The Anglo-Italian Connection documented in the IET Rare Book and Archives collections

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***Abstract* — The IET in London hold the extensive collections of books and pamphlets on electrical and other topics gathered by Sir Francis Ronalds and Silvanus Thompson, who both travelled in Itlay. Other collections include correspondence and the diary which Michael Faraday wrote when he visited Italy and other countries in 1813-15. More recently Gordon Rawcliffe visited Italy to study three-phase railway electrification in the course of his work on induction motors.**

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I. Sir Francis Ronalds

The story begins with Sir Francis Ronalds whose library was donated to the infant society of Telegraph Engineers (subsequently the IEE and now the IET) in 1875, two years after his death. Ronalds was born in London in 1788 and by 1816 was living in Hammersmith, West London, where he built the first electro-static telegraph in his garden. Two years later he left England to travel on the Continent, the first of many such journeys, when he began to collect continental books on electrical subjects. He journeyed to Italy via France, stopping briefly in Paris along the way. His journal, in the form of letters to "My Dear Armchair" begins as he left Milan by "the new canal", to arrive at Pavia the next day where he concluded that "the climate of Pavia must ... be very bad[,] for the people seem to be obliged to drink a great deal of punch to keep off the vapours". It contained "nothing very important [or] very interesting except the university which I suppose fully maintains its ancient reputation." Nevertheless he was warmly received when he introduced himself to the professor of natural philosophy, Signor Configliachi, who showed him Volta's laboratory with its original apparatus, although Volta himself, to Ronalds's great disappointment, was away at his country seat in Como. The university library, however, did meet expectations being "more richly stocked with really useful books than any other in Italy I suppose but contains few curiosities…." Remaining in Pavia only a few days, he resumed his travels through Vetorino, Cremona, Mantua and Modena to eventually arrive in Bologna and then Rome. Later he visited Naples and Sicily.

However lukewarm Ronalds may have been about Pavia, his visit here is reflected in his later acquisition of over sixty books and articles by and about Volta, including his rare first publication "De vi attractiva ignis electrici … ad Joannem Bapt. Beccariam, presented to him by Volta's nephew, Count Zanino Volta. Ronalds returned briefly to Italy in 1823 and 1824, but it was nearly another 30 years before he settled in Italy where he remained for several years.

In 1842 Ronalds became Superintendent of the meteorological observatory at Kew where he designed and built photographic self-registering mechanical and meteorological equipment. After retiring in 1852 from his position at Kew, he lived for the next twenty or so years in Italy. He now had unparalleled opportunities to acquire works published on the continent, especially those which had belonged to eminent men in the fields of electricity and magnetism, for example, several books and articles from Volta's library acquired from Count Zanino Volta.

Returning to England, Ronalds was knighted in 1870 and died in 1873, having left his library to Samuel Carter, his sister's husband, who presented the collection of books and manuscripts to the newly formed Society of Telegraph Engineers (now the IET). While abroad, Ronalds had compiled a "Catalogue of works on Electricity, Magnetism, and the Electric Telegraph". This was edited and published by the STE in 1880, and his library was made available to members and the wider public as soon as the books were suitably arranged.

By the time of his death Ronalds had amassed approximately 2000 books and 4000 pamphlets, of which approximately 1000 works and articles were by Italian scientists of the eighteenth and early nineteenth centuries. In addition to works on electricity, magnetism, there are several titles on meteorology, lightning, thunder and volcanology, reflecting Ronalds's interests developed while at Kew. Of these over eighty titles were published in Pavia during the late eighteenth and early nineteenth centuries.

Some of the Pavia material comprised articles from Luigi Brugnatelli's (1761-1818) two journals, Annali di Chimica, and the Giornale Physico-medico. In addition to his publishing activities, Brugnatelli, a pupil and close friend and colleague of Volta, invented the first practical method for electro-plating and published a short account of his results in the Philosophical Transactions of the Royal Society in 1805. In addition to the many titles by Volta, Ronalds acquired a 1792 edition of Galvani's De viribus electricitatis in motu musculari. Commentarius, but it was left to Silvanus Thompson (of whom more later) to acquire the prized association copy with an inscription in Volta's hand on the title page.

II. Michael Faraday

The next notable infusion of Italian material came in the early twentieth century with the gift of Michael Faraday's travel diary, part of the collection of Faraday manuscripts and correspondence given to the then IEE in the early twentieth century by David James Blaikley, the husband of Faraday's favourite niece.

Michael Faraday was one of the great experimental scientists of his age, or indeed of any age, making ground-breaking discoveries in electricity and magnetism and in analytical chemistry, discovering benzene in 1825 and electro-magnetic induction in 1831. Born in London in 1791, at the age of fourteen he was apprenticed to a London bookbinder and bookseller, Mr Riebau, who encouraged him to read books in the shop during his leisure time. Faraday was fascinated by an article on electricity by Mrs Jane Marcet and decided to devote himself to the study of science. His chance came in 1812, when Humphry (later Sir Humphry) Davy, the charismatic professor of chemistry at the Royal Institution was temporarily blinded by an explosion in the laboratory. He hired Faraday as a temporary amanuensis and then as his laboratory assistant. The appointment later became permanent and eventually Faraday replaced Davy as Professor of Chemistry at the Royal Institution. He became a great communicator of science to the general public through his Friday Evening Discourses, which he instituted in 1825. He went on to make further discoveries in electromagnetism and was in much demand as a scientific consultant. He died in 1867.

A fascinating insight to the beginning of Faraday's career can be seen in the diary and several letters to his family and friends in which he described his journey to France, Italy and Switzerland with Sir Humphry Davy from 1813 to 1815. They spent several months from mid-February to mid-June in Italy in 1814, before leaving for Switzerland. By October they had returned to Rome, where they remained until the beginning of March 1815. They left Rome quickly, as did many other English visitors, after hearing that Napoleon had escaped from Elba and arrived home before the Battle of Waterloo.

They began their journey in October 1813 travelling through France, crossing into what is now Italy in February 1814 via the Alps Maritime through heavy snow. Arriving in Turin they stayed a few days before pressing on to Genoa. In Genoa Faraday assisted Davy with experiments on torpedoes (electric fish of the ray family). From Genoa, they sailed to Lerichi staying the night in Sestris, where they were unimpressed by the accommodation. From Lerichi they travelled overland to Florence, where they conducted experiments in the Museo di Storia Naturale with the "great burning glass [lens] of the Grand Duke of Tuscany [Cosimo III, 1742-1723)] a very powerful instrument." In several experiments the glass was used to apply focused heat from sunlight to diamonds. During one experiment "the diamond glowed brilliantly with a scarlet light inclining to purple and when placed in the dark continued to burn for about four minutes. After cooling the glass[,] heat was again applied to the diamond and it burned again though not nearly so long as before. This was repeated twice more and soon after the diamond became all consumed. This phenomenon of actual and vivid combustion which has never been observed before was attributed by Sir H Davy to the free access of air … The globe and contents were put bye (sic) for future examination." After several further experiments, Davy concluded "… it is probable that diamond is pure carbon…"

Faraday's diary entry for 3 April notes "Left Florence this morning with regret for in no place since I left England have I been so comfortable and happy." A few days later they arrived in "Rome that City of Wonders… but they are wonders created by a former nation & in a former age." Nevertheless he was most impressed by both the "Coliseum [sic] & St Peter's "… and one is not more worthy of the ancients than the other is of the moderns. The coliseum is a mighty ruin and indeed so is Rome & so are the Romans…"

Davy and Faraday repeated Domenico Pine Morichini's experiments "in giving magnetism to a needle by the solar rays", but found the results inconclusive. A month later In May they travelled to Naples, where they also climbed Mount Vesuvius and Monte Summa and visited the Queen of Naples, (Caroline Marat, sister of Napoleon, Queen Consort of Naples until 1815) whom Davy advised about the pigments used in classical art. Of great interest to Faraday was Mount Vesuvius, which they visited two days in succession. "Sir H kindly explained to me that all, or nearly all, the water which was condensed by the mountains and which would otherwise form streams and springs, was volatised by the heat, and was the principal cause of the smoke." The descent from the mountain reminded Faraday "very strongly of the descent from the Alps, and the principal difference was, that in the last case we sank and rolled in snow, and in the present case in ashes. Having, however, continued to slide to the bottom, we again got on a less inclined path…" Their last descent was made at night: "we began at half-past eight, to slide down as before, but with an increase in difficulties, for the uncertain and

insufficient light of a fickle torch was not enough to show rightly the path … During our descent, the beautiful appearance of the fire frequently drew the attention of all… and the long black cloud, barely visible by starlight, appeared as a road in the heavens."

After leaving Naples they headed north and on the 17th of June, in Milan, "saw M. Volta who came to Sir H. Davy, an hale and elderly man bearing the red ribbon [of the legion d'honneur] and very free in conversation". They continued northwards to Geneva, where they stayed several months, before returning to Rome in November. In January Faraday recorded "experiments at home all day on a new solid compound of iodine and oxygen which Sir Humphry discovered on Monday.… It is a gas of a very bright greenish colour which detonates into chlorine and oxygen by a heat a little above that of boiling water." Davy had discovered iodine pent-oxide.

In Italy, Davy had made several important discoveries, met scientists, such as Volta, and enjoyed his continental travels to such an extent that he returned several times later. For Faraday it was a marvellous introduction to the world of experimental science and some of its most eminent practitioners. He maintained contacts with Italian scientists throughout his career, including the physicist, Carlo Matteucci (1811-1868), to whom he wrote in 1836 about priority of formulation of the law "that the chemical power of a current of electricity is in direct proportion to the quantity of current which passes".

III. Silvanus Phillips Thompson

A few years after the IET acquired the Faraday Papers, it acquired another fine library of books and manuscripts relating to the history of electricity and magnetism, that of Silvanus Phillips Thompson. Thompson was born at York in 1851 and was educated at Bootham School, York, where his father was senior master. His great uncles, Richard and William Phillips were friends of Faraday. On leaving school, Thompson trained as a teacher, returning to teach at Bootham School, where he remained for five years, before spending a year at Heidelberg studying. He earned a DSc. in 1878, two years after he had begun lecturing at University College, Bristol. He became a professor there in 1878 and in 1885 he was appointed principal of Finsbury Technical College. He continued at Finsbury until his death in 1916. While still at Bristol, he began writing textbooks which became classics in their field. His "Dynamo-Electric Machinery" went through several editions and his "Calculus Made Easy", published anonymously during his lifetime is still in print today. He became fascinated by radiation, but delayed publishing his experiments until after Becquerel had published his paper, thus missing by only a few days credit for its discovery. He remained fascinated by the subject and lectured widely on it and was elected the first president of the Roentgen Society (now the British Institute of Radiology). He also served as President of the IEE (IET) in 1899. He was a talented amateur painter, but his main leisure interest was the history of electricity and magnetism, optics, and gemmology. He wrote fine biographies of William Gilbert, Faraday and Kelvin, and, most relevant to our story, he collected fine books on these subjects.

After his death his library was purchased by the IET in 1917 with donations from members, especially his old students at Finsbury Technical College, augmented by a grant from the IEE Council. The collection of over 900 rare books, about 2500 modern books (i.e. those published between 1850 and 19l5) and several thousand pamphlets includes very early printed books on magnetism and electricity published in Italy, together with Italian works reflecting his other wide-ranging interests. Unlike Ronalds and Faraday, Thompson spent comparatively little time in Italy although in 1892 he spent six weeks there, making the usual circuit of Pisa, Florence, Rome, Venice, and Amalfi. Although one of the reasons for his visit was to buy books, he made no record of any purchases. However, his Italian books represent most of the finest printed material in his library. Of the 930 or so fine books, approximately 150 were published in Italy. His finest manuscript is a fourteenth century copy of Petrus Peregrinus de Maricourt, "Epistola de Magnete", possibly written while Peregrinus was serving in the army of Charles, Duke on Anjou, King of Sicily, who was besieging Lucera in 1269. (Some authorities consider this story of Peregrinus's location while writing the book apocryphal.) In his manuscript, Peregrinus explains how to identify the poles of the compass, describes the rules of magnetic attraction and gives an account of his own experiments with magnets. Thompson was very proud of the provenance of the manuscript. It had been in the library of Prince Balthasar Boncompagni (1821-94), a noted historian of science and mathematics, whose books and manuscripts were sold in Rome in 1898. Another high-spot acquisition for Thompson was his copy of Galvani's De Viribus Electricitatis with the inscription "ex dono auctoris" in Volta's hand on its title page. It was one of his most cherished books, kept in his small library of fine books. Most of his library was stored in his study on the ground floor of the house. Another prized book, kept in the small library was Aphrodisiensis "Meteorologia", printed in Venice in 1527, at the Aldine Press, acquired by Thompson for its printer's mark of the Aldine anchor in one of its rarest forms. There were several other Venetian imprints, including a fine edition of Vitruvius, "L'Architectura", 1511, with contemporary hand-coloured wood-cut illustrations.

One author whose works were collected by both Ronalds and Thompson was Tibero Cavallo, who is worth noting in the context of the British-Italian connection. Born in Naples in 1749, Cavallo emigrated to London in 1771 to pursue mercantile interests, but soon became fascinated by

scientific work, publishing his "Complete Treatise on Electricity" in 1777. He was elected a Fellow of the Royal Society in 1779 and in 1880 published "Essay on the Theory and Practise of Medical Electricity". His "Treatise on Magnetism" followed in 1787. All his titles went through multiple editions, most of which were acquired by Ronalds and Thompson. Cavallo died in England in 1809.

IV. Twentieth Century Material

In 1929 The Illingworth Carbonization Company decided to build a works at Pozzoli and La Spezia. Building commenced in 1929 and continued during 1930, during which time a series of photographs was taken to document progress. The series was deposited much later in the IET Archives, but there is no record of what happened after the building was completed. Returning to electrical engineering, the British engineer Gordon Rawcliffe visited Turin in 1961 to study the Italian Railway's three-phase AC traction system. What he saw there influenced his later invention of the Pole Amplitude Modulated (PAM) motor. Gordon Hindle Rawcliffe (1910-1979) was born in Sheffield in 1910. He matriculated at Keble College, Oxford, to study mathematics, but switched to engineering and received his degree in 1932. He became an engineering apprentice at Metropolitan-Vickers, then one of the best routes into professional engineering, and was soon appointed a design engineer. In 1937, he became an academic, moving first to the University of Liverpool and then to the University of Aberdeen as lecturer in electrical engineering and department head of Robert Gordon's Technical College (now Robert Gordon University). In 1944 he moved to the University of Bristol as Professor of Electrical Engineering, a post he held until his retirement in 1975. He was elected to Fellowship of the Royal Society in 1972 and died suddenly in 1979.

His great interest was in polyphase winding of alternating current machinery, and like Ronalds and Faraday before him found Italy a source of ideas. In 1961, he made a visit to Turin to study the Italian State Railways Works and Depot there. His "Memorandum of Visit to Works and Depot of the Italian State Railways in Turin … 1961" now in the IET Archives, outlined what he learned there about the proposed change-over from a three-phase 3,600 volts 16 2/3 cycle system to the Italian standard 3,000 volts D.C. system. He concluded that "the three phase system did not appear to be as frightening or as complex as it is often represented to be." Rawcliffe invented the PAM motor a few years later and he and colleagues took out some 60 patents in this speciality.

The IET itself has had a long series of connections with Italy, beginning in the late nineteenth century which continues to the present day.

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All the material cited is in the IET Library and Archives in London, which include the Ronalds and Thompson Libraries. Faraday's diary is published in Brian Bowers and Lenore Symons (Eds.), *Curiosity Perfectly Satisfyed, Faraday's Travels in Europe, 1813-1815*, London, 1991. S.P. Thompson's travels and book collection activities are mentioned in J. S. Thompson and H G. Thompson *Silvanus Phillips Thompson, His Life and Letters*, London, 1920.