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Autor: Lenhoff, Sylvia G. / Lenhoff, Howard M.
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THE *MÉMOIRES* OF ABRAHAM TREMBLEY: I. THE *MÉMOIRES* IN THEIR GENRE

BY

Sylvia G. LENHOFF[1] and Howard M. LENHOFF[1]

INTRODUCTION

At a watershed juncture in the history of the life sciences, there appeared the extraordinary treatise on the hydra by Abraham Trembley, the *Mémoires, pour servir à l'histoire d'un genre de polypes d'eau douce, à bras en forme de cornes* (1744).

Scholar Jacques Roger (1971, p. 161 ff.) uses the date 1745 to close one epoch in the development of the life sciences and open another. Trembley's work does indeed fit into Roger's characterization (1971, p. 451) of the earlier period as one that saw the triumph of a science based on observation as opposed to *a priori* mechanistic stipulations.

Among the many discoveries and experiments published in Trembley's beautiful *Mémoires* are the demonstrations that: a) complete animals can regenerate from small cut pieces of those animals; b) animals can reproduce asexually by budding; c) tissue sections from two different animals of the same species can be grafted to each other; d) the materials oozing out of the edges of cut tissue have properties that fit the definition of protoplasm as described by Dujardin one hundred years later; e) living tissues can be stained, and those stained tissues can be used in experiments; and f) "eyeless" animals can exhibit a behavioral response to light.

In view of the pioneering nature of these findings and the meticulous experimental methods which Trembley used to make them, we suggest that his *Mémoires,* while very much part of a large genre of mid-eighteenth century writing on natural history, also have distinctive appeal for the modern reader because of the way they were shaped by the special background and outlook Trembley brought to his work.

Trembley conducted and reported his experiments with a detail, caution, logic, and rigor rare for his time. In recognition of his accomplishments, he was elected to the Royal Society of London and in 1743 was awarded its prestigious Copley Medal, considered then to be one of the highest accolades in science. Martin Folkes (1743), presi-

[1] Department of Developmental and Cell Biology, University of California, Irvine, CA 92717, U.S.A.

dent of the society, wrote to Trembley that the award was in honor of "those curious and surprising Discoveries . . . entirely unobserved in the Animal Creation, and indeed never so much as thought of, till they were brought to light, and made manifest by your diligent and exact Enquiries."

There is ample evidence for Bodemer's statement (1964, p. 21) that Trembley's "work profoundly agitated the imagination of his contemporaries and the polyp attained to great notoriety in the eighteenth century world". Certainly Trembley's discoveries created a stir in the universities, academies, salons and studies of Europe. They also fed an already existing passion for studying lower forms, encouraging or leading directly to a number of other important discoveries on a variety of small animals.

The Enlightenment Setting

For Trembley's findings to have had the extraordinary reception they did, both scholarly and popular interest in natural history had to have been extremely high. To set the scene, we first need to recall the general cultural surge of the European Enlightenment. Society and its ideas were in ferment. Cross currents of change and reaction were sweeping Europe, affecting all aspects of mid-eighteenth century life, including the pursuit of science.

When Trembley first set about his observations and experiments, the study of natural history was in a state of flux. Baconian empiricism of the previous century had taken a strange turn in the first quarter of the eighteenth century. Bacon had urged naturalists to forego conjecture until much more data had been amassed. Acting ostensibly on this Baconian principle, many of "the curious," and professional naturalists as well had naively set out to collect great cabinets full of specimens, or as Ritterbush (1964, p. 62) puts it, "torrents of shells, fossils, insects, dried plants, and other curiosities." Responding in part to this collection mania, the satirists went on the attack. In Addison's *Tatler* essays of 1710, we find that "standard comic figure of a virtuoso," Sir Nicholas Gimcrack, and in Swift's *Gulliver's Travels* of 1728, "witless scientific investigation" is taken to task. Later, John Hill launched a protracted battle with the Royal Society, charging it with publishing in the *Philosophical Transactions* "many trivial and foolish articles" (see Ritterbush, 1964, pp. 61-63; Stimson, 1948, p. 70 ff., p. 127 ff., pp. 140-141). The satirists often did not differentiate, of course, between the truly trivial and the painstaking new work which gave careful attention to the "minute creation," and which was beginning to lay the foundations of modern biology through the studies by the "great observers" of the period.

Ritterbush states that despite the tremendous impact Newtonian thought was having generally, "Newtonianism, whether in its experimental or speculative aspect, barely figured in the thought of naturalists before 1730." During the 1730s, however, Newtonian influences were reaching students of natural history and the number of more serious studies was growing (Hazard, 1946, Vol. 1, pp. 174-176). Mornet (1929, p. 86 ff.)

says that toward 1750, Baconian and Newtonian ideas became "commonplace". Ritterbush may emphasize (1964, pp. 109-117) that "botanical analogy" was still the dominant vogue, and that in the work of Linnaeus we find still the search for a "divine plan for the creation" and the orthodoxy of graded function still enthroned; this is also the era, however, of the precise work of Réaumur, Trembley, Lyonet, the young Bonnet and other careful experimentalists. Hazard tells us that geometry, geometric deductive reasoning and Descartes had by then lost their supremacy to natural history, to Newtonianism and to factualism. It would seem rather that there was neither a total dethronement of Cartesianism nor a triumph of new orthodoxies, but concepts roiling and clashing with a resultant melange of ideas. Even as late as 1787, several years after Abraham Trembley's death, his nephew Jean Trembley (1787, p. 23) still found it somehow necessary to criticize Cartesianism, contrasting his uncle's attitude with that of Descartes regarding "the advantages of philosophical doubt, that doubt which Descartes so extolled and of which he made such little use."

Growth of an International Scientific Community

Roger (1971, pp. 177-178) points out the decline of language barriers during this period as translations multiplied, learned men studied the living languages, and French became increasingly an international language. Periodicals were growing in number and influence. The "great observers" of nature in the mid-eighteenth century visited each other and corresponded and exchanged specimens. They translated each other's work and sought and recommended publishers for one another. They published reports which included news of colleagues' findings, and they corroborated and extended each other's observations. The following paragraphs afford a few examples.

When Bonnet discovered parthenogenesis in the course of studies suggested by Réaumur, the French savant (Wheeler, 1926, p. 243) invited the Genevans Trembley and Lyonet, both then resident in Holland, together with Bazin of Strassburg, to repeat Bonnet's experiments. The first extended reports of Trembley's studies were published by Réaumur (1742) in the preface to his sixth volume on the insects. In Trembley's preface to his own *Mémoires,* he presents recent work carried out by Lyonet on aphids, and some of Trembley's work on other organisms than the hydra is known to us only through Bonnet's publications (Baker, 1952, p. 113; Trembley, 1943, p. 286).

Bonnet and Trembley enjoyed a particularly close scientific friendship. In the *Mémoires* Trembley tells us that he was influenced by Bonnet's discoveries on the reproduction of aphids to be open-minded to the discovery of regeneration in his polyps. In the spring of 1743, Trembley wrote to Bonnet (translated in Dawson, 1983, p. 234):

> I ardently wish that you would find some Polyps. I am convinced that you could be a great help to me if you had some, in order to complete my experiments... I believe that there are wonderful discoveries to be made on all these Polyps; this is why I am extremely anxious for you to find some, for I am convinced that they could not fall into better hands.

In letters later that year Trembley offered to help Bonnet prepare the results of his own studies for publication (Dawson, 1983, p. 237 ff.)

Trembley tells us in the *Mémoires* not only of the assistance of Réaumur and Bonnet, but of other colleagues as well, such as J.N.S. Allamand, also in Holland as a tutor to the children of Leiden Professor 'sGravesande. Trembley relied on Allamand to repeat and verify his experiments on inverting hydra; Allamand carried them a step further, inverting animals that he had already inverted previously. Trembley and the Englishman John Needham were to have profound differences on the question of spontaneous generation, but in 1746 Trembley was scurrying about to have Needham's work not only translated, but also distributed in France (Roger, 1971, p. 497; Trembley, 1943, pp. 253, 285, 291-292).

POSSIBLE INFLUENCES ON TREMBLEY'S SCIENCE

This young Swiss who burst suddenly through no proper academic entry way onto the stage of mid-eighteenth century science, was he amateur or professional, a brillant isolate or integrated into the larger scientific and intellectual community? What can we say briefly of the men and ideas that influenced his contributions to science? To what extent does his work seem to reflect the scientific zeitgeist of that era, to what extent does it leap ahead into the future?

Réaumur

In a letter to Réaumur of December 15, 1740 (see Trembley, 1943, p. 14), in which Trembley first describes hydra to the French naturalist, he writes: "Since I am not learned in natural history, I am not aware of whether or not it [the hydra] is known." When he began his studies of hydra in 1739, Trembley did not know of the much earlier discovery of the animal by Leeuwenhoek (1704), nor of the report by the "Anonymous Gentleman" on the hydra in the *Philosophical Transactions* of the Royal Society (1704). Guyénot (see Trembley, 1943, p. X) views Trembley's knowledge of natural history at the time as "altogether elementary and superficial" and says that "Réaumur was his sole guide." Trembley himself expresses considerable diffidence about his limited knowledge of the subject in this and other letters of the period. Dawson (1983, p. 205) concludes, however, on the basis of her studies of the Réaumur-Trembley correspondence, that "Trembley's ingenuity in devising the experiments was clearly his own: Réaumur never suggested a particular experiment to Trembley."

His Mathematical Studies

Though when Trembley began his researches he was a novice in the study of natural history, his exposure to modern mathematical thinking under the mathematicians Cramer and Calandrini at the Geneva Academy of Calvin may have been more useful

to him than any studies in the life sciences he could have pursued in the university during that period. That Trembley's thesis at the Academy dealt with the infinitesimal calculus may help illumine the precision and independent imaginativeness with which he approached problem-solving in his investigations of living organisms.

Dawson (1984, p. 45) sees a direct link between Trembley's mathematical studies and his conceptualization of his work with the polyps. Since "the discovery of infinitesimal calculus by Leibniz and Newton provided a striking mathematical justification for the idea of biological continuity," it may have been "no coincidence that Trembley moved from the exploration of mathematical to biological continuity." Baker (1952, p. 187) points out that Réaumur and Trembley both started as mathematicians. Jean Trembley (1787, pp. 7-8), Abraham Trembley's nephew who was himself a mathematician of note, assigns great importance to his uncle's study of mathematics, in particular his thesis on Newtonian calculus, saying that "doubtless this study contributed more than everything else to inspiring in him the taste for that rigorous logic, that simple, lucid analysis, which shines in his works of natural history."

The Genevan Context

Rudolph (1977) describes the remarkable intellectual flowering of Geneva during the eighteenth century, particularly in the life sciences. The Genevans of that era, he says, were "in the vanguard of physiological research." Among these men Rudolph lists Trembley, Bonnet, and Jean Sénebier; he also comments on the early immunological work of Théodore Tronchin. Dawson refers to a Genevan "tradition in the natural sciences" which included Horace-Bénédict de Saussure, Pierre and François Huber, Jean-André de Luc, Nicolas de Saussure and Auguste de Candolle. In correspondence with the Genevan circle around Charles Bonnet were Albrecht von Haller, Lazarro Spallanzani and Jean-Nicholas Sébastien Allamand (Dawson, 1983, pp. 5-7).

In an article on Geneva in the *Encyclopedia* (see Rudolph, 1977, p. 50), d'Alembert remarks on the intellectual vitality both among natives and "famous foreigners." Perhaps the rich infusion of talent from descendants of Huguenot refugee families was at work here. That the "Empirical Newtonian tradition," channeled in part through Genevan connections with the Leiden circle of Boerhaave and 'sGravesande among others, was definitely formative for Trembley and Bonnet is amply demonstrated by Dawson. (See especially chapter III, "Geneva: The Cultural Matrix," in Dawson, 1983, pp. 58-94.)

Religion

Mornet (1929, p. 85 ff.) tells us that before eighteenth century science could become truly experimental, it had first to reject its old dogma, idols and goals of explaining the world, and to impose rigorous self-discipline upon itself. The attack on "scientific scholasticism" came not only from the philosophes, but also "from extremely pious people like the Abbé Pluche, Trembley, the Abbé Fromageot, president

Rolland and twenty other teachers." If we depict Trembley as removed philosophically from many of his colleagues in his antipathy to much of the generalization and theory-building of the time, and in his refusal to bend scientific findings to the service of religious views, we in no way mean to suggest that he was some kind of modern sceptic. He shared with many of his more theoretically-inclined colleagues a common religious starting point, that is, a pietistic appreciation of the wonder and beauty of nature as reflections of the deity. Adhering to a non-sectarian form of Christianity, he also shared their arguments for God from the evidence of design and of order in nature.

Like the popular Abbé Pluche among others, Trembley also wrote of the value of the study of nature in developing morality and virtue. Trembley tells us in the *Mémoires* that he "often witnessed how even children can begin to appreciate the pleasures of contemplating Nature. To a child, nature presents a pageant which at first entertains him but then spurs his curiosity, instructs him, enchants him, moves him, and accustoms his spirit to delight in all that is most beautiful."

Trembley shared the religiously-inspired humility of other "modest" or "simplicist" naturalists of the period, though not the anti-intellectualism that many of them also expressed (Lovejoy, 1955, p. 66 ff.; Lovejoy, 1961, p. 7 ff.; Mornet 1911, p. 140 ff.). Despite Trembley's unyelding empiricism and the absence from the *Mémoires* of the theological interpolations found in much of the writing of the other "pious" naturalists, Trembley's work may still be viewed as part of the "insecto-theology" literature of the period, according to which the small creatures, with all their minute complexity and perfection, were emphasized as among the best examples of God's handiwork. This enchantment with the most minute elements of God's creation, implied by the subject of Trembley's *Mémoires* but never explicit in them, is expressed clearly by Trembley's fellow student of hydra, Henry Baker, in his *Employment for the Microscope.* Baker says that all of God's creation is wonderful, but the tiniest "Specks of Life" by their "Minuteness" seem to embody "more Elegance and Workmanship (if the Term may be excused) in the Composition, more Beauty and Ornament in the Finishing" than he sees in the elephant, crocodile, and whale (H. Baker, 1753, p. 229). Such attitudes were in sharp contrast to "the contempt and neglect" which had been accorded the lower organisms for many centuries previous, as Wheeler (1926, p. 256) tells us.

In contrast to Bonnet and other theist naturalists of the time, Trembley appears to have had no difficulty in reconciling his discoveries with his religious beliefs. The *Mémoires* allude in only a few passages to God in terms of an infinite Creator of a complex and magnificent natural order. Trembley's later writings, however, show more fully his deeply religious orientation. According to Baker (1952, p. 41), from the start Trembley "regarded his scientific work as a religious exercise." Late in life after the death of a son, Trembley remarks in a letter, that he finally has found some solace in turning to nature (Geisendorf, 1970, p. 282). Nature, God, science, faith appear to have melded meaningfully and comfortably for this anti-theoretical, pragmatic observer.

In the course of our studies of Trembley, we often have wondered about the influence of his religious beliefs and attitudes on his science, and have raised the subject with both scientific and lay colleagues. In this age of "secular science" it is probably no surprise that most with whom we spoke believed that a pious religious outlook was likely to interfere with conceptualizing, carrying out, and accepting scientific breakthroughs. Among scholars, Sigerist (1945, pp. 161-162) as an example, writes that science and medicine flourish in rationalistic, materialistic environments rather than where national philosophies are "mystical" or romantic. However, in the case of Trembley at least, we find ourselves believing that his religious views were not only a motivational, but also a scientifically liberating factor.

In the magnificent universe of Trembley's God all marvels are possible. By contrast, the philosophic or scientific rationalist is constrained by the necessity that a phenomenon appear "reasonable," that it fit with what is already accepted knowledge, and that it be subject to confirmation by inductive or deductive logic. As Carl Becker points out, the supposedly free-thinking philosophers of the eighteenth century were thus by no means free (Becker, 1967, pp. 102-103). It is instructive perhaps that Voltaire had great difficulties accepting Trembley's discoveries on the polyp. Trembley was undismayed by the disconcerting findings that did not seem to fit accepted understandings. On December 11, 1742 he wrote to Bonnet, "Your worm with two tails is admirable, but it does not surprise me, because nothing surprises me" (see Dawson, 1983, p. 164). Was it perhaps precisely because of his non-doctrinaire but profoundly religious world view that Trembley's mind and spirit were open to whatever observation and experiment might demonstrate to him and were so opposed to closed systems of science?

Toward a Science Free of Systems and Speculation

Trembley's time was one of prolific system-making, and bitter theoretical controversy among the biologically-inclined scientific savants of Europe. Ovist versus animalculist, preformationist versus epigeneticist, Cartesian versus Newtonian, mechanist versus vitalist, the supporter of the concept of spontaneous generation, of the idea of the Chain of Being, and so on. They held forth, debated and disputed each other in the various public forums of the time, the burgeoning scientific societies, the fashionable salons, and of course, the world of books (see, for example, Mornet, 1911; Caullery, 1933, p. 31 ff.; Guyénot, 1941, pp. 209-401; Hazard, 1946, p. 184 ff.; Lovejoy, 1955, p. 66 ff.; Vartanian, 1963, p. 173 ff.; Ritterbush, 1964, p. 65 ff.; Gasking, 1970, p. 55 ff.).

Trembley, on the other hand, took an anti-theoretical stance in the *Mémoires* that was more pronounced even than that of his role model, Réaumur, who, for example, speculated on the animal soul (Réaumur, 1742, Vol. 6, p. lxvij). John Baker (1952, p. 183) asserts of Trembley that "it would be difficult to name a scientist who has pushed this objection [to theory] farther." Trembley combined the presentation of an unusual

level of experimental detail with such adamant rejection of speculative generalization (in Trembley's terms, dangerous "so-called general rules") that he drew upon himself the mockery of some of the grand literary figures of the Enlightenment, including Fielding, Smollett, Voltaire and Goldsmith. From Goldsmith (see Freedman, 1966, Vol. 1, p. 472), for example, we hear in *The Bee* of "the puny pedant, who finds one undiscovered property in the polype, or describes an unheeded process in the skeleton of a mole, and whose mind, like this microscope, perceives nature only in detail."

Trembley's opposition to theory and system building in natural history was so strenuous that it caused even Jean Trembley, his admiring nephew, and John Baker, his enthusiastic modern biographer, to concede that Trembley may have carried his aversion to theory a bit too far. Three years after his uncle's death, Jean Trembley (1787, p. 44) wrote that "perhaps his reserve on this issue was too great; perhaps the conjectures of such a precise and cautious philosopher would have given truth to new observations and opened a new field of study to naturalists."

Trembley in his first Memoir quotes Réaumur's statement that even after seeing regeneration take place hundreds of times, he still is nearly incredulous each time he sees it. Many of the intellectual elite reacted feverishly to the mechanistic and materialistic implications that could be drawn from the discovery of regeneration in the polyp, a discovery "rich in speculative promise," as Vartanian (1963, p. 177) puts it. In a foppish style that seems worlds removed from the deliberative caution of his cousin, Charles Bonnet (see Trembley, 1943, p. 60) wrote to Professor Cramer of Geneva, under whom both he and Trembley had studied:

> Now the animal studied by my cousin is thoroughly authenticated. Shall we attribute a soul to it, or none at all? . . . My great wish is only that my poor little creatures not be too much degraded . . . I implore you, Sir, not to allow them to become simple machines. I will be inconsolable about it. Really, I will no longer observe them with as much pleasure. Good-bye then to all industry, all skill, all kinds of intelligence.

Subsequently and somewhat more soberly, Bonnet (1744, pp. 479-480) brings these concerns to the Royal Society: "Where then does the Principle of Life reside in such Worms . . . . Are these Worms only mere Machines, or are they like more perfect Animals, a sort of Compound, the Springs of whose Motion are actuated by a kind of Soul?"

Dawson (1983, pp. 155-156, 167) shows us through her analysis of the correspondence of Réaumur, Trembley and Bonnet, that Bonnet took a central role in the "metaphysical debate in Geneva over the implications of the discovery of the polyp" and that he "served as the transmitter of the Geneva interpretation to Trembley." Trembley's matter-of-fact responses to these metaphysical concerns were found to be annoyingly "laconic" in Bonnet's Genevan circle.

Trembley's one lapse into speculation was in the matter of preformation. Nowhere in the *Mémoires* themselves, however, does he voice preformationist sentiment. There is a hint in the fourth Memoir, perhaps, of one of the considerations that may have

moved Trembley into the preformationist camp: he rails against "the hypothesis or rather prejudice" of spontaneous generation, and at the time, that theory was interconnected with epigenetic concepts (see Baker, 1952, p. 185). Several writers on this point stress the views of Bonnet as having had a major influence on Trembley (see Mees, 1946, p. 150; Dawson, 1983, p. 155 ff.; Baker, 1952, p. 183 ff.). Also, the materialist connotations of epigenesis must have been troubling to the religious Trembley. It is ironic, therefore, that by the turn of the century, Trembley's discovery of regeneration had played an important part in bringing about the "demise" of preformationism which had "in its various forms dominated embryological thought for almost one hundred years before yielding to epigenesis" (Bodemer, 1964, p. 22).

The Relative Isolation of Sorgvliet

Trembley sometimes spoke disparagingly of "the prejudices of the schools," pointing out several times in the *Mémoires* that simple fishermen and young children recognize the truth for what it is whereas the academic theoreticians are oblivious to the facts before their noses. This is by no means to say, however, that Trembley rejected the authority of the universities, the academies and societies, and the academicians. In the fourth Memoir, Trembley quotes professor Boerhaave of Leiden approvingly and at great length, exclaiming: "How this great man has worked to study the Plants and the Animals." Trembley's mentor, of course, is Réaumur, deeply involved with the Paris Academy. Through letters and later through his travels accompanying the young Duke of Richmond, Trembley, communicates broadly with academics across Europe. So, Trembley was hardly without academic connections.

During those four intense years from 1740 to 1744 when Trembley was making and publishing his amazing discoveries, however, he worked in a setting remote from the universities and academies of Europe and from his Genevan circle. He was at that time serving as tutor to the two young sons of Count Bentinck of Holland and living in the Count's mansion at Sorgvliet near The Hague. In a letter from Trembley to his father (see Geisendorf, 1970, pp. 256-257), announcing that copies of the *Mémoires* were en route to him, Trembley writes:

> You will see in them how I fill my leisure moments . . . .
> I have found the means, by applying myself to the study of nature, of always having by me a thousand objects of recreation. All my glasses populated with little creatures are such good company with which to relax from more serious occupations.

Trembley sounds here very much like the country parsons and village doctors who communicated the findings of their Sunday nature jaunts to the Secretary of the Royal Society. Indeed, it was in the ditches of Sorgvliet that he first found the polyps, and during those "leisure moments" in the quiet of his study in the Bentinck mansion that he made his surprising discoveries. The vignettes at the head of each of the four memoirs depict Trembley in the company of his two young charges. In the first three they are seen

in various stages of collecting polyps or food for the polyps, and in the fourth they are shown in Trembley's study where an experiment on the inversion of a polyp is in progress. These vignettes are in perhaps instructive contrast to those in other works of the period which often depict groups of savants in discussion or observation in the study of a king or in the meeting rooms of a scientific society.

Trembley certainly was in contact both with great scientists and the virtuosi during this time, as evidenced in his correspondence with Bonnet and Réaumur, and in such visits as that by the Duke of Richmond among others. But we find ourselves wondering if his physical distance and intellectual remove from the conflicting scientific schools of thought in the institutions of the city did not help him to approach his subject in a fresh, contemplative manner, inclining him to modes of thought relatively free of the crosscurrents of argumentation and pressures for recognition so prevalent in the culture of the university, scientific society, academy and salon.

The scholarly enterprise in Trembley's time may have been simpler, but it appears to have been no more serene or idealistic than it is today. Between the giants Leibniz and Newton, for example, controversy had not too long since waged bitterly as to which of the two had precedence in formulating the calculus. A few years into the future was the notorious "quarrel Buffon," the nastiness of which some commentators believe occasioned a virtual retirement from science for some years by one of Buffon's major targets, the great Réaumur himself (see Wheeler, 1926, p. 14 ff.). In the *Philosophical Transactions* of the Royal Society of the period, much is made of questions of priority of discovery regarding this finding or that. Some of this attitude appears even earlier in the *Transactions* of 1704 in the letter from the anonymous "Gentleman in the Country" who reports discovery of the polyps prior to Leeuwenhoek and states that he "was a little mortified to see . . . an account [Leeuwenhoek's] of a Creature which I thought that I had a sort of Propriety in, and of which I had made a Draught, with a design to present you and Mr. *C* with a rarity, which I believed no body had met with but myself." Trembley's relative isolation in Sorgvliet, then, may have afforded him some buffering from the public backbiting of the scientific societies and the salon as well as from the factious argumentation of the theoreticians of academia.

THE QUESTION OF AMATEURISM

Before the French revolution, as Caullery (1933, p. 13) tells us, "a theological spirit" dominated the French universities. Thus prior to the nineteenth century, much of the scientific progress that took place came from the work of isolated individuals outside the universities who had other major occupations, such as law, medicine and government. Guyénot (1941, pp. 189-190) describes the work on systematics and anatomy that was proceeding during this period in the universities and the medical schools; alongside it, but generally outside academia studies were being carried out by

the "curious," the observers and experimentalists who saw in organisms "something other than objects for collection," and who were excited by life processes, whether behavior, nutrition, reproduction or metamorphosis. These "great connoisseurs" of nature were, says Guyénot, the "precursors of modern biology."

Though the study of nature always remained important to Trembley, and though he engaged in some limited experimental work on and off throughout most of his life, yet as the Sorgvliet years wound down in the later 1740s, so did his systematic research. John Baker (1952) labels the years 1747-1757 "A Decade of Travel." Trembley was for a time engaged in a diplomatic mission for the British that is still today "shrouded in mystery," and upon the death of the senior Duke of Richmond, he took on responsibility for the care and education of the Duke's fifteen year old son. He returned for a time to Geneva with the youngster to further his education, then set forth with him on the requisite Grand Tour of Europe, which in this instance lasted three years.

During his travels with the young Duke of Richmond, Trembley met with many leading thinkers of the European Enlightenment. A few among them were Montesquieu, by whom he was said to have been deeply and uniquely affected, the mathematicians Frisi, Camus and Bouguer, the plant physiologist Duhamel, the architect-naturalist Donati, and the great scholar Haller. Trembley spent time in several of the great museum collections of the continent, including that of Emperor Francis I in Vienna. He engaged in some geological and archeological studies during his travels, communicating to the Royal Society periodically, for example, regarding Donati's findings on undersea fossils and some of his own on basalt prisms, Allamand's experiments on electricity and some of Bonnet's research on caterpillars. For a time Trembley performed studies on the incubation of eggs (see Trembley, 1787, p. 55 ff.; Baker, 1952, p. 139 ff.).

Baker (1952, p. 154 ff.) tells us that eighteen years elapsed before Trembley published any further kind of experimental work of his own at all. During those intervening years, however, we know that on behalf of the Republic of Geneva he did carry out studies on the protection of grain from attack by insects and that he taught the staff of the Geneva public library how to preserve in an alcohol preparation animal specimens being brought over from the western hemisphere. In 1765, together again with his cousin Charles Bonnet, he was lured back to the study of fresh-water "insects."

His preoccupations during those years of travel through Europe and his ventures into scientific fields outside zoology may further incline us to regard Trembley as an amateur. It may be well to recall that many of the great minds of the periods even among the professional scientists did not feel at all constrained to restrict themselves to a single discipline. It is also true, however, that despite his valuable discoveries of the mid-sixties, no scientific work of the scope and importance of the *Mémoires* followed from Trembley's pen after 1744. Perhaps as much as his antipathy to theoretical system-building, this fact may also partially account for the manner in which Trembley's name faded from prominence during the nineteenth century.

Trembley's relationships to some of the intellectual currents of his time were complex. Differences of opinion exist among scholars as to which players in the scientific scenario of the Enlightenment are to be deemed primarily Cartesian or Newtonian in outlook, as to whether the English or continental naturalists were the more empirical group, as to which philosophical trends were dominant, and so forth. We conclude that Trembley was certainly of his time and not out of step with it, but that the influences which shaped him were intriguingly diverse. We are inclined to think that Trembley reflects the intellectual eclecticism in his Genevan education and background of which Dawson (1983) writes.

Trembley does not fit neatly into one philosophical or practical niche. Whether an amateur or not, he was a man of exacting precision and produced solid and focused contributions. Although trained in mathematics, he favored observation and experiment over any kind of abstract reasoning, whether inductive or deductive; he most certainly valued knowledge of process and function over that of structure and orderly classification. One of "the pious" in religious matters, he believed in the study of nature as a means of glorifying God, but during his years of scientific productivity he refused to mix religious questions, whether of animal soul or final causes, into his science. He rejected the rationalist scholasticism found frequently among the religious naturalists, signifying simply that in the Grand Design of the Infinite Being all things were possible. He shared the humility of the "modest" naturalists, but not their anti-intellectualism. In the quarrel of the Ancients versus the Moderns, he paid due respect to the great Greek and Roman writers, but felt free to gently mock their lack of scientific method. He believed in the ennobling quality of scientific learning and saw the need for knowledge of science to be widely spread and he wrote attractively for a broad audience, but never sacrificed accuracy for style in the manner of a Buffon.

CONCLUSION

Mornet (1911, pp. 248-249) studied five hundred catalogues of libraries in eighteenth century Europe and tabulated the numbers of copies of the various works listed. As against Buffon's two hundred and twenty listings in library catalogues of the period examined by Mornet and the Abbé Pluche's two hundred and six, the work of the careful Réaumur is represented by eighty-two listings, Henry Baker's book on the polyp by eighteen and Trembley's *Mémoires* by seventeen. Trembley's *Mémoires* remain relatively difficult to come by. The current Union Catalogue shows twenty-six copies available in North American libraries, fourteen of those copies being the Leiden version. To make this fine work more readily accessible to English-speaking readers, Boxwood Press (Palo Alto, CA, USA) will publish our English translation of the *Mémoires* in 1986. In the meantime, we encourage readers who are able to do so to dip into the original *Mémoires* themselves, believing they will enjoy and benefit from following this gentle scholar who writes:

> The facts that I must report are too extraordinary to ask that anyone take my word for them. I shall explain as clearly as possible every consideration that guided me, and all the precautions I took to avoid self-deception. Insofar as I am able, I shall bring the reader into my study, have him follow my observations, and demonstrate before his eyes the methods I used to make them. He himself will be witness to my results.

We believe that there is profit to be had in clarifying the circumstances of Trembley's old discoveries and in considering possible new ones suggested by the work of this engaging figure who speaks to us clearly and interestingly across the centuries through his *Mémoires.*

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