title of Sacri Romani Imperii Academia Naturae Curiosorum, which effectively made it the scientific academy of the Holy Roman Empire. As such, its journal was probably widely distributed throughout Europe. In addition, Valentini republished the entire *Epistola* in 1700 and again in 1701 in a book titled *Polychresta Exotica*. Thus, by 1711, the *Epistola* had been published in several forms: the exceedingly rare original 1694 edition, as readily available excerpts in the *Ephemerides* (1696), and as the complete text in *Polychresta Exotica* (1700, 1701).

Given the scarcity of the original book, it is likely that Geoffroy first came upon excerpts of Camerarius' *Epistola* in Valentini's article in the *Ephemerides*. Support for this idea is found in Geoffroy's second botanical paper published in the *Mémoires*, *Année 1708*, titled "Observations on *Nostoc* which prove that it is a true plant" (1709). After noting the medicinal properties attributed to *Nostoc* by "les Paisans en Allemagne," Geoffroy referred the reader to an article that appeared in "les Ephemerides d'Allemagne année 1676." In general the *Ephemerides* seem to have been cited only rarely in the *Mémoires,* which makes Geoffroy's citation all the more significant.

As a close reader of the *Ephemerides*, Claude-Joseph would have come across Valentini's article sooner or later. Most likely it was Étienne-François who read it some time before 1704, in time to use Camerarius' results in his medical thesis. The Geoffroys certainly had the financial resources to enable them to obtain a copy of the complete text—either the original 1694 edition or the *Polychresta Exotica*. The library of Claude-Joseph Geoffroy was one of the largest private collections in Paris and has been preserved as a special collection at the Bibliothèque Nationale de France.[28] However, none of the versions of Camerarius' work are listed in the catalog of the Geoffroy collection. Perhaps it was owned by his brother.

According to Sturdy (1995), "Geoffroy had referred to Camerarius in some of his other publications. …" However, we could find no references to Camerarius in any of Geoffroy's botanical papers published in the *Mémoires* from *Année 1707* to *Année 1711*. In fact, we found no references to Camerarius in *any* of the botanical papers published in the *Mémoires* between *Année 1707* and *Année 1713*. Apparently the Geoffroys kept their knowledge of the *Epistola* close to their vests.

The aftermath of the 1711 lecture

For several years, Claude-Joseph Geoffroy basked in the afterglow of his 1711 lecture. An anonymous article published in 1714 in *Histoire de l'Académie Royale des Sciences, Année 1711*, probably written by Fontenelle, depicted Geoffroy as the young upstart, overturning the asexualist doctrine of the great Tournefort:

> The late M. Tournefort believed that this dust was a superfluous waste product, an excrement of the nourishment of the fruit, and that the stamens were a type of excretory canal which filtered out the useless sap and purified it for the growing embryo. But M. Geoffroy the Younger has dared to embrace an opinion contrary to that of the great Botanist, one that assigns the dust of the anthers a more noble use. According to this system, the dust, upon falling on the pistil, fertilizes the seed or the fruit which contains it. Therefore the stamens would be the male part of the flower and the pistil the female part, and the flower would contain both sexes, both contributing to reproduction (Anonymous 1714, p. 52).

The article went on to credit Geoffroy with having provided the definitive experimental proof of the sexual theory:

> Finally, settling the question once and for all, M. Geoffroy believes he has shown that cutting off the stamens before the dust has had a chance to fall causes seeds to abort or to become infertile (Anonymous 1714, p. 53).

Thus, by 1714, Claude-Joseph was still considered a rising star within the Botany Department. Then, in 1715, Homberg died, and Étienne-François Geoffroy was appointed *pensionnaire* in Homberg's place. Étienne-François' promotion, in turn, created an opening for an *associé chemiste*, and Claude-Joseph seized the opportunity to switch departments. The fact that his brother was now the senior chemist in the department must have made it relatively easy for him to do so.

On the surface, Geoffroy's transfer to the Chemistry Department can be seen as a perfectly natural and logical decision based on his longstanding preference for chemistry over botany. Botany had only been a stepping stone to expedite his election to the Académie, and Geoffroy may have planned to transfer to Chemistry at the earliest opportunity all along. Even before 1715, Geoffroy had ceased publishing botanical papers. He had already made the transition to chemistry in his mind. The actual transfer simply made it official.

It is also possible to read into the transfer a desire to escape from an increasingly uncomfortable situation in the Botany Department. With the publication of the 1714 article in *Histoire*, a widely disseminated journal, Geoffroy must have realized that it was only a matter of time before comparisons would be made between his experiments and those of Camerarius. Rather than continue the charade of mimicking Camerarius' exhaustive studies, which were bound to see the light of day sooner or later, wouldn't it be wiser to depart the stage while he was still ahead and try to establish a solid reputation as a chemist, which might serve as a bulwark against any future revelations?

Geoffroy's relationship with Vaillant was an uneasy one, and Geoffroy may have feared that Vaillant would soon discover his plagiarism of the *Epistola*. Vaillant was the protégé of Guy-Crescent Fagon (1638–1718). Fagon, the first doctor of the Queen, demonstrator in pharmacy, and demonstrator and professor of plants, was, according to Sturdy (1995), a "forceful and overbearing personality" who "used his senior position at the Jardin to promote other young life scientists," including Tournefort himself. Fagon thus exerted "considerable influence" over the Académie. Indeed, Étienne-François and Sébastien Vaillant were both beneficiaries of Fagon's patronage.

Fagon had been Vaillant's strongest supporter at the Académie. In fact, it was Fagon who appointed Vaillant to deliver the famous 1717 Jardin lecture as a substitute for Antoine de Jussieu, who was temporarily out of the country on that day. And afterwards, when the adoring students all clamored for Vaillant to continue teaching the course, it was Fagon who persuaded Antoine de Jussieu to step aside (Rousseau 1970). According to Rousseau, Vaillant was Fagon's most devoted personal secretary, even nursing him through a prolonged illness. In Fagon, therefore, Vaillant had a powerful ally who would back him in any academic dispute. If so, Geoffroy may have viewed the Chemistry Department, with his brother as senior member, as a safe haven from any future conflict from Vaillant.

The response to Vaillant: Geoffroy unleashed

Vaillant's broadside came on the morning of 10 June 1717, two years after Geoffroy's transfer to the Chemistry Department. In his 1717 *Discours* to the medical students at the Jardin du Roi, Vaillant chastised Geoffroy for "gleaning" most of the "beautiful facts" in his 1711 lecture from other authors, leading him to make many errors. This was the consequence, Vaillant opined, of Geoffroy's "trying to impress people" instead of relying on his own observations of nature as Vaillant had done. Trumpeting his own new classification scheme based on the sexual parts of flowers, Vaillant did a hatchet job on Tournefort's system of identification and used colorful erotic language to describe pollination, which caused a sensation and endeared him to the students (see Bernasconi and Taiz 2002).

Geoffroy wrote two drafts of a response: a rather intemperate diatribe probably composed in the heat of the moment and a more sober, dignified version, presumably written after he had cooled down. Wisely, he chose to present the toned down version to the Académie.[29] However, Geoffroy waited for over a year after Vaillant's lecture before going public with his response on 27 July 1718. Why the long delay? The two drafts of his response offer slightly different explanations. In the version he presented to the Académie, he stated:

> I have neglected to respond to this paper [until now] because I did not believe that it was capable of harming me in the public eye, and if it had not been for the complaints that Mr. Vaillant haughtily brought before the Academy, which for respect I now believe obliges me to justify myself, I would have kept my silence.

Contrast this with the explanation found in the first draft of his speech:

> I neglected to justify myself against the accusations he makes in his discourse because it seemed to me that it would only make people think ill of him.

The explanation he presented emphasizes Geoffroy's supposed initial conviction that Vaillant's attacks could not hurt him, whereas the explanation in the first draft expresses a condescending and disingenuous concern for Vaillant's reputation. Neither of these accounts rings true.

The most plausible explanation for the delayed timing of Geoffroy's counterattack was Fagon's death on 11 March 1718. While he was alive, anyone attacking Vaillant risked retribution from Fagon. With Fagon dead, Vaillant was left relatively unprotected. Geoffroy, backed by his brother in the Chemistry Department, now felt his position was stronger than Vaillant's. At one point, in the draft of his talk that he didn't present, Geoffroy went so far as to taunt Vaillant over the death of his patron:

> But what could he have claimed? He who has hardly discovered anything, except for the beautiful discourse with which I had the honor to entertain you, and which is known only because of the protection from the *late* [italics added] Mr. Fagon.

Here the emphasis is on "late," a not-so-subtle reference to Vaillant's vulnerable state. The colleague whom Vaillant had once dubbed "a sweet and officious Echo" had become his Nemesis. Claude-Joseph now circled round the wounded Vaillant like a lion moving in for the kill.

Claude-Joseph launched his attack on what he perceived to be Vaillant's two weakest points: his erotic and anthropomorphic descriptions of sex in flowers, and the disrespectful way in which he had criticized Tournefort's system of classification. Regarding Vaillant's language, Geoffroy states in his "rough" draft:

> One cannot dispute that this language is novel, and just to make one understand the meaning well, this means that Mr. Vaillant will be talking about the amorous commerce of plants not in covert words but in terms such that one would find in the Priapic festivals or as utilized during the feasts of Cythera and of Sapho.

Such language, Geoffroy asserts, is totally inappropriate in scientific discourse:

> I am not saying that a Philosopher should not observe all and describe all, as long as it is done truthfully and in good taste. But it seems to me worthy of blame to concoct romanticized descriptions in which one ridiculously takes pleasure with subjects one should never represent except with a great deal of restraint and always in a serious manner. Must one endure it when a learned dissertation is given with such ill-timed badinage and when a botanist, carried away by his imagination, uses words belonging to the loosest gallantry and gives obscene depictions for any purpose?

One cannot help remarking that, from a literary standpoint, Geoffroy's scathing condemnation of Vaillant's imaginative excesses makes much more interesting reading than his rather dull, plodding 1711 lecture. Indeed, these two letters have something of the same spark and flair that made Vaillant's lecture so entertaining, and they reveal a side of Geoffroy's character that would otherwise have remained hidden from historians. Ironically, Geoffroy seems to have drawn inspiration from Vaillant in order to attack him!

On the subject of Tournefort, Geoffroy deplores Vaillant's hateful treatment of this great man. He, too, had disagreed with Tournefort, Geoffroy tells us, but unlike Vaillant, he had expressed himself with "great care" in order to avoid "giving offense to such a respected author." In contrast,

> …Mr. Vaillant spews forth invectives at Mr. Tournefort, who is the greatest adornment of this Academy and whose memory will be cherished forever by the true savants. I think it is appropriate to point out to this Company how Mr. Vaillant unleashes his anger against this great man and against the other botanists who follow his method.

Vaillant was certainly open to criticism for his erotic flights of fancy and for his harsh treatment of the deceased Tournefort, and as in a scene from the movie *Ridicule*, in which members of the court of King Louis XVI verbally skewered each other, Geoffroy played the part of the virtuous Ponceludon to Vaillant's sinister Abbot de Vilecourt. However, the central issue, which Geoffroy ultimately had to address in order to exonerate himself, was the thorny problem of plagiarism. Here the arguments became more strained, and his voice more shrill. In addition, he used the age-old politician's trick of answering only that part of the question with which he felt comfortable. For example, in his first draft, Geoffroy begins by stating:

> It is not so long ago that Mr. Vaillant complained about me in front of the entire Academy, calling me a plagiarist who committed grand larceny of the usage of flower parts that serve for plant reproduction.… In order to justify myself against his reproaches and against the reputation of plagiarist he wants to give me, I believe I am unavoidably obligated to make an exact inventory of what properly belongs to Mr. Vaillant on the subject at hand and that this sole exposition will show…that one cannot reasonably think that on this matter he is "stealable."

In his 1717 *Discours*, Vaillant had insinuated that Geoffroy had committed two types of plagiarism: (1) that he had repeated Vaillant's terminology for flowers of different sexes, "Males" and "Females"; and (2) that he had filled his lecture with many "beautiful facts" that he had "harvested from various authors." Vaillant's claim that Geoffroy had somehow stolen the terms "male" and "female" flowers from him was absurd and completely unjustified since these terms had been in use at least since the late 17th century. Vaillant's second charge, however, was more serious.

Geoffroy's defense strategy was to focus entirely on the narrow issue of terminology. Vaillant's second charge, that he had "augmented" his lecture with other people's "beautiful facts," was glossed over. Thus, Geoffroy reduced the whole dispute to one of priority over the use of the terms "male" and "female" flowers:

> Would you believe that, because of two little words my accuser imagines I stole, he must cry so loudly, "thief?" A man who'd lost all his valiancy would not make any more noise. You'd think you were hearing the furious screams of a scrooge who lost his beloved safe.

Not only was Vaillant's charge trivial, it was totally unfounded, because:

> …these beloved little words, these precious corpses, these superb feathers that sneaky ravens can't wait to pick up so they can wear them as a foreign ornament, are not at all from Vaillant. He claims them wrongly, also the details he claims he did not hide from me, and that he alleges I disfigured. I disavow them, and this will suffice until he proves the particulars that he thinks that I used to my own profit.

Note that Geoffroy reframes the dispute solely in terms of his alleged plagiarism of Vaillant and avoids completely the more damaging allegation that he plagiarized from other authors. He was able to do this because Vaillant had failed to name any of Geoffroy's other alleged uncited sources, specifically Morland and Camerarius. Freed from having to explain why he hadn't cited these two authors, Geoffroy went on the offensive. Vaillant was not the originator of these two terms, his brother was:

> For these two words … have already been published, as well as the conjectures he claims for himself about the generation of plants. They were published in 1704 in the medical thesis published by my brother when he presided for the first time … This being said, Sirs, who better merits the epithet of "Echo," Mr. Vaillant or myself?

In the draft he presented to the Académie, Geoffroy even speculated how Vaillant might have gained access to his brother's thesis:

> It is true that Mr. Vaillant has already admitted in front of the full Academy that these contested terms are present in my brother's thesis but that he didn't know about them. [He was at the time the secretary of Mr. Fagon, Prof. of Medicine, to whom all the theses were forwarded, especially the ones that are the subject of the present question, since it was by the Court order that it was translated.]

The sentence in brackets was written in the margin. It implicates Fagon in the theft as well. This provides further evidence that Geoffroy had come to view Vaillant's alliance with Fagon almost as a conspiracy against his brother and himself.

In a rare moment of candor, Geoffroy acknowledged that the sexual theory had been around for a long time and that both he and Vaillant could be accused of plagiarism:

> But, in the end, this is my doctrine which preceded his by a long time, on behalf of which its authors, if they were in the same bad mood he is in, could cry "Thieves!" at us. Because one must admit, both of us are thieves in this matter, and I invite anyone to judge who is the good thief and who is the bad one.

Exactly who these "authors" were who could cry "Thieves!" Geoffroy doesn't say. Nor does Geoffroy define the difference between a "good thief" and a "bad thief." Nevertheless, the statement is the closest Geoffroy comes to admitting that he had misappropriated some of the material in his lecture, although he did not include this *mea culpa* in the version he presented to the Académie.

The nagging question remains: why didn't Vaillant simply identify Morland and Camerarius as Geoffroy's uncited sources in his 1717 *Discours*? Vaillant had never been shy about attacking his opponents in the past, so his reticence on this matter seems out of character. If we assume, for the sake of argument, that he was aware of both the *Epistola* and Morland's paper, why would he have not mentioned them?

It is possible that it was Fagon who held Vaillant in check. Prior to 1717 Vaillant was still very much under Fagon's influence, but Fagon had also been a strong supporter of Étienne-François. Since both Geoffroy brothers had used Morland's and Camerarius' results without citing them, revealing the uncited sources for one would also implicate the other. Such a double scandal would have caused the Académie considerable embarrassment, a situation that Fagon would have wished to avoid. One could easily imagine, therefore, that Fagon may have requested Vaillant not to identify Geoffroy's sources.

After Fagon's death, Vaillant may have faithfully abided by his mentor's wishes. In addition, his health was failing due to a respiratory disease complicated by asthma (Rousseau 1970). In his weakened state, and without Fagon's backing, he certainly wouldn't wish to take on both Geoffroy brothers at once. He was desperately trying to complete work on his 36-year project, the *Botanicon Parisiense*. Perhaps for these reasons Vaillant kept his silence about Morland and Camerarius, even after Geoffroy's slashing address to the Académie in 1718. He died in 1722.

The question of plagiarism

Did Claude-Joseph Geoffroy plagiarize key elements of his 1711 lecture according to 18th-century standards? As discussed by Long (2001), the concepts of openness, priority, authorship, and plagiarism evolved during the Middle Ages and Renaissance. By the 17th century, charges of plagiarism were so common that it is difficult to identify any scientist of note who had not at some point been embroiled in a plagiarism dispute (Merton 1965). To our knowledge, no clear rules governing plagiarism were ever defined in the early 18th century that could be compared with modern legal or industry standards. The French term for plagiarism is *plagiat*. A related term is *plagiaire*, referring to the person committing the plagiarism. Neither *plagiat* nor *plagiaire* are listed in Jean Nicot's *Thresor de la Langue Française* (1606), but *plagiaire* is defined in the first edition of the *Dictionnaire de l'Académie Française* (Académie Française 1694):

> Plagiaire. adj. Qui fait un ouvrage de ce qu'il a pillé dans les ouvrages d'autruy. Autheur plagiaire. Son plus grand usage est au subst. C'est un plagiaire. les plagiaires s'attirent le mespris de tout le monde.
>
> Transl. Plagiarist. Adj. One who makes a work from what has been pillaged from the works of others. It's greater use is as a noun: He's a plagiarist. Plagiarists attract the scorn of everyone in the world.

Thus, by 1694, at least, the term *plagiaire* was well entrenched in the French language. Given the high frequency of complaints about plagiarism, however, the standards were probably less stringent than they are today.

The Oxford English Dictionary (OED) defines plagiarism as "the wrongful appropriation or purloining, and publication as one's own, of the ideas, or the expression of the ideas (literary, artistic, musical, mechanical, etc.) of another" (Simpson and Weiner 1989). As straightforward as the definition sounds, it is open to interpretation, and disputes over what constitutes plagiarism persist to the present day.

It would seem self-evident, for example, that a direct quotation of textual material without attribution falls well within the definition of literary theft, or plagiarism. Yet in recent years, several noted historians and literary critics have argued that apparent instances of plagiarism found in their books were inadvertent, the result of careless note-taking, and therefore should not be regarded as plagiarism (Wyatt 2005). Surely anyone who has undertaken a large research project can testify to the hazards of note-taking. It therefore seems reasonable to exclude such unfortunate lapses from the definition of true plagiarism. In Claude-Joseph Geoffroy's case, however, the failure to cite either Morland or Camerarius was clearly intentional.

What about parody or inspiration. Do these forms of imitation constitute plagiarism? Parody can hardly be considered plagiarism because the intent of the author is to satirize the work of another and not to falsely represent it as one's own. Inspiration, it would seem, is a vaguer term, which potentially could cross the line into plagiarism. It depends on whether the original author is credited and how divergent the derived work is from the original. Reasonable people may disagree about the amount of divergence required to avoid the charge of plagiarism. Justice Stewart's famous comment about pornography — "I know it when I see it" — could be applied to plagiarism as well.

The most difficult aspect of plagiarism to pin down is the theft of an idea. Pamela Long distinguishes between plagiarism, or literary theft, and ownership, or intellectual property:

> Within modern legal systems plagiarism and intellectual property are overlapping but not entirely synonymous categories. Sometimes, for example, individual writers claim that ideas or plots have been stolen from them, but ideas and plots do not constitute property under copyright law, which protects textual expression (Long 2001, p. 10).

Post-modernist critics and philosophers of the late 20th century, such as Roland Barthes, Michel Foucault, and Jacques Derrida, further muddied the waters by challenging the whole notion of "authorship." According to Long (2001, p. 8), "Authorship became an issue in an epistemological revolution in which individual writers came to be viewed as participants in a common discursive practice rather than as authors of uniquely original works." Under a strict post-modernist regime, all authors are plagiarists and there is no such thing as originality.

A less extreme version of the everyone-is-a-plagiarist view has long been acknowledged by historians of science, namely, that certain new ideas seem to "come of age" at particular times in history, during which it is difficult to establish priority (defined by Long (2001, p. 12) as "the identification of first discoverers or inventors") because everyone is thinking along the same lines. This was certainly the case with the sexual theory of plants in the early 18th century, which, with a few notable exceptions, such as Tournefort and Malpighi, was widely accepted throughout Europe and the United States. However, controversies over priority involve disputes over chronology, whereas plagiarism is about stealing someone else's ideas or written work.

Geoffroy the Younger's discussion of hollow styles in his 1711 lecture was almost certainly "inspired' by Samuel Morland's 1703 paper, but Geoffroy neither copied Morland's text nor stole his spermist interpretation of pollen. These ideas were already being actively discussed among botanists at the Académie during this period. On the other hand, by any measure Geoffroy should have cited Morland's contribution, and his failure to do so violated the spirit of the Académie.

Did Geoffroy plagiarize Camerarius? The case is strongest for the passage on legume embryogenesis cited by Prévost (1965). Given the parallels in sentence structure and sentence order between the two versions, the conclusion seems justified that this resemblance is sufficiently close to warrant the charge of literary theft, or plagiarism. Because we are talking about a *literary theft*, it doesn't matter whether or not Geoffroy actually performed the experiments he described.

Geoffroy's emasculation experiments with maize and *Mercurialis* were clearly inspired by Camerarius, but here we are not dealing with literary theft. Did Geoffroy plagiarize the *idea* for these experiments? The idea in question is Camerarius' use of herbaceous monoecious and dioecious species to perform a series of carefully executed and well-documented emasculation experiments. Casual field observations on various monoecious and dioecious species had been made before Camerarius,[30] but no one had conducted systematic studies on the problem. On the other hand, ancient lore about male and female date palms extends as far back as Babylonian times, and most historians of botany would probably agree that the idea of using monoecious and dioecious species in emasculation experiments was already "in the air" by the late 17th century. Thus, the mere fact that Geoffroy may have done the same experiments as Camerarius does not, in itself, rise to the level of plagiarism.

But what about the *results* of Camerarius' experiments? In the OED's definition of plagiarism no mention is made of scientific results. Yet an author's scientific results are typically treated as intellectual property. Others might obtain similar results, but never the exact same ones. Until recently, to comply with modern copyright laws, authors of scientific textbooks were obliged to obtain the appropriate permissions before using data published by other scientists. Although this requirement has been relaxed somewhat, the ethical standard that such borrowed data be properly cited still holds. Accordingly, the issue of whether or not Geoffroy plagiarized Camerarius' emasculation studies in his 1711 lecture depends on whether he was reporting his own results or those of Camerarius.

Because Camerarius' results were summarily expressed in qualitative rather than quantitative terms, it is difficult to determine exactly where Camerarius leaves off and Geoffroy begins. However, we do know that Geoffroy — with only six months to prepare for his lecture — was under horrendous time constraints and that he was also planning for his wedding at the same time. In contrast, Camerarius carried out his experiments at the Botanical Garden at Tübingen over a four- or five-year period before publishing the *Epistola* in 1694 (Morton 1981). Thus, he had enough time to repeat each of his emasculation experiments several times. It is inconceivable that Geoffroy, in a mere six months, could have arrived independently at the same firm conclusions that Camerarius did in four or five years. The emasculation results Geoffroy reported with maize and *Mercurialis* could only have been those of Camerarius, which is plagiarism even by the most lenient definition.

The role of scientific societies

The 17th century saw the rise of many learned societies: The Accademia dei Lincei in Rome (1602), the Accademia del Cimento in Florence (1648), the Royal Society of London (1662), and the Académie Royale des Sciences in Paris (1666). One of the functions of the new scientific societies was to adjudicate disputes over priority and to implement rules that would protect members against plagiarism. Alice Stroup (1990) has lucidly discussed the interactions between scientists within and between the new scientific societies. Within the societies, recognition and personal glory became important as motivating factors, increasing the concern for intellectual priority. Rivalries developed between scientific societies, and limits were placed on what members could reveal to members of other societies, reminiscent of the modern corporate environment. In 1667 the Paris Academy even went so far as to establish a rule prohibiting the discussion of "the business of the Academy" with "outsiders" without the prior approval of the Academy. According to Stroup, this rule was enacted because of worries about "simultaneous discovery and preemptive publication" by scientists outside the Académie. In 1688 a second secrecy rule was established requiring prior approval by the Académie before members could publish their work. One of the aims of this rule was to avoid priority disputes by preventing "the misappropriation of material by immediate colleagues" (Stroup 1990). The implementation of the second rule suggests that the first rule had not been entirely effective.

As already noted, charges of plagiarism were especially common in the 17th century when scientific societies were in their infancy. Nevertheless, the dispute between Newton and Leibniz over the discovery of calculus illustrates how effectively the early scientific societies were able to protect and foster the reputations of their most esteemed colleagues (O'Connor and Robertson 1996; Hellman 1998). The debate over the discovery of calculus involved more than just a question of priority. In the late 1690's rumors began to circulate that Leibniz had actually plagiarized Newton. The accusation, brought mainly by British scientists, was based on the fact that Newton and Leibniz had regularly corresponded during the time leading up to Leibniz's publication and that Newton had discussed some of his ideas in these letters. It was also alleged that Leibniz had been shown some of Newton's unpublished manuscripts by third parties. In 1711 (the same year as Geoffroy's lecture), Leibniz sought to have his reputation cleared by the Royal Society, of which he was a foreign member. Newton, however, was by then the president. Not surprisingly, a special commission of the Royal Society backed Newton as the sole discoverer of calculus in 1715, further implying that Leibniz had plagiarized Newton's letters and manuscripts.

The outcome of the Newton-Leibniz controversy indicates that the absence of a strong scientific society, such as the Royal Society of London or the Académie Royale des Sciences of Paris, was a serious liability for scientists working in the Holy Roman Empire. Although in principle the Sacri Romani Imperii Academia Naturae Curiosorum served as the titular scientific academy of the Holy Roman Empire, the title was mainly honorary. In general German scientific societies of the 17th and early 18th centuries were smaller, more local, and less stable than their counterparts in Italy, France, and England (McClellan 1985, p. 114). On the title page of the *Epistola*, Camerarius identifies himself as a member of the "Kaiserlichen Academy (Nuremberg): Academieae Caesareo Leopold[ina] N[aturae] C[uriosorum]," a local scientific society in Nuremburg founded by J. C. Sturm. The Nuremburg Academy was apparently affiliated with the Sacri Romani Imperii Academia Naturae Curiosorum. Leibniz, himself, had been a tireless promoter of such local scientific academies throughout Germany and in St. Petersburg.

However, the German scientific academies were no match for the Royal Society of London, as Leibniz found out to his sorrow. Perhaps as Claude-Joseph Geoffroy nervously approached the podium on 14 November 1711, he took some small comfort in the hope that in any dispute over priority (or, heaven forbid, plagiarism) between an obscure botanist from Tübingen and himself, Académie members would not fail to protect their own.

Epilogue

Geoffroy's first wife, Marie-Elisabeth Ruel, died in 1719, just two years after his public humiliation at the Jardin du Roi by Vaillant. Although Geoffroy continued to publish papers in chemistry and pharmacy over the years, more and more he turned his attention to business and politics. In the words of David Sturdy (1995):

> The acquisitive habits which continued throughout Claude-Joseph's adult life reveal a personality anxious to exploit the opportunities to attain wealth which were offered by the France of his day.

In the 1720s he became Inspector of Pharmacy at the Hôtel-Dieu in Paris, and in 1731 he was appointed an alderman of Paris. In 1727 he married Marie Denis, the daughter of François Denis, the Lord of Suesnes. She bore him two sons, the elder of which — Claude-François Geoffroy (1729–1753) — went on to become an apothecary and member of the Académie in his own right, thus carrying on the Geoffroy family tradition. Claude-Joseph Geoffroy died in 1752, just one year before the untimely death of Claude-François at the age of 24.[31] Ironically, his most original and enduring contribution to science, the discovery of the element bismuth and the demonstration that it is distinct from lead, was published posthumously in 1753.

Claude-Joseph Geoffroy's colleagues at the Académie eventually learned about Camerarius' work, perhaps when Gmelin republished the *Epistola* in 1749. Yet no one other than the German plant physiologist Julius von Sachs in 1879 seems to have commented on Geoffroy's use of the *Epistola* until Prévost's article in 1965. Perhaps the entire episode was regarded as a painful and embarrassing aberration in a long and otherwise highly respectable career. Vaillant offended Académie members when he attacked Tournefort after his death. A similar respect for the dead may have prevented a critical postmortem of Geoffroy's 1711 lecture.

Although Geoffroy may have prevailed at the Académie in his dispute with Vaillant, forcing him to write a letter of apology, history has been kinder to Vaillant than to Claude-Joseph Geoffroy. It is Vaillant's name, not Geoffroy's, that adorns the façade of the imposing building at the head of the Jardin des Plantes in Paris, along with the names of his former chief rivals Tournefort and Jussieu. In a quiet corner of the alpine garden, there is an old pistachio tree said to have been planted by Vaillant, himself. At the foot of the tree is a small green sign with the inscription:

> Pistachier
> (*Pistacia vera* L.)
> Planted in the garden around 1700 (Jardin alpin actuel).
> This tree enabled Sébastien Vaillant to discover the sexuality of plants in 1716.

Pistachio, a dioecious species, would certainly have been appropriate for a study of plant sexuality. However, we are aware of no documentation for Vaillant's supposed pistachio experiments, and since they were not mentioned in his 1717 *Discours* or in Geoffroy's 1718 response, they may be the stuff of folklore. Claude-Joseph may have won the battle in his own time, but Vaillant won the war for posterity. Once again, Camerarius is given short shrift!

Like Leibniz, Camerarius was victimized by the weakness of German scientific societies compared to those in France and England. But unlike Leibniz, Camerarius suffered merely prolonged obscurity rather than professional disgrace. Geoffroy also got off relatively lightly during his lifetime compared to Leibniz, who was unjustly accused of plagiarism. Yet when viewed from the promontory of the present, Geoffroy's indiscretion presents a redeeming aspect as well. The brouhaha that continued to boil after Geoffroy's 1711 lecture, Vaillant's provocative rebuttal in 1717, and Geoffroy's spirited responses in 1718—all probably did more to spread public awareness of the new sexual theory of plants than any straightforward, properly referenced lecture Geoffroy might have given. Like it or not, despite all our ethical and proprietary scruples over intellectual property, in the final analysis the advance of science depends less on knowing who the true authors of discoveries are than on the discoveries themselves and their promulgation.

Acknowledgments

The authors wish to thank Dr. Alice Stroup for her thorough and authoritative critique of an earlier version of this manuscript and for her continued counsel throughout the revision process. LT would also like to thank his wife, Lee Taiz, for her help in researching 18th-century medical theses in Paris. We are grateful to Professor Georges Métailié, Centre Alexandre Koyré, CNRS in Paris, for his gracious hospitality in Paris and for facilitating our research at the Bibliotheque Centrale du Muséum National d'Histoire Naturelle, and to Nathalie Charrier-Arrighi, Bibliothécaire-documentaliste, Phanérogamie, Muséum National d'Histoire Naturelle, for supplying the 1714 version of Geoffroy's lecture that included the illustration of pollen grains.

Notes

1. According to Thomas Mallon (2001) plagiarism first came to be regarded as a serious offense during the early 17th century, not by scientists or engineers, but by writers. The spread of literacy resulting from the printing press encouraged a new profession, that of author. Writing became a means of livelihood, and authors soon developed a proprietary attitude towards their works. Ben Jonson (1573?–1637) in his play *Poetaster* (1601) was the first to apply the word "plagiary" (from the Latin word for "kidnapper") to stealing another's words: "Why, the ditty's all borrowed; 'tis Horace's: hang him, plagiary!"
2. It should be borne in mind that the Académie, unlike the Collège Royal or the University of Paris, did not function as a graduate school: According to Stroup, "There were no professors.

The *élèves* were not graduate students. No one enrolled for a course of study at the Académie ... the Académie Royale des Sciences was not and did not have a faculty. It might be better conceived as a think tank, a research institute whose research, discussions, and publications were underwritten by the state, and whose publications both glorified these savants and their patron and educated the Enlightenment public in current scientific paradigms and disputes" (Alice Stroup, pers. comm.).

3. The title given by Geoffroy appears to be a combination of the two titles that were used for the same book by Tournefort: *Élémens de Botanique* (1694) and its later Latin version, *Institutiones Rei Herbariae* (1700).
4. See Appendix: Claude-Joseph's 1718 letter.
5. Medical theses are available at the Université René Descartes, Bibliothèque interuniversitaire de médecine, 12, rue de l'Ecole de Médecine, 75270 Paris cedex 06.
6. For example, the margins of every page of Bertino Simone Dieuxivoye's 1695 thesis were crammed with references to both classical and contemporary sources. Phillippe Hecquet's 1704 thesis (given the same year as E.-F. Geoffroy's) was also packed with references, mainly from contemporary authors, including works by Boyle, Lister, and Leeuwenhoek.
7. "Worm" refers to the "animalcules" or sperm cells that Antony van Leeuwenhoek (1632–1723) discovered in human semen.
8. Malpighi described a "scar," present in both fertilized and unfertilized eggs. He then followed the evolution of the scar into an embryo in the fertilized egg. He noted that the structure of the scar is too subtle to be investigated, but "one must admit that the first outline pre-exists in the egg, and that it is 'deep rooted' in the same manner as the eggs of plants." Interestingly, Vaillant in his 1717 lecture incorrectly stated that Malpighi had claimed to see pre-existing embryos in unfertilized hen's eggs, which would have supported his own ovist position.
9. Fontenelle, in his eulogy, speculated that Bourdelin's premature death resulted from his routine of drinking copious amounts of strong coffee in the day, followed by opium at night (Sturdy 1995, p. 308).
10. Simultaneous appointments at different levels in different fields seem to have been quite common at the Académie. Individuals who held faculty positions in one discipline might concurrently become students in another.
11. This is the highest class of salaried researcher at the Académie (McClellan 1985, pp. 17–19).
12. Biographical information taken from the description of the library of Claude-Joseph and Claude-François Geoffroy at the Bibliothèque Nationale de France (http://elec.enc.sorbonne.fr/cataloguevente/notice8.php).
13. Claude-Joseph's personal library included 38 volumes of the *Philosophical Transactions* (Sturdy 1995).
14. embryos
15. Vaillant in his 1717 lecture pointed out that most styles are in fact solid rather than hollow. He accuses Geoffroy of doing shoddy, inaccurate science: "... he assured us contrary to the truth that if one would simply take the time to open the pistils (a favorite term under which he confounds the tubes and ovaries) one would recognize very distinctly that they are always open at their extremity, and pierced more or less obviously down to their bases. We might have taken his word for it if it weren't for the fact that most of the proofs he gives with a little too much self assurance contradict him" (Bernasconi and Taiz 2002).
16. Of course, we can hardly fault Geoffroy for being ignorant of the real mechanism of fertilization via pollen tubes, a phenomenon not discovered until 1823 by Amici. Camerarius wisely avoided the whole issue of fertilization in his *Epistola*.
17. The description of the *Epistola* presented in the paragraphs that follow is taken largely from A. G. Morton's excellent summary in *History of Botanical Sciences* (1981).
18. Camerarius assumed that all hermaphroditic flowers were self-fertile, an error that wasn't corrected until the discovery by Konrad Sprengel (1750–1816) of insect-mediated out-crossing.
19. Both passages were translated into English by us from Prévost's French versions.
20. Camerarius did not use the terms "monoecious" and "dioecious," which were first applied by Linnaeus (1707–1778).
21. There seems to be some disagreement on when these results on the appearance of hermaphroditic flowers on female plants were published. Julius von Sachs claims they were published before the *Epistola*, in the 1692 issue of the *Ephemerides* (see Sachs 1906, p. 386). A. G. Morton (1981) states they were published after the publication of the *Epistola*. If Sachs is correct, Camerarius failed to see the connection between his earlier result and the failed experiment with hemp.
22. Plantefol (1965) cited an article by Geoffroy titled "Observations sur les fleurs de Bled de Turquie

ou Mays (Observations on the flowers of Turkish Wheat or Maize)" without giving the source. Maize was earlier thought to have come from Turkey, India, or Spain.

23. Michele Bernardo Valentini, an Italian physician, was professor of medicine at the University of Giessen as well as in Italy.
24. A. G. Morton (1981) erroneously reported that the *Epistola* was "printed in the Transactions of the Tübingen Academy." However, there was no Tübingen Academy, and the letter was privately published by Camerarius, himself.
25. *Epistola*, page 80: "Tu modò haec maximum partem inter belli turbas & publicas patriae calamitates concepta aequi bonique consule …"
26. Taken from records stored at the Tübingen Rathaus.
27. John Dowson, Early Printed Collections, British Library, pers. comm.
28. Libraries of Claude-Joseph and his son Claude-François at the Bibliothèque Nationale de France: Catalogue des livres et estampes de defunts Mrs. Geoffroy père et fils (Q-7996). Paris, 1754. BN cote Q.7996.
29. Geoffroy, Claude-Joseph: Réponse à Vaillant au sujet du mémoire sur la structure et l'usage des principales parties des fleurs. Ms. 1274, Muséum Nat. d'Hist. Naturelle, Bibliotech Centrale. Contains two manuscripts: (a) Réponse à quelques objections repandues dans le discours de Mr. Vaillant contra mon mémoire sur la structure et l'usage des principales parties des fleurs. Lu le 14 novembre 1711. [In the margin] "Ce mémoire a été lu à l'Académie le 27 juillet 1718"; (b) Réponse aux plaints de Mr. Vaillant sur un prétendu vol qu'il croit avoir découvert dans mon mémoire sur sur la structure et l'usage des principales parties des fleurs, lu le 14 novembre 1711. [This text was the first draft written but was not presented. Neither drafts were published.]
30. For more of a discussion of the history of the problem before Camerarius, see A. G. Morton (1981).
31. Biographical information taken from the description of the library of Claude-Joseph and Claude-François Geoffroy at the Bibliothèque Nationale de France (http://elec.enc.sorbonne.fr/cataloguevente/notice8.php).

References

Académie Française. 1694. Dictionnaire de l'Académie Française. Paris: J. B. Coignard.

Anonymous. 1714. Sur les fleurs ou sur la Génération des Plantes. Hist. Acad. Roy. Sci. Mém. Math. Phys. (Paris, 4to). Année 1711: 51–54.

Anonymous. 1731. Diverses observations botaniques. Hist. Acad. Roy. Sci. Mém. Math. Phys. (Paris, 4to). Année 1712: 50–53. (Orig. ed. [1715].)

Bernasconi, P. and L. Taiz. 2002. Sebastian Vaillant's 1717 lecture on the structure and function of flowers. Huntia 11(2): 97–128.

Bodenheimer, F. S. 1958. The History of Biology: An Introduction. London: Dawson & Sons Ltd.

Bouvet, M. 1937. Histoire de la Pharmacie en France. Paris: Editions Occitania. P. 445.

Camerarius, R. 1694. Academiae Caesareo Leopold. N. C. Hectoris II. Rudolphi Jacobi Camerarii, Professoris Tubingensis, ad Thessalum, D. Mich. BernardumValentini, Professorem Giessensem excellentissimum, de sexu plantarum epistola. Tübingen: Rommeius.

Camerarius, R. 1696. De sexu plantarum epistola. Misc. Cur. Ephem. Med.-Phys. German. Acad. Caes.-Leop. Nat.-Cur. Dec. 3, ann. 3, appendix: 31–36.

Camerarius, R. 1700. De sexu plantarum epistola. In: M. B. Valentini. 1700. Polychresta Exotica. Frankfurt am Main: Johann David Zunner. (Second edition, 1701).

Dorveaux, P. 1931. Étienne-François Geoffroy. Rev. Hist. Pharm. 2: 118–126.

Furetière, A., H. Basnage de Beauval and J.-B. Brutel de la Rivière. 1727. Dictionnaire Universel, new ed. 4 vols. The Hague: P. Husson [etc.]

Gmelin, J. G. 1749. Sermo Academicus De novorum Vegetabilium post Creationem divinam exortu. Tübingen: Typ. Erhardt.

Geoffroy, C.-J. [1708.] Observations sur les huiles essentielles, avec quelques conjectures sur la cause des couleurs des feuilles & des fleurs des plantes (Observations on the essential oils with some hypothesis as to what causes the color of the leaves and plant flowers). Hist. Acad. Roy. Sci. Mém. Math. Phys. (Paris, 4to) Année 1707: 517–526.

Geoffroy, C.-J. 1709. Observations sur le *Nostoch*. Qui prouvent que c'est veritablement une plante (Observations on *Nostoc* which prove that it is a true plant). Hist. Acad. Roy. Sci. Mém. Math. Phys. (Paris, 4to) Année 1708: 228.

Geoffroy, C.-J. 1714a. Observations sur la végétation des truffes (Observations on the [vegetation of] truffles). Hist. Acad. Roy. Sci. Mém. Math. Phys. (Paris, 4to) Année 1711: 23–35.

Geoffroy, C.-J. 1714b. Observations sur la structure & l'usage des principales parties des fleurs. Hist. Acad. Roy. Sci. Mém. Math. Phys. (Paris, 4to)

Année 1711: 210–234. [Ed. note: The illustration was taken from this likely first printing of the lecture. The French text reproduced on pages 61–74 and from which the English translation was made was taken from a later reprinting of the journal for which we have been unable to determine the exact publication date, but it is probably circa 1730 or later.]

Geoffroy, E.-F. 1705. These soutenue aux ecoles de la Faculté de medecine de Paris (An hominis primordia, vermis?), transl. N. Andry. Medical school thesis. Académie Royale des Sciences de Paris, Faculté de Medecine. Paris: Chez Laurent d'Houry. (Orig. Latin ed. 1704, Paris).

Greene, E. L. 1983. Landmarks of Botanical History, Part II. F. N. Egerton, ed. 2 vols. Stanford, Calif.: Printed for Hunt Institute for Botanical Documentation by Stanford University Press.

Grew, N. 1682. Anatomy of Plants, ed. 2. London: Printed by W. Rawlins for the Author. Part II.

Hahn, R. 1971. The Anatomy of a Scientific Institution: The Paris Academy of Sciences, 1666–1803. Berkeley: University of California Press.

Hellman, H. 1998. Newton versus Leibniz: A clash of titans. In. H. Hellman. 1998. Great Feuds in Science: Ten of the Liveliest Disputes Ever. New York: John Wiley & Sons, Inc. Pp. 39–61.

Long, P. O. 2001. Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance. Baltimore: Johns Hopkins University Press.

Mallon, T. 1989. Stolen Words: Forays into the Origins and Ravages of Plagiarism. New York: Ticknor & Fields.

McClellan, J. E., III. 1985. Science Reorganized: Scientific Societies in the Eighteenth Century. New York: Columbia University Press. Pp. 17–19.

Merton, R. K. 1965. On the Shoulders of Giants: A Shandean Postscript. New York: Free Press.

Morland, S. 1703. Some new observations upon the parts and use of the flower in plants. Philos. Trans. 23: 1474–1479.

Morton, A. G. 1981. History of Botanical Science: An Account of the Development of Botany from Ancient Times to the Present Day. London and New York: Academic Press.

Nicot, J. 1606. Thresor de la Langue Française. Paris: D. Douceur.

O'Connor, J. J. and E. F. Robertson. 1996. The Rise of Calculus. In: J. J. O'Connor and E. F. Robertson. 2004. History of Mathematics Archive. School of Mathematical and Computational Sciences, University of St. Andrews, Scotland. http://www-history.mcs.st-andrews.ac.uk/HistTopics/The_rise_of_calculus.html (27 July 2006).

Plantefol, L. 1965. Les conditions du plagiat par Geoffreoy le Jeune des résultats publiés antérieurement par Camerarius. Compt. Rend. Séances Acad. Sci. 261: 2039–2044.

Prévost, A.–M. 1965. Rapprochement entre l'Epistola de sexu plantarum de R.J, Camerarius (1694) et les Observations sur la structure et l'usage des principales parties des fleurs de Geoffroy le Jeune. Compt. Rend. Séances Acad. Sci. 261: 2045–2048.

Ray, J. 1686. Historia Plantarum. 3 vols. 1686–1704. London: Typis M. Clark, prostant apud H. Faithorne and J. Kersey. Vol. 1.

Rendle, A. B. 1910. Botany. In: H. Chisholm, ed. 1910–1911. The Encyclopaedia Britannica, ed. 11. 29 vols. Cambridge, England and New York: Cambridge University Press. Vol. 4. Pp. 299–302.

Roger, J. 1997. The Life Sciences in Eighteenth-Century French Thought. K. R. Benson, ed., R. Ellrich, transl. Stanford, Calif.: Stanford University Press. (Orig. French ed. 1963.)

Rousseau, J. 1970. Sébastien Vaillant: An outstanding 18th-century botanist. In: P. Smit and R. J. Ch. V. ter Laage, eds. 1970. Essays in Biohistory. Utrecht, Netherlands: International Association for Plant Taxonomy. Pp. 195–228. [Regnum Veg. 71.]

Sachs, Julius von. 1906. Geschichte der Botanik (History of botany, 1530–1860), transl. H. E. F. Garnsey, rev. I. B. Balfour. Oxford: Oxford University Press. (Reprint, English ed. 1890, Oxford; orig. German ed. 1875, Munich.)

Simpson, J. A. and E. S. C. Weiner. 1989. The Oxford English Dictionary, ed. 2. 20 vols. Oxford: Clarendon Press.

Stroup, A. 1990. A Company of Scientists: Botany, Patronage, and Community at the Seventeenth-Century Parisian Royal Academy of Sciences. Berkeley: University of California Press.

Sturdy, D. J. 1995. Science and Social Status: The Members of the Academie des Sciences, 1666–1750. Woodbridge, Suffolk, U.K. and Rochester, N.Y.: The Boydell Press.

Sturdy, D. J. 2002. Fractured Europe, 1600–1721. Oxford and Malden, Mass.: Blackwell Publishers.

Tournefort, J. 1694. Élémens de Botanique. 3 vols. Paris: l'Imprimerie Royale.

Tournefort, J. 1700. Institutiones Rei Herbariae. 3 vols. Paris: Typographia regia.

Wyatt, E. 2005. E.E. Cummings scholar is accused of plagiarism. New York Times 16 April, p. B7.

(272)

OBSERVATIONS

On the structure and use of the principal parts of flowers.

By Mr. GEOFFROY the Younger.

14th of November 1711.

Flowers are, for the most part, composed of petals[1] of different forms and different colors, of a calyx, which serves as an envelope, of a small hollow stem, which rises from the middle of the leaves, which we call the *Pistil*, and finally, of some filaments called *Stamens*, terminating with small bodies of a different structure, which are called *Anthers*.[2]

(273)

These different parts can be seen at the beginning of Tournefort's *Elements of Botany*, in the first and following plates, to which we refer the reader, in the belief that it is unnecessary to report here either these figures or their descriptions.

Experience has been sufficient to enable us to see that all these parts are intended for the birth and nourishment of the fruit and the seed, on which the reproduction of the plant depends.

It is thus true to say that in plants, whose bodies are organized like those of animals,[3] the flowers correspond to the parts in the latter that are intended for generation. It is no longer difficult to conjecture that, since plants do not have the facility of movement as animals do, nature usually has included in the same flower all the parts that will contribute to the conservation of the species, which in animals are separated, forming the different sexes.

It even seems as if nature had wrapped the generation of all living bodies in a mystery, but had let us penetrate it with regard to plants. Because, if she has mixed the different sexes in certain flowers, she separated them in others, which contributes not a little to our ability to discriminate between them.

Based on this, botanists were led to distinguish certain plants as male and female, without knowing the reason why, only because they saw that one carried flowers that were followed by nothing, and that the seeds were on a

(274)

different plant. The first type has since been called *Stamens* or *Chatons*, and the other type *Pistils*. See the *Elements of Botany*, *plate* 346 and, in the same *Elements, plate* 31.

The function of the stamens has always been quite ignored, a mistake if we are to gain a proper understanding of nature,[4] which seems to lead us to propose that the stamens are the male parts intended for the conservation of the species, just as the fruit flowers are the female parts. In some plants, the staminate flowers are so completely separated from the fruit flowers that they are on different plants; in others, they are found on the same plant; and in all the rest, the staminate flowers and the fruit flowers are united in the same flower, as I hope to demonstrate in the following observations.

Let's start by clarifying which parts of the flowers play the premier role in the production of seeds. Judging by their appearance, the petals, by their beauty, their structure, their vivid brilliance and variety of their colors, and the pleasing fragrance they give off, would seem to be the most important; it is indeed that part which occupies the amateur, who neglects all the rest, but the scientist[5] must judge it differently. Considering that the petals of the flowers do not bear anything in themselves remarkable, that they are situated around the other parts as if to serve them as an envelope and to defend them against injuries from the air, that they fall as soon as the fruit, being set, doesn't need their help anymore, one is easily led to reconsider such a prejudice. For the calyx, which is even more exterior than the

(275)
petals, what else can it be but a first envelope covering the essential parts of the flower? It remains for us only to examine the stamens surmounted by their anthers and the pistil, which contains within itself the ovules[6] and which is, so to speak, like the ovary.[7]

These filamentous stamens and their anthers look so insignificant in flowers that they have been regarded as mere excretory vessels, designed for the separation of the excess sap needed for the nourishment of the young fruit. But, upon closer examination, and in view of the similarity they have with the anthers of the staminate flowers of the plants that I will call male, there is reason to conclude that they truly are the male parts of plants.

Indeed, these anthers are capsules, or vesicles, which, once they reach a certain point in their maturation, split open and pour out dust particles whose shapes vary in different plants, and which, from my own observations,[8] appear to me to contribute to their generation as essential parts.

In the majority of these plants, as in the lily and the tulip, these small bodies are attached to the stamens, which are these filaments that come out of the calyx or the petals of the flower.

In some tubular flowers whose petals are formed into a pipe, as in *Narcissus*, *Digitalis*, and primrose, these stamens are very short, and in a few, they are completely absent, as in the long *Aristolochia*,[9] in which the anthers are attached directly to the capsule that encloses the fruits.

276

In the flowers with florets, half-florets, or ray flowers,[10] the anthers are enveloped or hidden in the stamens, which unite in the form of a sheath, as one can see in the cornflower, thistle, lettuce and chicory: see *Elements of Botany, plates* 2 and 3. Whereas in these flowers, at the region of the petal of the floret or half-floret where it starts to flare out, five stamens or filaments are united to form a small pipe, like a kind of sheath, whose insides are decorated by these anthers or capsules filled with dust, the rest of the cavity is occupied by the pistil, which is a small filament placed on the ovule.[11] When the flower starts to bloom, the filament remains hidden in the sheath, but, as the flower enlarges, it grows, elongates, and at the same time the anthers open up, make space for it, and it appears at last out of the sheath, loaded with the dust that the anthers have poured onto it.

These capsules are usually membranous (see *Elements of Botany, plate* 4), but in some aromatic plants, such as rosemary, sage, and thyme, they are very hard.

There is such an infinity of variations to be seen in the shapes of these capsules, their number, and their ways of opening, that it would take too long to report them here. However, since they are always constant in each species, one should not neglect them as characteristics of flowering plants, since, of all the flower parts, they are the most essential.

(277)

The difference that one observes between the dust particles of the different species of plants is no less great, be it color, size, or shape.

There are some that are clear and even transparent as a crystal, such as those from the Maple, *Melianthus* [Honey flower], Borage, and Hemlock; white, like those of Balsamine [*Impatiens balsamina*] and Henbane; blue, like those of *Linum* [flax]; the color purple, like those of some tulips; and flesh-colored, as in some species of *Lychnis*. But the vast majority of these dust particles are yellow, of varying intensity. Those from *Geum* with red flowers are also red, even if Mr. Grew claims never to have seen any of that color.

It appears, however, that the color of the dust varies within the same species according to the color of the flower, and sometimes the dust particles of the same flower have different colors, as I have observed in those of *Caryophyllus arvensis*.

It would be difficult to describe all the different forms of these dust particles, for although they may appear finer than flour to the naked eye, nevertheless each of these tiny grains has a defined shape, fixed and constant for all the flowers of the same species, and I haven't seen any significant variation on that point. It is true that some of these dust particles change their shape slightly when they dry up; that's why the ones from *Cucumis sylvestris* when taken from a fresh flower first appear round like little globules, and some moments later they

(278)

take the shape of a date kernel with a groove down their middle as they dry out.

In the vast majority of flowers, these dust particles have an oval shape that is more or less pointed at their ends with one or more indentations along the long axis, so that when seen under the microscope they look like a date kernel, a grain of wheat, a coffee bean, or an olive. Such are those of *Polygonatum* [Solomon's Seal], Bugle [*Ajuga reptans*, mint family], *Bryonia* [Cucurbitaceae], Ancolie [*Aquilegia*, Columbine] and *Tithymalus* [Euphorbiaceae].

1. The ones from St. John's wort appear like small ovals, similar to olives with pointed extremities, slightly wider in their middle, with a luminous (shiny) point.

2. The ones from the clover (Trefoil in the picture of our paper) appear like cylinders or rolls with a slit along their length.

3. The ones from the violet (pansy) are prisms with four irregular sides, slightly transparent, which, depending on their position, represent different figures.

4. The ones from the Borage are also rolls, but they are narrower in their middle and have light spots on their length at three different places.

5. The ones from the Comfrey represent quite well two crystal balls, tightly glued to each other.

6. The ones from the Maple or Sycamore represent two cylinders placed like a cross, one shorter than the other one.

7. The ones from the Lily resemble olives with pointed ends, with a coarse, leathery

(279)

look and a slit along their length.

8. The ones from the Daffodil (Jonquil in the picture in our paper) look like kidneys.

9. The ones from the *Ephemerum virginianum*[12] are of the shape of a barley seed.

10. The ones from Tithymale,[13] the castor bean, are ovoid in shape, with a slit along their length.

11. The ones from the *Acanthus* (bear's breech) are oblong, round at their ends and have a slit along their length.

12. The ones from the Spanish broom look oblong, rounded at their ends and bearing two kinds of slits or two raised and shiny regions.

13. The ones from Tuberose are oblong, wider in their middle, looking like a prism with three faces.

14. The ones from the pyramidale[14] and other species of Campanelles[15] are almost round, transparent, and bearing on their surface a few raised regions and a shiny point in the middle.

15. The ones from the passion flower are also almost round, with uneven surfaces.

16. The ones from *Caryophyllus sylvestris*[16] are round, multifaceted.

17. The ones from the geranium and some other species are round, with a kind of navel, as seen in the apple.

18. The ones from the pumpkin are round, loaded with very short small spikes.

19. The ones from the *Caltha,*[17] *Corona folis*[18] and some of the radiated flowers are small balls covered with very short hairs.

(280)

20. The ones from *Althaea frutescens*, *Malva* and *Convolvulus*[19] are like globes covered with spikes that are quite thick and sharp at their extremities.

One will find at the end of this dissertation the figures of these dust particles as seen under a microscope and drawn as precisely as possible.

Some of these particles seem very hard, while others are soft and easily squashed.

They all contain much more sulfurous material than the other parts of the flower, therefore they also have a stronger smell. Those of lily are so loaded with oils that the paper used to contain them becomes greasy as if it has been oiled. The dust of most of the aromatic plants swim in essential oil or a type of liquid turpentine; others seem enveloped in a dry resin, like the ones from *Lycopodium* or *Muscus terrestris clavatus*[20] CB., since if we blow this dust through the flame of a candle it lights up as if it were resin powder. Other dust particles, such as those of Fumeterre [*Fumaria officinalis*], seem enveloped in a mucilaginous matter. Indeed, they are so sticky that they attach to anything they touch, and it is difficult to separate them from each other.

These little grains, however, fail to dissolve in water, olive oil, turpentine oil, or spirit of wine, even with the aid of fire. The last three

(281)

liquors do release some color, but they do not change, or only slightly change, the shape of the dust particle.

Some have claimed that these dust grains are just wax or resin particles.[21] To test this, I boiled them in water, but they did not melt; moreover, upon placing them in a spoon over a fire, they burned and turned to charcoal without melting, from which it seems that these small grains of powder are small bodies with a specific structure, and they keep, as I have said, a constant shape in each species of flower.

Let us move on to the examination of the other essential part of the flower that ordinarily occupies the center and that consists of the pistil that contains the ovules, either at its base or throughout its length. It originates from the pedicel of the flower or in the center of the calyx and later becomes the young fruit, which is sometimes hidden within the calyx and is sometimes located completely outside it.

Its appearance is very different in a large number of flowers. It is sometimes like a small stem that enlarges at its two ends in the shape of a pestle; sometimes it is a filament. It can be round, square, triangular, oval, spindle-like, or some other way. One can see the different shapes of these pistils in the first plates of the *Elements of Botany*.

Almost all the pistils are decorated at their tip with small, very fine hairs that are like velvet, or with filaments arranged

(282)

in plumes or crests, or they are covered with small vesicles full of a sticky sap. One can observe the velvet on the top of the pistil of the flower of Coquelicot [poppy], Populago [*Ranunculus*], gentian, and Campanelle.[22] One notes these plumes and crests on top of the pistil of wheat, at the extremity of the pistil of the flower of the grape, violet, and most of the flowers of the legumes. The vesicles appear very distinctly on top of the pistils of lily and *Convolvulus*.

There are some flowers in which one notes several pistils,[23] or pistils terminating in several horns that are born from a young fruit or which leave from different seed-enclosing capsules, each capsule containing either a single seed or several. Thus, in *Tithymalus* [Euphorbiaceae], the Toutefaine, one notes three pistils and as many seed capsules. In the Ancolie [*Aquilegia*, Columbine] and Fraxinella [*Dictamnus albus*], five or six: in the lily and tulip there is only one pistil, but it forms at its extremity a triple head that corresponds to the three seed chambers that partition the fruit. In pumpkin, one observes the same thing in the female flower, which has only one pistil that subdivides at its extremity into several heads indentated along their length, and these different heads correspond to seed chambers of the young fruit.

All these pistils, whatever their appearances, have some opening at their extremity, or some slits that continue down their whole length to their base, or to the embryos of the seeds. This is

(283)
what one readily sees in the lily, narcissus, pomegranate, and particularly in pumpkin, by splitting these pistils lengthwise or by cutting them transversely.

If, after having cut the pistil of lily, one plunges its end in water, and sucks from the other end, one can draw up water in the same manner as one would by using a very fine straw.[24]

If one takes the trouble to open the pistils at different stages of maturity, one will recognize very distinctly that they form the young fruits and that they contain inside them the ovules, whether they are distributed throughout the length of the pistil or are contained at the base, it is always open at its end and pierced more or less noticeably all the way to its base. Often this cavity disappears as the young fruit grows; sometimes the same part of the pistil that M. Malpighi calls "style" or "needle" dries up and falls. However, in several fruits the cavity, which contains the pistil and stamens, remains and even becomes quite noticeable, as one can observe in pears, apples and particularly in those of the Calvil.[25] See *Figures* 26 and 27.[26]

This is what one observes in the plants whose flowers contain, so to speak, both sexes. The same things can be observed separately in plants where they are separated, that is to say, where the anthers are at one location

(284)
and the immature fruit at another, sometimes on the same plant, sometimes on separate plants. Such is the pumpkin that bears on the same plant sterile flowers that are commonly called false flowers, and which I call male flowers, and the fruit flowers that are called "knotted flowers,"[27] and which I will call female flowers.

These two types of flowers are composed of petals in one piece like a flared bell and divided in several parts on their edges.

From the center of this bell in the male flower rise several branches that join together and form a body that subsequently becomes a cylindrical structure loaded with anthers on its surface winding from one end to the other. See *Figure* 21. These anthers are divided lengthwise by a partition separating two cavities. See *Figures* 22 and 23.

When that flower reaches a state of perfection, these anthers open along their length at two half channels from which a very fine dust escapes (see *Figure* 23), which is then transported onto the female flowers in order to fertilize them.

The female flower crowns the head of the immature fruit that is not seen in the male flowers; from the top of this young fruit rises like a kind of inverted pyramid a body, the pistil,[28] which divides into several heart-shaped lobes, with a furrow running lengthwise and bristling with short hairs, good for snagging and retaining the dust particles that the male flower gives off.

(285)
If one cuts this pistil transversely in the region where it is narrowest, one will find

as many conduits as there are divisions at its head. These conduits correspond to the chambers, each of which contain two sets of seeds arranged in rows on a spongy placenta. See *Figure* 25.

In addition to pumpkin, plants whose staminate flowers are found in a separate place from the fruit flowers on the same plant include cucumber, melon, gourd, corn, Job's tears, sunflower, ambrosia, walnut, hazel, hornbeam, oak, beech, fir, pine, alder, cypress, birch, cedar, juniper, yew, mulberry, and plane tree.[29]

Among the plants in which some individuals bear the staminate flowers without fruit and others bear fruits without staminate flowers are included some species of palm, willow, poplar, dog's mercury, hemp, spinach, nettle, and hops.[30]

There is no need for us to go into a great deal of detail here. Our only task is to examine the uses of the different parts that we've just described.

First, as far as the anthers and dust with which they are filled are concerned, it is obvious that they are not the excrement of the flower, since as soon as the flower is formed, one can already distinguish these fully formed dust particles, and they are enclosed within the anthers as soon as these anthers can be detected.

One can even see them grow and exit

(286)
the scrotum[31] that contains them after some time, when they have acquired a certain degree of maturity. One finds them in the male flowers, but one does not see them in the fruit flowers. Why would plants that do not make any fruits needlessly produce this type of excrement, whereas we do not detect any trace of it in the fruit flowers, for which they supposedly perform this imaginary purification?

Thus, one must state that these anthers are intended for a more noble use, and that they must be regarded as the principal cause of the fertility of plants.

This assertion is what I am going to support by three observations. First, there are almost no known plants that do not have anthers with their dust, whether they are in the same flower, at different places in the same plant, or on separate plants.

Second, when they are joined with the pistils in the same flower, they are always placed in such a way that the tip of the pistil necessarily receives the dust particles that they emit.

Third, the ovules either abort or become infertile when they are deprived of these dust particles.

I say that there are hardly any plants in which one cannot find these anthers and dust, either on the same plant or on separate plants. I am not talking about the aquatic or marine plants, although, following the observations of M. Marchand[32] on the flowers and seeds of the fungi, and the relationship that has been found between these plants and the tree corals,[33]

(287)
one can presume that the marine plants have their flowers and fruits in the same manner as the terrestrial ones. The observations that Count Marsigli[34] (1658–1730) made on the coral and on a lot of other marine plants, in which he claims to have discovered the flower and the fruit, favor this conjecture.

As for the terrestrial plants, it is really only the mushrooms, the truffles, the mosses and certain species of ferns[35] and others in which one cannot see anthers filled with dust particles; however, I have demonstrated in the truffles some bodies that appeared to me as if they could be the seeds, together with something that could substitute for the flower, which is a sort of mold or white flower that can be remarked for a while and that apparently contains this dust that is too finely divided and too small an amount to be easily visible. As for the mushrooms, the dust particles hidden in the gills[36] under the head could be the dust particles rather than the seeds, and I suspect the same is true for some species of ferns. These little leaves or cells[37] located on the backs of the leaves appear to me more like anthers than fruits, and in some species, I would be more inclined to believe that the grains that are contained within them are dust particles rather than seeds, since some of them, when sown, do not produce anything[38]; therefore, in these species of plants one can be more confident of knowing the flower than the fruit. It is the same for the mosses, in which can be observed

(288)

in some species small oval pointed bodies, covered with a bonnet or a hood that later becomes a capsule like an urn with four raised sides. These urns are filled with a very fine dust that some believe to be the seeds. Other species of moss have a scaly head like an ear of grain, which contains under each scale a kind of fruit shaped like a small kidney. This fruit opens on two sides and contains two increasingly minute seeds, which, when seen under the microscope are little yellow transparent globules. On the other hand, M. Vaillant has seen that some other species of moss, in which until now nothing has been discovered, produce small bodies filled with similar dust particles, which could be the seeds of these plants or, as well, could be the dust contained in the anthers.

The fig is the lone example of the production of a fruit for which one cannot see the flower. However, Valerius Cordus[39] suggested that it must have one, and the learned Malpighi showed the picture of it in his *Anatomy of Plants*. The earliest stage of the fig is just a bud of leaves placed around a placenta, on which all the ovules are arranged. These leaves are bent inward and placed as in a rose, forming a sort of small vault above the seeds. Each ovule has a particular calyx split in five or six spears that wraps around it, and from each ovule rises a small pistil that grows a lot over time.[40] As the fruit grows, the leaves, which at first take up most of the space,

(289)

become reduced in size and confined to the small navel of the fig, where one can hardly see them.

Here is a type of flower in which I couldn't discover any anthers and which one must regard as a fruit flower only, until somebody is lucky enough to discover them, if they exist.[41]

As another example, no one has observed, in our own country, the seeds of the horsetail. One sees in this plant only the staminate flowers, loaded with dust. Would we say, because of this, that they do not bear any fruits?[42] Cesalpino found some that came on plants different from those that bear stamens.[43] In a word, these examples are too few in number and don't have anything that could formally contradict what we observe in the countless multitude of plants that all have anthers with dust particles.

The arrangement of these anthers around the pistils is a second proof of what I have advanced. The pistil is so surrounded by them that its tip is necessarily covered by their dust when they bloom.[44]

In all the flowers that stand upright, the anthers are above or at least level with the tip of the pistil, and the pistil extends above them only when the embryos of the seeds start to grow, elevate, and do not need the dust anymore.

In the flowers that bend down or are completely upside down, such as the Crown Imperial,[45] or the flower of cyclamen, the pistil

(290)
is elongated well beyond the stamens, so that the dust falling from the anthers, necessarily powders the tip of the pistil.

In the flowers of *Antirrhinum* or "calf's muzzle," and in others of the same genus, the stamens are disposed in such a way that the tip of the pistil is resting on the feather bed[46] of the lower petal and covered by the upper one, and two of the anthers are placed above and two below, in such a way that the head of the pistil is completely surrounded by the anthers and necessarily covered by their dust when they scatter it.

In the flowers with florets and half-florets, the tip of the pistil is hidden in the sheath formed by the stamens, as we said before, and it exits it only when the anthers open and create a passage for it, in such a way, that by growing it covers itself with the dust.

When one considers the presence in most flowers of all this apparatus of anthers filled with dust, placed around or above the pistil, which, for its part, is open, decorated with hair, or covered with a sticky material for retaining these dust particles, which are themselves hairy and viscous, how could one not conclude that all this artifice is designed for the sole purpose of making sure that the dust, as it leaves the anthers, sticks to the pistils and slips inside their cavity?

I realize that in the flowers that bend down, like the one from the Crown Imperial, Cyclamen and *Acanthus*, the location of the pistils does not seem favorable for the intromission[47]

(291)
of the dust particles that leave the anthers; but is it not sufficient that the dust particles attach to the pistil, and that its tip is thus covered, to speculate that it insinuates itself little by little, with the aid of the viscous sap that coats them, the outside air that pushes them in, and perhaps also by the particular morphology of these pistils?

Does one follow the production of animals without encountering similar obscurities?

Whatever mechanisms this dust uses to enter the pistil, it is so essential to the fecundity of plants that without it the seeds abort or are incapable of reproducing the species: this is my third observation, to which I can add the following.

Nothing is more common than to see the productivity of the earth being limited by the suppression of the anthers and their dust. In spring, when the fruit trees are in flower, if a freeze occurs followed by a sunny day, which desiccates the pistil and prevents it from receiving the summit dust, everything aborts and all hope is lost. If, on the contrary, the flowers come out well and the dust has time to fertilize the pistils, the fruit sets and there is nothing more to fear.

When wheat is in flower, one worries about the smut.[48] What happens afterwards? The wheat spike blackens, the sterile grains stretch out and form a germless horn of a substance more closely approaching a mushroom than a wheat seed. At the least, the chambers are empty.

(292)
Isn't that the same thing that happens with berry drop in grapes? The rain that arrives suddenly during flowering removes both the anthers and the dust, thereby interfering with the work of fertilization and causing the seeds to abort, as one can readily see.

But, in order to show that all my previous observations are not just idle speculations advanced without proof, let's observe what happens in all flowers that, as I said, unite the two sexes, i.e., the anthers with their dust and the pistils.

One never perceives any body or plant germ in very young ovules, and one begins to see a change only after the stamen dust has fallen. Therefore, it is this dust that fertilizes the young fruit. What is true is that in the plants where the stamens are born on the same plant but at a different place or on a separate plant, if one cuts these stamens as soon as they are visible; and before they open, the fruits do not mature, or if they ripen, they do not contain any germ and consequently are sterile.

This requirement for the dust of the stamens for the fertility of the seeds is confirmed by the observations of all the botanists on the date palm.

This species of tree bears the stamens and fruits on separate plants, so they are usually distinguished as males and females, respectively. Theophrastus,

(293)
Prosper Alpino, and all the botanists who have made these observations themselves, agree that if a female plant doesn't have a male plant in its vicinity, it doesn't bear fruits, or if it bears them, they don't mature, they are bitter, with a bad taste, without kernel, and therefore without a germ. For these fruits to ripen and to render them good to eat and fertile, one needs either to plant a male palm in the vicinity or to cut branches of a male tree loaded with anthers in full bloom and to bind them above the branches of the female palm tree, and it produces an abundance of good fruits. This observation was confirmed to M. Tournefort in 1697 by Adgi Mustapha Aga, a spirited and inquisitive man, Tripoli's Ambassador to the King, as this learned botanist reports in his *Institutions Botaniques*. It is not only on the palm trees that these observations can be verified. It is very easily observed on most of the plants that have flowers and fruits on different plants or at different locations on the same plant, provided that one takes great care to cut the stamens before they begin to develop, or provided that one keeps the female flowers in a location where the dust of the stamens does not have any access.

I have raised several plants of corn, which, as we know, bears at the top of its stem stamens loaded with anthers and the fruits or ears along the stem in the axils of some of the leaves. I have cut the stamens with as much care as it has been

(294)
possible, as soon as they were visible, and before the anthers blossomed.

On some of the plants the ears, after they reached a certain size, dried up completely without the ovules having profited, and on some other plants there were some grains along the ear that grew considerably and looked as if they contained germs and were therefore fertile, while all the others aborted; but no ear developed in its entirety.

It could be that despite all the precautions I took to take away all the anthers before they blossomed, a few blossomed before I could cut them, or that some hidden anthers were left that blossomed afterwards. Perhaps also some dust was brought in from elsewhere by the wind and benefited a small number of grains. I also raised some fruit-bearing plants of dog's mercury separately from the ones with stamens, and it is true that they produced a few seeds, but most of them aborted, with the exception of five or six on each plant that looked to me very viable and capable of producing new plants, because what I have said about corn also occurred to them, otherwise why wouldn't they all have profited equally?

One could object to the above by citing what M. Tournefort reports in the very same preface of his *Institutions Botaniques*, which is, that he saw a female plant of hops produce seeds in the Royal Gardens

(295)
where there weren't any male plants, not even in the vicinity. In this situation, the dust could

only have been transported by the wind from the islands near Charenton, where I found the closest plant with flowers. I will not contest that it is a long distance, but I would answer that it can be as much as you like, it doesn't matter, as long as the wind can bring in the dust.

And that it is not impossible, we have a lovely example reported by Jovianus Pontanus, tutor of Alphonse, King of Naples, who relates that two palm trees were seen in his time, one a male tree cultivated at Brindisi and the other a female tree cultivated in the woods of Otronto; that the latter went for many years without bearing fruits, until, having grown taller than the other trees of the forest, it could see, as the poet reports, the male palm of Brindisi, even though it was more than fifteen leagues[49] away, because it started to bear an abundance of good fruits.

There is no reason to doubt that it commenced bearing fruits only because it commenced receiving on its branches and on its fruit primordia the dust from the stamens that the wind blew from the top of the male palm over the tops of the other trees. Thus we explain in a natural and reasonable way this fertility that so embarrassed the ancient scientists and that they attributed to the sympathy or to the love that the trees have for each other, without knowing how this love mystery can take place. This is what one can see in the poem that Pontanus

(296)
wrote about an event that looked so miraculous.[50]

This story, while proving the necessity of the dust for the fertility of the female palm tree, shows that the distance between trees of the different sexes is not a valid argument to use.[51]

It is therefore a constant that the dust contributes to the fertility of plants. It remains to be discovered how they contribute, and on this we can form only two hypotheses. The first hypothesis is that the dust particles are all sulfurous and full of subtle and penetrating parts as their odor sufficiently proves, and when they fall on the pistils of the flowers, they return to their elements; and their most subtle parts penetrate the substance of the pistil and the young fruit where they trigger a fermentation capable of developing the young plant encased in the ovule. For one must suppose, according to this idea, that this ovule contains in miniature the young plant that will be born, and the only thing that is missing is a sap suitable for making it develop and grow.[52]

The second hypothesis is that the dust particles of the flowers are the true germs of plants, and that they need the sap they find in the ovules to develop, as the animals need the egg and uterus to see the light of day. That last proposition is further supported by the fact that, even with the best microscopes, no hint of a germ can be seen in the small ovules when examined before the

(297)
flower matured or before the anthers open; and it is not only in these ovules that one cannot see them but also in these same seeds that are examined later in their development, at the stage in which the germ is usually visible, when these seeds have not been fertilized by the dust.[53]

[54]Indeed, if one examines in the leguminous plants the pistil, or that part that becomes the pod, before the flower opens, after having freed it of its petals and stamens, and if one looks at it in sunlight under a microscope, one can very easily see the little green and transparent vesicles that will become the seeds placed in their natural order, and in which one distinguishes nothing else besides the envelope or seed coat. If one continues to observe it during several successive days in other flowers, as they develop, one notices that these vesicles

grow and fill up with a clear liquor in which, once the dust has been dispersed and once the petals have fallen, one begins to see a small, freely floating dot or greenish globule. One cannot see anything organized in this small body, but with time and as it grows, one distinguishes little by little two small leaves like two horns. The liquor is consumed noticeably as the small body enlarges and the seed becomes completely opaque. If one opens it, one finds the cavity filled with the little miniature plant

(298)
made up of the germ or plumule, the radicle and the lobes of the fava bean or the pea.

If, on the contrary, in the peonies with double flowers,[55] which are completely devoid of stamens and anthers, one examines the seeds they produce, either aborted or not, one finds them empty and containing only a few desiccated membranes and without any hint of germ, similar in this to an unfertilized chicken egg. Indeed, had a germ been present in these membranes, shouldn't it have grown in proportion to these envelopes and become clearly visible?

Following this hypothesis, it is not difficult to determine the way in which the germ gets into this vesicle, for besides the fact that the cavity of the pistil extends from its tip to the ovules, these vesicles [ovules] also have a tiny opening near their attachment point that is located at the tip of the pistil conduit, in such a way that the little dust particle can naturally fall through this opening in the cavity of the vesicle, which is the ovule. This cavity leaves a tiny scar that is easily seen in the majority of seeds: one can see it very easily without recourse to a microscope in peas, fava beans and *Phaseolus*.[56]

The root of the little germ is very close to this opening, and it is through this that it exits when the seed germinates.

But, regardless of which hypothesis one holds,

(299)
it remains always constant through my observations that the dust particles from the anthers, which have been neglected until now as if they were vile excrements which somehow disfigure the beauty of flowers, are in fact essential parts and necessary to the fertility of plants.

Explanation of the figures.
Figs. 1–20: Different flowers.

(300)
Figure 21 represents the male flower of the pumpkin, which doesn't bear any fruit, and from which one has removed the petal positioned on the circle *(FF)*, in order to better show the other parts.

ABE represents the head placed at the center of the flower, formed by the convolutions of the anthers *(B)*, and supported by four kinds of columns *(GGGG)*.

Part *B* of this head represents the convolutions of the still closed anthers, and Part *E* shows them open and covered with the dust that they contain, which gets dispersed at the time of flower maturity.

(301)
H is the pedicel that supports the flower and that produces nothing in the male flower.

Fig. 22 represents a portion *(B)* of these anthers as seen under the microscope: they form a kind of duct *(B)*, divided in two cavities *(DD)*, filled with dust particles separated by the middle partition *(C)*.

Fig. 23 represents the two cells (*DD* from *Fig.* 22) opened and emptied of their dust. They are opened along their length, revealing the partition *(CC)*. Some dust particles *(E)* have been left in the cell *(D)* to show the way they spring out at the time when the ducts or cells *(B)* that contain them burst.

Fig. 24 represents the female flower of the pumpkin, which is the flower that bears the fruit. As in the preceding [male flower], the petal positioned on the circle *(FF)* has been removed to better show the other parts.

A represents the knot of the flower or the embryonic fruit.

BBB represents the pistil, which is part of the knot of the flower of the embryonic fruit *(A)*. The tip of the pistil opens in *BB* in several heart-shaped bodies *(C)*.

C represents one of these hearts, divided in two lobes by a slit. These heart-shaped bodies are bristling with vesicles and hairs for retaining the male flower's dust and for conducting them to the mouths of the channels that communicate with the seed compartments in the young fruit.

(302)

Fig. 25. represents the same parts from the female flower and its fruit.

The pistil below the head *(B)* has been cut horizontally to show the four channels *(DD)* that correspond to each of the heart-shaped heads of the same pistil *(BB)*. These canals descend vertically from the summit of the pistil *(B)* to the compartments of the fruit *(AA)*.

The fruit *(A)* has also been cut horizontally to show the four compartments *(D)* of the seeds. These four compartments correspond to the four canals of the pistil and to the four heads of the same pistil *(BB)* that are heart-shaped.

As each head of the pistil *(BB)* is divided into two lobes by a slit *(C)*, so are each of these seed compartments of the fruit *(A)* divided in two by a parenchyma that forms a sort of half-partition, in such a way that it can be seen in each of the two rows of seeds attached to a placenta that correspond to the eight pistil divisions.

Fig. 26 represents one half of a Calvil apple, cut along its length to show all the internal parts.

A represents the navel of the apple formed by the ends of the leaves of the calyx that form a kind of arch.

B is a cavity that starts from the tip of the arch and continues to the cavity of the seed compartments *(C)*. These two cavities, *B* and *C*, terminate at a point near the stalk *(D)*. At the upper end of the cavity *(B)*, near the navel, are found the dried stamens

(303)

attached to the walls of this cavity, surmounted by their anthers *(E)*, emptied of their dust.

F represents the five divisions of the pistil, resting below the stamen *(E)*.

The pistil is represented in its entirety to better show its position. The five divisions of this pistil correspond to the five angles of the capsules of the seeds *(G)* upon which it rests. The channels of the pistil *(F)* bend in *(H)* and form, as they climb, the placenta *(I)* of the seeds *(K)*.

Fig. 27 represents half of a Calvil apple, cut transversely to show the order of the five cartilaginous cells *(EEEEE)*.

K represents the seeds or pips attached at the base of the compartments.

B shows the cavity that extends from the navel of the apple to the bottom of the seed compartments, around which they are arranged in a circle.

Notes

1. In Geoffroy's original, "feuilles" (leaves) is used in this context to denote petals. Although Tournefort initially referred to petals as "leaves" in the *Élémens de Botanique* (1694), in later writings he adopted the term "petal," which, according to Edward Lee Greene (1983), was a term already being used by earlier contemporaries, including Morison, Ray, and Rivinus. The fact that Geoffroy used Tournefort's older term may suggest that he was not as aware as he should have been of Tournefort's later work. Sébastien Vaillant makes a point of correcting the use of "leaves" for petals early in his 1717 lecture.

2. Geoffroy uses the term "sommets" to denote the anther, in keeping with Tournefort's usage.
3. Presumably Geoffroy is specifically referring to the presence of two sexes.
4. The phrase "faute d'entrer dans les vûës de la nature" is literally translated as "a mistake if we are to enter the views of nature." We have translated this somewhat cryptic phrase as, "if we are to gain a proper understanding of nature."
5. "Physicien" (physicist) is a general term for a scientist who studies the natural world.
6. Geoffroy uses "les embryons des graines" (literally, embryos of the seeds) to refer to the ovules, or immature seeds.
7. The ovary of animals, that is. Geoffroy does not apply the term "ovary" to the base of the carpel.
8. Here Geoffroy foreshadows the material he presents near the conclusion of his lecture purporting to demonstrate the role of pollen in fertilizing the flower. Note that he clearly states that the results he will present represent his own observations, whereas it is now clear that he was plagiarizing Camerarius.
9. Perhaps a climbing form of the genus *Aristolochia*. For example, *Aristolochia serpentaria* has six stamens with anthers sessile and adnate to the back of the stigma.
10. The tubular florets, ligulate florets, and ray flowers, respectively, of the Compositae. See Fig. 5 from Tournefort's *Élémens.*
11. Here Geoffroy equates the ovule with the ovary.
12. Geoffroy later refers to this plant as "spiderwort" (*Tradescantia virginiana*).
13. Tithymale usually refers to *Euphorbia* species, but here it seems to be referring to castor bean.
14. It is not clear to what is referred here; possibly *Ochroma pyramidale* (Balsa).
15. Either *Leucojum aestivum* or *Calystegia sepium*.
16. Possibly clove (*Eugenia caryophyllus* synonym *Caryophyllus aromaticus*) or the clove pink (*Dianthus caryophyllus*).
17. *Caltha palustris* 'Alba' (marsh marigold or king cup).
18. Based on the figure, sunflower.
19. *Althaea frutescens* and *Malva* are mallows; *Convolvulus* is morning glory.
20. *Muscus terrestris clavatus* is an alternative name for *Lycopodium clavatum*, a club moss. Geoffroy here confuses spores with pollen grains.
21. The view that pollen is a waste product was espoused both by Tournefort and his mentor, Marcello Malpighi (1628–1694).
22. See note 15.
23. In modern botanical terminology, the ovule-containing female structure is called the carpel, while the pistil may consist of two or more carpels fused together in a composite structure.
24. Try this at home. It works!
25. A popular variety of apple: "Pomme de Calvil."
26. These flowers all have "inferior ovaries," also referred to as epigyny, so that their floral parts are attached above the developing fruit.
27. Geoffroy's term is "fleurs noüées," literally "knotted flowers." The ovary of the flower was referred to as an "embryonic fruit" or "knot" (see Geoffroy's Figure 24).
28. Again, Geoffroy uses the term pistil to denote the style and stigma, while the ovary is referred to as an "embryonic fruit." Geoffroy notes that the end of the pistil may be differentiated in various ways, but he does apply the term "stigma" to this structure.
29. Monoecious species.

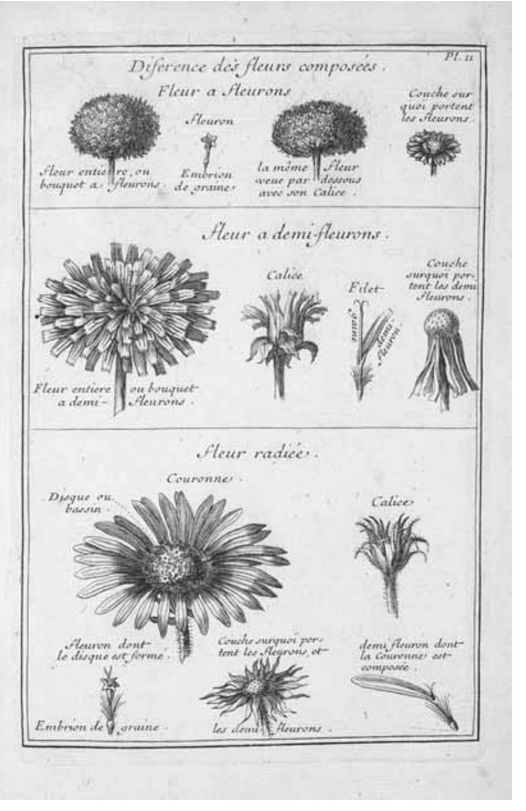

Figure 5. Compositae flower types from Joseph Pitton de Tournefort's *Élémens de Botanique* (Paris, de l'Imprimerie Royale, 1694, vol. 2, pl. 2). Courtesy of Hunt Institute for Botanical Documentation.

30. Dioecious species.
31. The term "bourse" is defined as a small leather purse or sack. However, in the plural form "bourses," as used here, it can also mean "scrotum." It is likely that Geoffroy had selected this word intentionally to take advantage of the double meaning. This is as close as Geoffroy gets to the kind of playful sexual innuendo that distinguishes Vaillant's 1717 lecture. Of course, Vaillant's lecture was primarily aimed at students, while Geoffroy's was a formal presentation to the French Academy.
32. Presumably Jean Marchant (?–1738) provided a detailed description of the liverwort, *Marchantia*, which he named after his father, Nicholas Marchant (?–1678), also a botanist and French Academy member.
33. "Lithophytons." Geoffroy considered tree corals as plants and did not distinguish between fungi and flowering plants nor between ferns and flowering plants, views shared by most of his contemporaries.
34. Luigi Ferdinando, Count de Marsigli, was an Italian geographer and naturalist.
35. "Capillaire" (*Adiantum capillus-veneris*, maidenhair fern).
36. Geoffroy uses the term "feullets" (leaves or pages) for gills.
37. "Cells" here refer to small compartments, not biological cells.
38. The first stage in fern spore germination is the gametophyte, which was probably too inconspicuous and different in appearance from the more familiar sporophyte stage for Geoffroy to notice.
39. German physician and professor (1515–1544).
40. Geoffroy again confuses the ovule with the ovary.
41. The fig fruit is called a *syconium* and consists of unisexual flowers contained inside a pear-shaped receptacle with a small opening at the apex. The pistillate (female) flowers occupy the interior lining a central cavity, while the staminate (male) flowers are fewer in number and are restricted to the small pore. Geoffroy apparently missed these small staminate flowers in the pore region.
42. Horsetails (*Equisetum*) are a primitive vascular plant, like ferns, which produce spores rather than seeds. Geoffroy confuses spores with pollen and thus assumes that female "fruit flowers" must also be present. In contrast, Camerarius, in his *Epistola*, specifically excluded such plants as horsetails and club mosses from consideration because of their apparent lack of flowers.
43. This reference is obscure, in part, because the term "stamen" was used by Cesalpino to refer to the style and stigma while the term "flocci" was used to denote stamens. Cesalpino was, of course, completely unaware of the sexual significance of these structures and regarded them simply as nonessential filamentous petals. (See Greene 1983).
44. Geoffroy had no way of knowing that the vast majority of plants are out-crossers and do not self-pollinate. Indeed, insect-mediated pollination was not fully understood until the work of Joseph Kölreuter (1733–1806), published between 1760 and 1766.
45. *Fritillaria imperialis*
46. The use of the metaphor "sur le duvet" (literally, "on goosedown") to describe the softness of the petal on which the stigma is resting while it is being fertilized by the stamens is mildly suggestive and is the closest the otherwise colorless Geoffroy comes to the extravagant and vivid sexual metaphors employed by Vaillant in his 1717 lecture. It is possible that Vaillant's more racy description of the floral bud as a "nuptial bed," a metaphor later repeated by Linnaeus, was actually inspired by Geoffroy's original more restrained use of poetic license.
47. "Intromission" is used here in the sexual sense and is reminiscent of Grew's comparison of pollination with animal coition, either by intromission or adosculation: "And that these Particles, only by falling down on the Uterus [ovary of flower], should communicate to it or to the sap therein, a Prolifick Virtue: it may seem the more credible, from the manner wherein Coition is made in some Animals; as by many Birds, where there is no Intromission, but only an Adosculation of Parts…" Nehemiah Grew, *Anatomy of Plants*, Book II, 1682.
48. The term "nielle" is a general term for fungal diseases. Based on the symptoms described, smut seems to be the disease indicated.
49. About 80 km
50. Here is a fragment of Pontanus' Latin poem:

    Brundusii late longis viret ardua terris
    Arbor, Idumaeis usque petita locis
    Altera Hidruntinis in saltibus aemula palma;
    Illa virum referens, haec muliebre decus.
    Non uno crevêre solo, distantibus agris,
    Nulla loci facies, nec socialis amore.
    Permansit sine prole diù, sine fructibus arbor
    Utraque, frondosis et sine fruge comis.
    Ast postquam patulos fuderunt brachia ramos,
    Coepere et coelo liberiore frui.
    Frondosique apices se conspexêre, virique
    Illa sui vultus, conjugis ille suae,

Hausêre et blandum venis sitientibus ignem,
Optatos foetus sponte tulêre sua:
Ornarunt ramos gemmis. Mirabile dictu,
Implevêre suos melle liquente favos.

English translation:

In Brindisi a tree grows verdantly from a great distance,
Reaching to the lands of Idumea;
Another, a similar palm, grows on the wooded hills of Otranto;
One resembles a man, the other resplendent in femininity.
They were not created on the same land,
But on field distant from one another,
With no similarity in their localities
And no reciprocal love between them.
Both trees long remained without progeny and without fruits,
With leafy barren crowns.
But when the shoots spread out their outstretched branches,
The trees began to use freer soil,
The leafy tops took notice of one another,
One absorbed the features of its husband,
The other the image of its wife.
And they began to imbibe the vein, sating pleasant flame;
Willingly they bore the desired fruit;
They adorned their branches with buds; it's wondrous to relate,
They filled their honey combs with liquid honey.

Translation from L. I. Dzhaparidze, *Sex in Plants* (Jerusalem, Israel Program for Scientific Translations, 1967, p.15).

51. This statement, which appears to give as much credence to anecdote as to experimental results, is a far cry from Camerarius' rigorous evaluation of his own evidence.
52. In this interpretation, which Geoffroy seems to reject, the young plant arises by a type of "fermentation" that is triggered by elements of the pollen that somehow penetrate the pistil and enter the ovule. What forms is a miniature plant, in keeping with the Geoffroys' preformationist views.
53. The interpretation that Geoffroy clearly prefers is the spermist view that the pollen provides the embryo of the plant. This explanation requires that the pollen be able to enter the cavity of the ovary intact so that it can deposit the embryo inside the ovule.
54. This is the beginning of the passage about embryogenesis in legumes that seems to have been largely plagiarized from Camerarius (see Introduction).
55. "Double flowers" are normally sterile because the stamens and either some or all of the pistils have been converted to petals.
56. Geoffroy is referring to the micropyle, the opening in the seed coat through which the pollen tube grows when it deposits the two sperm cells into the ovary sac, or female gametophyte, of the ovule. Geoffroy's interpretation of the function of the micropyle as an entry point for the embryo is thus much closer to the truth than was Nehemiah Grew's speculation (*Anatomy of Plants*, 1682) that the micropyle served as an opening for water to enter the seed during germination.

272

OBSERVATIONS

Sur la structure & l'usage des principales parties des Fleurs.

Par M. GEOFFROY le Jeune.

* Les Fleurs pour la plûpart sont composées des feuilles de differente forme & de differente couleur, d'un calice qui leur sert d'enveloppe, d'une petite tige creuse qui s'éleve du milieu des feuilles qu'on appelle le *Pistile*; & enfin de quelques filets, qu'on appelle *Etamines*, terminés par de petits corps de differente structure qu'on nomme *Sommets*.

*14. Novembre 1711.

273

On pourra voir ces differentes parties au commencement des *Elemens de Botanique* de M. *Tournefort, planche premiere & suivantes,* ausquelles nous renvoyons le Lecteur, ne croyant pas qu'il soit necessaire d'en rapporter ici les figures ni les descriptions.

L'experience fait assez voir que toutes ces parties sont destinées à la naissance & à la nourriture du fruit & de la graine, d'où dépend la reproduction de la plante.

Il est donc vrai de dire que dans les plantes qui sont des corps organisés comme ceux des animaux, les fleurs répondent aux parties qui dans ceux-ci sont destinées à la génération. Il n'est pas difficile non plus de conjecturer que comme les plantes n'ont pas la facilité de se mouvoir qu'ont les animaux, la nature a renfermé pour l'ordinaire dans une même fleur toutes les parties qui doivent contribuer à la conservation de l'espece, & qui étant separées dans les animaux, forment les differens sexes.

Il semble même que la nature en nous faisant un mystere de la génération de tous les corps vivans, ait voulu en quelque sorte se laisser pénétrer dans la conduite qu'elle tient à l'égard des plantes. Car si elle a confondu les differens sexes en certaines fleurs, elle les a séparé d'autres, ce qui ne contribuë pas peu à nous les faire discerner.

C'est de-là que les Botanistes ont été forcez de distinguer certaines plantes en mâles & femelles, sans en savoir bien la raison, mais seulement parce qu'ils voyoient que les unes portoient des fleurs qui n'étoient suivies de rien, & que les graines étoient sur des pieds

274

differens: on a depuis appellé les premieres *Fleurs à Etamines* ou *Chatons,* & les autres *Fleurs à fruit.* Voyez les *Elemens de Botanique planche 346.* & dans les mêmes *Elemens la planche 31.*

L'usage des Chatons a toûjours été assez ignoré, faute d'entrer dans les vûës de la nature, qui semble nous induire à conjecturer que les Chatons sont les parties mâles destinées à la conservation de l'espece, comme les fleurs à fruit sont les parties femelles. Dans certaines plantes les Chatons sont tellement séparez des fleurs à fruit, qu'ils sont sur differens pieds; dans d'autres ils se trouvent sur le même pied, & dans tout le reste les Chatons & les fleurs à fruit sont réünies dans la même fleur, comme j'espere le démontrer par la suite de ces Observations.

Commençons donc par démêler quelles parties des fleurs tiennent le premier rang dans la production des graines. A en juger sur l'apparence, les feuilles par leur beauté, leur structure, le vif éclat & la varieté de leur couleur l'agréable odeur qu'elles répandent, passeroient pour ce qu'il y a de plus considérable; c'est en effet ce qui occupe le curieux qui néglige tout le reste, mais le physicien en doit juger autrement. Quand on considere que les feuilles des fleurs ne portent rien en elles-mêmes de remarquable; qu'elles sont situées autour des autres parties, comme pour leur servir d'enveloppe & les défendre des injures de l'air; qu'elles tombent dès que le fruit venant à se noüer n'a plus besoin de leur secours, on revient bien aisément d'un tel préjugé. Pour le calice qui est encore plus exterieur que les

275
feuilles, que peut-il être qu'une premiere enveloppe des parties essentielles de la fleur? Il nous reste donc plus à examiner que les étamines surmontées de leurs sommets, & le pistile qui renferme en soi les embryons des graines, dont il est, pour ainsi dire, comme l'ovaire.

Ces filets d'étamines & leurs sommets paroissent si peu considérables dans les fleurs, qu'on ne les regardoit que comme des vaisseaux excrétoires, propres à séparer le surplus du suc destiné à la nourriture du jeune fruit. Mais à les examiner de plus près, & à voir la conformité qu'ils ont avec les sommets des Chatons dans les plantes que j'appellerai mâles, on a tout lieu de juger que ce sont véritablement les parties mâles des plantes.

En effet, ces sommets sont des capsules ou vésicules qui étant venuës à un certain point de maturité, s'entrouvrent & versent une poussiere de differente configuration selon la difference des plantes, & qui par les observations que j'ai faites, m'ont paru contribuer à leur géneration [*sic*] comme parties essentielles.

Dans la plûpart des plantes, comme dans le Lis, dans la Tulipe, ces petits corps sont attachez aux étamines qui sont ces filets qui partent ou du calice ou des feuilles de la fleur.

Dans quelques fleurs tubulées, ou dont les feuilles sont formées en tuyau comme dans le Narcisse, dans la Digitale, dans la Primevere, ces étamines sont très-courtes, & dans quelques-unes mêmes il n'y en a point du tout, comme dans l'Aristoloche longue où les sommets sont attachez immediatement à la capsule qui enferme les fruits.

276
Dans les fleurs à fleuron, à demi fleuron ou radiées, les sommets, sont enveloppez ou cachez dans les étamines qui se réunissent en forme de gaine, comme on peut l'observer dans le Bleuet, les Chardons, la Laituë, la Chicorée: voyez les *Elemens de Botaniq. planches* 2. & 3. Car dans ces fleurs il part de la feuille du fleuron ou du demi fleuron dans l'endroit où il commence à s'évaser cinq filets ou étamines qui se réünissant, forment un petit tuyau comme une espece de gaine garnie par dedans de ces sommets ou capsules remplies de poussieres, le reste de la cavité est occupé par le pistile qui est un petit filet posé sur l'embryon de la graine. Lorsque la fleur ne fait que commencer à s'épanouïr, le filet reste encore caché dans la gaine; mais à mesure que la fleur s'augmente, il croît, s'allonge, & en même temps les sommets venant à s'ouvrir, lui font jour entre eux, & il paroît enfin hors de la gaine chargé de poussieres que les sommets y ont versez.

Ces capsules sont pour l'ordinaire membraneuses: voyez les *Elem. de Botaniq. planch.* 4. mais dans quelques plantes aromatiques, comme dans le Romarin, la Sauge, le Thym, elles sont fort dures.

Il y a une infinité de varietez à observer sur la forme de ces capsules, sur le nombre, sur la maniere dont elles s'ouvrent, qu'il seroit trop long de rapporter ici: mais comme elles sont toûjours constantes dans chaque espece, on ne doit point les négliger dans les caracteres des plantes tirés des fleurs, puisque de toutes les parties des fleurs c'en est une des plus essentielles.

277
La difference qui s'observe entre les poussieres de differentes especes de plantes n'est pas moins grande, soit pour la couleur, soit pour la grosseur, soit pour la figure.

Il y en a de claires & mêmes transparentes comme du cristal: telles sont celles de l'Erable, du Meliante, de la Bourrache & de la Ciguë: de blanches, comme celles de la Balsamine, de la Jusquiame; de bleuë, comme celle de Lin; de couleur de pourpre, comme celles de quelques Tulipes; de couleur de chair, comme celles de quelques especes de *Lychnis,* mais la plus grande partie de ces poussieres sont jaunes, plus ou moins foncées: celles de *Geum* à fleur rouge, sont aussi rouges, quoique M. *Grew* assure n'en avoir jamais vû de cette couleur.

Il paroît cependant que la couleur des poussieres varie dans la même espece suivant la couleur de la fleur, & quelquefois les poussieres dans une même fleur sont de differentes couleurs, ce que j'ai observé dans celle du *Caryophyllus arvensis*.

Il seroit difficile de décrire toutes les figures differentes de ces poussieres: car quoiqu'elles paroissent aux yeux plus fines souvent que de la farine, cependant chacun de ces petits grains a une figure reguliere, déterminée & constante dans toutes les fleurs d'une même espece, & je n'ai point remarqué sur cela de varieté considerable. Il est vrai que quelques-unes de ces poussieres changent un peu de figure en le desséchant; c'est pourquoi celles du *Cucumis sylvestris* prises sur la fleur fraîche, paroissent d'abord rondes comme de petits globules, & quelques moments après elles

278

prennent la figure de noyau de Dattes, avec une renure dans leur milieu à mesure qu'elles se dessechent.

Dans la plus grande partie des fleurs ces poussieres ont une figure ovale plus ou moins pointuë par leurs extrémitez avec une ou plusieurs canelures dans leur longueur, en sorte que vûës par le microscope, elles ressemblent assez à un noyau de Datte, à un grain de Bled, à une Féve de Caffé, ou à une Olive. Telles sont celles du *Polygonatum,* de la Bugle, de la Bryone, de la l'Ancolie [*sic*], du Tithymale.

1. Celles du Millepertuis paroissent de petits ovales en maniere d'Olives pointus par leurs extremitez, un peu renflez dans leur milieu avec un point lumineux.

2. Celles du Melilot paroissent des Cylindres ou des rouleaux avec une renure dans leur longueur.

3. Celles de la Pensée sont des prismes à quatre faces irrégulieres un peu transparens, qui, selon, leur position, représentent differentes figures.

4. Celles de la Bourrache sont aussi des rouleaux, mais ils sont étranglez dans leur milieu, & éclairez dans leur longueur en trois differens endroits.

5. Celles de la grande Consoude représentent fort bien deux boules de cristal étroitement collées l'une à l'autre.

6. Celles de l'Erable ou Sycomore représentent deux cylindres posez en croix, l'un plus court que l'autre.

7. Celles du Lis sont en Olives pointuës par les extremitez, chagrinées en leur sur-

279

face avec une renure dans leur longueur.

8. Celles de la Jonquille sont en forme de Rein.

9. Celles de l'*Ephemerum virginianum* sont de la figure d'un grain d'Orge.

10. Celles du Tithymale, du Ricin, sont des figures ovoïdes, chargées d'une renuer dans leur longueur.

11. Celles de l'Acante sont oblongues, arrondies par les extrémitez, & chargées aussi d'une renure dans leur longueur.

12. Celles du Genest d'*Espagne* paroissent oblongues, arrondies dans leurs extrémitez, & chargées de deux especes de renures, ou de deux éminences lumineuses.

13. Celles de la Tubereuse sont oblongues, renflées dans leur milieu en maniere de prisme à trois faces.

14. Celles de la Pyramidale & des autres especes de Campanelles sont presque rondes, transparentes, & chargées en leurs surfaces de quelques legeres éminences, & un point lumineux au centre.

15. Celles de la fleur de la Passion sont aussi presque rondes, inégales dans leurs surfaces.

16. Celles du *Carophyllus* [*sic*] *sylvestris* sont rondes, taillées à facettes.

17. Celles du *Geranium* & quelques autres especes sont rondes, avec une espece de nombril, comme on le voit à la Pomme.

18. Celles du Potiron sont rondes, chargées de petites pointes élevées fort courtes.

19. Celles du *Caltha,* du *Corona solis,* & une partie des fleurs radiées, sont de petites boules herissées de poils fort courts.

280

20. Celles de *l'Athæa* [*sic*] *frutescens*, de la Mauve, du *Convolvulus*, sont des globes herissez de pointes assez épaisses & fort aiguës à leurs extrémitez.

On trouvera à la fin de ce Memoire les figures de ces poussieres vûës au microscope, & dessinées le plus exactement qu'il a été possible.

Quelques-unes de ces poussieres paroissent fort dures, d'autres sont tendres & très-aisées à s'écraser.

Elles contiennent toutes beaucoup plus de matieres sulphureuses que les autres parties de la fleur, aussi ont-elles beaucoup plus d'odeur. Celles du Lis sont tellement chargées d'huile, qu'elles engraissent le papier dans lequel on les tient enfermées, comme s'il avoit été huilé. Les poussieres de la plûpart des plantes aromatiques nagent dans une huile essentielle ou espece de Terebentine liquide; d'autres paroissent enveloppées d'une resine séche comme celle du *Lycopodium* ou *Muscus terrestris clavatus,* CB. car si l'on souffle cette poussiere à travers la flamme d'une chandelle, elle s'allume de même que si c'étoit de la raisine en poudre. Quelques autres poussieres comme celles de la Fumeterre, paroissent enveloppées d'un peu de matiere mucilagineuse. En effet, elles sont si gluantes qu'elles s'attachent à tout ce qu'elles touchent, & qu'on ne peut qu'à peine les séparer les unes des autres.

Ces petites graines cependant ne se dissolvent ni dans l'eau, ni dans l'huile d'Olive, ni dans l'huile de terebentine, ni dans l'esprit de vin, pas même à l'aide du feu: les trois der-

281

nieres liqueurs entirent [*sic*] bien quelque teinture, mais qui ne change point ou que très-peu la figure du grain.

Quelques-uns ont prétendu que ces grains de poussieres n'étoient que des particules de cire ou de resine. Pour voir ce qui en étoit je les ai fait bouillir dans de l'eau, ils ne s'y sont point fondus, & en les faisant chauffer sur le feu dans une cueillere, ils s'y sont brûlez & réduits en charbon sans se fondre, d'où il paroît que ces petits grains de poussiere sont de petits corps d'une structure particuliere, & qui gardent, comme je l'ai dit, une forme constante dans chaque espece de fleurs.

Passons à l'examen de l'autre partie essentielle de la fleur qui en occupe ordinairement le centre, & qui comprend le pistile où sont renfermez les embryons des graines, soit dans sa base, soit dans toute sa longueur. Il prend son origine du pedicule de la fleur ou du centre du calice, & devient par la suite le jeune fruit qui est tantôt caché dans le calice & tantôt tout-à-fait dehors.

Sa figure est très-differente dans un grand nombre de fleurs. C'est quelquefois une petite tige qui s'élargit par ses deux bouts en forme de pilon, quelquefois c'est un filet. Il y en a de ronds, de quarrez, de triangulaires, d'ovales, de semblables à un fuseau, ou d'autre façon. On peut voir differentes figures de ces pistiles dans les premieres planches des *Elemens de Botanique.*

Presque tous les pistiles sont garnis à leur extremité de petits poils très-deliez, qui font comme un velouté, ou de petits filamens dis-

282

posez en panaches ou en aigrettes, ou bien ils sont parsemez de petites vessies pleines d'un suc gluant. On peut observer ce velouté sur le haut des pistiles de la fleur de Coquelicoc, de la Populago, de la Gentiane, de la Campanelle. On remarque ces panaches & ces aigrettes au haut du pistile du Bled, à l'extremité des pistiles de la fleur de Vigne, de Violette, & de la plûpart des fleurs legumineuses. Les vesicules paroissent très-distinctement au bout des pistiles du Lis & du *Convolvulus*.

Il y a des fleurs dans lesquelles on remarque plusieurs pistiles, ou dont les pistiles se terminent en plusieurs cornes qui prennent naissance sur autant de jeunes fruits, ou qui partent d'autant de differentes capsules qui renferment les graines, soit que chaque capsule ne contienne qu'une seule graine, soit qu'elle en renferme plusieurs: ainsi dans le Tithymale, la Toutesaine, on remarque trois pistiles & autant de capsules de graine. Dans l'Ancolie & dans la Fraxinelle cinq ou six: dans le Lis & dans la Tulipe il n'y a qu'un pistile, mais il forme à son extremité une triple tête qui répond aux trois cellules des graines qui partagent le fruit. Dans le Potiron on n'observe de même dans la fleur femelle qu'un seul pistile qui se subdivise à son extremité en plusieurs têtes échancrées dans leur longueur, & ces differentes têtes repondent aux cellules des graines du jeune fruit.

Tous ces pistiles, quelques figures qu'ils ayent, ont quelques ouvertures à leur extremité, ou quelques fentes qui continuent dans toute leur longueur jusqu'à leur base, ou aux embryons des graines: c'est ce

283

qu'on apperçoit très-aisément dans le Lis, dans le Narcisse, dans la fleur de Grenade, & particulierement dans le Potiron, en fendant ces pistiles dans leur longueur, ou les coupant transversalement.

Si après avoir coupé le pistile du Lis on en plonge une extremité dans l'eau, & si on suce par l'autre bout, on y fera monter l'eau de la même maniere que dans un chalumeau très-delié.

Pour peu que l'on veuille se donner la peine d'ouvrir les pistiles dans leurs differens états d'accroissement, on reconnoîtra très-distinctement qu'ils forment les jeunes fruits, & qu'ils renferment au dedans d'eux les embryons des graines, soit que ces graines soient repanduës dans toute la longueur du pistile, soit qu'elles soient renfermées dans sa base, il est toûjours ouvert à son extremité, & percé plus ou moins sensiblement jusqu'à sa base. Souvent cette cavité s'efface à proportion que le jeune fruit grossit, quelquefois même une partie du pistile que M. *Malphigi* [*sic*] nomme le stile ou l'aiguille, se desséche & tombe. Cependant dans plusieurs fruits la cavité, qui contient le pistile & les étamines, ne laissent pas de se conserver, & même de se rendre très-sensible, comme on peut l'observer dans les Poires, dans les Pommes, & principalement dans celles de Calvile. Voyez les *Figures* 26. & 27.

Voilà ce qu'on remarque dans les plantes, dont les fleurs contiennent, pour ainsi dire les, deux sexes réünis. Les mêmes choses s'observent séparément dans les plantes où ils sont separez, c'est-à-dire où les sommets sont d'un

284

côté, & les embryons du fruit de l'autre, tantôt sur le même pied, tantôt sur des pieds differens. Tel est le Potiron qui porte sur le même pied des fleurs steriles que l'on nomme communément fausses fleurs, & que je nomme fleurs mâles, & des fleurs à fruit que l'on nomme fleurs noüées, & que je nommerai fleurs femelles.

Ces deux sortes de fleurs sont composées de feuilles d'une seule piece en cloche évasées & découpées en plusieurs parties sur leurs bords.

Du centre de cette cloche dans la fleur mâle s'élevent plusieurs branches qui se réünissent & forment un corps qui devient par la suite de figure cylindrique chargé à sa surface de sommets qui serpentent d'un bout à l'autre. Voyez la *Figure* 21. Ces sommets sont des corps partagez dans leur longueur par une cloison mitoyenne en deux cavitez. Voyez la *Figure* 22. & 23.

Lorsque cette fleur est dans son état de perfection, ces sommets s'ouvrent selon leur longueur en deux demi canaux, d'où s'échappe une poussiere très fine . Voyez *Figure* 23. qui est chariée sur les fleurs femelles pour les féconder.

La fleur femelle couronne la tête d'un embryon de fruit qui ne se voit point aux fleurs mâles; du sommet de cet embryon s'éleve en maniere de pyramide renversée un corps qui est le pistile qui se divise en plusieurs lobes faits en cœur, avec un sillon tracé dans leur longueur & hérissez de poils courts, propre à accrocher & retenir les poussieres que la fleur mâle répand.

285

Si on coupe ce pistile transversalement dans sa partie la plus étroite, on y trouvera autant de canaux qu'il y a de divisions à sa tête. Ces canaux vont repondre à autant de cellules qui renferment chacune deux ordres de semences rangées dans un *placenta* spongieux. Voyez la *Figure* 25.

On compte entre les plantes, dont les Chatons se trouvent en des endroits séparez des fleurs à fruit sur le même pied, outre le Potiron, le Concombre, le Melon, la Courge, le Bled de Turquie, la Larme de Job, le Tóurnesol, l'Ambrosie, le Noyer, le Noisetier, le Charme, le Chêne, le Hêtre, le Sapin, le Pin, l'Aune, le Cyprès, le Bouleau, le Cedre, le Genevrier, l'If, le Meurier, le Platane.

Entre celles dont certains pieds portent des Chatons sans fruit, & dont certains autres pieds portent des fruits sans Chatons, sont comprises quelques especes de Palmier, le Saule, le Peuplier, la Mercuriale, le Chanvre, l'Epinard, l'Ortie, le Houblon.

Nous n'avons pas besoin ici d'un plus grand détail. Il s'agit seulement d'examiner l'usage des parties que nous venons de décrire.

Premierement pour ce qui regarde les sommets & la poussiere dont ils sont remplis, il est évident que ce ne sont point des excremens de la fleur, puisque dès la premiere conformation, on commence à distinguer ces grains de poussiere tous formez & renfermez dans les sommets, aussitôt que ces sommets sont assez sensibles pour cela.

On les voit même s'accroître & sortir des

286

bourses qui les renferment au bout d'un certain temps, qui est lorsqu'elles ont acquis un certain degré de maturité. On les trouve dans les Chatons, & on ne les remarque point dans les fleurs à fruit. Pourquoi les plantes qui ne rapportent point de fruit produiroient-elles inutilement ces sortes d'excremens, pendant qu'on n'en découvre pas la moindre marque dans les fleurs à fruit, pour qui cette prétenduë dépuration a été imaginée?

Il saut donc dire que ces sommets sont destinez à un plus noble usage, & qu'ils doivent être regardez comme la principale cause de la fecondité des plantes.

C'est ce que je vais appuyer de trois observations. La premiere, qu'il n'y a presque point de plantes connuës qui n'ait ses sommets & ses poussieres, soit dans la même fleur, soit en differens endroits du même pied, soit sur des pieds séparez.

La seconde, que quand ils se trouvent joints dans la même fleur avec les pistiles, ils sont toûjours disposez de maniere que l'extremité du pistile reçoit necessairement les poussieres qu'ils repandent.

La troisiéme, que les embryons des graines, ou avortent ou deviennent inféconds, s'ils sont privez de ces poussieres.

Je dis qu'il n'y a presque point de plantes dans lesquelles on ne trouve des sommets & des poussieres, soit sur le même pied, soit sur des pieds séparez. Je ne parle point des plantes aquatiques ou marines, quoi qu'après les Observations de M. *Marchand* sur les fleurs & les graines des *Fungus,* & le rapport qu'il a trouvé entre ces plantes & les Lithophytons,

287

il y a tout lieu de présumer que les plantes marines ont leurs fleurs & leurs fruits à leur maniere de même que les terrestres. Les observations que M. le Comte *Marsigli* a faites sur le corail & sur beaucoup d'autres plantes marines, dont il a prétendu avoir découvert la fleur & le fruit, favorisent assez cette conjecture.

Pour ce qui est des plantes terrestres, il n'y a guere que les Champignons, les Truffes, les Mousses, certaines especes de Capillaires, & quelques autres où il ne paroisse point de sommets garnis de leurs poussieres; cependant j'ai démontré dans les Truffes des corps qui m'ont paru pouvoir être les graines: & aussi ce qui peut tenir lieu de la fleur, qui est une certaine moisissure ou fleur blanche qu'on y y [*sic*] remarque dans un certain temps, & qui renferme apparemment cette poussiere trop fine & en trop petite quantité pour pouvoir être apperçûe aisément. Pour les Champignons, les poussieres cachées entre les feuillets sous la tête du chapiteau pourroient bien être des poussieres plûtôt que des graines, je soupçonne la même chose de diverses especes de Capillaires. Ces petites feuilles ou ces cellules placées au dos des feuilles ont bien plûtôt l'apparence de sommets que de fruits, & dans quelques especes je serois assez porté à croire que les graines qu'elles renferment sont des poussieres plûtôt que des graines, puisqu'en les semant il y en a qui ne produisent rien; de sorte que dans ces especes de plantes on peut être plus assuré de connoître la fleur que d'en connoître le fruit. Il en est de même des Mousses, où l'on a observé en

288

quelques especes certains petits corps ovales pointus, couverts d'une coëffe ou capuchon qui deviennent dans la suite des capsules en urnes relevées des quatre côtes. Ces urnes sont remplies d'une poussiere très-menuë, que quelques-uns regardent comme les graines. D'autres especes de Mousses ont une tête écailleuse en épi, qui renferme sous chaque écaille une espece de fruit de la figure d'un petit Rein. Ce fruit s'ouvre en deux parties, & contient de petits grains fort menus, qui, vûs au microscope, sont des globules jaunes transparens. M. *Vaillant* cependant a reconnu que d'autres especes de Mousses, où l'on n'avoit jusqu'ici rien découvert, produisent de petits corps pleins de semblables poussieres qui peuvent être la graine de ces plantes, & peut-être aussi n'est-ce que la poussiere contenuë dans les sommets.

La Figue est l'unique exemple qu'on puisse apporter d'un fruit dont on n'apperçoit point la fleur. Cependant *Valerius Cordus* a avancé qu'elle en avoit une, & le savant *Malpighi* en a donné la figure dans son *Anatomie des Plantes*. Le premier œilleton de la Figue n'est qu'un bouton de feuilles disposées autour d'un *placenta,* sur lequel tous les embryons des graines sont rangez. Ces feuilles sont recourbées en dedans & disposées en rose, formant une espece de petite voûte au dessus des graines. Chaque embryon de graine a un calice particulier partagé en cinq ou six pointes qui l'enveloppent, & de chaque embryon s'éleve un petit pistile qui s'augmente beaucoup avec le temps. A mesure que le fruit grossit, les feuilles qui en occupoient d'abord plus de la

289

moitié sont reduites dans le petit espace du nombril de la Figue, où à peine les apperçoit-on.

Voilà une espece de fleur dans laquelle je n'ai pû découvrir de sommets, & qu'on ne peut regarder que comme une fleur à fruit, jusqu'à ce que quelqu'un ait été assez heureux pour les découvrir s'il y en a.

Nous ne connoissons point par exemple en ce païs-ci les semences de la Prêle: on ne remarque dans cette plante que des fleurs à étamines chargées de poussieres. Dirons-nous pour cela qu'elle ne porte point de fruits? *Cæsalpin* en a trouvé qui viennent sur des pieds differens de ceux qui portent les étamines. En un mot, ces exemples sont en trop petit nombre, & n'ont rien qui puisse formellement contredire à ce que nous remarquons dans cette multitude presque innombrable de plantes qui ont toutes leurs sommets & leurs poussieres.

La disposition de ces sommets autour des pistiles est une seconde preuve de ce que j'ai avancé. Le pistile en est tellement environné, que son extremité se trouve necessairement couverte de leurs poussieres, lorsqu'ils viennent à s'épanouïr.

Dans toutes les fleurs qui se tiennent droites, les sommets sont en dessus ou au moins au niveau de l'extremité du pistile; & le pistile ne s'allonge au de-là, que lorsque les embryons des graines commencent à grossir, s'élevent, & n'ont plus besoin de poussiere.

Dans les fleurs panchées ou tout-à-fait renversées, comme dans la Couronne imperiale, ou dans la fleur du *Cyclamen,* le pistile est al-

290

longé beaucoup au de-là des étamines; ensorte que la poussiere des sommets en tombant, poudre necessairement l'extremité du pistile.

Dans les fleurs de l'*Anthirrinum* [*sic*] ou mufle de Veau, & dans les autres de ce genre, les étamines sont tellement disposées, que l'extremité du pistile étant appuyée sur le duvet de la feuille inferieure & couverte de la superieure, deux des sommets sont placez au dessus, & deux au dessous; de sorte que la tête du pistile se trouve toute entourée par les sommets, & necessairement couverte de leurs poussieres, lorsqu'ils viennent à la répandre.

Dans les fleurs à fleurons & à demi-fleurons, l'extremité du pistile est cachée dans la gaine que forment les étamines, comme nous l'avons déja dit, & il n'en sort que lorsque les sommets en s'ouvrant lui ont fait passage; de sorte qu'en croissant il se couvre lui-même de poussiere.

Lorsque l'on considere dans la plûpart des fleurs tout cet appareil de sommets remplis de poussieres, placez autour au dessus du pistile, qui de son côté est ouvert, garni de poils ou enduit d'une matiere gluante, propre à retenir ces poussieres qui sont elles-mêmes veluës & visqueuses, comment ne pas conclure que tout cet artifice ne tend qu'à faire que ces poussieres, en quittant les sommets, s'attachent aux pistiles pour s'insinuer dans leur cavité.

Je sai bien que dans les fleurs panchées comme celle de la Couronne imperiale, du *Cyclamen* & de l'Acanthe, la situation des pistiles ne semble pas favorable à l'intromission

291

des poussieres qui partent des sommets: mais ne suffit-il pas que les poussieres s'attachent au pistile, & que son extremité en soit couverte, pour conjecturer de-là qu'elles s'y insinuent petit à petit à l'aide du suc visqueux qui les enduit, de l'air exterieur qui les y pousse, & peut-être aussi de la configuration particuliere de ces pistiles.

Suit-on la production des animaux sans y rencontrer des obscuritez pareilles?

De quelque maniere donc que ces poussieres s'insinuent dans les pistiles, elles sont si absolument necessaires à la fécondité des plantes, que sans cela leurs graines avortent, ou sont incapables de reproduire l'espece: c'est ma troisiéme observation, à laquelle je puis joindre les suivantes.

Rien n'est plus commun que de voir les biens de la terre manquer par la suppression des sommets & de leurs poussieres. Au printemps quand les arbres fruitiers sont en fleurs, qu'il vienne une gelée blanche avec un coup de Soleil qui desseche le pistile & l'empêche de recevoir les poussieres des sommets; voilà tout avorté, & l'esperance perduë. Si au contraire les fleurs viennent à bien, que les poussieres ayent le temps de féconder les pistiles, le fruit se noüe & il n'y a plus rien à craindre.

Quand les Bleds sont en fleurs, on craint la nielle. Qu'arrive-t-il ensuite? l'épi noircit, les grains inféconds s'allongent & forment une corne sans germe, d'une substance plûtôt approchante du Champignon que d'un grain de Bled. Le moins qu'il puisse arriver, c'est que les cellules soient vuides.

292

N'est-ce pas de la même maniere qu'arrive la coulure de la Vigne? La pluye qui survient pendant la fleur enleve & sommets & poussieres, & troublant ainsi l'œuvre de la fecondité, fait que les grains avortent, comme on le voit sensiblement.

Mais pour montrer que toutes mes observations précedentes ne sont point des conjectures avancées sans preuves; observons ce qui se passe dans toutes les fleurs, qui, comme j'ai dit, réunissent les deux sexes, c'est-à-dire, les sommets garnis de leurs poussieres, & les pistiles.

Jamais on n'apperçoit aucun corps ou germe de plante dans les embryons des graines, & on ne commence à y voir du changement que lorsque la poussiere des étamines est tombée. C'est donc cette poussiere qui féconde le jeune fruit. Ce qui est si vrai, que dans les plantes où ces étamines naissent sur le même pied en des lieux differens ou sur differens pieds, si on vient à couper ces étamines si-tôt qu'elles commencent à paroître; & avant qu'elles soient ouvertes, les fruits ne viennent point à maturité, ou s'ils meurissent, ils ne contiennent point de germes & sont par conséquent steriles.

Cette necessité de la poussiere des étamines pour servir à la fécondité des graines est confirmée par les observations de tous les Botanistes sur le Palmier qui produit les Dattes.

Cstte [*sic*] espece d'arbre porte les Etamines sur un pied separé de celui qui porte les fruits, de maniere qu'on en distingue ordinairement les pieds en mâle & femelle. *Theophraste*,

293

Prosper Alpin, & tous les Botanistes qui par eux-mêmes ont pû faire ces observations, conviennent que si un pied femelle n'a point de mâle dans son voisinage, il ne porte point de fruits, ou que s'il en porte, ils ne viennent point à maturité, ils sont âpres, de mauvais goût, sans noyau, & par consequent sans germe. Mais pour faire meurir ces fruits & pour les rendre bons à manger & féconds, on a soin ou de planter un Palmier mâle dans le voisinage, ou de couper des branches du Palmier mâle chargées de sommets épanouïs, & de les attacher au dessus des branches du Palmier femelle, & pour lors il produit de bons fruits féconds & en abondance. Cette observation fut confirmée à M. *Tournefort* en 1697. par *Adgi Mustapha* Aga, homme d'esprit & curieux, Ambassadeur de *Tripoli* vers le Roi, comme ce savant Botaniste le rapporte dans ses *Institutions botaniques*: ce ne sont pas les seuls Palmiers sur lesquels ces observations se verifient. Cela est encore très-sensible sur la plûpart des plantes qui portent les fleurs & les fruits sur differens pieds ou sur differens endroits du même pied, pourvû que l'on ait un très-grand soin de couper les étamines avant qu'elles ayent commencé à se developper, ou pourvû que l'on tienne les plantes femelles dans des endroits où la poussiere des étamines ne puisse avoir aucun accès.

J'ai élevé plusieurs pieds de Bled de *Turquie*, qui comme l'on sait, porte dans le haut de sa tige ses étamines chargées de sommets, & les fruits ou les épis le long de la tige dans quelques aisselles des feuilles. J'ai coupé les étamines avec le plus de soin qu'il m'a été

294

possible, tout aussi-tôt qu'elles ont commencé de paroître, & avant que les sommets fussent épanouïs.

Sur quelques-uns des pieds, les Epis, après être venus à une certaine grosseur, se sont séchez entierement sans que les embryons des graines ayent profité, & sur quelques autres pieds il y a eû quelques grains le long des épis qui ont grossi très-considérablement, & qui ont paru chargés d'un germe, & par conséquent feconds, pendant que tous les autres sont avortez, mais aucun épi n'est venu entier.

Il se peut faire que quelque précaution que j'eusse prise pour emporter tous les sommets avant qu'ils fussent épanouïs, il y en ait eu cependant quelqu'un d'épanouï avant que j'aye pû les couper, ou bien il sera resté encore quelque sommet caché qui se sera épanouï par la suite. Peut-être aussi quelque poussiere apportée d'ailleurs par le vent, aura fait profiter ce petit nombre de grains. J'ai élevé de même quelques pieds de mercuriale à fruit, séparement de celle qui porte les étamines, il est vrai qu'ils ont produit quelques graines, mais avortées pour la plûpart, à la reserve de cinq ou six sur chaque pied qui m'ont paru fort saines & capables de reproduire de nouvelles plantes, parce qu'il leur est arrivé ce que je viens de dire du Bled de *Turquie*, sans cela pourquoi n'auroient-elles pas toutes profité également?

On pourra m'objecter ce que rapporte M. *Tournefort* dans la même Préface de ses *Institutions Botaniq.* qu'il a vû un pied femelle de Houblon produire des graines dans le Jardin

295

du Roi, où il n'y avoit point de pied mâle, ni même dans le voisinage; en sorte que les poussieres ne pouvoient être apportées par le vent que des Isles qui sont vers *Charenton* où se trouvoient les pieds à fleurs les plus proches. Je ne contesterai point l'éloignement, mais je repondrai que quelqu'il puisse être, il ne nuit en rien, pourvû que le vent puisse apporter les poussieres.

Or cela n'est pas impossible, nous en avons un bel exemple rapporté par *Jovianus Pontanus,* Précepteur d'*Alphonse* Roi de *Naples*, qui raconte que l'on vit de son temps deux Palmiers, l'un mâle cultivé à *Brindes*, & l'autre femelle élevé dans les bois d'*Ottrante* (c'est bien une autre distance); que ce dernier fut plusieurs années sans porter de fruits, jusqu'à ce qu'enfin s'étant élevé au dessus des autres arbres de la Forêt, il pût appercevoir, dit le Poëte, le Palmier mâle de *Brindes*, quoiqu'il en fut éloigné de plus de quinze lieuës, car alors il commença de porter des fruits en abandance [*sic*]& fort bons.

Il n'y a aucun lieu de douter qu'il ne commença pour lors de porter des fruits, que parce qu'il commença à recevoir sur ses branches & sur les embryons de ses fruits, la poussiere des étamines que le vent enlevoit de dessus le Palmier mâle par dessus les autres arbres. Nous expliquons par là d'une maniere naturelle & sensible cette fecondité qui a bien embarrassé les anciens Physiciens, & qu'ils attribuoient à la sympathie ou à l'amour qui se rencontroit entre les arbres, sans savoir comment ce mistere d'amour s'accomplissoit. C'est ce que l'on peut voir dans le Poëme que *Ponta-*

296

nus fit au sujet d'un évenement qui parut si merveilleux.

Cette histoire en prouvant la necessité des poussieres pour la fecondité du Palmier femelle, fait voir que l'éloignement entre les arbres de differens sexes, n'est point une raison à opposer.

Il est donc constant que les poussieres contribuent à la fecondité des plantes. Il s'agit de découvrir presentement de quelle maniere elles y contribuent, & sur cela on ne peut former que deux conjectures. La premiere que les poussieres étant toutes sulphureuses & pleines de parties subtiles & pénétrantes comme leur odeur le prouve assez, tombant sur les pistiles des fleurs, s'y resolvent; & que leurs parties les plus subtiles pénétrent la substance du pistile & du jeune fruit, où elles excitent une fermentation capable de developper la jeune plante renfermée dans l'embryon de la graine. Car l'on suppose dans ce sentiment que cet embryon contient en racourci la jeune plante qui en doit naître, & qu'il n'y manque qu'un suc propre à la développer & à la faire croître.

La seconde conjecture est que les poussieres des fleurs sont les premiers germes des plantes, qui pour se developper, ont besoin du suc qu'ils rencontrent dans les embryons des graines, comme les animaux ont besoin de l'œuf & de l'*uterus* pour paroître au jour. Cette derniere conjecture est d'autant mieux fondée, que l'on ne sauroit découvrir même avec les meilleurs microscopes aucune apparence de germe dans les petits embryons de graines, lorsqu'on les examine avant que la

297

fleur soit épanouïe, ou que les sommets se soient ouverts; & ce n'est pas seulement dans les embryons des graines qu'on ne le découvre point, mais on ne le trouve point non plus dans ces mêmes graines examinées en un état plus avancé, lorsque le germe est ordinairement visible, s'il est arrivé que ces graines n'ayent point été renduës fécondes par les poussieres.

En effet si l'on examine dans les plantes legumineuses, le pistile ou cette partie qui devient la gousse, avant que la fleur soit encore éclose, & qu'après l'avoir débarrassée des feuilles & des étamines, on la regarde au Soleil avec un microscope, on y remarque très-aisément les petites vésicules vertes & transparentes qui doivent devenir les graines placées dans leur ordre naturel, & dans lesquelles on ne distingue rien autre chose que l'enveloppe ou l'écorce de la graine. En continuant d'observer pendant plusieurs jours de suite dans d'autres fleurs à mesure qu'elles avancent, on remarque que ces vésicules grossissent & se remplissent d'une liqueur claire dans laquelle, lorsque les poussieres se sont répanduës & lorsque les feuilles de la fleur sont tombées, on commence à appercevoir un petit point ou globule verdâtre qui y flotte librement. On n'apperçoit encore rien d'organisé dans ce petit corps, mais avec le temps & à mesure qu'il grossit, on y distingue peu à peu deux petites feuilles comme deux cornes. La liqueur se consomme insensiblement à mesure que ce petit corps grossit; & la graine étant devenuë tout-à-fait opaque, en l'ouvrant on trouve sa cavité remplie de la petite plante en racourci,

298

composée du germe ou de la plumule, de la radicule & des lobes de la Féve ou du Pois.

Si au contraire dans les pivoines à fleurs doubles, qui sont tout-à-fait denuées d'étamines & de sommets, on examine les graines qu'elles produisent, soit qu'elles soient avortées ou qu'elles ne le soient pas. On les trouve vuides contenant seulement quelques membranes dessechées & sans aucune apparence de germe, semblables en cela à l'œuf d'une poule qui n'a point été fécondé. En effet, s'il y eût eû un germe dans ces membranes, n'auroit-il pas dû grossir à proportion de ces enveloppes & devenir très-sensible?

En suivant cette conjecture, il n'est pas difficile de déterminer de quelle maniere le germe entre dans cette vésicule; car outre que la cavité du pistile s'étend depuis son extremité jusques aux embryons des graines, ces vésicules ont encore une petite ouverture près de leur attache qui se trouve à l'extremité du conduit du pistile; ensorte que le petit grain de poussiere peut tomber naturellement par cette ouverture dans la cavité de cette vésicule, qui est l'embryon de la graine. Cette cavité ou espece de cicatricule reste encore assez sensible dans la plûpart des graines: on l'apperçoit très-aisément sans le secours du microscope dans les Pois, dans les Féves & dans les Phaseoles.

La racine du petit germe est tout proche de cette ouverture, & c'est par cette même ouverture qu'elle sort, lorsque la graine vient à germer.

Mais à quelque conjecture que l'on s'ar

299

rête, il demeure toûjours constant par mes observations, que les poussieres des sommets qu'on avoit negligées jusques ici comme de vils excremens qui defiguroient en quelque sorte la beauté des fleurs, en sont pourtant des parties essentielles & necessaires pour la fecondité des plantes.

EXPLICATION DES FIGURES.

Figures des Poussieres de differentes Fleurs vûës au Microscope.

1. Millepertuïs, *Hypericum vulgare, C. B. Pin.*
2. Melilot, *Melilotus officinarum Germaniæ, C. B. P.*
3. Pensée, *Viola montana tricolor odoratissima, C. B. P.*
4. Bourrache, *Borrago floribus cœruleis, J. B.*
5. Grande Consoude, *Symphytum Consolida major, C. B. P.*
6. Erable, *Acer montanum candidum, C. B. P.*
7. Lis, *Lilium album vulgare, J. B.*
8. Jonquille, *Narcissus Juncifolius, luteus, minor, C. B. P.*
9. *Ephemerum Virginianum, flore cœruleo majori, J. R. H.*
10. Tithymale, *Tithymalus Characias angustifolius, C. B. P.*
    Ricin, *Ricinus vulgaris, C. B. P.*
11. Acanthe, *Acanthus rarioribus & brevioribus aculeis munitus, J. R. H.*
12. Genêt d'Espagne, *Genista Juncea, J. B.*
13. Tubereuse, *Hyacinthus Indicus, Tubero-*

300

sus, flore Hyacinthi Orientalis, C. B. P. Les deux Figures acollées sont la même poussiere vûë differemment.

14. Campanule Pyramidale, *Campanula Pyramidata, altissima, J. R. H.*
15. Fleur de la Passion, *Granadilla polyphyllos fructu ovato, J. R. H.*
16. Oeillet sauvage, *Caryophyllus sylvestris, Calidarum regionum, J. R. H.*
17. Bec de Gruë, *Geranium sanguineum, maximo flore, C. B. P.*
18. Potiron, *Melopepo compressus, C. B. P.*
19. Souci, *Caltha vulgaris, C. B. P.*
    Soleil, *Corona Solis perennis, flore & semine maximis, Hort. Lugd. Bat.*
20. Mauve, *Malva vulgaris flore minore, folio rotundo, J. B.*
    Althæa frutescens, folio acuto, parvo flore, C. B. P.
    Liseron, *Convolvulus purpureus, folio subrotundo, C. B. P.*

Figure 21. represente la fleur mâle du Potiron qui ne porte point de fruit, dont on a ôté la feuille qui étoit posée sur le cercle *FF,* pour mieux laisser voir les autres parties.

ABE représentent la tête placée au centre de la fleur, formée par les circonvolutions des sommets *B,* & soutenuë par quatre especes de colonnes *GGGG.*

La partie *B* de cette tête représente les circonvolutions des sommets encore fermés, & la partie *E* les représente ouverts & recouverts de la poussiere qu'ils contenoient, & qui se répand au dehors dans le temps de la maturité de la fleur.

301

H est le pedicule qui soutient la fleur, & qui ne produit rien dans la fleur mâle.

Fig. 22. représente une portion *B* de ces sommets vûs au microscope: ils forment une espece de canal *B,* divisé en deux cavités *DD,* remplies de poussieres séparées par la cloison mitoyenne *C.*

Fig. 23. représente les deux cellules *DD* de la *Fig. 22.* ouvertes & vuides de leur poussiere. Elles sont ouvertes selon leur longueur, & montrent à découvert la cloison *CC*: on a laissé dans la cellule *D* quelques poussieres *E* pour faire voir de quelle maniere elles s'élancent au dehors dans le temps que les canaux ou cellules *B* qui les renferment viennent à crever.

Fig. 24. représente la fleur femelle du Potiron qui est la fleur qui porte le fruit: on a ôté comme à la précedente la feuille qui étoit posée sur le cercle *FF* pour mieux laisser voir les autres parties.

A represente le nœud de la fleur ou l'embryon du fruit.

BBB représente le pistile qui ne fait qu'un corps avec les nœuds de la fleur ou l'embryon du frnit [*sic*] *A,* le haut du pistile s'élargit en *BB* en plusieurs corps formés en cœur *C.*

C représente un de ces cœurs partagé en deux lobes par un sillon. Ces corps faits en cœur sont herissés de vesicules & de poils propres à retenir les poussieres de la fleur mâle, & à les conduire aux embouchures des canaux qui communiquent jusqu'aux cellules des graines contenuës dans le jeune fruit.

302

Fig. 25. représente les mêmes parties de la fleur femelle & de son fruit.

On a coupé le pistile horizontalement au dessous de la tête *B* pour démontrer les quatre canaux *DD* qui répondent à chacune des têtes du même pistile *BB* formées en cœur. Ces canaux descendent verticalement depuis le sommet du pistile *B* jusques dans les cellules du fruit *AA.*

On a aussi coupé horizontalement le fruit *A* pour y démontrer quatre cellules *D* des graines. Ces quatre cellules répondent aux quatre canaux du pistile & aux quatre têtes du même pistile *BB* qui sont formées en cœur.

Comme chaque tête du pistile *BB* est subdivisée en deux lobes par un sillon *C*; aussi chacune des cellules des graines du fruit *A* est divisée en deux par le parenchyme qui forme une espece de demi-cloison; ensorte qu'il se voit dans chaque deux rangées de graines attachées à un *placenta* qui répondent aux huit divisions du pistile.

Fig. 26. représente la moitié d'une Pomme de Calvil coupée dans sa longueur pour y faire voir toutes les parties internes.

A représente le nombril de la Pomme formé par l'extremité des feuilles du calice qui se rapprochent en maniere d'arc de voûte.

B est une cavité qui prend depuis le sommet de la voûte, & qui se perpetuë jesqu'à la cavité des cellules des graines *C*: ces deux cavités *B* & *C* viennent se terminer en un point vers la queuë *D.* A l'extremité superieure de la cavité *B* vers le nombril se trouvent attachés au parois de cette cavité les étamines sé–

303

ches & surmontées de leurs sommets *E* vuides de leurs poussieres.

F représente les cinq divisions du pistile posées au dessous des étamines *E.*

On a figuré le pistile dans son entier pour faire voir plus sensiblement sa position. Les cinq divisions de ce pistile répondent aux cinq angles des capsules des graines *G* fur lesquelles il se trouve posé. Les canaux du pistile *F* viennent se replier en *H* & former en remontant le *placenta I* des graines *K.*

Fig. 27. représente la moitié d'une Pomme de Calvil coupée transversalement, pour démontrer l'ordre des cinq cellules cartilagineuses *EEEEE.*

K représente les graines ou pepins attachez à la base des cellules.

B fait voir la cavité qui s'étend depuis le nombril de la Pomme jusqu'au fond des cellules des graines, autour de laquelle elles sont disposées en rond.

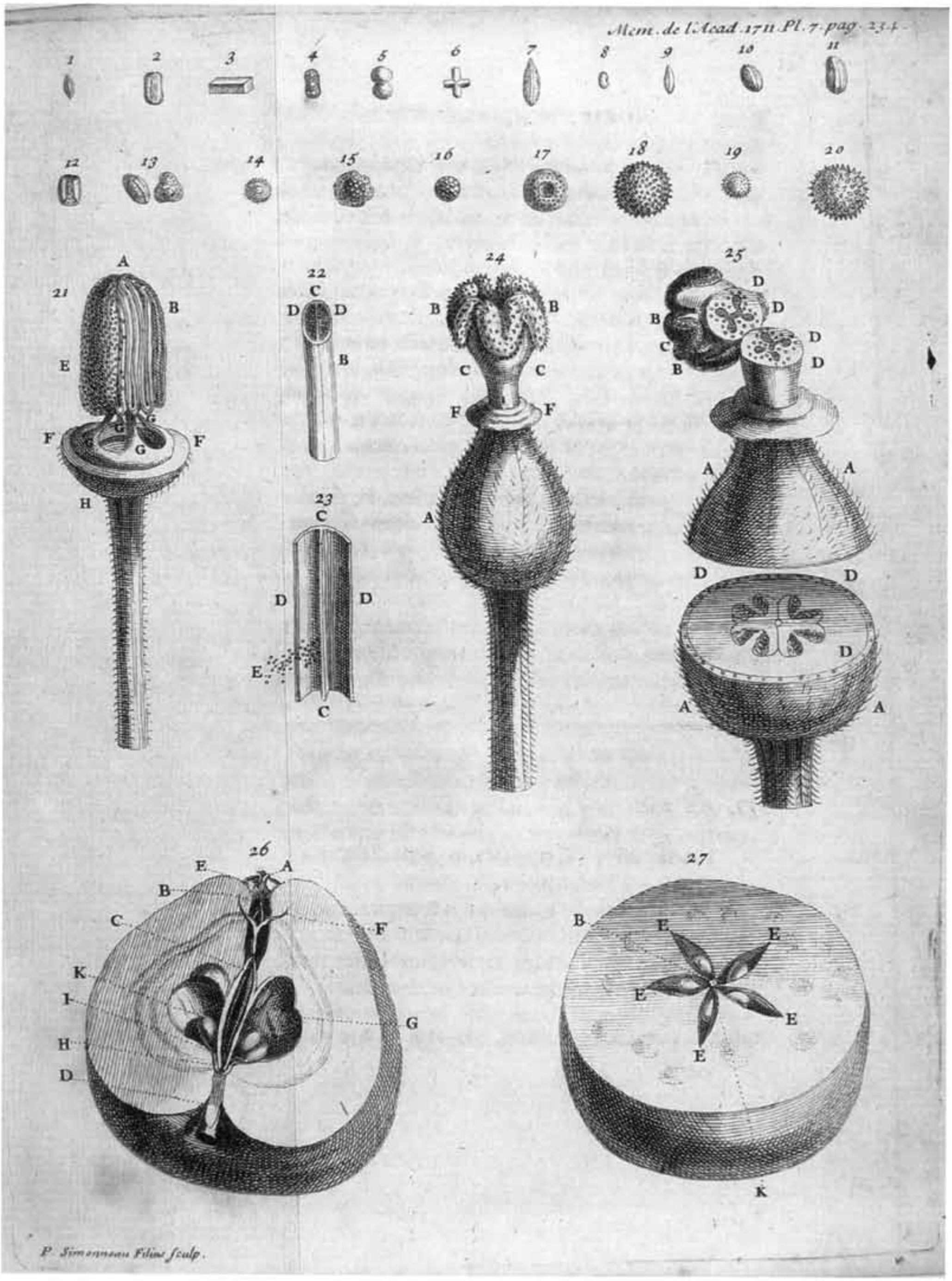

Figure 6. Figures for Claude-Joseph Geoffroy's "Observations sur la structure & l'usage des principales parties des fleurs" in *Histoire de l'Académie Royale des Sciences, Année MDCCXI: Avec les Mémoires de Mathématiques & de Physique, pour la même Année, Tirés des Registres de cette Académie* (Paris, de l'Imprimerie Royale, 1714, pl. 7, p. 234). Courtesy of Muséum National d'Histoire Naturelle.

Appendix

Letter 1: Answer to some objections spread through the discourse of Mr. Vaillant, against my memoir on the structure and use of the principal parts of the flowers, read on the 14th of November 1711

(Presented to the Académie on 27 July 1718)

Ever since the anatomists made new discoveries on the parts of the animals that are used for the conservation of the species, from which they have made new conjectures apparently more likely than the old ones, botanists have, so to speak, followed in their footsteps, convinced that nature acts in a uniform manner in the production of all living beings.

Two parties reign among the anatomists: the *Ovarists*, who believe that the germs of the animals are contained in the eggs of the female where they are vivified by a Spirit emanating from the male, and the *vermiculaires*, if I am allowed to give them that name—those believe that the germs are hidden in the male as little worms and that they insinuate themselves in the eggs of the female where they get their food and grow until they are ready to see the light of day.

Mr. Leeuwenhoek and Hartsoeker have given observations that appear to confirm this system, since they remarked in the males of different species of animals a prodigious quantity of what looked like little worms swimming in the seminal liquids and which had a uniform shape in each species.

The botanists, then, only have to choose which one of these two positions to take for the generation of plants. My brother embraced the latter in a thesis he defended at the School of Medicine the 13th November 1704, when he presided for the first time. It was translated in 1705 by Mr. Andry and was published by Mr. d'Houry, who also published Mr. Vaillant's discourse.

It is therefore not surprising that, profiting from my brother's reflections, I agreed with his sentiments, and accordingly, I have taken upon myself to show with particular care the diverse shapes of the dust of the stamens in different species of plants, dust that appears to take the place of the little worm-like germs that Mr. Leeuwenhoek and Hartsoeker observed in the males of the animals, without making either them or me deserving of being called "visionaries" by Mr. Vaillant on page 16 of his discourse.

During the time I was working on my memoir, I knew that it would not be sufficient that I *"made precise observations in the Laboratory,"* an ironic praise that Mr. Vaillant could have done without bestowing me (p. 24). I went to the Royal Gardens where the plants of all species are always in abundance. There I had the opportunity to discuss my project and my observations with Mr. Vaillant and even to make some observations while he was present. He admits as much in his memoir: *"making the dust fly without getting a single grain in our eyes"* (p. 22). My memoir was read in a public assembly of this Academy, without his claiming anything at the time. He even states in his own words in his discourse: *"Since everyone in the whole world knows that they are not always assembled in the same flower and that, to the contrary, one is often separated from the other, either on the same individual or on different plants […]."*

After such a confession, I was not expecting the subsequent reproach from Mr. Vaillant that I stole his views and his observations. On pages 24 and 26 he states, *"I thought it convenient to establish three types of flowers: Males, Females and Androgynes, names that a sweet and officious Echo cared to repeat* (these are his own terms) *(at least the first two) in front of a Royal Assembly in order to transmit them to posterity,* *as well as some details that he did not report so faithfully, since he believed*—Mr. Vaillant goes on—*them to be simply a case of the fabled crow dressing itself up with the feathers of a jay. But as it would displease God*—he adds—*if I were to take away from him these details and envy even the smallest of the pretty things he harvested here and there from various authors to augment his observations, I abandon them to him with a light heart*—he says, finishing—*The other details I take directly from pure Nature, the only book one must peruse in order to avoid making mistakes by trying to impress others."*

Here is the accusation this is about, where he cites me as a footnote. Even if I were convinced that I did commit the alleged theft Mr. Vaillant pretends I have done, it hardly allows his complaining in such an irritated manner. But what kind of reparation is rightfully mine if I show that the terms of *male* flowers, *female* flowers, *androgynes*, and *hermaphrodites* are no more his than the terms *ovary*, *tubes*, *umbilical cord* and *placenta,* for which he wants so much honor bestowed on him?

All these terms are found in my brother's thesis, translated in French (p. 30). Here is what one reads in precise terms: *"The plants have their sexes as do the animals. The male parts of plants are the stamens decorated with their anthers, and the female parts are the pistils."* The thesis goes on to read on page 31: *"The lily, as an example of a plant in which the two sexes are borne together in the same flower, is expressly named androgynous plants."*

Here are the exact words on page 32 of the thesis: *"Most plants have the two sexes on the same flower. They are called androgynous plants."*

There are other species where the sexes are separated on different parts of the same plant and others where they are found on different plants and completely apart. Among the latter, the "males" are the ones that bear the stamens with their anthers; the females are those that bear the pistils. Regarding these same pistils, the author of the thesis has written the following, page 35:

"The relationship between this part and that which contains the eggs in animals authorizes us to give them the name of ovaries. It seems, also, that we can also call by the name 'tube' the canal that exits this ovary as well as the opening that is found at the tip of the pistil, since by its use it appears to be similar to the tubes of the womb." The rest of the thesis contains the system by which the flower parts take part in the propagation of the species.

About the terms "umbilical cord" and "placenta," couldn't we say that he borrows them from Mr. Marchant in his *Memoirs of the Academy*, 1693, p. 32, where one reads these words: *"because the style is to the flowers what the tubes of the womb are to the animals, and it contains in its membranes the siliques that take the place of the chorion and the amnios, providing the air that is necessary for perfecting the seed that links to the placenta through its umbilical cord."*

I leave it to you to judge who better invites the name "Echo," Mr. Vaillant or me, except that the way he goes about it can hardly be described by the epithets "officious" and "sweet."

It is true that Mr. Vaillant has already admitted in front of the full Academy that these contested terms are present in my brother's thesis but that he didn't know about them. [He was at the time the secretary of Mr. Fagon, Prof. of Medicine, to whom all the theses were forwarded, especially the ones that are the subject of the present question, since it was by the Court order that it was translated.][1] But is that enough to exonerate him? And isn't he just looking to insult one of his colleagues, from whom he never received any displeasure, based on an ill-founded suspicion about which he could easily have obtained clarification since several years had elapsed between my memoir and his discourse at the Royal Gardens that he subsequently made public by having it printed in both Latin and French.

I have neglected to respond to this paper [until now] because I did not believe that it was capable of harming me in the public eye, and if it had not been for the complaints that Mr. Vaillant haughtily brought before the Academy, which by respect I now believe obliges me to justify myself, I would have kept my silence. Indeed, I do not favor polemic papers that ordinarily bring little honor to savants, and I ask only to be able to employ all my time and all my application to perfect my art, and once in a while to present, in my mediocrity, some productions to the Academy that will not be unworthy of its approbation.

With respect to the other objections Mr. Valliant expressed to my conjectures, they can be reduced to three principal ones.

1) He objects to my losing an infinity of the germs in question in very pathetic terms (p. 22, line 4): *"And who wouldn't fly into a rage at these mothers, who give birth to so many beautiful children for the sole pleasure of casting them out without any resources, leaving the task of saving just a few of them to the caprice of Lady Luck? For*—he adds—*one sees flowers with up to twenty-five or thirty stamens (as in most stone fruits), yet only one egg. Such destruction of germ*—cries Mr. Vaillant—*! For that's what I suspect from the prodigious number each head expels, and by the number left within the head, from which these nestlings never fly away*—his terms—. *This does not*—continues the same author—*include germs from sterile flowers, which, because they must be transported by air to the fertile flowers, all fly off together, whether by their natural weightlessness*—he says—*or by the sharp and sudden jolt they receive from the strong contraction of their capsule. In contrast, those from flowers bearing both sexes, finding themselves adjacent to the object of their desire*—he goes on—*, are virtual legless cripples compared to the others. Enervated by the long and sweet exhalation of their prolific breath, they remain partially hidden in their opened capsule or stuck to the sides of the styles*—*linger there and dry out with them."* So ends Mr. Vaillant's objection, which Mr. Andry has already answered at the end of the translation of my brother's thesis (see the answer to the 4th objection p. 57, 58). My brother also answered this objection in a letter inserted in the treatise on worms of Mr. Andry.

Furthermore, is it Nature's intention that all seeds are destined to produce plants? If only a few achieve this, does this mean that we should mourn over the disgrace of the others that die uselessly or are used for purposes that are contrary to the birth of the plants and to the general views of Nature regarding the conservation of its species?

2) My metamorphosis of the dust particles into plants is opposed as implausible:

"But—says Mr. Vaillant on pages 20 and 22—*let us not torture our brains and reproach Nature by trying to grasp this last line of reasoning! For who can imagine that a prism with four faces becomes a Pansy; a narrow roll the Borage; a kidney, the Daffodil; that a cross can metamorphose into a maple; two crystal balls intimately glued to each other, a Grande consoude, etc.? These are nevertheless the shapes favored*—he says—*, in these diverse plants, by their lowly little embryos."*

But this objection refutes itself. Is it more difficult to conceive that these dust particles, with their particular shapes, are the germs of a certain species, than the changes that transform a seed into a plant, and that surprise no one, not even the person on the street? For who is astonished that an acorn, for example, converts itself into an oak, a sort of corrugated roll into a palm tree, a heart-shaped object into a tree carrying the *lasse*?[2] I could name an infinity of the same sort.

Is one surprised to see tadpoles transform into frogs, and all sorts of worms take the shapes of butterflies and a variety of other flying insects?

3) The last objection found in Mr. Vaillant's discourse is against the way I conjecture that the dust particles (which appear to me to

be completely formed germs) can insinuate themselves through the pistils or ovaries to the little eggs they must fertilize.

The existence of the tubes that I observed and the possibility of the entry of the dust particles into the interior of the ovaries has been disputed.

It is sufficient for me to have demonstrated this in several species of plants and mainly in the lily, to have the right to conjecture that the same thing happens in other flowers according to the uniform laws of nature.

It is useless to object that (p. 18) *"styles of the Pumpkin [are] filled, throughout their length as well as in the belly of the ovary, with a succulent pulp, which couldn't without extreme difficulty*—one says—*permit the slightest grain of dust to intrude into the ovary."* Because, provided one can speak in absolute terms, as I tried to do for the pumpkin, in which I observed the continuity of the cavity in the pistil from the top to the ovary, in which the seed embryos are arranged on their placenta in cells whose order and number correspond to the divisions in the head of the pistil, provided, I say, that one can speak in absolute terms—I do not guarantee that one won't find difficulties here, mainly because nature takes pleasure in concealing itself from our knowledge in the same way even in animals where these parts are more distinct and in which the difficulties are not found to be any less, regardless of the opinion one embraces. Indeed, I have reported them both in my memoir.[3] Therefore, however hidden these routes may appear in certain plants, it doesn't follow that they are neither natural nor practicable as Mr. Vaillant expressed on page 20.

So much for Mr. Vaillant's objections. Now, if I wanted to claim something for myself from that discourse, it would be easy for me to do so; and it is good that this Company sees the difference in our expressions on this matter. Here is what I say about the use of the stamens in my memoir: *"The function of the stamens has always been quite ignored, a mistake if we are to gain a proper understanding of nature, which seems to lead us to propose that the stamens are the male parts intended for the conservation of the species, just as the fruit flowers* [pistils] *are the female parts, etc."*

I add a little later, *"These filamentous stamens and their anthers look so insignificant in flowers that they have been regarded as mere excretory vessels, good for the separation of the excess sap needed for the nourishment of the young fruit, etc."*

I expressed myself with care to avoid giving offense to such a respected author as Mr. Tournefort whose opinion I contradict, which is perfectly permissible, not wishing to attack him directly as Mr. Vaillant does, who, while using my thoughts, adds to them a style that is uniquely his:

"The stamens—he says, page 10—, *which I call male organs, and which the famous author of the* Institutiones Rei Herbariae *calls the vilest and most abject in plants, are actually the noblest, since they correspond to those in animals that serve for the multiplication of the species. These organs,"* says Mr. Vaillant, *"are composed of a head and a tail, or, if one wants to stick with the usual terms, of summits* [anthers] *and filaments."*

"These heads, which one could plausibly call testicles," he continues, *"not only because they often have the same shape but also because they perform the same function, etc."*

In another place, pages 14 and 16, here is how he expresses himself on the same subject:

"Returning to the styles—which, before and since Malpighi, no one has sufficiently distinguished from the body of the ovary, and which from time to time have been called other vague names [...] these organs were given the sole occupation of discharging the filth and excrements from the young fruit and the seed embryo, and were never meant to be equated with the pistil, this famous war horse, for which, on several occasions, these styles were given the honor of being mistaken."

This is not the only place where Mr. Vaillant spews forth invectives at Mr. Tournefort, who is the greatest adornment of this Academy and whose memory will be cherished forever by the true savants. I think it is appropriate to point out to this Company how Mr. Vaillant unleashes his anger against this great man and against the other botanists who follow his method. Here is what he says at the end of his discourse on pages 36 and 38: *"For to pretend, like a celebrated author, that the majority of the genera can be established solely on the basis of the ill-defined structures of the two types of parts he used, and by certain similarities he imagined they have with well-known things to which he compares them — is truly a mockery* — says Mr. Vaillant — *. And if one follows a method based only on such vague and fleeting principles, one soon becomes disgusted. Finally, nowadays,"* he continues with the same contempt, *"one sees more than a few imitators of the latest genre of books on plant identification,"* this is how he treats the botanists of this Academy who walk in Mr. Tournefort's footsteps, *"who are dazzled by its flashy tinsel — that is, by its beauty and the large number of figures, three quarters of which are useless — and who are persuaded by the authentic testimonies of the author that this is an excellent method, and that other methods are impractical, and that this is the only method with any utility"* — a sentence that Mr. Vaillant took care to print in big letters to emphasize the irony. *"One watches,"* says he, *"these gentlemen, full of self-confidence, as they dare to step boldly through this field bristling more with brambles and thorns than with portraits of flowers and fruits. I ask you, who wouldn't cringe at the sight of all their mistakes!"*

I wish that it were not dishonorable for Mr. Tournefort, nor for the others that Mr. Vaillant attacks with such a light heart, to be treated in a harsh manner, but at least it is feared that it is so for this Company when represented by one of its members with writings of such an extraordinary style, and that rail against colleagues with such animosity.

Letter 2: An answer to the complaints of Mr. Vaillant about an alleged theft he thinks he has discovered in my memoir on the structure and the use of the principal parts of the flowers, read on 14th November 1711.

(This memoir has not been published[4])

It is not so long ago that Mr. Vaillant complained about me in front of the entire Academy, calling me a plagiarist who committed grand larceny of the usage of flower parts that serve for plant reproduction.

Apparently he tired of my patience and of the disdain I showed for this discourse, which was read at the opening of the Royal Garden. He even published it in Latin and French. He thus thought that if he attacked me in front of the Academy he'd force me to break the silence I wished to keep.

I neglected to justify myself against the accusations he makes in his discourse because it seemed to me that it would only make people think ill of him. This I do not say to disoblige him: an infinity of honest persons, and I can cite among them some from this Academy, have read the discourse before me and had come to the same judgment, and even his most intimate friends had advised him to drop this work.

In order to justify myself against his reproaches and against the reputation of plagiarist he wants to give me, I believe I am unavoidably obligated to make an exact inventory of what properly belongs to Mr. Vaillant on the subject at hand and that this sole exposition will show not only that I never thought of stealing from him but further that one cannot reasonably think that on this matter he is "stealable."

Mr. Vaillant begins by declaring that he will speak a language novel for botany on the use of the flower parts. *"I believe,"* he says, and these are his terms, *"that it will be more comprehensible than the old fashioned terminology, which—being crammed with incorrect and ambiguous terms... leads into error those whose imaginations are still obscured, and who have a poor understanding of the true functions of most of these structures."* One cannot dispute that this language is novel, and just to make one understand the meaning well, this means that Mr. Vaillant will not be talking about the amorous commerce of plants in covert words but in terms such that one would find in the Priapic festivals or as utilized during the feasts of Cythera[5] and of Sapho. You'll see, Sirs, that he keeps his word.

After saying that the flowers contain the organs of the different sexes—a sentiment that has not been invented by him as I will demonstrate soon by a date predating the times during which he embraced, rather late, this concept—he falls hard on these false flowers that some authors called staminate flowers.

"One can see," says he, *"at the very outset that I completely ignore the staminate flowers or those captious flowers without flowers—damned race—that seem to have been created or invented to challenge the greatest experts and to drive younger botanists to despair. Once rid of these nuisances, the latter find themselves proudly able to enter the vast Kingdom of Flora, and to decide as Masters on all matters concerning the parts of flowers."* Surely, Sirs, this language is novel, and Mr. Vaillant is true to his word. Such writings within your *Memoirs* will make a very singular contrast to you, Sirs, who prefer a pure, simple, and precise style; thus one of the biggest griefs of Mr. Vaillant is to be able to obtain that distinction.

But do not believe that he stops at inveighing against the flowers. It is only to better take flight so he can suddenly come down on *"that author who has contributed the most to floral biology,"* that author who, parenthetically, is the celebrated Tournefort. And this parenthesis does not appear useless. *"If he had followed my example,"* he goes on (that is to say, if he had approached the problem the same way Mr. Vaillant did—so modest is Mr. Vaillant that he only points to himself without giving further details), *"he wouldn't have argued on several occasions that it is very difficult to determine what should be called leaf (or if one wants to avoid ambiguity—petal) and what should be called calyx. He would less often have confused the latter with the former, or, more often, the former with the latter."* What a style, Sirs! What an accusation against Mr. Tournefort, who so mistook this for that and that for this. It is this style, so familiar only to Mr. Vaillant, that not too long ago made him say to this very Academy with a kind of disdain that "*he thought he was speaking to Frenchmen*." I leave to others to ask of him, *if he believes he is speaking French*.

But perhaps Mr. Vaillant will sound clearer to you when he talks about the flings of the flowers. Let's listen to the description from his own mouth: *"From my definition of the true flower, one can easily understand that it should be in full bloom, because, when still a bud, the corolla not only completely surrounds the reproductive organs, but also conceals them so perfectly that one can consider the bud as a nuptial bed, since it is usually only after they [the reproductive organs] have consummated their marriage that they are permitted to show themselves; or if the bud happens to open slightly before they are through, it opens completely only after they have left each other."* Here are truly well described circumstances. The rest is no less interesting. It is an amorous combat of another type. *"The opposite,"* says he, *"happens to the flowers that have only one sex, and the reason for that is obvious. But if on the same plant one finds flowers surrounding only female organs and others that surround both sexes,"*—here is where the Priapic rites begin— *"the tension or swelling of the male organs occurs so rapidly that the lips* *of the bud, giving way to such impetuous energy, open with astonishing speed. In that moment,"* says Mr. Vaillant, quite excited now, *"these frantic organs, which seem to think only about satisfying their violent desires, abruptly discharge in all directions, creating a tornado of dust that expands, carrying fecundity everywhere," ("Omnen uno impetu ejaculentur genituram,"* says he in his translation, "*diffusa minimum pulvulentâ nubucula spargente qua qua versum fecundationem arvi genitalis"), "and by a strange catastrophe,"* he goes on, *"they now find themselves so exhausted that at the very moment of giving life they bring upon themselves a sudden death."*

One needs Mr. Vaillant's imagination to bring such a tale to its conclusion. It is a free-wheeling description of a pleasure that he brings it to us in a poetic style, not as a modest exposition as would be appropriate to a philosopher.[6] Because at the end of the day, all this Apollonian[7] nonsense means nothing except that the flower dust, which is the subject here, carries a fecundity that renders the seed capable of perpetuating the species.

But Mr. Vaillant is so engrossed in his subject that he keeps going, giving in to his poetic furor: "*Nor does the scene end there. As soon as this sport has ended, the lips of the flower approach each other with the same speed as they came apart, returning the bud to its original shape. One would never suspect that the flower had suffered any violence unless one had witnessed it, or unless one noticed the frail corpses of those valiant champions, which remain for some time displayed on the tip, where, like so many weathervanes, they serve as toys for the Zephyrs."* So if it ever occurs that someone sues on behalf of some plants that were raped and deflowered, here is an expert, Mr. Vaillant, who will give a detailed report on the evidence of such rape, a report that will be worth adding to those one can find in Laurent Joubert.[8]

But how, you might ask, can he be the only one who is so clear-sighted on this issue? The following will help you see. *"All these mechanisms,"* he goes on, *"can be observed easily in the Parietaire, at the shepherd's hour."* Here it is, Sirs. This is what makes him so knowledgeable. He finds himself right at the time during which the different sexes of the flowers usually cavort, to use his terms. He catches them in the act, so to speak. He cracks open the curtain of their nuptial bed. He even forces them to satisfy his curiosity, and here is how he does it: *"And if the flowers are unwilling to perform while being observed, one can force them to by gently prodding them with the tip of a needle; for as long as the flower has reached, as we say, a competent age,"* (he knows everything this Mr. Vaillant, even about puberty in flowers, and when the flowers are still virgins!), *"it is sufficient that we pull the lips apart slightly, the hampes or filaments of the stamens, initially bent or arched*—he says—*become upright in a violent effort, immediately enabling one to discover what happens in all its particulars in this type of amorous exercise."* Aren't these rare discoveries and ones well worth reporting on? I am not saying that a philosopher should not observe all and describe all, as long as it is done truthfully and in good taste. But it seems to me worthy of blame to concoct romanticized descriptions in which one ridiculously takes pleasure with subjects one should never represent except with a great deal of restraint and always in a very serious manner. Must one endure it when a learned dissertation is given with such ill-timed badinage and when a botanist, carried away by his imagination, uses words belonging to the loosest gallantry and gives obscene depictions for any purpose? Could Mr. Vaillant give us a dirtier image when he talks about flowers where both sexes are joined? *"The vast majority of these act*—says Mr. Vaillant—*almost imperceptibly, but one has to assume that the slower they move, the longer the duration of their innocent pleasures. Furthermore, on some plants, the subtle flower will give obvious* *signs of life, even if only barely touched."* What a nice expression! I would forgive it to a follower of l'Aretin,[9] but should we allow this from a professional botanist? Desirous of continuing with a metaphor he finds so pleasurable, he goes on to talk the biggest nonsense. What else would you call what he has to say about double flowers? *"Since the tails of the testicles are of the same nature as the petals, it often occurs that in some species of flowers of the polypetalous type, they disguise themselves as petals so as to form those pleasant monsters that one cultivates with great care under the name of "double flowers," in which one finds few if any testicles. Those cruel step-mothers devour them while still in their crib, appropriating all their nourishment for themselves. But these gluttonesses,"* Mr. Vaillant goes on using the gallant tone, *"do not stop there. Being equally the enemy of all sex, after they defeat the one they immediately attack the other, and by starving it little by little, finally cause it to languish and die. That is why all the seeds are aborted and a viable one is a rare find among the unfortunate fruits of these superb flowers."*

Sirs, it is not necessary to tire you any further with the retelling of these rare discoveries that truly belong only to Mr. Vaillant. I couldn't add much more to the idea you have already conceived of the singular character of his writings when I relate, *"Having observed that eggs laid by hens living a celibate and chaste existence must (as in the case of fruits that haven't been fertilized by the all-powerful grain of dust) be smaller, less full and less tasty than the others, henceforth people take great care to give these chaste hens some good males in order to have excellent eggs."*

It is therefore time to close my inventory, to point out that everything Mr. Vaillant says is so uniquely his, there isn't a plagiarist courageous enough to take on the task of stealing anything from him.

Finally, after having proven that he is not "stealable," it remains for me to make you see that, indeed, I did not steal from him.

After having expressly insulted me on several occasions during his discourse, Mr. Vaillant makes an accusation against me written in terms so shocking that this Company will judge if it is possible to show some restraint while refuting these terms. Here is how he expresses himself on page 24 of his discourse: *"I return to the different sexes of plants. Since everyone in the whole world knows that they are not always assembled in the same flower and that to the contrary, one is often separated from the other, either on the same individual or on different plants, I thought it convenient to establish three types of flowers: Males, Females and Androgynous (or hermaphrodite), names that a sweet and officious Echo,"* (by which, Mr. Vaillant does me the honor of citing me in the margin), *"cared to repeat (at least the first two) in front of a Royal Assembly in order to transmit them to posterity, as well as some details that he did not report so faithfully, since he believed them to be simply a case of the fabled crow dressing itself up with the feathers of a jay. But as it would displease God if I were to take away from him these details and envy even the smallest of the pretty things he harvested here and there from various authors to augment his observations, I abandon them to him with a light heart. The other details I take directly from pure Nature, the only book one must peruse in order to avoid making mistakes by trying to impress others."*

Would you believe that, because of two little words my accuser imagines I stole, he must cry so loudly, "thief?" A man who'd lost all his valiancy[10] would not make any more noise. You'd think you were hearing the furious screams of a scrooge who lost his beloved safe.

Yet these beloved little words, these precious corpses, these superb feathers that sneaky ravens can't wait to pick up so they can wear them as a foreign ornament, are not at all from Vaillant. He claims them wrongly, also the details he claims he did not hide from me, and that he alleges I disfigured. I disavow them, and this will suffice until he proves the particulars that he thinks that I used to my own profit.

For these two words, and even the third one—although he has some doubts about this one, since this man is so devious that he imagines that everything is taken from him—for these three words, I say, have already been published, as well as the conjectures he claims for himself, about the generation of plants. They were published in 1704 in the medical thesis published by my brother when he presided for the first time, and in 1705 in the translation Mr. Andry did after he was kindly asked by Mr. Boudin, State Counsel and first doctor for Monsignor.

Here is what one can read exactly: "*Plants have sexes, as well as the animals. The male parts are the stamen with their summits and the female parts are the pistils.*" It is true that, recently, new terms have been used in botany, but [he was] unwilling to use terms such as "testicles," "wombs," "tubes," "bodies," or "neck." These words are reserved for Mr. Vaillant, by whom the trashy[11] analogies implied by them are very well liked. But, in the end, this is a doctrine that preceded his by a long time, on behalf of which its authors, if they were in the same bad mood he is in, could cry "Thieves!" at us. Because one must admit, both of us are thieves in this matter, and I invite anyone to judge who is the good thief and who is the bad one.

In that thesis, the lily was given as an example of plants whose flowers contain both sexes, and they were given the name *androgyne plants*, another beloved term Mr. Vaillant wants to call his own and that had already been in common usage even before he knew or believed he saw this type of plant, as he would acknowledge if he were acting in good faith.

Furthermore, the terms "ovary" and "tube," of which he is so proud, are not his. One can find them in the same thesis on page 35. Here is how the pistil is described: *"The relationship of this part with the one that contains the eggs in animals allows us to give it the name of ovary; it seems to me, as well, that we can call 'tubes' these canals that exit this ovary and whose opening is at the very end of the pistil, since its function seems similar to the tubes of the womb."* The remainder of the thesis contains the system followed for the use of the flower parts in the propagation of the species.

This being said, Sirs, who better merits the epithet of "Echo," Mr. Vaillant or myself? Except that the way he's approaching this can hardly be described as "sweet and officious," epithets he kindly bestowed on me.

If I wanted to take my turn and claim something from Mr. Vaillant's discourse, regardless of how disfigured it is, it would be easy for me to do so. And, maybe, this Company will see with pleasure the difference between our expressions on the same matter. Here is what I say about the use of the stamens at the beginning of my memoir:

"The function of the stamens has always been quite ignored, a mistake if we are to gain a proper understanding of nature, which seems to lead us to propose that the stamens are the male parts intended for the conservation of the species, just as the fruit flowers [pistils] *are the female parts. In some plants, the stamens are so completely separated from the fruit flowers that they are on different plants; in others, they are found on the same plant; and in all the rest, the staminate flowers and the fruit flowers are united in the same flower, as I hope to demonstrate in the following observations."*

And later I added: *"These filamentous stamens and their anthers look so insignificant in flowers that they have been regarded as mere excretory vessels, designed for the separation of the excess sap needed for the nourishment of the young fruit, etc."*

I have expressed myself with restraint so as not to offend in the least an author as respected as Mr. Tournefort, with whom I am in contradiction. This is perfectly permissible, without having to designate him or cause him the least sorrow by attacking him directly as Mr. Vaillant does, who, in using[12] my thoughts, simply adds to them his trademark style.

"The stamens — he says —*, which I call male organs, and which the famous author of the* Institutiones Rei Herbariae *calls the vilest and most abject in plants, are actually the noblest, since they correspond to those in animals that serve for the multiplication of the species. These organs, I say, are composed of a head and a tail, or, if one wants to stick with the usual terms, of summits* [anthers] *and filaments."*

"These heads that one could plausibly call testicles, not only because they often have the same shape but also because they perform the same function, etc.," and in another section, pages 14 and 16, he expresses himself on the same subject:

"Returning to the styles which, before and since Malpighi, no one has sufficiently distinguished from the body of the ovary, and which from time to time have been called other vague names … were given the sole occupation of discharging the filth and excrements from the young fruit and the seed embryo, and were never meant to be equated with the pistil, this famous war horse, for which, on several occasions, these styles were given the honor of being mistaken."

As you can see, I predate Mr. Vaillant, when it comes to criticizing what Mr. Tournefort has to say, unless he pretends to betray the trust I put in him when, telling him about the memoir I was planning, I asked him for plants to conduct my observations. I asked him since he lived at the Royal Gardens where, thanks to the efforts of Mr. Tournefort first and his excellent successor Mr. Jussieu next, the plants were grown in such abundance that one can call upon them at any moment.

If it were true that I stole anything from him, he could have claimed it then, and he would probably have done it without doubt, without letting several years pass by.

But what could he have claimed? He who has hardly discovered anything, except for the beautiful discourse with which I had the honor to entertain you, and which is known only because of the protection from the late Mr. Fagon.

There was nothing he could sink his teeth in about my observations, some of which were made with him as he was present, nothing, I am saying, since he himself admits that *"[I] pride [myself] in making the dust fly,"* speaking of dust of these stamens, *"without getting a single grain in our eyes."*

With respect to our conjectures, neither his nor mine are assured to be correct. He presumes, with those who claim that the male only provides the vital spirit to fertilize the eggs of the females, this spirit he calls with an unfortunate choice of words "the breath" that Genesis speaks of. He presumes, I say, that the dust of the stamens brings only a simple *"vapor, this volatile spirit, that, exiting from the dust particles, vivifies, animates, and, with the aid of the nourishing juice, develops these miniature plants, or the germs of their little eggs."*

And I, as a scrutinizer of the visions of Leeuwenhoek and Hartsoeker (since this is how he likes to call me) — I believe that the grains I observed having so many different shapes in the dust of the flowers, and which keep their distinct shape in each of the species — I believe, I say, that these grains are the germs that will insinuate themselves in the eggs located at the bottom of the pistil or of the ovary, however one wants to call it. The anatomists, who have other, more distinguishable parts to observe than the ones from the flowers we believe serve the same purpose, are still divided between these two beliefs. How then can the botanists, who, as Mr. Vaillant himself admits, depend on the anatomists in this occasion, how can they decide on this question with such haughtiness? This is why I have reported on the two beliefs following the observations I reported to the Academy.

But even if the belief to which Mr. Vaillant is so devoted prevails, does this give him the right to be so haughty and so arrogant against his colleagues? Can we not contradict an author without treating him with the outmost contempt, especially when this author has such a solid, established reputation as Mr. Tournefort has, and about whom Mr. Vaillant speaks with such disregard, even though he never had any reason to complain about him, any more than he had to complain about me.

Here is how Mr. Vaillant treats this learned man at the end of his discourse:

"For to pretend, like a celebrated author, that the majority of the genera can be established solely on the basis of the ill-defined structures of the two types of parts he used, and by certain similarities he imagined they have with well-known things to which he compares them — is truly a mockery. And if one follows a method based only on such vague and fleeting principles, one soon becomes disgusted.

"Finally,"(he continues with the same contempt), *"nowadays one sees more than a few imitators of the latest genre of books on plant identification"* (this is how he treats the botanists who follow in the footsteps of Mr. Tournefort) *"who are dazzled by its flashy tinsel — that is, by its beauty and the large number of figures, three quarters of which are useless — and who are persuaded by the authentic testimonies of the author that this is an excellent method, and that other methods are impractical, and that this is the only method with any utility."* A sentence that Mr. Vaillant took care to have printed in large characters to better draw attention to the irony, *"One watches* — he says — *these gentlemen, full of self-confidence, as they dare to step boldly through this field bristling more with brambles and thorns than with portraits of flowers and fruits. I ask you, who wouldn't cringe at the sight of all their mistakes!"* Beautiful conclusion, Sirs, and definitively worthy of the introduction.

I wish that it would not be dishonorable for Mr. Tournefort, and for the others that Mr. Vaillant attacked with such a light heart, to be treated in such a brusque and impolite manner. At the very least it seems to me a dishonor for this Academy because it is being played out publicly and shows that there are people within this Academy who like to write in such an extraordinary, not to say extravagant, fashion and who unleash their fury against their colleagues with so much animosity. This is a character unworthy of an honest man, of a true savant, of a perfect academician, and who will cause the rest of the Company to be ill-judged if it allows this to go on unpunished.

Notes

1. This sentence was added in the margin of the manuscript.
2. The meaning of "la lasse" is unclear.
3. This abominable sentence seems to reflect Geoffroy's discomfort and insecurity in the face of Vaillant's criticism.
4. This draft was neither read before the Académie nor published.
5. The Greek love goddess Aphrodite was born from the sea near the island of Cythera, where she was worshipped.
6. By "philosopher" Geoffroy meant a biologist or scientist.
7. Geoffroy actually used the term "Phoebus," another name for Apollo.
8. Laurent Joubert (1529–1582) was the personal physician of Catherine de' Medici and became one of the king's physicians. He wrote several medical texts, including his *Erreurs Populaires*, which caused considerable scandal. Geoffroy is referring specifically to a work dedicated to Princess Marguerite de France in which he spoke openly of human sexuality and described medical secrets in the vulgar tongue that had previously been accessible only in Latin. (Dulieu, Louis. 1969. Laurent Joubert, chancellier de Montpellier. Bibliothèque d'Humanisme et Renaissance 31: 139–167.)

9. Pietro Aretino (1492–1556) was an Italian poet and dramatist who gained fame throughout Europe for his lewd verses and viciously satirical lampoons, which sometimes amounted to blackmail of the rich and powerful. Aretino became wealthy from the gifts he received from his illustrious victims who hoped thereby to gain his favor. (Anonymous. 2006. Pietro Aretino. In: Encyclopaedia Britannia Online. http://search.eb.com/eb/article-9009348.)
10. Here Geoffroy plays on the words "Vaillant" and "vaillance," or valor.
11. This word, "ordurier," had been lined out in the manuscript. The offensive nature of the terms "testicles," "wombs," etc., presumably derives from their use in animal anatomy, which suggests carnality.
12. Geoffroy at first wrote "stealing" but struck it out.