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ORIGINAL PAPER

Vincenzo Malacarne (1744–1816) and the First Description of the Human Cerebellum

Alberto Zanatta[1] · Céline Cherici[2] · Alessandro Bargoni[3] · Serena Buzzi[3] · Valentina Cani[4] · Paolo Mazzarello[4] · Fabio Zampieri[5]

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Abstract
Vincenzo Malacarne, professor of medicine, surgery, and obstetrics in Turin, Pavia, and Padua, Italy, represented a perfect example of an eighteenth century "letterato", combining interests in humanities, sciences, and politics, embodying the ideal of an encyclopedic and universal culture. He made important contributions in anatomy and surgery, teratology, obstetrics, neurology, and history of medicine, adopting a interdisciplinary approach based on the correlation between anatomy, surgery, and clinics. He deserves a special place in the history of neurology because of the first complete description of the human cerebellum. He quantified the units of the cerebellar internal structures, the lamellae being numbered for a systematic description of the human cerebellum. He thought the mental faculties depended on their number, considering a relation between the number of cerebellar lamellae and the expression of intellectual faculties. In this way, he made first statistics on human faculties. He advanced the concept that the number of cerebellar folia was influenced by the environment, thus providing the first nature-nurture hypothesis made on the basis of observations, and the concept of neuroplasticity in the scientific literature. Finally, he also contributed to the emergence of a new science, namely electrophysiology, because he laid down experimental foundations of a project on the recording of brain electricity, comparing the structure of the human brain with Volta's galvanic pillar.

Keywords Vincenzo Malacarne · Cerebellum · History of medicine · History of neurology

Vincenzo Malacarne (Fig. 1) was born in Saluzzo in the province of Cuneo, Piedmont region, Italy, on September 28, 1744. Educated by the Dominicans, he manifested a precocious talent and a particular predilection for literary studies, including the classic languages. In 1762, he entered in the *Royal College of Turin's Provinces*, where young promising students from Piedmont were selected and supported by the State for studying surgery [1]. He obtained the graduation at the college in 1769. Between 1775 and 1783, Malacarne was called as director of the thermal baths and professor of surgery of Acqui Terme in the province of Alessandria. Isolated from the animated intellectual life of the capital, Malacarne focused on his researches on the brain and the cerebellum in particular. He eventually published two fundamental books in the history of neurology, where he made the first complete description of the human cerebellum, namely the *Nuova esposizione del cervelletto umano* (1776) [2] and the *Encefalotomia nuova universale* (1780) [3]. In 1783, he came back to Turin, called to the position of "main surgeon of the town." In 1789, he was called to the chair of Surgery and Obstetrics at the University of Pavia, maintaining this role only 4 years. Finally, in 1794, Malacarne was called to the chair of Practical and Theoretical Surgery at the University of Padua, passing to the chair of Surgical Principles and Obstetrics in 1806. He remained in Padua until his death, on September 4, 1816.

Malacarne represented a perfect example of an eighteenth century "letterato," term that can be translated with "scholar," or "intellectual," rather than with "man of letters" [1]. This particular figure, typical of the Enlightenment, combined interests in

✉ Alberto Zanatta
alberto.zanatta.1@unipd.it

[1] Museum of Pathological Anatomy, University Museums Centre, University of Padua, Padua, Italy

[2] University Picardie Jules Verne, Amiens, France

[3] University of Turin, Turin, Italy

[4] Department of Nervous System and Behaviour Sciences, University of Pavia, Pavia, Italy

[5] Department of Cardiac, Thoracic and Vascular Sciences, University of Padua, Padua, Italy

Fig. 1 Vincenzo Malacarne (1744–1816)

humanities, sciences, and politics, embodying the ideal of an encyclopedic and universal culture. Malacarne did not confine his scientific interest only to a specific branch of medical sciences, because he made important contributions in anatomy

and surgery [4, 5], teratology [6–8], obstetrics [9], neurology [2, 3], and history of medicine [10]. In general, in almost all these studies, Malacarne adopted an interdisciplinary approach based on the correlation between anatomy, surgery, and clinics. For instance, he founded surgical anatomy by stressing the importance for surgeons of knowing clinical manifestations and anatomical seats of diseases, as giving the fundamental insights for guiding their hands [5]. In his scientific writings, he paid much attention to the language and the style of exposition, to the point that he sent many of his manuscripts to expert reviewers for corrections both in the form and in the scientific content [11]. Moreover, he used his knowledge of classic languages to coin scientific terms based on Greek etymologies. In particular, he introduced new definitions in teratology, which are still used today, such as acranius, microsomia, macrosomia, micromelia, macromelia, and polymelia [12].

Malacarne's interest on the brain and nervous system dated back to the period when he was student of surgery in Turin. Training his surgical skill by dissection of animals, he was able to prove the existence of the pineal gland in birds against the opinion of many naturalists [13]. Since 1772, Malacarne studied many cases of "cretinous" found along the Po Valley, which inspired him the fundamental concept of the organic nature of mental diseases [14]. Note that "cretin" and "idiot" were terms in common usage at that time for describing different levels of intellectual disability. Their current pejorative sense emerged much later.

Between 1775 and 1782, he dissected the bodies of three "cretinous," describing the brain anomalies which could give account of their mental disorders [15]. In particular, he noted that the cerebellum was underdeveloped with regard to the number of lobes and folia compared to normal brain, forming his first hypothesis on the relationship between intelligence and the cerebellum: the degree of human intelligence was proportional to the number of folia of the cerebellum. Based on his anatomical analysis, he advanced possible surgical interventions for correcting some of the anomalies and partially restoring brain and cerebellum physiology [15].

With regard to the cerebellum, his complete description published in 1776 became immediately a classic on the subject, praised by the Swiss anatomist and physiologist Albrecht von Haller (1708–1777) [16] and by the French anatomist Félix Vicq d'Azyr (1746–1794) [17]. Malacarne introduced terms such as tonsil, pyramid, lingual, and uvula that are still in use today [18]. He outlined a significant research program for understanding brain functions, based on anatomo-clinical method: given a big hospital, all mental characteristics of the patients should be noted and then correlated with the morphology of their brains through dissection after death [2]. In this scientific context of exchanges and polemics, he quantified the units of the cerebellar internal structures, the lamellae being numbered for a systematic description of the human cerebellum. He thought the mental faculties depended on their number: so, he considered a relation between the number of cerebellar lamellae and the expression of intellectual faculties. In this way, we can say that he made first statistics on human faculties.

Between 1778 and 1789, Malacarne had an epistolary exchange with the Swiss naturalist Charles Bonnet (1720–1793) about the seat of the soul and the intelligence in the brain [3, 19]. In patients affected by cretinism, as already stated, Malacarne observed that there was a reduction of the cerebellar size and a decrease in the number of folia. He reported a wide variation in the number of folia from 500 to 780 while in an idiot, the number was 340 [2]. He was able to predict the development of folia before the dissection of a patient, on the basis of the more or less intelligence manifested during his/her life [19]. Bonnet, who at the beginning of the correspondence was quite doubtful on the possibility to find the specific seat of human mind in the brain, praised this result a lot. They also discussed whether such variability was innate or acquired by experience. Malacarne proposed bringing up twins of different species of mammals and birds in poor and enriched environments and then verifying the number of folia [19]. It is not known whether the experiment was ever done. At any case, the most interesting aspect of his finding remains the hypothesis that the number of folia is influenced by the environment, thus providing the first nature-nurture hypothesis made on the basis of observations, and the concept of neuroplasticity in the scientific literature [20].

If Malacarne's anatomical research on the cerebellum could be considered the starting point of the discovery of this organ, his proposals concerning cerebellar function were much less successful. That the degree of intelligence could be proportional to the cerebellum's folia represented a hypothesis already advanced by Erasistratus a millennium and a half earlier in the case of the cerebral gyri [18, 21]. It is worth mentioning, however, that recently acquired evidence shows that the human cerebellum is activated during mental recall of emotional personal episodes and during learning of a conditioned or unconditioned association involving emotions [20]. Scientists have discovered that the cerebellum not only is implicated in sensori-motor function but also plays a cardinal role in the modulation of cognitive and affective processes. A "cognitive cerebellum" is identified in the posterior lobe, the dysfunction of which is at the base of the so-called cerebellar cognitive affective syndrome [22]. This is a new nosological entity introduced in 1998, more recently recognized as the third cornerstone of ataxology, together with cerebellar motor syndrome (CMS) and vestibule-cerebellar syndrome [23]. Nevertheless, the most significant aspect of Malacarne's work was methodological, because it represented a systematic attempt to localize the intellect and the madness in the brain, unifying physical and moral, as well as physiological and psychological dimensions, establishing potentially quantifiable variations between the normal and the pathological [24]. The quantification was based on parameters such as cerebellar volume, weight, and number of folia. He quantified in 600

laminae the mean number for a normal cerebellum, above which the intelligence could be affected. Malacarne proposed to use also a new instrument, the "cefalometro," to calculate the proportion between the size of the skull and the volume of the brain, because he supposed that an insufficient volumetric grown of the skull could block the development of the cerebellum, affecting the degree of intelligence [19]. By this approach, it could seem that Malacarne anticipated the idea of Franz Joseph Gall (1758–1828), father of phrenology, according to whom there was a one-to-one correspondence between well-circumscribed areas of the brain and intellectual or emotional functions. However, Malacarne was quite doubtful about Gall's theory, of which he questioned many imprecisions, in particular from an anatomical point of view [25]. There were not at all or at least not enough proofs for any of the anatomical seat mentioned by Gall, that this seat performed exactly the function advanced by him [26].

At the end of his life, Malacarne had led down experimental foundations of a project on the recording of brain electricity [27]. He pointed out a metaphor comparing the structure of the human brain with Volta's galvanic pillar. Between his first researches on the morphology of the cerebellum and this article, Malacarne moved from anatomical studies to experimental considerations on the origin of animal electricity. Therefore, he also contributed to the emergence of a new science, namely electrophysiology.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

References

1. Bargoni A. Formazione e carriera di un giovane intellettuale nella Torino illuminista. Bull Hist Épistém Sci Vie. 2017;24:131–41.
2. Malacarne V. Nuova esposizione della vera struttura del cervelletto umano. Torino: G. Briolo; 1776.
3. Malacarne V. Encefalotomia nuova universale. Torino: G. Briolo; 1780.
4. Malacarne, V. Delle osservazioni in chirurgia. *Trattato*. G. Briolo, Torino 1784.
5. Malacarne V. Ricordi d'anatomia traumatica pubblicati ad uso dei giovani chirurghi militari di terra et di marina. Venice: G.A. Pezzana; 1794.
6. Malacarne V. De' mostri umani, de' caratteri fondamentali su cui se ne potrebbe stabilire la classificazione, e delle indicazioni che presentano nel parto. Mem Matem Fis Soc ital Sci. 1802;9:49–84.
7. Malacarne V. Osservazioni anatomiche […] in conferma d'una proposizione circa all'origine de' Mostri. Mem Matem Fis Soc ital Sci. 1805;12:164–78.
8. Malacarne V. Conferma della proposizione circa alla produzione de' mostri umani. Mem Matem Fis Soc ital Sci. 1810;15:1–19.
9. Malacarne V. L'esplorazione proposta come fondamento dell'arte ostetrica. Milano: Nella stamperia di Giacomo Barelle; 1791.
10. Malacarne V. Delle opere de' medici, e de' cerusici che nacquero, o fiorirono prima del secolo XVI negli stati della Real Casa di Savoia, monumenti raccolti da Vincenzo Malacarne. Torino: Nella Stamperia Reale; 1789.
11. Buzzi S. Un medico saluzzese tra circoli letterari e accademie scientifiche. Bull Hist Épistém Sci Vie. 2017;24:141–52.
12. Ongaro G. Vincenzo Malacarne, Professore a Padova e il suo contributo alla teratologia. Bull Hist Épistém Sci Vie. 2017;24:117–29.
13. Cani V, Mazzarello P. La difficile docenza pavese di Vincenzo Malacarne. Bull Hist Épistém Sci Vie. 2017;24:151–62.
14. Pogliano C. Vincenzo Malacarne "geografo del cerebro". In: Ferro MF, editor. Passioni della mente e della storia. Protagonisti, teorie e vicende della psichiatria italiana tra '800 e '900. Milano: Vita e Pensiero; 1989. p. 157–169.
15. Malacarne V. Su i gozzi e sulla stupidità che in alcuni paesi li accompagna. Stamperia Reale, Torino: Tentativi; 1789.
16. Haller A. De partium corporis humani preaecipuarum, fabrica et functionibus. Bernae-Lausannae: Ex prelo Societatis Typographicae; 1778.
17. Vicq d'Azir F. Traité d'anatomie et de physiologie, avec des planches coloriées représentant au naturel les divers organes de l'homme et des animaux. Paris: Didot; 1786.
18. Clarke E, Jacyna LS. Nineteenth-century origins of neuroscientific concepts. Berkeley – Los Angeles – London: University of California Press; 1987.
19. Malacarne V. Sulla nevro-encefalotomia. Lettere anatomo-fisiologiche di Vincenzo Malacarne e di Carlo Bonnet. Pavia: Stamperia del Monastero di San Salvadore; 1791.
20. Strata P. The emotional cerebellum. Cerebellum. 2015;14:570–7.
21. Clarke EO, Malley CD. The human brain and spinal cord. A historical study illustrated by writings from antiquity to the twentieth century. Berkeley and Los Angeles: University of California Press; 1968.
22. Schmahmann JD, Sherman JC. The cerebellar cognitive affective syndrome. Brain. 1998;121:561–79.
23. Manto M, Mariën P. Schmahmann's syndrome-identification of the third cornerstone of clinical ataxology. Cerebellum Ataxias. 2015;2:2–5.
24. Cherici C. Vincenzo Malacarne (1744–1816): a researcher in neurophysiology between anatomophysiology and electrical physiology of the human brain. C R Acad Sci. 2006;39:319–29.
25. Malacarne, V. Oggetti più interessanti di ostetricia e di storia naturale esistenti nel museo ostetrico della Regia Università di Padova fra quali un insigne idrocefalo congenito interno notomizzato pubblicamente dal prof. direttore Vincenzo Malacarne da Saluzzo richiamò ad esame le nuove opinioni del dott. Gall sulla origine, e la struttura del cervello e de' nervi. Nella stamperia del Seminario, Padova 1807.
26 Alberto Zanatta, Giuliano Scattolin, Gaetano Thiene, Fabio Zampieri, (2016) Phrenology between anthropology and neurology in a nineteenth-century collection of skulls. History of Psychiatry 27(4):482-492
27. Malacarne, V. Se il cervello, il cervelletto, la spinal midolla, fors'anche le cartilagini e le ossa della spina formano qualche cosa di simile alla colonna Galvanica del Volta. Problema proposto alla Accademia Reale delle Scienze, Lettere e Arti di Padova. Giornale della Società d'incoraggiamento delle scienze e delle arti 1808;4:124.