

## ABEL'S SURVIVING MANUSCRIPTS INCLUDING ONE RECENTLY FOUND IN LONDON

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We list and locate all N.H. Abel's surviving manuscripts and trace a short history of them. We also present, with some comments, a manuscript that was discovered in London very recently.

Elenchiamo e localizziamo i manoscritti di N.H. Abel esistenti e tracciamo una loro breve storia. Inoltre presentiamo, con qualche commento, il manoscritto che è stato scoperto recentemente a Londra

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### **Introduction.**

Most of Abel's important works were published in the *Journal für die reine und angewandte Mathematik* founded by Leopold A. Crelle in 1826. Some of them were translated into German by Crelle himself, others appeared in French, the language used by Abel in the manuscripts he sent to him. Apart from the *Mémoire sur les équations algébriques, où on démontre l'impossibilité de la résolution de l'équation générale du cinquième degré*, published by Abel at his own expense in Christiania in 1824, all his other early works from 1823 up to 1826 appeared in his mother tongue in Norwegian journals. A revised version of the above mentioned memoir was published in the first issue of Crelle's journal. Two papers appeared in *Astronomische Nachrichten* (1828, 1829) and one in the *Annales de Gergonne* (1826-27). His masterpiece, also known as the "Parisian memoir" which he presented himself to the Paris Academy in 1826, entitled *Mémoire sur une propriété générale d'une classe très étendue des fonctions transcendentes* was published posthumously in Paris 1841. All other papers appeared in Crelle's journal. It goes without saying that Crelle came into possession of many of Abel's original manuscripts.

After the first edition of the *Oeuvres complètes* had been printed in 1839, the editor Bernt M. Holmboe kept the manuscripts of Abel's earlier works, his workbooks and other autograph documents that remained after Abel's death. Most of this material was destroyed in a fire at Holmboe's house in 1849. Six workbooks and some of Abel's letters escaped the fire. The content of five workbooks, known as A, B, C, D and E, was described in the second edition of the *Oeuvres complètes* edited by S. Lie and L. Sylow [Abel 1881, II, p. 283–289]. At that time the manuscripts D and E were in the ownership of Carl A. Bjerkenes and Ole J. Broch respectively, while the others were held by the University Library of Christiania. The sixth workbook was found among Holmboe's papers and books in 1883 and described in [Sylow 1902, pp. 3-9]. All six workbooks are now preserved in the Manuscripts' Department of the Norwegian National Library in Oslo. In 1882 the Royal Academy of Berlin gave the

copies made by Crelle of five of Abel's manuscripts to the University of Christiania, those corresponding to Memoirs from XXIV up to XXVIII in [Abel 1881, I]. Some of Abel's autograph letters also still exist, among which: eleven addressed to Holmboe, five to Ch. Hansteen and one to A.-M. Legendre all held by the Manuscripts' Department of the Norwegian National Library. From [Stubhaug 2000, pp. 294, 558] we learn that the Royal Danish Library holds the letter that Abel sent to F.C. Olsen on August [September] 13, 1823 and the letter that Abel sent to F.C. Degen on March 2, 1824. From [Holst 1902, pp. 116-122] we know that some of Abel's letters to Mrs. Hansteen and one to his sister Elisabeth were held by Mrs. Thekla Lange born Böbert (daughter of Elisabeth), but there is no trace of these letters at present.

Part of the manuscript of the Parisian memoir, which vanished shortly after it was printed, was found by V. Brun in Florence in 1952. This manuscript and the search for it have been the subject of many papers and books (see [Del Centina 2002<sub>a</sub>, 2002<sub>b</sub>] and the references therein): all I will say here is that only four pages of it, two leaves, are still missing.

In this note I give a brief account of what happened to the manuscripts that Abel sent to Crelle, and report the very recent discovery of the memoir that Crelle published under the title *Remarques sur quelque propriétés générales d'une certaine sorte de fonctions transcendentes* in the fourth issue of his journal in 1828, in the Library of the University of London.

### **The fate of Abel's manuscripts published by Crelle.**

Crelle died in 1855 and his library and archive were put up for sale. On 3 August 1856 the Berlin bookseller A. Asher wrote to Guglielmo Libri:<sup>1</sup>

...La belle lettre de Keppler (1 ½ page in folio avec pleine signature) me coûte 130 francs et vous l'aurez pour 150. Celle de Abel est au prix de 30 francs. Quant aux manuscrits de Jacobi c'est presque la collection complète de tous ses travaux pour le Journal de Crelle et pour vous en donner une idée je n'ai qu'à vous renvoyer à la table de matières de ce journal, pour le tomes 1 à 50, publiée en 1855. [...] A côté des manuscrits de Jacobi je possède presque tous le mémoires manusc. des autres savants qui ont contribué au Journal et vous vous trouverez également l'indication dans la table mentionnée, à l'exception de ceux de Abel. Je voudrais vendre toute cette collection importante ensemble au prix de 1000 francs –prix très modéré, vu que les manusc. de Jacobi seulement produiraient plus que cela, en les dépareillent. Je ne veux pas oublier que tous ces manusc. portent des changements, soit de la main de l'auteur, soit de celle de M. Crelle. Jusqu'ici faisant parvenir votre décision le plutôt possible.

La bibliothèque et le manuscrits de Gauss sont entrées dans la Bibl. de l'université de Göttingen rien n'en a été ni sera vendu....

This letter, interesting for many reasons, says that Asher bought (almost) all the material in Crelle's journal archive and that Abel's manuscripts were no longer there. The letter of Abel, to which Asher is referring, is probably the one that Abel wrote to Legendre on November 25<sup>th</sup> 1828. This appears to be confirmed by what K. Weierstrass wrote to S. Lie the 10<sup>th</sup> of April 1882 regarding a letter of Abel that belonged to him: "Der Brief ist wohl durch Legendre liegen geblieben; ich habe ihn von einen Antiquar, der ihn beim Verkauf der Crelle'schen Bibliothek erstanden, im Jahre 1857 oder 1858 erworben..."[The letter probably came to Crelle through Legendre and it remained among his papers; I acquired it in the year

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<sup>1</sup> Biblioteca Moreniana, Firenze: collection *Palagi-Libri*, box 431, folder 18.

1857 or 1858 from an antique dealer in that area, who had bought it at the sale of Crelle's library] [Holst 1902, pp. 107–109]. Weierstrass also enclosed Abel's letter, and asked Lie to give it, in his name, to the University Library. This autograph letter is the above-mentioned held at the National Library in Oslo.

Libri got on very well with Crelle. The two met for the first time in 1830 when Crelle was sent on an official tour to Paris by the Prussian Ministry of Education, to study the methods of teaching mathematics in France. They struck up an immediate friendship, as a letter dated 7<sup>th</sup> August 1830 that Crelle wrote to Libri from Saarbrück on his journey home shows. Crelle published several of Libri's memoirs and he had a great admiration for him, not only as mathematician and historian of mathematics but also as a man of letters, bibliophile and scholar in many fields of knowledge. As is well known, Libri was also a great collector of books, manuscripts and autograph documents, and it is certain that Crelle was keen to publish facsimiles of autograph documents by famous scientific figures in his journal. On the 1<sup>st</sup> of November 1842 Crelle wrote to Libri:<sup>2</sup>

Monsieur je vous remercie très humblement de la lettre que vous m'avez écrite le 14 Août dern. et que j'ai reçu par M. Jacobi, avec les autographes des Descartes, Torricelli et Roberval que vous avez bien voulu me communiquer. J'ai fait faire de fac-similés d'extraites de ces précieux morceaux, et j'ai l'honneur de vous les renvoyer ci-joint, avec le expressions de une très vive reconnaissance. [...] si d'ailleurs vous voulez avoir la bonté de me communiquer encore d'outre autographes de géomètres célèbres je vous en serai très reconnaissant.

Autograph documents by Descartes, Roberval and Torricelli were, in fact, published in facsimile in volumes 28 and 25 of the *Journal* respectively, and other autograph documents, such as those by Fermat and Galileo that Crelle had undoubtedly got from Libri, were published within the first 50 volumes. It is possible that Libri's great admiration for Abel (in fact in 1833 he wrote an impassioned short biography of him), caused him to ask Crelle for some of Abel's manuscripts which Crelle made him a present of. Be that as it may, Libri came into possession of some of Abel's manuscripts, as well as the Parisian memoir which, as is well known, he held after having supervised the printing. In fact the manuscripts of Abel's last two works appeared in the catalogue of the first auction sale held by Libri in London in 1859 [Libri 1859]:

5 ABEL (N.H) *Précis d'une Théorie des Fonctions Elliptiques*, 4to. Sæc. XIX. on paper  
An autograph manuscript (with the author's signature at the beginning) of this Norwegian mathematician, who died when only twenty-six years old, and whose admirable discoveries in the elliptical functions will be recorded as long as mathematics are held in honour. This Manuscript, consisting of fifty-six columns besides four pages of introduction, contains many corrections and alterations, which have never been printed in the *Journal de M. Crelle*, where this *Précis* was published.

6 ABEL (N.H) *Démonstration d'une Propriété générale d'une certaine Classe de Fonctions transcendentes*, 4to. 1829, on paper  
In the author's handwriting, with a short German note, dated Christiania, 6 Jan. 1829, respecting the printing of this *Démonstration*, and the illness of his intended bride [sic], also in his autograph with signature. Abel died on the 6<sup>th</sup> of April, 1829.

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<sup>2</sup> Biblioteca Moreniana, Firenze: collection *Palagi-Libri*, box 431, folder 95.

The *Précis* was bought by the London bookseller B. Quaritch for 2 shillings and 6 pennies, but the other remained unsold [Libri 1868, p.1]. I do not know whether the manuscript that Quaritch bought still exists or not. My hope is that it is hidden in some Library in England. No more of Abel's manuscripts were offered for sale in the auctions that Libri held in London later on.

In 1868 Libri decided to return to Florence, his birthplace. He shipped his archive and what remained of his library, after all the sales, to Florence, via Leghorn, packed in twenty crates weighing two tons. A year later he was dead. A great quantity, almost half, of the hand-written papers and autograph documents constituting the archive was sold cheaply (almost as waste paper) by his cousin and namesake, in contravention of the terms of Libri's will, at the end of 1869. Two small parts of this material were recovered. One was soon bought by the Secretary of the Province of Florence, Giuseppe Palagi, and in 1882 went to constitute the *Fondo Palagi-Libri* of the Biblioteca Moreniana and here, in 1952, Viggo Brun found seventeen pages of the manuscript of the Parisian memoir. The other part was retrieved by the engineer Tommaso Montanari in 1870 and later sold to Prince Baldassarre Boncompagni [Boncompagni 1892, p. 397]. The remaining half of Libri's archive and library was acquired in 1870 by Count Giacomo Manzoni, a land-owner and bibliophile, from Libri's second wife H el ene de La Motte at a cost of 2,000 Liras in gold. In 1876 Manzoni sold some of the most important autograph documents from Libri's collection to Boncompagni, but none of Abel's, as the catalogue shows [Boncompagni 1892].

These are a few significant lines from the letter that Vito Volterra sent to his teacher Enrico Betti on 21<sup>st</sup> July 1889:<sup>3</sup>

In Lugo I met Ricci [Gregorio Ricci Curbastro] and together we went to visit Count Manzoni. In his library I found many papers coming from Libri, which may become very precious once the authenticity is proved. First of all I found many sheets that I figure as Abel's autographs.[...] Unfortunately I fear that everything will remain buried in the library without possibility of being scrutinized and published, because Manzoni did not allow us to take pictures, nor even allow another visit.

In December 1889 Manzoni died. His archive and library were sold in Rome in a series of auction sales during the year 1894. In the catalogue of autograph documents [Manzoni 1894] the first three items are Abel's manuscripts, they are described (in Italian) as follows:

1. Abel (Niels Henrik) great geometer of Norway died in the prime of the life at the height of his talent (1802–1829). – *Th eor emes sur les fonctions elliptiques*, in French signed at the beginning and dated at the end Christiania 27 Ao ut 1828, 28 autograph numbered pages in-8.
2. — *Recherches sur les fonctions elliptiques* (continuation), in French signed at the beginning 37 autograph numbered pages in-8.
3. — *Notes sur quelques formules elliptiques*, signed autograph memoir (25 Sept. 1828) in French, 4 pages in two columns in-4, the last in German.

From the Libri collection.

These manuscripts came into the possession of M.G. Mittag-Leffler (but I do not know whether this was a direct result of the sale or some time later), probably through the Swedish Consul in Rome. These manuscripts are presently held in the Library of the Institute Mittag-

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<sup>3</sup> Scuola Normale Superiore, Pisa: Archive *Betti*. This letter is published in whole in [Del Centina & Fiocca, 2004].

Leffler in Djursholm, Sweden (see also [Grattan-Guinness 1971]). In 1902 Mittag-Leffler devoted volume 26 of his journal *Acta Mathematica* to the celebration of the Centennial of Abel's birth, and, referring to *The recherches sur les fonctions elliptiques (second mémoire)* he wrote in the introduction:

Le mémoire d'Abel que nous publions ci-après était destiné au Journal de Crelle. Comme le montrent des annotations de la main de Crelle, le mémoire était arrivé à sa destination, mais Crelle, on ne sait pour quelle raison, n'en a publié que le § 1. Le Manuscrit provient de la collection Manzoni-Borghesi qui a été vendue à Rome en 1894. [...] Dans la collection des manuscrits du Journal de Crelle que possède la bibliothèque de l'académie des sciences de Berlin, et où, comme on sait, les manuscrits originaux d'Abel sont remplacés par des transcriptions faites à Berlin, la copie du présent mémoire est en défaut, même pour la partie du mémoire qui a été publiée.

En publiant le § 1 Crelle lui a donné le titre *Théorèmes sur les fonctions elliptiques* (Crelle Journal, B.4, p. 194. Sylow et Lie t. 1, p. 508). Le commencement du § 2 se retrouve changé et raccourci en partie dans le troisième paragraphe des *Fragments sur les fonctions elliptiques* que Sylow et Lie (t. 2, p. 251) ont publiés pour la première fois. La formule (40) est identique à la dernière formule donnée dans ce fragment. La continuation et la fin du § 2 n'ont pas été retrouvées autre part sous cette forme: le résultat pourtant n'est pas resté inconnu.

Le commencement du § 3 se retrouve presque sans changement dans la *Démonstration de quelques formules elliptiques I* (Holmboe, t. 2, p. 210, Sylow et Lie, t. 2, p. 194). La suite se trouve, sous une forme un peu modifiée, dans le *Précis d'une théorie des fonctions elliptiques* (Crelle, Holmboe, Sylow et Lie. Chez Sylow et Lie, t. 1, p. 533 et suivantes).

Le § 4 se retrouve dans les *Fragments sur les fonctions elliptiques* ainsi que dans *Précis...* (Sylow et Lie, t. 1, p. 523).

Le commencement du § 5 contient à peu près même chose que *Fragments...1*. La circonstance que le théorème 15 se trouve dans cette combinaison paraît confirmer la supposition faite par Sylow dans la note ou *Precis...*, p. 526 et 527, qu'Abel à la page 527 pensait à l'*équation modulaire*. Le théorème n'a pas été retrouvé parmi les publications d'Abel. Pourtant il n'est guère resté inconnu de ceux qui se sont occupés de cette matière.

Le théorème final 16 n'a pas non plus été retrouvé autre part chez Abel: il se rapporte comme on voit à la multiplication complexe.

Si la publication de ce manuscrit n'apporte pas à la science actuelle des résultats nouveaux, elle semble pourtant d'une très grande valeur pour l'étude de l'enchaînement et du développement des idées d'Abel. On ne peut s'empêcher de penser que, si Crelle avait publié le mémoire en entier, les *Recherches sur les fonctions elliptiques* auraient constitué, dès le début, une doctrine plus complète et plus achevée, de nature à faire ressortir Abel aux yeux de ses contemporains comme le vrai et principal créateur de la théorie des fonctions elliptiques.

This passage sheds some light on the manner in which Crelle organised the publication of Abel's memoirs, on his practice of "cutting and pasting" the text and publishing the "patchworks" separately. This practice, which seems confirmed by the analysis of the manuscript discovered in London (see next section), was a poor one. In fact –as Mittag-Leffler wrote in the introduction quoted above–, the discovery and the publication of the manuscript did not bring new results in the field, but certainly it was of great value for the study of Abel's line of thought, and we cannot help but think that, if Crelle had published the memoir in its entirety, the *Recherches sur les fonctions elliptiques* would have constituted from the beginning a more complete theory, and placed Abel in the eyes of his contemporaries as the real and main creator of the theory of elliptic functions.

After the sales in Rome much (though possibly not the most valuable part) of the archive

still remained in the possession of the Manzoni family. This mass of papers (including part of Libri's archive) was stored at the country villa in Frascati, near the small town of Lugo where Count Manzoni had his palace. In 1916 the villa was partly destroyed by fire and many documents perished. In the summer of 1945, during tragic events following the war, the villa was looted. In 1947 the lawyer Giuseppe Seganti of Lugo bought what remained of the archive from a descendant of the Manzoni family. This material was then sold by Seganti's daughters to the Town Archive of Lugo in 1986. An inspection of this material produced nothing but the certainty that there had once been another manuscript of Abel's among the papers! In fact I found the following card written (in Italian and French) in the hand of Giacomo Manzoni there:<sup>4</sup>

Abel Niels Henrik

§§ VIII, IX and X of the *Recherches sur les fonctions elliptiques*.

This precious autograph contains the original manuscript corresponding to the printed version from p. 221 to p. 251 of the first volume of the *Oeuvres complètes d'Abel*, Christiania 1839. We know from the notice of prof. B. Holmboe, editor of these works that Abel wrote his papers "en français, mais les neuf premières mémoires ont été traduits par M. Crelle en allemand, d'où on les a de nouveau traduits en français. Quant aux originaux des oeuvres publiées de notre auteur on n'en a point trouvé dans ses papiers". These autographs are part of them, and they came, I thought, to Professor Libri (from whom I have got them) after the death of Mr. Crelle whose library was sold by Asher the year 1856 in Berlin (see my catalogues).

So Libri also possessed the manuscript of Abel's seminal work on elliptic functions, or at least part of it. I found no trace of it in the collections I inspected so, presumably, this fragment must have gone missing during the tragic events at "La Frascati".

### **An Abel manuscript in London.**

Libri once wrote [Libri 1845]:

Cependant, lorsqu'il s'agit de manuscrits, on ne doit jamais désespérer de rien. Souvent ce qu'on croit perdu n'est que caché, et il ne faut pas oublier que les manuscrits autographes de Galilée, que sa correspondance inédite, qu'on supposait depuis long-temps anéantie, ont été retrouvés un beau jour dans la boutique d'un charcutier auquel un domestique, qui les avait découverts dans un vieux silo, les vendait au poids.

In November 2003, I learned by chance of the existence at the Library of the University of London of a manuscript thought to be by Abel.<sup>5</sup> I asked for a copy of that manuscript, and after having studied it I can say that is undoubtedly in Abel's hand. This is the original manuscript of the work published in the fourth issue of Crelle's journal in 1828 under the title *Remarques sur quelques propriétés générales d'une certaine sorte de fonctions transcendentes*, and in which Abel considered the case of "hyperelliptic functions". As is well known, Abel hoped that this paper would attract the attention of mathematicians to his as yet unpublished and neglected *Mémoire sur une propriété générale d'une classe très étendue de fonctions transcendentes* (the Parisian memoir).

In September 1828, while his fame was growing in Europe, Abel became seriously ill again and was bedridden for a month. In Christiania he was absolutely alone, but, as he

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<sup>4</sup> Town Archive of Lugo (Ravenna), Collection *Seganti*.

<sup>5</sup> University of London Library, MS 768.

confessed to Mrs Hansteen “Nevertheless, this lack of friends is not on my mind because I have horribly much to do for the *Journalen*” [Stubhaug 2000, p. 465]. Encouraged by Crelle, Abel wrote his first letter to Legendre on 3<sup>rd</sup> October, in which, as we can deduce from Legendre’s reply of 25th October, he talked about “hyperelliptic functions” [Holst 1902, p. 78]:

La fin de votre lettre me confond par la généralité que vous avez pu donner à vos recherches sur les fonctions elliptiques, et même sur des fonctions plus compliquées. Il me tarde beaucoup de voir les méthodes qui vous ont conduit à de si beaux résultats; je ne sais si je pourrais les comprendre, mais ce qu’il y a de sûr, c’est que je n’ai aucune idée des moyens que vous avez employés pour vaincre de pareilles difficultés. Quelle tête que celle d’une jeune Norvégien !

Abel was flattered and pleased by what he said, and few days later he wrote to Mrs Hansteen and told her what Legendre had said [Holst 1902, p. 81]. At the same time he wrote again to Legendre. In this second letter (the one acquired by Weierstrass), he provided the explanations that Legendre had asked for in his first reply. At the end Abel wrote ([Holst 1902, p. 90] also [Lie and Sylow 1881, p. 279]):

Si vous me permettez de vous écrire je désirerais bien vous communiquer un bon nombre d’autre [résultats] tant sur les fonctions elliptiques et des fonctions plus générales que sur la théorie des équations algébriques.

During the Christmas holidays Abel went to visit his fiancée in Froland. Soon after Christmas he developed pneumonia and started to cough terribly. On January 6, he felt a little better and was able to write a two page demonstration of the main result of his Parisian memoir: this was to be his last work. Legendre answered Abel’s second letter after having read the *Remarques* that appeared in Crelle’s journal in December. In his letter, that arrived in Froland in late January, Legendre wrote [Holst 1902, p. 91]:

[...] Mais le mémoire imprimé sous le n° 30 [sic] ayant pour titre *Remarques sur quelques propriétés générales* etc. me paraît surpasser tout ce que vous avez publié jusqu’à présent par la profondeur de l’analyse qui y règne, ainsi que par la beauté et la généralité des résultats. Ce mémoire occupe peu de place, mais il contient un grand nombre de choses...

It is likely that Abel never replied, and he may have taken Legendre’s words to mean that his Parisian memoir was lost forever [Stubhaug 2000, p. 485].

From the archivist’s note of January 2002, I learned that the manuscript of the *Remarques* had been found behind the title page, tucked into a copy of the first volume of the first edition of Abel’s *Oeuvres complètes*, which had previously belonged to Augustus De Morgan, and that this copy had been transferred from the General Library to the Historical section of the University of London in 1970.

The manuscript in question consists of four pages (two leaves) each divided into two columns numbered from 1 to 8, and is entitled “Sur une propriété générale d’une certaine classe de fonctions transcendantes” and signed “par M. N.H. Abel de Christiania”. The content, apart from some minor linguistic changes and a shift in the numbering of the formulae from 37 up to 41, is the same as the printed article [Abel 1828] (also [Abel 1881, I p. 288–298]). For instance in the famous footnote, with which Abel intended to attract the attention of mathematicians to his Parisian memoir, he even wrote: “Un mémoire sur ces fonctions a été présenté à l’académie royale des sciences de Paris vers la fin de l’année

1826". These corrections were probably made by Crelle at the printing stage, and therefore the manuscript would seem to me to be the "final" version that Abel sent to Crelle and not a draft, as asserted in the archivist's note. I should like to draw attention to one point here. Abel had thought of (and possibly written) at least one further section after the 11<sup>th</sup>. In fact from the manuscript he appears to have written:

12. Si le degré de la fonction  $\varphi x$  est 1 ou 2 on a  $v = 1$  et par conséquent le second membre de l'équation ne contient que la fonction  $v$ . La fonction  $\varphi x$  est

at the end of column 8, exactly at the bottom of page 4. This part had been crossed out and a tick line (possibly denoting the end ) inserted after section 11. There is simply no knowing whether Abel had changed his mind after writing a few lines and then slashed through them, or whether it was Crelle who decided to eliminate section 12.

This manuscript, inserted in the first volume of Abel's collected works sitting on a dusty shelf in the Library of the University of London was forgotten, and mathematicians and historians knew nothing of its existence for over a century.

It is not known how De Morgan came into possession of Abel's manuscript. All I can do is guess. Maybe the story went as follows. All Abel's manuscripts, apart from the Parisian memoir, came into Libri's possession through Crelle. De Morgan, like Crelle, was a very good friend of Libri's. When Libri fled to London in 1848, accused of having stolen material from French public libraries, he was made welcome by the scientific community and by De Morgan in particular, who also remained his faithful defender in England. De Morgan may have obtained Abel's manuscript from Libri, or it may have come to him, hidden in the copy of Holmboe's edition of the *Oeuvres complètes*, which was sold in 1861 during the auction sale of Libri's mathematical library in London. In the catalogue of that sale [Libri 1861] this item appears as:

10. Abel (N.H.) *Oeuvres complètes* (déjà publiées et inédites) avec des Notes et Développement rédigés par B. Holmboe, 2 vol. 4.to Christiania, 1839.

This celebrated Norwegian Mathematician died at the early age of twenty-six; but the admirable discoveries in the elliptical functions, and the theory of numbers, will be mentioned with the highest honour as long as the exact sciences are cultivated.

De Morgan bought several books during that sale, as can be seen from the purchasers' names on the page margins of the catalogue held at the Central National Library of Florence. Perhaps he also bought the two volumes of Abel's complete works, but it is impossible to say for sure since, unfortunately, the purchasers' names are only given from the the third day of sale onwards, whereas Abel's *Oeuvres complètes* were sold on the first.

### **Acknowledgements.**

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