Introduction
The scientific study of hallucinations began in a drawing room in Geneva, Switzerland on May 28, 1759. A 90-year-old, partially blind, retired government official, Charles Lullin, completed dictating a report of the curious visions he had experienced the previous year, signed the document as best he could, and had it witnessed by his secretary. The report had been prepared at the request of his grandson, a distinguished natural philosopher, Charles Bonnet, who, recognizing the importance of the experiences, wished them recorded for posterity. Although not published in full until 1902 [1] and never translated into English, the 18-page document arguably marks the beginnings of a modern approach to psychiatric phenomenology, predating the term hallucination. Almost 250 years later we are only now beginning to recognize the high prevalence of visual hallucinations across a spectrum of ophthalmologic, psychiatric, and neurologic conditions.

Historical Perspective
Charles Bonnet wrote on topics as diverse as parthenogenesis in aphids to the functions of what he referred to as the soul (l’âme) but which we may today refer to as the mind. He held a strikingly modern view of the brain, arguing that it consisted of multiple independent organs, each of specific function. He influenced Gall and the later development of organology (phrenology was a term introduced by Spurzheim). In a prophetic view of 21st century imaging sciences, Bonnet suggested that if one could perceive the workings of the brain, one could read the workings of the mind as if they were a book.

Without being initiated into the secrets of anatomy, it is known, at least in general, that a Brain is an organ of intricate composition, or rather really an Assemblage of different organs, themselves formed by the combination and intertwining of a prodigious number of Fibres, Nerves and Vessels, etc…It follows from this that a rational being that would understand thoroughly the Mechanisms of the Brain and that would perceive in the greatest detail all that took place there, would read as if from a book. This prodigious number of infinitely small Organs appropriate for Sensation and for Thought would be to this rational being as Printed Characters are to us (La Palingénésie, 1770 cited in Clarke and Jacyna [2]).

The first edition of Bonnet’s Analytical Essay on the Faculties of the Soul was published in 1760, a year after Lullin’s dictated report, and contained a brief summary of the hallucinations, although Lullin’s anonymity was preserved until the 1782 edition when he was named in a footnote.
Bonnet reported Lullin’s hallucinations of scaffolding and brickwork patterns, changes in the tapestries lining his apartment, men, women, birds, carriages, and buildings—all silent and appearing in the same vivid detail as if the objects were present. Bonnet’s summary failed to do justice to the wealth of detail in Lullin’s report. For example, Lullin’s hallucinations of “women” were neatly dressed and coiffured ladies carrying caskets or inverted tables on their heads, or young girls approximately 8 to 10 years old who danced around the room dressed in yellow silks with rose-colored ribbons, pearl collars, golden buckles, and diamond pendants. His hallucination of a “carriage,” a coach complete with drivers and horses, expanded in correct proportion to the size of a house. Perhaps Bonnet’s most serious omission in the light of subsequent developments was that Lullin saw what we would now consider to be simple hallucinations. His most frequent hallucinations included a multitude of atoms whirling about in his field of view; clover patterns covering the walls and furniture; a blue handkerchief with four black-bordered, yellow circles in the corners and another circle in the middle, which varied in size depending on where it was projected; and spinning objects that reminded him of a hexagonal, spoked component in an 18th century weaving machine. Bonnet’s description also omitted details of the events that had preceded the visions. In 1753, Lullin had a cataract operation on his left eye, which in the mid-18th century is likely to have been a couching procedure whereby a hook was inserted to displace the lens from the optical axis. After the operation he was able to read with glasses until September 1756, when the vision in his left eye deteriorated. By January 1757, he could perceive only light and dark in his left eye. At approximately the same time his right eye deteriorated and he had a second cataract operation in May 1757. The operation on the right eye was less successful than that on the left, although his vision improved enough to allow him to get around and have a fogged view of objects at 30 to 40 paces. However, he could not to read or write. His hallucinations started in February of the following year (1758) and continued intermittently until September, when Lullin felt that his vision had deteriorated, having lost the ability to see Lake Geneva from his window or colors worn by passers-by in the street. Although his ophthalmologic diagnosis will never be known, it seems likely that Lullin had age-related macular degeneration in his right eye. He had the characteristic preservation of peripheral vision that allowed him to get around but he also had a central scotoma that prohibited reading and writing. His left eye, in which he was almost completely blind, may have had glaucoma related to the couching procedure.

The Charles Bonnet Syndromes

In addition to Lullin’s hallucinations, Bonnet’s summary contained brief clinical details. It was noted that Lullin was old but cognitively intact when he had the experiences, that his vision had deteriorated, and that he recognized the phenomena as unreal. These three facts are directly responsible for the confusion and controversy that has marked the 20th century study of visual hallucinations. They have resulted in three mutually exclusive Charles Bonnet syndromes.

**Charles Bonnet syndrome 1: visual hallucinations in the cognitively intact elderly**

The Charles Bonnet eponym was coined in Geneva by neurologist Georges de Morsier (1894–1982). De Morsier studied in Paris under Gaétan-Gatian de Clérambault and was strongly influenced by his doctrine of mental automatisms, which held that psychiatric phenomena were stereotypical responses of organic origin. Toward the beginning of his academic career, de Morsier wrote a piece on neurologic visual hallucinations in support of de Clérambault’s doctrine, describing the different neurologic contexts in which visual hallucinations occurred and pointing out the stereotyped nature of their content and their similarity to the visual hallucinations found in psychiatry [3]. One such neurologic context was, what he described as, “certain states of the aged brain, often accompanied by eye disease,” reminding him of Bonnet’s 18th century description. To his later regret, he went on to refer in passing to the Charles Bonnet syndrome as “senile syndromes with lesions of the eye.” However, it was Bonnet’s description of Lullin’s age not his eye disease that de Morsier meant to emphasize. He thought that visual hallucinations were caused by the brain, an example of de Clérambault’s mental automatisms. In 1938 he refined the definition by removing any mention of eye disease, changing it to “visual hallucinations in the elderly with intact cognition” [4] but the damage had been done. As will be seen below, by the 1950s de Morsier’s eponym had evolved into an entirely different entity. Lhermitte was one of the few authors to follow de Morsier and categorize visual hallucinations in the elderly and those in eye disease as distinct clinical entities [5]. The final insult was that the year after de Morsier retired as Head of Neurology, the Head of Psychiatry at the same University, de Ajuriaguerra (another pupil of de Clérambault), published a paper on the Charles Bonnet syndrome titled, “The visual hallucinations of ophthalmomopathes” [6]. De Morsier [4] used the early years of his retirement to write a comprehensive review of the syndrome he had defined, defending his anti-opthalmologic stance on the grounds that five of 18 patients in the literature had little or no eye disease. In his last published thoughts on the matter, he outlined what he thought to be his true etiology: an age-related isolated pathology in the pulvinar-extrastriate visual cortical pathways, pathology which, he suggested, may have a genetic basis [7]. De Morsier’s definition of Charles Bonnet syndrome is rarely used today.