Preface

We are pleased to present what is actually a double issue of the *Nuova Voltiana*: it includes thirteen new contributions. The total number of papers published so far in the five issues is thirty-seven, an indication of the interest and relevance of the theme. We are also pleased to announce the publication of a CD-ROM[1] with detailed 3D animations of all the instruments Volta "invented" and many others he used. The CD is also distributed as part of a new volume[2] dedicated to Volta's cabinet.

Volta's studies are growing and our feeling is that there are still a number of important problems to be tackled. We know that new important studies are about to be published. In the meanwhile we hope the community of historians of science and researchers interested in Volta's works will appreciate the interesting contributions summarised below.

ALFRED NORDMANN discusses Lichtenberg's introduction, in 1778, of the algebraic notation "+E", "-E" to indicate the contrary charges of electrified bodies. After showing that this formal notation was specifically meant to provide a common language to dualists and unitarians in the dispute over the nature and number of electrical fluids, the author argues that such notation may have helped resolve that controversy, not by solving the problem but by dissolving the issue. Specific analysis is conducted on the conceptual transformations which accompanied the new notation and prepared the peculiar dissolution of the scientific controversy to which it was related.

JÜRGEN TEICHMANN suggests an interesting inversion of the relationship between writing style and scientific procedure in Lichtenberg's production. Formulated by Albrecht Schöne, the standard view on this issue takes scientific experimentation as the basis from which Lichtenberg derived a writing method aimed at getting new insights into human life, intellect and soul. The author suggests on the contrary that experimental physics was not the starting point of Lichtenberg's

[1] FALOMO, L. (ed.), *Il Gabinetto di Fisica di Alessandro Volta*, 1 CD-ROM, Milano: Hoepli, 2003.
[2] BELLODI, G., BEVILACQUA, F., BONERA, G. and FALOMO, L. (eds.), *Gli strumenti di Alessandro Volta: Il Gabinetto di Fisica dell'Università di Pavia*, Milano: Hoepli, 2002.

intellectual life, but was just one of the outputs of a more general propensity to express his ideas in an aphoristic style.

PAOLA BERTUCCI explores medical electricity in mid-eighteenth-century London. By focusing on a particular instrument, i.e. Read's machine coupled with Lane's discharging electrometer, she characterises this particular area of electricity and reconstructs its complex interaction with various other branches of electrical science. She argues in particular that medico-electrical instruments crossed the borders of the particular area for which they were originally designed, contributing to the work carried out in related areas, especially atmospheric electricity. Particularly interesting is the relationship she points out between medical electricity and quantification, with the latter responding to the need for administering definite quantities of electrical fluid in medical treatment.

ISABEL MARIA MALAQUIAS discusses the state of electrical science at the University of Coimbra in Volta's times. In the context of the University reform started in 1772 by the Marquis of Pombal, Giovanni Antonio Dalla Bella was appointed professor of experimental physics, which confirmed a well-established tradition of teaching posts given to Italian scholars in Portugal. The author focuses mainly on Dalla Bella's teaching, through analysis of a textbook he wrote belatedly. Dalla Bella's catalogue of the University physics cabinet is used to establish the composition of the electrical section. Information is finally given on the reception of Volta's battery in Portugal by 1820.

Focusing on a specific individual – Giacomo Bianchi, or Jakob von Bianchy, according to the Germanised and self-ennobled version of the name – OLIVER HOCHADEL provides insights into the contributions to Enlightenment scientific culture in German countries by itinerant lecturers and instrument makers operating outside the established institutions. The author examines the background and self-awareness of these "scientific salesmen", together with their role in the diffusion of scientific knowledge and scientific equipment.

HELGE KRAGH discusses Pfaff's long, staunch defence of Volta's contact theory, from his conversion to it in 1801 up to his death in 1852. Pfaff's work on galvanism and voltaism is placed in the wider context of the debates on the contact and chemical interpretations these areas were given in the first half of the nineteenth century. The author develops interesting considerations at various levels. Concerning terminology, he analyses the use of the terms "galvanism" and "voltaism" by the scientists involved in the debates. He also argues that the contact and chemical interpretations were not defended by separate communities of "physicists" and "chemists", but were permeable between the two. He stresses furthermore that the crucial experiments devised to support one or the other view were not at all crucial.

JUOZAS AL. KRIKŠTOPAITIS examines one early important consequence of Volta's battery, i.e. the theory of electrolysis which Theodor Grotthuss formulated in 1805. The author shows that Grotthuss conceived electrolysis and the galvanic phenomena produced by the battery as deriving from a universal electropolar model

existing in Nature. According to this model, the transfer of charge occurs in leaps of instantaneous division and recombination of molecular parts. The author argues that three important conceptual antecedents lurked in this theory: Faraday's lines of force, the idea that natural processes can take place in minimal interaction acts and the notion of ion as a unipolar fragment of a polar molecule.

In his paper, MASSIMO TINAZZI reconstructs Giuseppe Zamboni's attempts to manufacture "dry piles" doing without acid or other types of corrosive liquids that damaged the bimetallic pairs. Concerning these piles, Zamboni had a short but intense correspondence with Volta about which solutions and substances to use in order to increase the duration of the piles. Black manganese (manganese dioxide), as Volta suggested, turned out to be very effective to this end. In the following years Zamboni improved further his "perpetual electromotors", as he called them, and used them to operate pendulums and clocks for very long periods of time.

JULIENNE TUTTLE deals with another early important consequence of Volta's battery, namely the famous electrochemical researches conducted by Humphry Davy between 1806 and 1810. She argues that Davy wanted to demonstrate his powers of genius by conquering the battery and transforming it into an instrument of discovery. Building larger and larger batteries, Davy was able to direct undreamed of powers towards overcoming nature's most refractory bonds. He was seeking to discover nature's true elements and forces. For all of his successes, Davy's achievements fell short of his highest goals. Yet, based on his heroic efforts with the battery alone, Davy stood as the embodiment of his own ideals of scientific genius.

VALERIA MOSINI presents Nicholson and Carlisle's experiments with Volta's battery as representing a major scientific breakthrough in the study of the connections between the electric current and chemical phenomena. She discusses Nicholson's comments on the methodology underpinning Volta's interpretation of the cause of the electric current through the pile, concluding that such comments show Nicholson's desire to go beyond the observation of the facts and offer a complete theory of the phenomena. This endeavour he pursued with determination not just with his own research, but with the help of his *Journal of Natural Philosophy, Chemistry, and the Arts* (1797-1813).

ARCANGELO ROSSI, LIVIO RUGGIERO AND ENNIO DE SIMONE discuss the piles realised in the 1860s by two scholars from the Salento region: Giuseppe Candido's regulating diaphragm pile and Giuseppe Eugenio Balsamo's iron-lead pile. Combining Callaud and Minotto's piles, Candido obtained an economically and easily manageable device supplying a steady current for large spans of time, as required to operate electric clocks and telegraphs. With these piles, he realised a network of synchronous electric public clocks in Lecce. Balsamo devised a particular version of the lead battery which performed well and was economically convenient. It employed cheap materials and yielded ceruse – a substance largely employed in the dye industry – as a by-product.

NAHUM KIPNIS investigates the complex controversies between the animal, the contact and the chemical interpretations of galvanic and voltaic phenomena from

1792 to about 1850. He draws the conclusion that Kuhn's paradigmatic-revolutionary account of scientific change cannot serve as a guide in this case. He points out various elements which appear to contradict Kuhn's tenets. A theory can be immediately challenged without having to wait for its failure to explain new experimental tests. Anomalies in a theory can be pointed out by outsiders, rather than by a "puzzle solving" activity within the accepted paradigm. The formulation of a new theory does not necessarily require a preliminary crisis within an accepted paradigm. Two paradigms can emerge at the same time and coexist for a very long time. The conflict between different theories can be resolved by synthesis, rather than by revolutionary replacement.

OLIVIER DARRIGOL considers first the early picture which Helmholtz suggested for voltaic phenomena in his famous paper *Über die Erhaltung der Kraft* and examines then the important role this picture played in the next decades in the interpretation of phenomena as diverse as electrolysis, electric discharges in gases and the conductivity of flames. Helmholtz's early model of voltaic phenomena was based on Laplacian reduction to central forces acting between couples of atomistic particles. The author argues that, despite profound epistemological changes as to the value accorded to Laplacian reductionism and atomistic arguments, Helmholtz believed that his early picture of voltaism contained a basic structure that was independent of the true nature of electricity. He suggests further that, through its influence on various authors, Helmholtz's early reflections on voltaism contributed substantially to the fin-de-siècle development of the ion and electron theories.

Pavia, June 2003

FABIO BEVILACQUA and LUCIO FREGONESE