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Editorial

FELICE FONTANA: A FORGOTTEN PHYSIOLOGIST OF THE TRENTINO

Of old, an *abbot, abbé* or *abbate* was primarily an ecclesiastic, who presided over an abbey or other community of monks or was treasurer of its revenues. But even before the Council of Trent, there were lay, as well as clerical abbots, who discharged no spiritual functions, even while subsisting on the revenues of abbeys. Eventually the term was loosely applied to lay clergyman of the type of La Fontaine or Galiani or Liszt, who wore "the dress of a secular ecclesiastic." Some of these men have played no inconsiderable part in the history of science or of medicine. One thinks offhand of Nollet, Quillet, Spallanzani, the abbé de l'Epée and his successor Sicard, or the great name of Mendel. Prominent in the lay group stands the name of the *abbate* Felice Fontana (1720-1805), pioneer in the investigation of serpent venoms, whose life-span covered the greater part of the 18th Century; who was alive when Marengo was fought, Fort Dearborn built and the Eroica Symphony played; who lived to see Napoleon made Emperor of the French and died a few months before the battle of Trafalgar. Born at Pomarole, near Rovereto (Austrian Tyrol), on April 15, 1720, Fontana gained his education at Verona, Parma, Padua and Bologna, and early occupied the chair of philosophy at Pisa. Eventually he was called by the Grand Duke of Tuscany (later Leopold II) to take charge of the Museum of Physics and Natural History at Florence, founded by the Accademia del Cimento, and repository of the apparatus used by Galileo, Torricelli

and Viviani in their epoch-making experiments. To this Museum, after some years of travel, spent in collecting specimens in France and England, Fontana devoted the last thirty years of his life. Outstanding in this unrivalled collection was his great assembly of anatomical preparations in colored wax, of which he was the special creator. No less than eight separate Italian biographies of Fontana have been written and published in recent years.[1] As an experimental physiologist, he has come into his own but latterly. During his lifetime, Italy, like Germany, existed as a loose congeries of petty principalities, dominated mainly by Austria and Spain, and devoid of any realistic aspiration toward nationhood, beyond a vague feeling for the past glories of Roman power. Mental independence and spontaneity were submerged by a rigid, schematic system of scholastic dogma and all sense of national character was lost. Nevertheless, for Italy, as for the rest of Europe, the 18th Century was a "germinal century," matrix *in posse* of all the going ideas of the modern world, even the egalitarian principles of the French Revolution, in which Fontana became involved, to his cost, toward the end of his life.

Recent interest in Fontana centres on his work in physiology, which has been considerably overshadowed by the spectacular interest attaching to his Museum of wax preparations. He began as a promoter of the ideas of Haller (*fautor Halleri*), in particular of the Hallerian doctrine of irritability.[2] In his book on the anatomy of the liver (1654), Glisson had stated that vital phenomena depend upon the ability of all living things to react to stimuli; in other words, upon the tendency of living tissues to react to irritation. This property of irritability is expanded at length in Glisson's posthumous treatise on the stomach and the intestines (1662-77). In Haller's hands, irritability became merged into muscular contractility while the conductibility of nerve was differentiated as "sensibility." Zimmerman had found that application of laudanum will arrest the pulsations of an isolated heart without destroying the irritability of the cardiac muscle (1751). Fontana found that opium will inhibit intestinal but not cardiac

irritability (1757). He denied the irritability of nerve, since no irritation of cardiac nerves will inhibit the motions of the heart; and reasoned that the dura mater, the tendons, veins, arteries, membranes and placenta are alike insensible to laceration or the action of caustics. Alcohol applied to the brain, the medulla or the crural nerves will inhibit the action of the corresponding muscles, where a watery solution of opium is inert; whence the effect of laudanum is ambiguous. Experiments upon 300 frogs showed the effect of opium upon an exposed nerve to be *nil*. The main interest of these findings is their effect upon such phases of 18th Century doctrine as the tonic-atonic hypothesis of Hoffmann, the sthenic and asthenic pathology of Brown or the stimulus and contrastimulus of Rasori. Fontana's researches of 1775[3] reveal the loyal standard-bearer of Hallerian doctrine as to the autonomy of the heart: that its rhythmic contractions are consequent upon inherent muscular "irritability," and independent of nerve-supply. In our own time, Ehrlich defined irritability as "the most obscure phase of physiology." In his monograph on the movements of the iris (1767)[4], Fontana confirms Haller and Caldani in associating the pupillary reflex with the reactions of the retina to light. At the same time, he noted the effect of cerebral excitement upon the dilatation of the pupil, thus anticipating the "psychic pupillary reflex," of Gratiolet (1855). In 1778, he discovered Fontana's space and the ciliary (Fontana's) canal[5].

A pioneer in histology, Fontana studied the effects of acids, alkalies and colored solutions upon the irritability of tissues and red blood corpuscles. With such microscopes as he had, he appears to have noted the cell nucleus in the epidermis of the eel; the pus cells and the compressibility and elasticity of red blood corpuscles (Bilancioni). He teased out the fasciae and the cylindric fibrils in muscle preparations and noted the transverse striae. Cirincione points out that Fontana described the axis cylinder of nerve (*cilindro primitivo nervoso*) before Remak and the nerve sheath before Schwann (1779).[6] The same observant spirit is apparent in his studies on the structure of the

brain, and on the effects of compression of the nerves. While visiting the Hunterian Museum in London (1779), Fontana made microscopic observations on the regeneration of nerve, simultaneously with Cruikshank.[7] In 1783, he described hydatid disease of the brain in sheep and man.[8] From the clinical effects of this malady, he takes the extremist view that nervous and mental diseases are attributable to lesions in the nervous system and not to psychic disturbances.

Fontana's pioneer experiments on serpent venoms (1767-81)[9] are classical in the history of toxicology and pharmacology. Employing the common European viper (*Vipera berus*), he found that it is immune to its own venom; that the venom is ejected and injected by the canalized teeth; is of a gummy consistency, neither acid nor alkaline, or as Lucien Bonaparte saw later, an albuminoid; and that, in the serpent itself, it is not so much an offensive weapon as a digestive juice (Calmette). Its fatal effects he attributes not to clumping or dissolution of red blood cells, but to muscular atony and paralysis. Fontana made innumerable experiments with the venom, not only upon animals, but also upon himself, even to the extent of swallowing the poison. In all this, he was the venerated precursor of Weir Mitchell, Reichert, Noguchi, Fraser, Kyes and Calmette. He extended his researches to the effects of animal and vegetable poisons, notably curare and *Laurus cerasi.* In like manner, Fontana was forward and prominent in those investigations of "dephlogisticated air," "fixed air" and other gases discovered by Cavendish, Scheele, Priestley and Black, which remained meaningless up to the luminous synthesis of Levoisier. Fontana's discovery that carbon will absorb gases (1777) was confirmed by Priestley himself (1779). In the matter of physical experimentation, Fontana was a facile inventor of instruments. Among these was an apparatus for the inhalation of oxygen in phthisis (Bilancioni). As a botanist, he was equally active and made his mark in vegetable pathology by his investigations on the rust of grain (1767) and spurious ergot (1775).

Like all the greater physicians of the 18th Century, Fontana was thus one of the most versatile biologists of his period. Yet, the variegated mass of his experimental work has been almost completely overshadowed by his extraordinary museum of wax preparations at Florence. The medical collection of this exhibit originally comprised some 3000 specimens and 24 life-sized statues, viz., 4 each of the muscular lymphatic systems, 8 of the circulatory system, 5 of the nervous system, one each of the ligaments and chyliferous system and one gravida. The viscera comprised 650 separate pieces; the brain 55 and the nervous system, the finest of all, over 500 pieces, apart from the man-sized *écorchés*. In addition, there were representations of all phases of labor and obstetrics, of surgical operations, of mushrooms and plants. Fontana was not only the inventor of colored anatomic illustration in wax, but through the cooperation of his assistant Manzolini, probably the greatest artist in this medium in his period. His anatomic preparations were executed as a sort of composite figuration from many dissections, in keeping with the "anatomic norm" of Albinus. The photographic reproductions from the Montpellier collections, published by Bilancioni;[10] are not only accurate in detail but also beautiful in execution. So impressed was Joseph II with the Florentine collection that he ordered Fontana to reproduce it in entirety for the Josephinum in Vienna. Upon the death of this kindly and kingly patron, Fontana's troubles began. Leopold II, a colder and narrower man, did not hold the anatomist in esteem. A gigantic *écorché,* which Fontana had begun, proved a fiasco, through cracks in the wooden framework, not remediable by varnish. He became involved in religious and political tangles of a distressing character. When the French entered Italy he espoused the cause of the Republic, was subsequently arrested and imprisoned by the Austrian authorities and, upon his rescue by the Napoleonic forces, was required to duplicate his wax collections in France. Thirty-three specimens in the Anatomic Museum at Montpellier are all that survive of this episode. In his sympathies with the French Revolution and Republic, Fontana was obvi-

ously a stifled precursor of the *Risorgimento.* In this terminal episode, he had discovered that patriotism, so often "the last refuge of a scoundrel," yet "thrives upon the blood and tears of those whose hearts it has broken." As he advanced in years, he adopted an indifferentist philosophy, allied to the Stoic *ataraxia,* concerned himself not at all about foreign adulation and so lived more at ease with his captious fellow townsmen. He died on March 9, 1805, at the age of 85, and was buried with great pomp in the Florentine Pantheon, Santa Croce, where repose the remains of so many illustrious dead.

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