THE PUBLISHED AND UNPUBLISHED WORKS OF PIETRO COSSALI, ASTRONOMER, METEOROLOGIST, AND HYDRAULIC IN THE PARMA UNIVERSITY. MANUSCRIPTS AND CORRESPONDENCE

Massimo Tinazzi
Institut "C. Montanari, vicolo Stimate 4, Verona

ABSTRACT In this work I produce the complet catalogue of the published scientific works of Pietro Cossali, astronomer and mathematician, the expounded and analysed catalogue of the collection of manuscripts left by Cossali. They are kept in the Civic Library of Verona. Here I give a short account of the history and the accidents suffered by the legacy, with a commentary of the personal relations that Cossali had with his collegue scientists through a intense epistolary exchange.

INTRODUCTION

The revaluation and the recovery of Pietro Antonio Cossali's works is now substantial because the cataloguing of all the documents about him has been completed. These documents, kept at the Civic Library of Verona, make up the main corpus of his writings. The material consists of manuscripts and letters put together in 37 boxes and catalogued as "Cossali Pietro, Manoscritti $1512^{(1\text{-}37)}$ Poligr. 82.8", containing on average from 200 to 400 sheets for a total of 11033 pages; it also includes the collection of his posthumous published works (articles and books). There are in addition a few letters sent by Cossali to some Veronese correspondents, catalogued in their respective collections. We can find 50 letters sent to Alessandro Carli and recorded under "Cossali Pietro, 50 lettere ad Alessandro Carli (s.l., Parma 9 aprile 1801 - 14 settembre 1804), b 930/45"; 28 more letters written to Benedetto del Bene and registered under "Cossali P., 28 lettere (S. Cristina Parma, 10 dicembre 1782 - 6 maggio 1804) a Benedetto del Bene, b 276 carteggio B. Del Bene"; 26 further letters are in the correspondence of Giuseppe Murari della Corte registered in "Cossali Pietro, 26 lettere (Parma 22 gennaio 1793 - Parma 23 febbraio 1796) a G. Murari Della Corte, b. 83". The correspondence with countess Silvia Curtoni Verza is peculiar because of their close

friendship, and it is registered in "Cossali Pietro, 18 lettere (Parma 7 dicembre 1790 - Padova 7 ottobre 1815) a Silvia Curtoni Verza + 3 sonetti, b. 77"; finally there are some letters held in different collections, recorded in "Cossali Pietro, 3 lettere (1784 - 1808), b. 215", a letter sent to his brother-in-law Giovanni Bottagisio recorded in "Autograf. Giuliari, b 215", a letter written to Pietro Guarienti in "b 115.1", a letter sent to Antonio Evangelisti in "Autografoteca veronese b. 367", a letter sent to Ippolito Pindemonte in "b. 40" and one to Benedetto del Bene in "Carteggio del Bene, VARI, b. 281".

Several published mathematical works are kept at the Library of Major Seminary in Verona and at the Library of the Agriculture Science and Letters Academy in Verona. We should finally remember that there are several Cossali's letters kept in collections of manuscripts of some mathematicians and astronomers, which are held in other cities. However these constitute a minor percentage compared to the material at the Civic Library of Verona.

THE MANUSCRIPTS OF PIETRO COSSALI'S COLLECTION

It is possible to find some news about Pietro Cossali in a well known collection of historical biographies(1), and though we could find a very good biographical sketch in the *Dizionario biografico degli italiani* (Baldini U., 1984), we still lacked an in-depth monographic study about this scholar and his scientific production. Therefore in the following pages we would like to bring out this outstanding personality, among the most stimulating of the late XVII° century, a great man of science who collaborated with the most important scientists of his time. In this work I tried to reconstruct the complete Cossali through a first phase in which I catalogued all his documents kept in the Civic Library of Verona, that reveal a close relationship with his Italian and foreigner colleagues (Tinazzi M., 1994).

The Collection of Pietro Cossali's manuscripts is practically complete, first of all because Cossali himself during his life had always collected and kept with utmost care the correspondence he received and sent. Moreover he had put in order the preliminary works to his publications and to his commissions as a hydraulic consultant. He divided and partially ordered the documents and his legacy contains nearly all his manuscripts. All the papers of the collection were numbered step by step in each container, always starting from number 1. Then the system of numbering was partly modified, and we cannot know if this was due to his pupil Floriano Pasetti, to the heirs or further to an internal revision of the Civic Library in the

past century. The pages are numbered on recto and verso, with the exception of those ones contained in folders 1512[30] and 1512[31], which are numbered only on recto.

Unfortunately his personal library was lost. It was in fact in part sold and in part given as a heritage to several people, but we have some news about it from Cossali himself. There is a partial hand-written catalogue, some letters and the will, with information that allow us to evaluate the breadth of his interests so that we are able to rebuild his bibliographic heritage from which he had derived the documentation for his works.

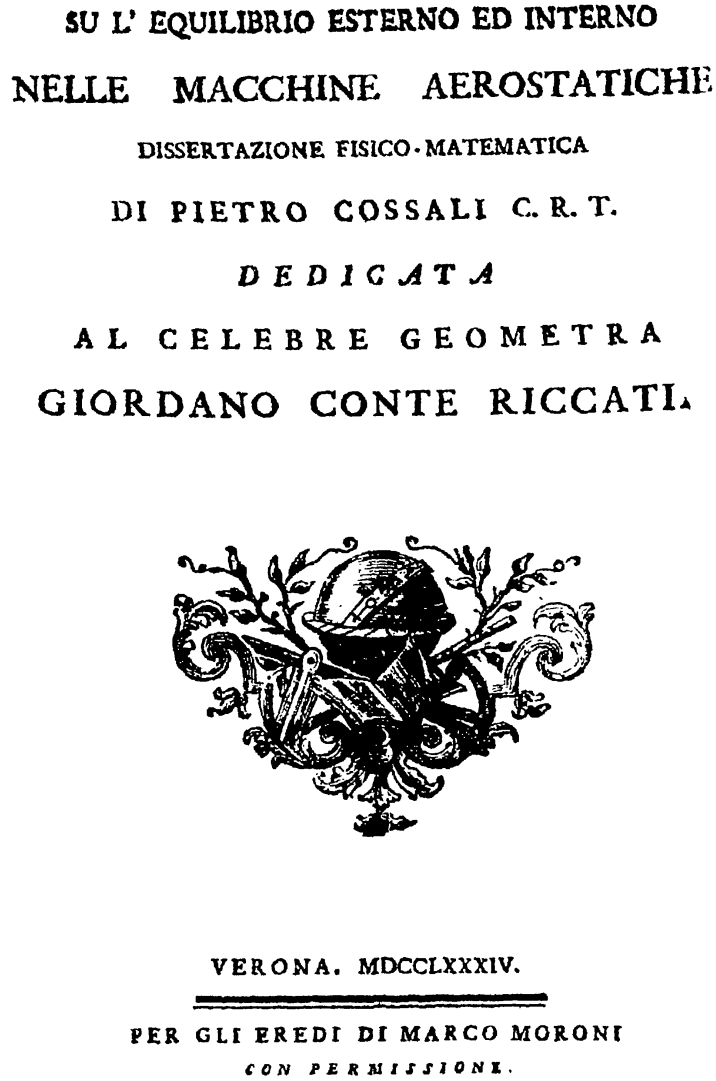
Before arriving at the Library of Verona, the 37 boxes of papers were property of Pietro Cossali's nieces, the sisters Teresa and Teodora Cossali, the latter married with Count Pandolfo di Serego Alighieri. We know for certain that Cossali had left an already arranged heritage, as reported in a publication of 1857 written by Baldassarre Boncompagni(2), *Scritti inediti del p. P. Cossali chierico regol. teatino.* The great Italian historian of mathematics (Picutti E., 1994) had published a series of Cossali's unpublished mathematical exercises after a research and prolonged contacts with the nieces of the Theatine abbot; Boncompagni's work is preceded by a long preface in which he sketched out a short chronicle of the correspondence, which shows us that Pietro's sisters had the actual care of the collection of writings already divided in 37 numbered folders.

Being a good mathematician, Cossali used to organize his work so he wrote a precise and detailed heritage(3), written in Padua the 3 of July 1814, about one year and a half before his death: his universal heirs were the Counts Benassù and Carlo Cossali, his brother Domenico's sons (died in 1812). When Benassù died in 1819, his brother Carlo became the only owner of the manuscripts until his death in 1849, and this fact helped the unitary preservation of the papers.

Carlo Cossali's daughters, Teodora and Teresa, received the folders from Countess Maria Bevilacqua and when their father died they became owners of the manuscripts. However, their aunt Countess Laura Cossali, Benassù and Carlo's sister, widow of Count Giovanni Bottagisio, remained the depository of the papers, *de facto* and *de iure*.

Pietro Cossali bequeathed the scientific texts of his library to Floriano Pasetti a university student in Padua who was commissioned to copy the best among the several unpublished works and send them to the Library of Padua University, in order to leave the papers at disposal for a prospective posthumous publication. This disposition was probably not fully accomplished, though the Paduan Cesareo Institute had repeatedly asked the relatives the already finished manuscripts. Actually only two works were published, and as for the other writings, in particular those dealing with historical matters, we could formulate only two hypotheses: either

they are no longer available or Pasetti gave them to the family and the papers were added to the other manuscripts they owned.



SU L' EQUILIBRIO ESTERNO ED INTERNO

NELLE MACCHINE AEROSTATICHE

DISSERTAZIONE FISICO-MATEMATICA

DI PIETRO COSSALI C. R. T.

DEDICATA

AL CELEBRE GEOMETRA

GIORDANO CONTE RICCATI.

VERONA. MDCCLXXXIV.

PER GLI EREDI DI MARCO MORONI

CON PERMISSIONE.

Fig. 1 Title-page of the study "Su l'equilibrio esterno ed interno nelle macchine aereostatiche. Dissertazione fisico-matematica" published in Verona by typography Moroni in 1784.

We know that, apart from the Civic Library of Verona, a lot of Cossali's letters are kept in other libraries, where we can find the correspondence with his several epistolary interlocutors. We report, for the sake of brevity, only two examples, because too many personalities

were involved in the impressive correspondence that Cossali had during his life. Some letters sent to Giuseppe Slop de Cademberg (astronomy professor at Pisa University) are collected in his correspondence kept in the Library of Pisa University (ms 165) while we can find the letters sent to Antonio Cagnoli (Baldini U., 1973) and Barnaba Oriani at the Brera Astronomical Observatory in Milan. We feel sure that we can also find his letters in the correspondence of his several correspondents, but their quest will constitute the second part of this research.

One of the most interesting aspects of the manuscripts regards the inductive considerations they suggest. In fact to understand how a scientist living at the end of 1700 worked, we also have to know which technical and theoretical material he used, and which bibliographic references he could consult. The reconstruction of his library is one of those lucky circumstances that allow us to understand the cultural formation of such a scholar. And Cossali's one comes out from a list of books that he had sold, or that he had asked a colleague to sell after his departure from Parma, when he returned to Verona in 1805. Unfortunately we can recover but a few volumes among those he left in Parma when he definitively moved to Padua where he had the chair in *calculus sublime* (Favaro A., 1922). However some letters of 1807 show a keen passion for books and a clear love for his library. He worried so much for its transport from Parma to Padua, that he was obliged to hire a special wagon and choose a large enough residence to contain it. The library consisted of course of a rather bulky *corpus* and still he didn't want to part from it.

His notable eclecticism comes impressively out from his heritage from which we learn the vast range and the multiplicity of his readings. After appointing his nephew Francesco Piero Venezze, son of Marcantonio, as executor and after arranging the monetary matters with his relatives (universal heirs were the nephews Benassù and Carlo Cossali) and with his servants, he stated who would receive his books. A library composed by volumes of mathematics, physics, astronomy, chemistry, natural history, agriculture, civil and military architecture, geography, historical biography, theology, arts and engravings, the encyclopaedia of Lausanne (all books left to his student Floriano Pasetti).

Cossali was also very much concerned in history because one of the personal catalogues for his library contains hundreds of volumes with historical matters, and the writings and biographies of the best known figures such as Lucio Anneo Seneca, Diogene Laerzio, Marco Tullio Cicerone, Tranquillo Svetonio, Caio Giulio Cesare, Leonardo da Vinci, Giovanni Boccaccio, Andrea Mantegna, Alessandro Magno, Dionigi d'Alicarnasso, Bartolomeo Colleoni, and others whose names don't tell us anything today.

LETTERA

AL SIGNOR ANTONIO CAGNOLI

DEL SIG. ABBATE PIETRO COSSALI

SUL PROBLEMA.

DETERMINARE IN UN' ORBITA ELITTICA A QUALUNQUE

DATO TEMPO IL PICCOLO MOVIMENTO GEOCENTRICO.

INSERITA NEL TOMO XVIII. DEGLI ATTI

DELLA

SOCIETÀ ITALIANA

DELLE SCIENZE

RESIDENTE IN MODENA.

MODENA

PRESSO LA SOCIETÀ TIPOGRAFICA

MDCCCXVII.

Fig. 2 Cossali P., title-page of the "Lettera al sig. Antonio Cagnoli sul problema: determinare in un'orbita ellittica a tempo qualunque dato tempo il piccolo movimento geocentrico di un pianeta (con emendazione di una formula del Frisi)" published posthumous in Modena in 1817. It is inserted in vol. XVIII of "Atti e Memorie della Società Italiana delle Scienze".

There were also books of poetry, Greek, Latin, Tuscan, French literary prose, codes in parchment and in common paper, books of metaphysics and laws, forbidden books at index of first class as the *Systeme de la nature* or *L'indifferenza del sec. XVIII* by Erasmo da Rotterdam, and the series of the History of the Republics. There were many volumes of

Greek, Latin and Italian grammars, the dictionaries, texts of rhetoric, of profane and holy history, books of anatomy, medicine and veterinary science with writings by Ippocrate, Giovan Battista Morgagni, Gabriele Falloppio and Vincenzo Malacarne. We can finally single out Alexander Popes's works, Milton's *Paradise Lost* and Tobias Smollet's *Travels through France and Italy* , all texts revealing Cossali's pleasure in reading for personal amusement.

Among the books he left in Parma there are technical and professional texts as *L'Algebra* by Tommasini, *Meccanica e trigonometria spherica* by Caravelli, a vocabulary by Facciolati, a philosophical volume by Sagner and Martini, *La Fisica* by Barbadici, *Elettromagnetismo e fisica* of Barletti, the *Clinica* by Kleini, the *Elementi di geometria* by Sanvitali, *Meccanica e pneumatica* by Scotti, *Il nuovo giornale de lett. d'Italia Moderna*, la *Storia critica delle opinioni filosofiche*, a dissertation of Muratori about antiques. We would also like to point out his preliminary and definitive manuscripts of published mathematical (Franci R., 1987), astronomical and theological works, in particular the materials that he used for his major work: *Origine, trasporto in Italia e primi progressi dell'algebra* (Cossali P., 1797). It was a valuable historical synthesis since it actually was the first History of Maths written by an Italian scientist and published in Italy.

Perhaps the reading of *Histoire des mathematiques* (Montucla, 2 voll., Paris, 1758), fundamental text of the Enlightenment mathematical historiography with its large circulation in northern Italy, had a remarkable role to excite his interest in historical problems. However I think that Cossali read Montucla's text after the publication of his *Storia critica* as we deduce by a letter written by Francesco Soave(4) in the Spring of 1802 in which he communicated the recovery, in Milan, of the two volumes of Montucla's history "in quarto" for L. 55, and also the LaCroix's *Del calcolo differenziale e integrale* in 3 tomes for L. 86.

From the manuscripts we can see Cossali's meticulousness in his research and in the evaluation of the original source; in fact he was not satisfied of the one already published or translated but he got the original texts, as it is testified by the letters of many correspondents sending him copies of the works he had asked and that were kept in various libraries. The research of the Italian origins conducted him to the original writings of the ancient mathematicians as Leonardo Pisano, Diofanto, Girolamo Cardano, Luca Pacioli, Tartaglia, with the works of Arab mathematicians who inspired the Italian mathematicians.

An important part of the Cossali collection is constituted by the letters coming from various personalities: astronomers, mathematicians, physicists, doctors, philosophers, theologians, brothers, members of the

family, friends, that gave way to a large interest in many scientific subjects, from astronomy to medicine up to the attempt to explain the mechanisms that permit bats' night flight, a topic present in many letters by Lodovico Borbone. In the physical and mathematical part we meet the best personalities oh his time as the Veronese astronomer Antonio Cagnoli who worked for many years at Brera Observatory, Gregorio Fontana (superior mathematics professor at Pavia University and member of the legislative staff of Italian Republic), Paolo Frisi (Barnabite, philosophy professor at Milan Alexandrine public school and mathematics professor at palatine school), Petronio Matteucci (director of Bologna Observatory), Giordano Riccati (Pellizzari A., 1802; Bernardi J., 1844), mathematics professor at Padua university with whom Cossali had a large correspondence about integration problems.

There are also letters of Girolamo Saladini (Geometry, astronomy and mathematics professor at Bologna university), Giovanni Maria Carminati (Physics professor at Bologna university), Geminiano Montanari (Physics professor at Parma Royal university), Lazzaro Spallanzani (Logic and Metaphysics professor at Reggio University and Natural Sciences professor at Modena University), Sebastiano Canterzani (Mathematics and general physics professor at Bologna University, president of the National Institute of the Italian Republic).

Eventually we find Tommaso Valperga Da Caluso, professor of oriental languages, criticism, chronology and astronomy at Turin University, Barnaba Oriani and Giovanni Angelo De Cesaris (astronomers at Brera Observatory), Marsilio Landriani (physics professor and court marshal of Herzog Albert von Sachsen-Teschen in Vienna and in Italy, correspondent of Paris Academy), Giuseppe Piazzi, founder and director of Palermo astronomical Observatory, Paolo Ruffini, geometry and analysis professor at Modena university, Antonmaria Vassalli Eandi (experimental physics professor at Turin university).

In the correspondence with mathematicians the most frequent topics are the solution of equations over the quadratic ones and the integration systems (Grugnetti L., 1989; Palladino D., 1989). The solution of differential equations caused difficulties that had to be solved above all for their application in the astronomical calculus, where the differential equations were and are fundamental instruments.

So we can assert that Cossali was a famous personage, probably feared, respected and with a large number of admirers and colleagues who esteemed his work and his genius, as it is demonstrated by the certificates of the several academies which he was a member of them. They are the Academy of Eccitati in Bergamo (from 1777), Academy of Sciences in Turin (from 1783), Academy of Science and Beauty Letters in Mantua and

Naples (from 1792), Academy of Agriculture Sciences and Letters in Verona (Biadego G., 1903), from 1793 Italian Society of Sciences born in Verona and today with seat in Rome, from 1795 of Academy in Padua, Academy of Sciences Letters and Arts in Padua from 1807 (and that admitted only the best thirty Italian personality), of Italian Academy of Sciences, Letters in Livorno (from 1807), while in the same year he was elected member of College of Erudite.

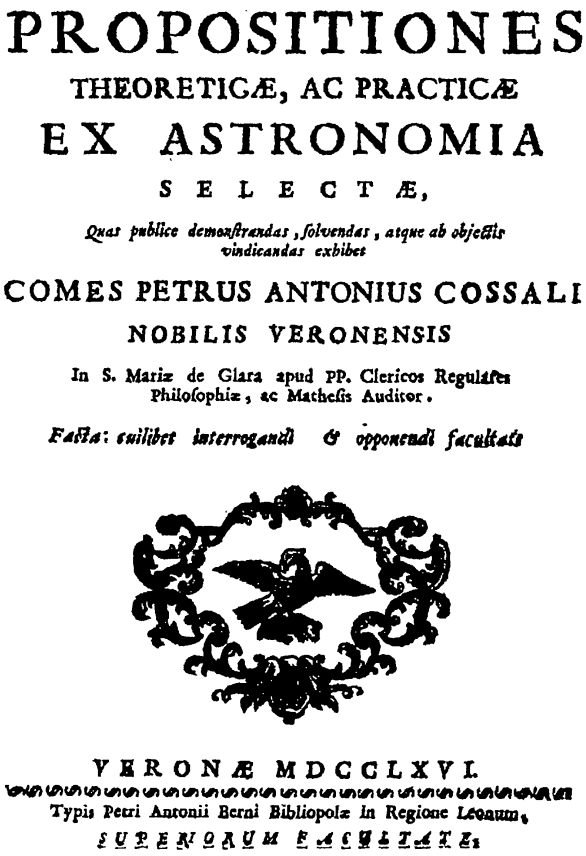
Among the most important documents there are a series of notes that form a set of preliminary notebooks of his lessons first at Parma University, and then at Padua University; a rich collection of lists of physics and mathematics titles, some notes about electricity, atmosphere and meteorology and above all the notes about his experiences at the Physics Academy he founded in Verona and that was in function for 4 years before his leaving to Parma in 1786. Founding this academy he had wished to let his fellow citizens to learn the news about physics, he explained through laboratory experiments.

A remarkable part of correspondence consists of letters and reports that he exchanged with the Hydraulic Commission when he worked as hydraulic consultant: we find writings about regulation of rivers and channels, the rectification of the loop of the river Adige in the southern Legnago countryside, about the intervention to eliminate some little flooding in Parma, about the judgement in some litigation for the property of the waters of landowners. He was very busy for the continuous convocations at the Hydraulic Commission, for the technical problems caused by the beds of such rivers as Brenta (not to mention the economical aspects: he had to dun the Milanese government for his payment).

There are also some curiosities like the documentation of the experimental researches about bats' sight at night that is the theme of a few letters of the correspondence between Cossali and Prince Lodovico I Borbone, before he ruled Parma. The Prince considered Cossali together with Spallanzani a privileged interlocutor with whom discuss his technical opinions.

There are eventually the personal letters that do not deal with scientific subjects but that significantly point out Cossali's wide range of interests. We must mention the correspondence with Ippolito Pindemonte as Cossali also wrote several poetical works, sonnets and panegyrics. For a long time he had another important correspondence on various matters with Benedetto del Bene and with Count Girolamo Murari Della Corte (professor at Mantua Royal Academy of Sciences, and Cossali's cousin); and of course we cannot forget his very peculiar pen friend the King Ferdinando Borbone, with whom he had a very friendly relationship, enriched by mutual respect. The friendly correspondence with Countess

Silvia Curtoni Verza was curious and continuous too (Biadego G., 1884; Uglietti F., 1983): she was the wife of count Francesco Guastaverza, animator of a Veronese salon in which gathered the best personalities of letters , arts and sciences in Verona. Of course the religious texts are also kept in the collection: for example there is a great work about San Gaetano from Thiene, a composed survey of 8 propositions about the system of Nature, some praises of the Virgin Mary(5), etc.



PROPOSITIONES

THEORETICÆ, AC PRACTICÆ

EX ASTRONOMIA

SELECTÆ,

Quas publice demonſtrandas, ſolvendas, atque ab objectis vindicandas exhibet

COMES PETRUS ANTONIUS COSSALI

NOBILIS VERONENSIS

In S. Mariæ de Glara apud PP. Clericos Regulares Philoſophiæ, ac Matheſis Auditor.

Facta: cuilibet interrogandi & opponendi facultate

VERONÆ MDCCLXVI.

Typis Petri Antonii Berni Bibliopolæ in Regione Leonum.

Fig. 3 When Cossali was only 18 years old, at the end of his studies, he held a public debate. The developed themes were published after two years, in 1766, with this title "Propositiones theoreticae, ac praticae ex astronomia selectae, quas publice demonstrandas, solvendas, atque ab objectis vindicandas exhibet".

A final consideration concerns Cossali as a man of letters. His interest in literature was not just a subordinate or a pleasant hobby because apart from the already remembered correspondence with Ippolito Pindemonte and other contemporary men of letters, we should not forget that the Academic Staff committed him the panegyrics and the funeral orations for

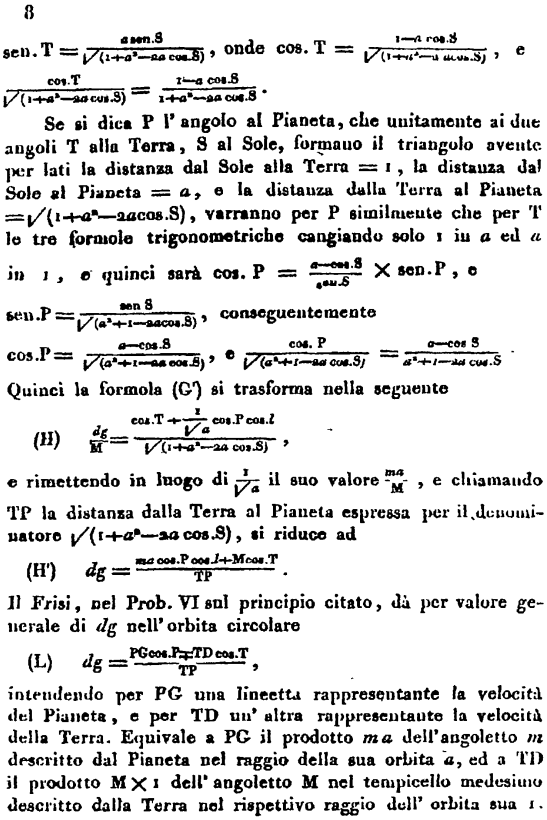
the physics and mathematics colleagues died in Padua (Cossali P., 1811; Cossali P., 1813a; Cossali P., 1813b). Moreover he published many sonnets dedicated to his friends and to his sister (Cossali P., 1807; Cossali P., 1805) while he often sent poems to celebrate particular events. In his letters we can find the texts of these very sonnets, at times unpublished, with which he used to delight his Veronese correspondents as Countess Silvia Curtoni Verza.

We may say that Cossali became one of the pivots round whom gravitated so many personalities who marked the age , and the cataloguing of his collection has offered us the opportunity to single out not only an outstanding scientific personality but also a culturally eventful age and a lively scientific world that characterized a century. Eventually it has given us a privileged view of the most culturally active society in the Verona of late XVIII century. We could verify the trends of the scientific studies that developed in this period: mathematical, physical, anatomical, zoological, meteorological and medical researches that show both Cossali's professional intercourse with various scholars of different disciplines and his wide range of interests which also included financial matters (Cossali P., 1812). Therefore lighting up Cossali's figure we have also lighted up a century of history, the cultural and historical events occurred in the little dukedom of Parma, from the development of an university to some interesting news about the Borbones including a mystery on Ferdinando Borbone's death.

We have pointed out some examples from the later lists to stress some significative subjects from manuscripts and published works. Cossali published his first work when he was 18 years old. It was written at the end of a first stage of studies and it was later debated in front of an audience. Its full title was "*Propositiones theoreticae, ac praticae ex astronomia selectae, quas publice demonstrandas, solvendas, atque ab objectis vindicandas exhibet*" (fig. 1) and it was a sort of thesis on some of the most important problems debated by the astronomers of the time.

In 1784 Cossali devoted himself to the aerostatical machines, and then to fluids physics to study the behaviour of hydrogen under particular conditions of temperature and pressure. In fact he dedicated to the famous Trevisan mathematician Giordano Riccati his work "Su l'equlibrio esterno ed interno nelle macchine aerostatiche" taking part to the theoretical and experimental debate risen by the first ascension of Montgolfier brothers (fig. 2). After analyzing the problem Cossali made an aerostat and gave a public demonstration lifting up his flying machine from Bra Square in Verona. A short time later Francesco Zambeccari failed a similar attempt.

A letter posthumously published in 1817 in Transactions of the Italian Society of Sciences regards instead the problems specifically connected to the orbits.



8

sen.T $= \frac{a \text{ sen.S}}{\sqrt{(1+a^2-2a\cos.S)}}$, onde cos. T $= \frac{1-a\cos.S}{\sqrt{(1+a^2-2a\cos.S)}}$, e

$\frac{\text{cos.T}}{\sqrt{(1+a^2-2a\cos.S)}} = \frac{1-a\cos.S}{1+a^2-2a\cos.S}$.

Se si dica P l'angolo al Pianeta, che unitamente ai due angoli T alla Terra, S al Sole, formano il triangolo avente per lati la distanza dal Sole alla Terra $= 1$, la distanza dal Sole al Pianeta $= a$, e la distanza dalla Terra al Pianeta $= \sqrt{(1+a^2-2a\cos.S)}$, varranno per P similmente che per T le tre formole trigonometriche cangiando solo 1 in a ed a in 1, e quinci sarà cos. P $= \frac{a-\cos.S}{a\,\text{sen.}S} \times$ sen.P, e

sen.P $= \frac{\text{sen S}}{\sqrt{(a^2+1-2a\cos.S)}}$, conseguentemente

cos.P $= \frac{a-\cos.S}{\sqrt{(a^2+1-2a\cos.S)}}$, e $\frac{\text{cos. P}}{\sqrt{(a^2+1-2a\cos.S)}} = \frac{a-\cos S}{a^2+1-2a\cos.S}$.

Quinci la formola (G') si trasforma nella seguente

(H) $\frac{dg}{M} = \frac{\text{cos.T} + \frac{1}{\sqrt{a}}\text{cos.P cos.}I}{\sqrt{(1+a^2-2a\cos.S)}}$,

e rimettendo in luogo di $\frac{1}{\sqrt{a}}$ il suo valore $\frac{ma}{M}$, e chiamando TP la distanza dalla Terra al Pianeta espressa per il denominatore $\sqrt{(1+a^2-2a\cos.S)}$, si riduce ad

(H') $dg = \frac{ma\cos.P\cos.I + M\cos.T}{TP}$.

Il *Frisi*, nel Prob. VI sul principio citato, dà per valore generale di dg nell'orbita circolare

(L) $dg = \frac{PG\cos.P \mp TD\cos.T}{TP}$,

intendendo per PG una lineetta rappresentante la velocità del Pianeta, e per TD un'altra rappresentante la velocità della Terra. Equivale a PG il prodotto ma dell'angoletto m descritto dal Pianeta nel raggio della sua orbita a, ed a TD il prodotto $M \times 1$ dell'angoletto M nel tempicello medesimo descritto dalla Terra nel rispettivo raggio dell'orbita sua 1.

Fig. 4 A page of the letter to Cagnoli in which Cossali proposed the generalization for elliptic orbits of Earth motion compared to another planet.

It was the "Lettera al S ;nor Antonio Cagnoli sul problema. Determinare in un'orbita elittica a qualunque dato tempo il piccolo movimento geocentrico" (fig. 3). This one is particularly interesting because it was prepared for the occasion of the first observations of the Olbers planet (asteroid Cerere). The necessity to calculate its orbit originated various mathematical approaches among which Cossali elaborated one by which it was possible to find the heliocentric latitude, without knowing the distance from the Sun of the new planet, assuming the hypotetical principle that the retrograde motions of the external planets close to each other at the time of the oppositions were the inverse of the distances from the Sun. The curiosity to know if this hypothesis was right pushed Cossali to search for a general formulation for the little geocentric motions of the planets

considering their orbits as elliptic. Paolo Frisi in his *Cosmografia* had elaborated a formulation of the little angular geocentric motion in the case of circular orbit but without completing the calculus for elliptic orbits. Using a work written by Riccati, Cossali found the formulation to find the geocentric motion at any time starting from the knowledge of the characteristics of elliptic orbit of another planet (fig. 4).

In the formula (L) which betters that of Frisi

$$dg = \frac{PG\cos P \mp TD\cos T}{TP}$$

the term dg is the range of orbit run along by the earth during a time interval in which the considered planet runs along a part of its orbit; PG is the velocity vector of the planet in the P point, TD is the Earth speed in the T point while TP is the distance Earth-planet. The length PG is produced by the product ma where m is the angle between the ray a of the orbit of planet and a is the ray Sun-G point while TD is the product of the M angle between the ray of terrestrial orbit, considered with length 1, and the ray Sun-D point, angles traced in the same time Δt.

A quote from the unpublished letters regards instead the correspondence with Giangiacomo Barattieri from S. Pietro in Cerro near Piacenza, professor at the Centre of Parma University in Piacenza. We chose a minor unknown personality to light up this daily correspondence.

"Avendo avuto la fortuna di avervi qui in Piacenza l'egr. Sig. Dr. Dentoni, per mezzo suo sono stato favorito dell'opuscolo da V. R. pubblicato con codesta reale stamperia sottotitolato il prenuncio del solare eclisse del giorno 3 aprile 1791 dal quale ella da un saggio della profondità di lei nell'astronomia. Il signor Antonio Cagnoli di Verona mi ha fatti di lei li giusti elogi e mi ha animato ad aprire con lei una astronomica corrispondenza.. Io sono una persona ignota alla Repubblica letteraria, ma l'astronomia è sempre stata la mia passione predominante; per questo ardisco prevenirla, che la latitudine parmense temo sia sbagliata di molto se è stata così determinata 30 sono di gr 44.41'.50" poiché io l'ho recentemente provata questa nostra di Piacenza al centro della città gr 45.3'.54,5". Bisognerebbe che la distanza di queste due città fosse quasi sotto la stessa longitudine, ma essendo l'intervallo nostro più in longitudine, che in latitudine, perché Parma rispetto a Piacenza è all'Est sud est, e Piacenza rispetto a Parma è al ovest nord ovest, così dubbito vi sia qualche notabile errore.

Però ella lo riconoscerà meglio di me quando vorrà assicurarsene. Se ella desiderasse sapere gli argomenti di cui mi sono servito per determinare la latitudine piacentina, o sia la nostra altezza di polo, io la

ubbidirò volentieri, anzi avrei piacere sentire il pregiato giudizio di lei, se mai potessi dubbitare più io de miei errori, che di quelli può aver fatti il Padre Belgrado 30 anni or sono, mentre io era in codesto collegio de Nobili di Parma e fino d'allora faceva seco lui delle osservazioni sulla specola di S. Rocco ed ebbi la fortuna di vedere il famoso passaggio di Venere sul disco solare con il padre Belgrado e il padre Tortasa, ed il padre Contarelli lettore allora di matematica.

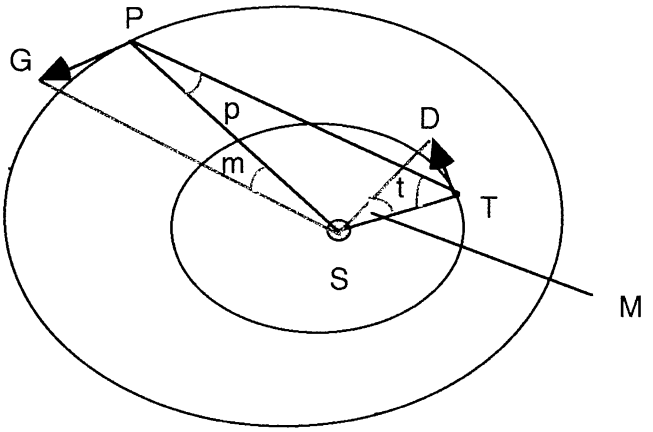


Fig. 5 Geometrical scheme of the orbital elements of the Earth and of another planet for the generalization of the formula developed by Cossali.

Anzi se vostra R volesse avere tanta bontà di lasciarsi da me comunicare il processo che tengo per segnare un orologio solare sulla nostra nuova facciata della piazza grande con gnomone di lunghezza circa piedi 15 parallelo all'asse mondano corrispondente però alla lunghezza di uno stile perpendicolare di 10 piedi, che deve segnare tutte le ore, e minuti per il tratto di tempo, che il sole potrà illuminare tale aspetto, ed una tangente che deve segnare mediante una larga ombra orizzontale d'un gnomone di circa 9 piedi separatamente tutti li gradi di declinazione del sole, e tutti li giorni dell'anno in forma di kalendario, mi farebbe una grazia particolare per avvertirmi de miei sbagli, dovendo tutto restar segnato in marmo di carrara con molto dispendio, perché sono solo, non ho con chi conferire, non ho altri instromenti, che quelli grossolani frutti di mia mano; un quadrante di legno però col lembo tutto di ottone di piedi 6 pollici 4 di legno armato di un tubo di 7 piedi per il cannocchiale col micrometro, colla divisione estesa di tutti li minuti primi, ma senza cerniera; e una macchina parallattica, o sia settore equatoriale tutto di ferro salvo l'orario, e il tubo di 5 piedi del cannocchiale in un osservatorio mio nel mio vasto giardino, in cui posso osservare 12, e più orari.

Quesito

Mr. Rev.do Padre.

Quando avuta la fortuna di riverirla qui in Piacenza l'egregio Sig.r D.re Deotoni, per mezzo suo sono stato favorito dell'opuscolo da V. P. pubblicato con codesta Reale Stamperia sotto il titolo dell'apparente del solare Eclisse del giorno 3. Aprile 1791. dal quale ella dá un saggio della profondità di lei nell'astronomica. Il Sig.r Antonio Cagnoli di Verona mi ha fatti di lei li giusti elogj, e mi fa animato ad aprire con lei una astronomica corrispondenza. Io sono una persona ignota alla Repubblica letteraria, ma l'astronomia è sempre stata la mia passione predominante. per questo avviso prevenirla, che la latitudine Parmense fino ora sbagliata di molto se è stata così determinata 30. anni sono di gr. 44. 49. 50. poiche io ho recentemente fissata questa nostra di Piacenza al centro della città gr. 45. 3. 54.5. bisognerebbe, che la distanza di queste due città fosse quasi sotto la stessa longitudine, ma essendo l'intervallo nostro più in longitudine, che in latitudine, perche Parma rispetto a Piacenza è all'Est sud est, e Piacenza rispetto a Parma e al Ouest nordouest, così dubbito vi sia qualche notabile errore però ella lo riconoscerà meglio di me quando vorrà assicurarsene. Se ella desiderasse sapere gli argomenti di cui mi sono servito per determinare la latitudine Piacentina, oltre la nostra altezza di polo, io la ubbidirò volentieri, anzi avrei piacere ricevere il pregiato giudizio di lei, se mai potessi dubitare più io che miei errori, che di quelli può aver fatti il P.re Belgrado 30. anni sono, mentre io era in codesto collegio de Nobili di Parma,

e fino

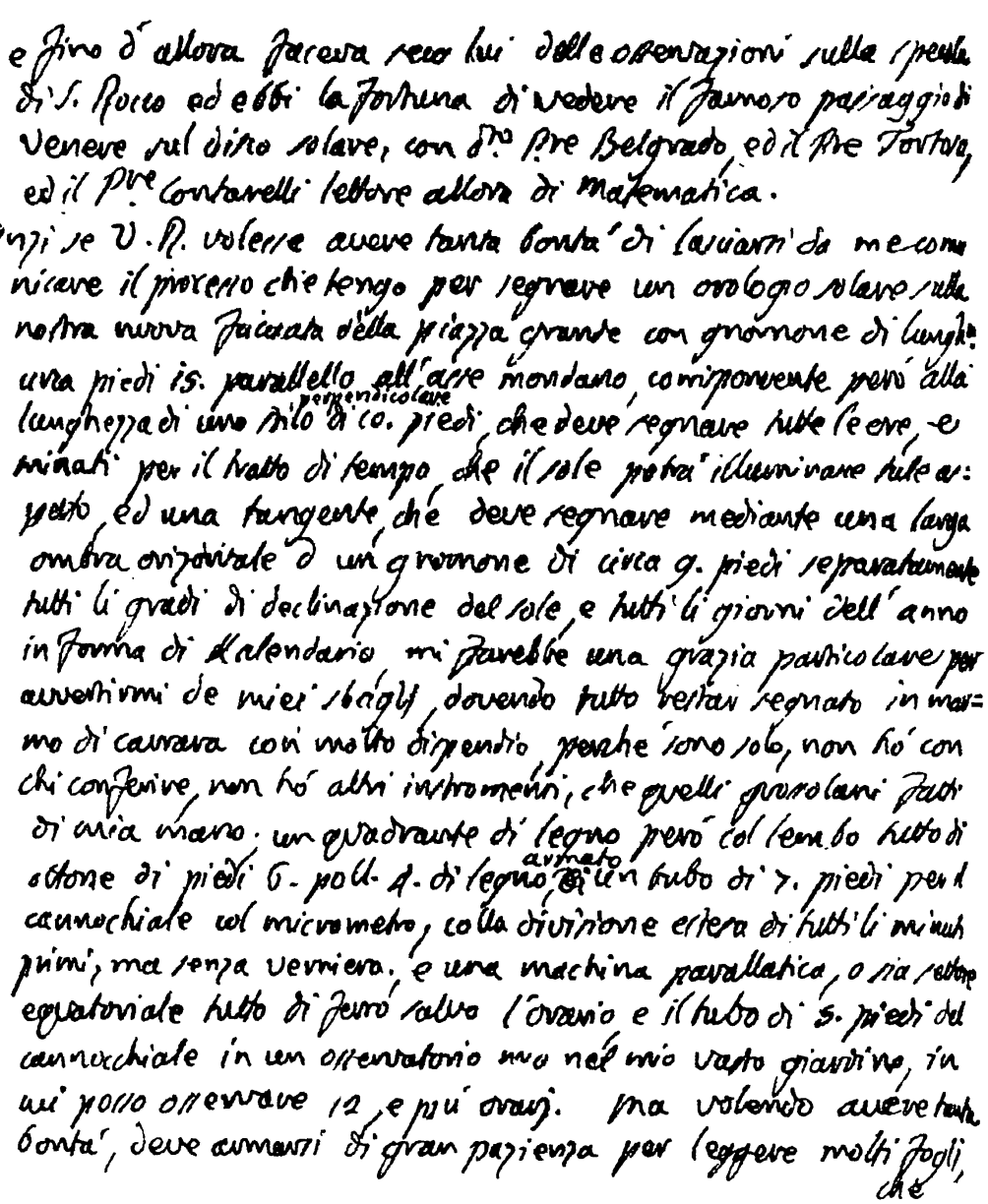


Fig. 6 Letter written from Giacomo Barattieri to Pietro Cossali in 1791 in which was described a wall quadrant and a parallactic machine realized by Barattieri himself.

Ma volendo aver tanta bontà, deve armarsi di gran pazienza per leggere molti fogli che per suo minore incomodo le manderei franchi di posta e

vorrei tutta la possibile segretezza. Attenderò dunque il cortese riscontro di lei, prevenendola, che non mi offenderò, ancorché ricusasse tale importunità per le occupazioni della cattedra, a cui è destinata, o altre sue particolari, e frattanto augurandomi di poterla servire con tutta la stima mi dice di V. R.
Piacenza adi 4 aprile 1791"

The interesting aspect of this letter, rather than the question of correctly making a sun-dial, regards the confirmation that an observatory for astronomical observations in Parma, had already existed for many years as well as the presence of self-made instruments of observation such as the quadrant with micrometer, and an equatorial sector with telescope, all revealing not only an amateur's research but the result of a passion transformed in professionalism at a private level.

The published and unpublished works listed herewith do not represent Cossali's complete production since we selected only those dealing with Astronomy and Physics. To remain in the scientific field the mathematical papers would require an autonomous research and analysis because of the great size of the manuscripts and the important contribution given to the history of Maths. And also his literary and religious production is worth while further investigation.

NOTES TO THE CATALOGUE

The herewith cataloguing has been ordered according to the following standards: the list of published works regards Cossali's complete scientific production. The publications are kept in greater number at the Civic Library of Verona. Those ones that are kept in the Library of Episcopal Seminary in Verona are marked by an asterisk (*), those ones with dollar ($) are not in Verona and those ones with snail (@) are kept in the Civic Library of Treviso.

Cossali's manuscripts of the collection are catalogued with press-mark (MSS 1512^{n} s. m), with n as number of the case, and m the progressive number of the sheets of the specified case. The letters kept in other collections are marked with the name of the collection and the sign of the case in which they are contained. In addition to the location of any quoted document there is a synthetic description of the papers. The sign PC is the abbreviation of Pietro Cossali.

PUBLISHED WORKS

$Cossali P., Relazione sulla pila elettrica a secco dell'ab. G. Zamboni pros. di fisica al liceo convitto di Verona, printed in Padova

$Cossali P., La virtù dell'acqua e l'impotenza del mercurio a salire lungo i tubi capillari

$Cossali P., Dipendenza dei movimenti del barometro dalla elettricità artificiale e dalla naturale

Cossali P., Propositiones theoreticae, ac praticae ex astronomia selectae, quas publice demonstrandas, solvendas, atque ab objectis vindicandas exhibet, Verona, Antonio Berni, 1766

$Cossali P., Misterium casus irreducibilis explicatione capitis primi libri Cardani, Venezia, Tipografia Palasi, 1779

$Cossali P., Osservazione e ragionamento su di un fulmine accompagnato da strani fenomeni, Giornale Confini d'Italia, Graziosi, Venezia, 1783

Cossali P., Su l'equilibrio esterno ed interno nelle macchine aerostatiche. Dissertazione fisico-matematica, Verona, Moroni, 1784

*Cossali P., Apparenze del solare eclissi del giorno 3 aprile 1791 in Parma, con spiegazioni atte a mettere all'intelligenza delle persone un po' colte alcuni articoli generali di astronomia anche elevata, Parma, Stamperia Reale, 1791

*Cossali P., Effemeride astronomica ad uso comune per l'anno bisestile 1792, Parma, Stamperia Reale, 1792

$Cossali P., Effemeride astronomica per l'anno 1793, Parma, Stamperia Reale, 1793

*Cossali P., Effemeride astronomica ad uso comune per l'anno MDCCXCIV, Parma, Stamperia Reale, 1794

$Cossali P., Effemeride astronomica per l'anno 1796, Parma, Stamperia Reale, 1796

$Cossali P., Effemeride astronomica per l'anno 1797, Parma, Stamperia Reale, 1797

$Cossali P., Effemeride astronomica per l'anno 1798, Parma, Stamperia Reale, 1798

$Cossali P., Origine, trasporto in Italia e primi progressi dell'algebra, voll. 2, Parma, Stamperia Reale, 1799

$Cossali P., Discorso o calcolo astronomico su l'eclissi del 1800, Parma (1800)

Cossali P., Lettera da Verona (9 March 1800) all'Avvocato Luigi Bramieri sulla quistione, se l'anno denominato 1800, sia l'ultimo del secolo XVIII o il primo del secolo XIX, in Lettere sopra vario argomento utile e dilettevole, Parma, 1801, p. 14

Cossali P., Su la celebrazione della Pasqua del corrente anno 1802. Dichiarazione popolare, Parma, Stamperia Reale, 1802

$Cossali P., Effemeride astronomica per l'anno 1803, Parma, Stamperia Reale, 1803

*Cossali P., Effemeride astronomica ad uso comune per l'anno bisestile 1804, Parma, Nazionale, 1804

*Cossali P., Prenuncio ristretto su l'eclissi del giorno XI febbrajo MDCCCIV, Parma, Mussi, (Vicenza, Parise; Venezia, Longo) 1804

Cossali P., Sul giorno della celebrazione della Pasqua nell'anno venturo 1805, Parma, Carmignani, 1804

Cossali P., Sull'opinione delle piogge de' sassi dei vulcani lunari. Disquisizione matematica, Modena, Soc. Tipografica, 1806, in Mem. Soc. Ital. delle Sci., Tomo XIII, 1807

Cossali P., Continuazione delle indagini per assoggettare a calcolo i movimenti del barometro, Modena, Soc. Tipografica, 1810

Cossali P., Sui barometri luminosi con appendice dimostrante nel barometro una macchina elettrica singolare, Verona, Mainardi, 1810, in Mem. Soc. Ital. delle Sci., Tomo XV, P. II, 1811

Cossali P., Lettera al sig. Antonio Cagnoli sul problema: determinare in un'orbita ellittica a tempo qualunque dato tempo il piccolo movimento geocentrico, Modena, Soc. Tipografica, 1817, Tomo XVIII degli atti e Memorie della Società Italiana delle Scienze

Cossali P., Indagini per sottomettere a calcolo il barometro nelle diverse sue forme nelle sue dipendenze e ne' suoi usi, Verona, Mainardi, 1810, or in Mem. Soc. Ital. Tomo XV e XVIII, 1820

$Letters of Pietro Cossali to Barnaba Oriani, Parma, 9 aprile 1791, in Raccolta di lettere di uomini illustri

LETTERS AND UNPUBLISHED WORKS

Letter of Giangiacomo Barattieri to PC, convent of S. Pietro in Cervo, Piacenza, 4 April 1791 (MSS 1512^1 s. 33-34)
Barattieri receives from a common acquaintance Cossali's publication "Apparenze del solare eclisse...", he thanks and signals an error in latitude of Parma because he personally measured for Piacenza that has it similar to Parma, that is 45° 3' 54,5''.
From the Barattieri's observations of the eclipse of the 3 April 1791 measured with parallactic machine, the start of eclipse is at $1^h\ 22^m\ 18^s$ while the end is at $3^h\ 49^m\ 25^s$.

Letters of Giangiacomo Barattieri to PC, Piacenza, 16 May 1791 (MSS 1512^1 s. 35-36)
Question about construction of a vertical sun-dial.

Letters of Giangiacomo Barattieri to PC, Piacenza, 18 January 1796 (MSS 1512^1 s. 37)
Barattieri receives and sells 4 copies of Cossali's ephemeris and agrees about the forwarding of money. He quotes the ephemeris published in Milan by the abbe de Cesaris of who he protest the geographical coordinates of Piacenza e Parma because De Cesaris provides for Parma a latitude of 44° 46' and longitude 27° 59' 33''.

Letters of Gregorio Fontana to PC, Pavia, 30 July 1787 (MSS 1512^1 s. 59)
About the Eulero's differential equations, he asks news about Eulero's works.

Letters of Gregorio Fontana to PC, Pavia, 13 January 1788 (MSS 1512[1] s. 60)
He received the Eulero's work, news about series

Letters of Petronio Matteucci to PC, Bologna, 25 November 1790 (MSS 1512[1] s. 66)
He congratulates for the assignment as astronomy meteorology and hydraulic professor and suggests some instruments for the astronomical observation.

Letters of Petronio Matteucci to PC, Bologna, 28 March 1791 (MSS 1512[1] s. 67)
He congratulates for the assignment as astronomy meteorology and hydraulic professor and for Cossali's astronomical research

Letters of Petronio Matteucci to PC, Bologna, August 1798 (MSS 1512[1] s. 68)
He sends to PC an ephemeris and a book

Letters of Maria Agnesi to countess (MSS 1512[1] s. 94)

Letters of father Carminati to PC, Parma, 12 December 1783 (MSS 1512[4] s. 19-20)
About differential equations

Letters of father Carminati to PC, Parma, 17 February 1784 (MSS 1512[4] s. 21)
About differential equations

Notes in Latin about differential equations (MSS 1512[4] s. 31-52)

Letters of PC to Giovanni Carminati, Verona, 25 December 1783 (MSS 1512[4] s. 53)
About differential equations

Cossali's notes in Latin about trigonometry and cubic equations of 1629 (MSS 1512[4] s. 69-78)

Notes from memory of Paris Academy from 1666 to 1750 about the infinitesimals, the infinities and differential equations (MSS 1512[4] s. 79-84)

Appendix about equations (Cossali's manuscript) (MSS 1512[4] s. 87-94)

About differential equations and algebraic curve (MSS 1512[4] s. 133-176)

About polynomial equations (MSS 1512[4] s. 177)

Problems with differential equations (MSS 1512[4] s. 181)

About differential equations (MSS 1512[4] s. 185)

Off-print of a mathematical work (MSS 1512[4] s. 189)

About D'Alembert's differential equation (MSS 1512[4] s. 191)

About snow of 1795 (MSS 1512[4] s. 193)

Off-prints from Bombelli's works (MSS 1512[4] s. 387-400)

Cossali P., "Copia dell'Elogio di Fra Luca Pacioli" (MSS 1512[5] Carte 1-36) I

Cossali P., "Esemplare Originale dell'Elogio di Fra Luca Pacioli" (MSS 1512[5] Carte 37-79) II

Notes about velocity and motion of a body in curvilinear motion (MSS 1512[6] s. 11-16)

Notes about osculating curves (MSS 1512[6] s. 17-24)

Collection of calculations during his Parmesan period and related to planetary orbits with develops of Keplero equation about 4° Jupiter satellite (MSS 1512[6] s. 111-130)

Comment about a M. Richet's work about method to sole the problems of equations near infinite (MSS 1512[6] s. 131-140)

"Sopra il grado di longitudine nella latitudine di Venere" (MSS 1512[6] s. 141-148)

Method of solution of cubic equations (MSS 1512[6] s. 149-160)

Problem of a curve with double curvature (MSS 1512^6 s. 161-168)

Collèction of some exercise books linked with a wrapper titled "Alcune lezioni di fisica" (in Latin) (MSS 1512^7 s. 1-144)

"Adoberemus (sic) Physicam ingredientibus" (MSS 1512^7 s. 1-6)

"De physica generali" (MSS 1512^7 s. 7-26)

"Caput tertium. De materiis divisibilissimis (sic)" (MSS 1512^7 s. 27-76 e 77-144)

Reflections about the Galileo's "Dialogo sui massimi sistemi" (MSS 1512^7 s. 223-232)

Collection of problems of astronomical subject and about bodies dynamics (with a drawing) (MSS 1512^7 s. 233-256)

Note about space and substance of the bodies (MSS 1512^7 s. 257-268)

Three exercise books of physics linked with wrapper titled "Logica della fisica", In physicam prefazio (praefatio), cap II De hypotesium (sic) in phisica usu, cap III De analogia principio (MSS 1512^7 s. 353-432)

Exercise book about planetary motions and satellites, Keplero's law (MSS 1512^7 s. 433-464)

Collection of physical experiments (MSS 1512^7 s. 465-492)
Horizontal impulses and perpendicular pressures of the arches, about evaporations, experiments about water from snow, altitude of a well upon the plateau of valley plateau, about Galvani's experiments, machine for parabolic fall, broken lever

Physical problems (MSS 1512^8 s. 1-94)
Exercise books linked in wrapper (in Latin)

Exercise book "Dissertatio de gravitatis causa contra cartesianos" propositione 1° (MSS 1512^8 s. 1-30)
Reflections about gravitation

Exercise book with "propositione 2°" (MSS 1512[8] s. 31-53)
About gravitation and reference to Newton

Exercise book with "propositione 3°" (MSS 1512[8] s. 51-74)
About gravitation and reference to Van Muschenbroek

Exercise book with "propositione 4°" (MSS 1512[8] s. 75-94)
About gravitation

Drawings of physics (MSS 1512[8] s. 95-160)
Collection of pictures of physical and mathematical experiments

Exercise book 1° "De lucis directae, reflexae et refractae motibus" (MSS 1512[8] s. 161-180)
About light propagation in various matter

Exercise book 2° (MSS 1512[8] s. 181-258)
About bright phenomena, their propagation, origins of shadows (containing "Leges peculiares reflexionis lucis ex speculis convexis")

Exercise book 3° "De lucis reflexus motu" (MSS 1512[8] s. 259-342)
About light reflection

Exercise book "Theoria lucis ab Eulero consecta (conserta?)" (MSS 1512[8] s. 343-373)
About light propagation and use of imaginary numbers

Exercise books and sheets linked in wrapper with title "Elettrologia" (MSS 1512[9] s. 17-170)
Collection of writings about artificial and atmospheric electrical phenomena. The sheets are undertitled for chapters:

"Elettricità dell'atmosfera" (MSS 1512[9] s. 17-25);

"Degli artifici per esplorare la elettricità dell'atmosfera"; "Dei globi aerostatici"; Dei razzi"; Dei conduttori nobili"; "Dei lunghi fili metallici orizzontali"; "Conduttori per l'elettricità delle piogge"; "Dell'elettrometro e del conduttore della elettricità" (MSS 1512[9] s. 25-40);

"Aggiunta alla fusione dei metalli" (Sull'effetto del fulmine) (MSS 1512[9] s.41-42);

About electricity of clouds (MSS 1512[9] s. 43-48);
Athmospherical electricity (MSS 1512[9] s. 49-56);

"Del periodo giornaliero della elettricità di cielo sereno" (MSS 1512^9 s. 57-78);

"Periodo annuo della elettricità di cielo sereno" (MSS 1512^9 s. 64);

"Dell'elettricità a cielo coperto" (s. 66);

"Dell'elettricità della pioggia" (MSS 1512^9 s. 79-98);

"Dell'elettricità della neve" (s. 81); continuation about atmospherical electricity (MSS 1512^9 s. 99-112);

Still about atmospherical electricity (MSS 1512^9 s. 113-114);

"Aggiunta alla fusione del vetro" (MSS 1512^9 s. 115-120) (about thunderbolt effects

about electric fire (MSS 1512^9 s. 121-130);

about electrical machine of Van Der Noren (MSS 1512^9 s. 131-156);

Sheets linked (MSS 1512^9 s. 157-170): "Descrizione delle specie della elettricità atmosferica" (MSS 1512^9 s. 161), "Della celerità o tardità del conduttore elettrico atmosferico a ricaricarsi e dell'influenza in tal celerità del mezzo e del umido" (MSS 1512^9 s. 163)

Aerometric dissertation (MSS 1512^{10} s. 1-80)

Problem about stability of external and internal pressure in cavity in which there is the vacuum (MSS 1512^{10} s. 3-6)

Text copied from the "Tubo Torricelliano De macchina pneumatica seu rarefactionis ..." "De aeres gravitate (MSS 1512^{10} s. 11-80)
Among these papers there is the "Dissertatio IV De pressione particlarum ..." (MSS 1512^{10} s. 13-16, 17-20, 21-32)

Dissertation about air, air pressure, sounds emission, sound propagation (in Latin) (MSS 1512^{10} s. 81-122)
Among these papers there are: "Harmonia universali gallica" (s. 83-84), "Illustrazione della dissertazione del sig. Lambert sopra alcuni stromenti musicali" (MSS 1512^{10} s. 85-88)

"Dissertatio Lez I" about chemistry of air, atmospheric pressure, the barometer and pneumatic machine (MSS 1512^{10} s. 123-164)

Exercise book about "l'assorbimento di umidità nell'aria da combustione del fosforo Lez II" (in Latin) (MSS 1512^{10} s. 165-190)

Exercise book about hydrostatics Lez III (MSS 1512^{10} s. 191-242)

Exercise book: Lez IV about barometric pressure (MSS 1512^{10} s. 243-290)

Exercise book: Lez V about barometric pressure (MSS 1512^{10} s. 291-306)

Exercise book: Lez VI about barometric pressure (MSS 1512^{10} s. 307-330)

Exercise book: Lez VII about barometric pressure (MSS 1512^{10} s. 331-356)

Exercise book: Lez VIII about barometric pressure (MSS 1512^{10} s. 357-380)

Drawings on cartoon (MSS 1512^{10} s. 381-388)
(Drawing about waves propagation (MSS 1512^{10} s. 381-382, 383-384), perhaps pneumatic machine (MSS 1512^{10} s. 385-386), communicating vessels (MSS 1512^{10} s. 387-388)

About sound propagation in air (MSS 1512^{10} s. 389-406) with inserted note about echo (MSS 1512^{10} s. 391-394)

About echo propagation (MSS 1512^{10} s. 407-426)

"Esperienze sull'aria nell'accademia di Fisica esperimentale da me istruita e per 4 anni sostenuta in Verona mia Patria. Con il riparto stampato delle lezioni" (MSS 1512^{11} s. 1-54)
Lessons of experimental physics held by Cossali in Verona in the Physics Academy founded by himself

"Esercitazioni esperimentali teoriche sistematiche su l'aria atmosferica (MSS 1512^{11} s. 3-4) also (MSS 1512^{11} s. 143-144, 145-146)
Printed

"L'aria rapporto al calore. Scheletro di una lezione nell'Accademia di Fisica esperimentale da me istruita in Verona con una prefazione adatta. Poi altre idee relative ad altre lezioni" (MSS 1512^{11} s. 35-54)

About atmosphere and barometers (MSS 1512^{11} s. 55-100)

Notes about barometers, thermograph, anemometer, drawings (MSS 1512^{11} s. 113-116)

Note about heat (MSS 1512^{12} s. 235-246 e 263-268)

Collection in wrapper "Lezioni astronomiche" (MSS 1512^{13} s. 1-204)

Exercise book 1 (MSS 1512^{13} s. 1-26)
About lunar motion relative to stars, cometary orbits, aspects of comets observation

Exercise book 2 "De Solis Planetarum Lune, Camerarum natura: Dissertatio de Solis Maculis" (MSS 1512^{13} s. 27-38)
Observations and models about solar spots

Exercise book 3 (MSS 1512^{13} s. 39-54)
About moon and lunar phenomena

Exercise book 4 "Articulus II De stellis fixis seu solibus" (MSS 1512^{13} s. 55-84)
About fixed stars and their position, origin, list of constellations

Exercise book 5 (MSS 1512^{13} s. 85-108)
About solar spots, solar and lunar eclipses, lunar phases, planets

Exercise about earth coordinates of various places (MSS 1512^{13} s. 109-112)

Exercise book 6 (MSS 1512^{13} s. 113-156) with zodiac drawings (MSS 1512^{13} s. 137-138)
About revolution around Sun in planetary system, apparent dimensions of planets, planetary parallaxes

Exercise book 7 "Astri in sphera mundana locus guatonis (sic) vel eclipses ope determinatus" (MSS 1512^{13} s. 157-162), "De iis quibus sit ut astra diverso loco appareant ac sunt ou De refractione et parallaxi in seno scholto" (MSS 1512^{13} s. 163-168), "scholim" (MSS 1512^{13} s. 169-192)
Celestial coordinates systems, twilight in various places

"Raccolta astronomica" (MSS 1512^{13} s. 289-374)

Envelop with various articles titled "Note di astronomia e cronologia" (MSS 1512[13] s. 289-310)
About the reform of Gregorian calendar elaborated by Luigi Lilio Veronese doctor and astronomer, examined in 1582 and approved by catholic princes (MSS 1512[13] s. 289-290)

People that promoted astronomy during 16° century in Verona and that proposed questions to Nicolò Tartaglia: Francesco Feliciano, friar Raffaele da S. Zorzi, Bernardin Donà da Zano, friar Ambrosio da Ferrara, Alessandro Veneziano (MSS 1512[13] s. 291-292)

Note of solar observations (MSS 1512[13] s. 297-298)

Notes of solar observations and repertory of historical observations (MSS 1512[13] s. 299-306)

Notes about method to change Julian calendar in Gregorian calendar (MSS 1512[13] s. 307-310)

Repertory of celestial objects (MSS 1512[13] s. 311-312)

Notes about differences of Lalande's meridians tables (MSS 1512[13] s. 313-314)

Notes about repertories of observations (MSS 1512[13] s. 315-316)

Notes about Julian calendar (MSS 1512[13] s. 321-322)

Orbital parameters for a planetary object (MSS 1512[13] s. 323-324)

Meteorological observations, "Notizie dell'orazione sui pregi dell'astronomia del Piazzi", various problems of mathematics and physical experiments (MSS 1512[13] s. 325-330)

Notes about calendar (MSS 1512[13] s. 331-332)

Notes about physics (MSS 1512[13] s. 333-334)

Collection of astronomical, technical and instrumental news (MSS 1512[13] s. 335-350)

Collection of astronomical news (MSS 1512^{13} s. 351-374)

"Giorno 14 marzo 1804. Aspetto del sole con delineazione delle Macule, Nebulosità, e facole nello spettro" (drawings) (MSS 1512^{13} s. 375-378)

Collection of various astronomical problems (in Latin) (MSS 1512^{13} s. 389-390)

Notes about reflection of conical surfaces and determination of position of a star related to earth coordinates (MSS 1512^{13} s. 391-408)

"Tavole del principio e del fine dell'oscurità nelle notti dell'anno 1805 per regola della illuminazione" (MSS 1512^{13} s. 409-412)
About the changing of range of obscurity during the year

"Apologia sul prenuncio della oscurità dell'eclissi degli 11 febb. 1804" (MSS 1512^{13} s. 413-420) With sheet (MSS 1512^{13} s. 415-418), off-prints of eclipses observations from various cities

"Contra astrazionem" 1794 (in Latin) (MSS 1512^{13} s. 425-432)
About astronomical subjects, stars and planets

Collection in case of "figure di astronomia" (MSS 1512^{13} s. 433-440)
Drawings about solar system

Description of comet characteristics (in Latin)
(MSS 1512^{13} s. 441-454)

"Materiali della dissertazione sulla necessità ed utilità sull'acconciare all'astronomia e fisica ..." (MSS 1512^{14} s. 184-185)

Notes about construction of the sun-dial (MSS 1512^{14} s. 506-507)

Writings about ice (in Latin) (MSS 1512^{16} s. 117-124)

Writings about sound propagation (in Latin) "De Propagatione soni an. 1794" (MSS 1512^{16} s. 125-128)

"Note sopra la Theoria motuum planetarum o di Eulero" (MSS 1512^{19} s. 41-54)

Notes about motion of a body (MSS 1512^{19} s. 55-56)

Drawings for geometrical representation of celestial sphere in azimuthal and ecliptical reference systems (MSS 1512^{19} s. 217-232), "Problema astronomico graviorum" (MSS 1512^{19} s. 233-238), "De motu oscillatorum genere" (MSS 1512^{19} s. 239-250), "Studio problematis physiologici"

Calculus about projection of elliptic orbit (MSS 1512^{20} s. 359-366)

Letters of Sebastiano Canterzani to Padre Carminati, Bologna, 15 January 1783 (MSS 1512^{27} s.59-60)
Problems of curvilinear dynamic, hypotheses of two motions to explain gravity

Letters of Sebastiano Canterzani to Padre Carminati, Bologna, 2 May 1779 (MSS 1512^{27} s.61-62)
He thanks for some books, problems to apply the laws of motion at a mass, about Eulero' s geometrical place, naval science

Letters of Sebastiano Canterzani to Padre Carminati, Bologna, 26 May 1777 (MSS 1512^{27} s.63-66)
Dynamic in earth gravity, motion of a body crossing Earth center, integral calculus, request of purchasing Condorcet's complete works

Letters of Sebastiano Canterzani to Padre Carminati, Bologna, 14 March 1779 (MSS 1512^{27} s.67-70)
Problems of dynamic and gravity

Letters of Sebastiano Canterzani to Padre Carminati, Bologna, 16 June 1777 (MSS 1512^{27} s. 71-72) with note of Cossali
Thanks for the book that he had as a present, problems of dynamics and fluid dynamics

Letters of Sebastiano Canterzani to Padre Giovanni Maria Carminati, Bologna, 9 December 1784 (in French) (MSS 1512^{27} s. 73-76) Content: problems of bodies dynamic

Letters of Sebastiano Canterzani to Padre Carminati, Bologna, 9 April 1781 (MSS 1512^{27} s. 77-78)
Analysis of problems of dynamic and oscillation of a plate

"Nota del cittadino L. C. sull'eclissi Solare degli 11 Febbraio Anno corrente" printed (MSS 1512[28] s. 125-126)

Letters of Antonio Cagnoli to PC, Verona, 9 May 1791 (MSS 1512[28] s. 127-128)
About calculations for an eclipse in which Cossali considered an obliquity too little with secular diminution of 45", thanks for approval of his trigonometric publication, about Delambre's planetary tables

Letters of L. Ciccolini to PC, Bologna, 22 July 1802 (MSS 1512[28] s. 135-136)
Received from Canterzani Cossali's observations about Cerere and Pallade, he reminds him that the Milan Observatory permits more precise observations because it is equipped with a mural quadrant and of an equatorial

Letters of Antonio Cagnoli to PC, Modena, 2 December 1802 (MSS 1512[28] s. 137-138)
Compliments for the oration about new great planets, problems about Lorgna's legacy

Letters of Antonio Cagnoli to PC, Modena, 30 January 1804 (MSS 1512[28] s. 139-140)
He waits the ephemeris from Cossali in which he hopes to find a solution for the problem of the residual light during the eclipse quoted in his "Prenuncio"

Letters of L. Canali to prior Romino Tonani, Perugia, 10 May 1804 (MSS 1512[28] s. 143-146)
Canali deals with the eclipse observed in that year and of the memory of professor Ciccolini who perhaps knows Cossali, description of the phenomenon and vision of Venus

Letters of Giovanni Angelo Cesaris to PC, Milan, 5 May 1802 (MSS 1512[28] s. 221-222)
He sends observations of Cerere realized with the mural quadrant with conjunction of some stars in Lion

Letters of Giovanni Angelo Cesaris to PC, Milan, 28 July 1802 (MSS 1512[28] s. 223-224)

Some news about Gauss that calculated the best orbit for Cerere and Pallade, he sends orbital elements of Cerere (first citation of asteroids)

Letters of De Lalande to PC, Paris, 31 October 1802 (MSS 1512[29] s. 105-108)
Exchange of news about ephemeris, about an astronomical history and a astronomical bibliography in printing by Lalande

Letters of De Lalande to PC, Paris, 25 January 1804 (MSS 1512[29] s. 109-112)
Thanks for the memory about eclipse

Letters of Giovanni Battista Nelli to PC, Florence, 10 February 1789 (MSS 1512[29] s. 261-262)
He sends news about construction and use of pendulum-clocks

Letters of Barnaba Oriani to PC, Milan, 7 May 1791 (s. 279-282)
Congratulations for the booklet about eclipses of 3 April and about assignment as astronomy, meteorology and hydraulic professor, bout his misadventures to observe the eclipse from Guastalla Tower, he invites to view the Ramsden's instrument, news about London artisans for instruments.

Letters of Giuseppe Veneziani Tacito to PC, Piacenza, 23 May 1802 (MSS 1512[30] s. 119)
Observation of Cerere, thanks for algebra history had as present

Letters of Giuseppe Veneziani Tacito to PC, Piacenza, 26 May 1802 (MSS 1512[30] s. 120)
Received the volumes to sell, about planetary observations realized in Milan

Letters of Giuseppe Veneziani Tacito to PC, Piacenza, 30 June 1802 (MSS 1512[30] s. 121)
Thanks for collection of writings, about attempts of observation of planets Cerere and Pallade, request to come and see in Piacenza, pneumatic machine of S. Lazzaro, telescope built by Jacchini

Letters of Giuseppe Veneziani Tacito to PC, Piacenza, 31 August 1802 (MSS 1512[30] s. 122)

News about his health, congratulations for the ephemeris, he sends some orbital elements of Pallade

Letters of Giuseppe Veneziani Tacito to PC, Piacenza, 21 November 1802 (MSS 1512[30] s. 123)
Thanks for the ephemeris with oration about two new planets Cerere and Pallade, he asks for ten copies, sorry not to meet in Caraccioli's hill house

Letters of Giuseppe Veneziani Tacito to PC, Piacenza, 16 December 1802 (MSS 1512[30] s. 124)
Thanks for received favours, he asks the reciprocal distance of Saturn rings, Herschel's discovery of his planet with two normal rings

Letters of Giuseppe Veneziani Tacito to PC, Piacenza, 12 January 1803 (MSS 1512[30] . 125)
Received the copies of pre-announcement about eclipse, he asks comparison of inclination of lunar orbit

Letters of Giuseppe Veneziani Tacito to PC, Piacenza, 8 January 1804 (MSS 1512[30] s. 126-127) with Cossali's notes to reply to the questions
He describes the machine of eclipses that is under construction, he asks an opinion about some problems with inclination of lunar orbit

Letters of Giuseppe Veneziani Tacito to PC, Piacenza, 22 January 1804 (MSS 1512[30] s. 128)
He exposes the problems found in the construction of eclipses machine, particularly about solar parallax, he asks twelve copies of pre-announcement of eclipse because it is in great demand

Letters of Giuseppe Veneziani Tacito to PC, Piacenza, 12 February 1804 (MSS 1512[30] s. 129)
He expresses disappointment for not observing the solar eclipse because there were clouds and fog

Letters of Giuseppe Veneziani Tacito to PC, Alessandria, 2 June 1804 (MSS 1512[30] s. 130)
He sends the description of eclipses machine and he asks an impartial examination

NOTES

1) News about life and work of Pietro Cossali can be found also in ancient biographical collection, that we point out.

Dizionario degli uomini illustri, Remondini, 1816; *Dizionario biografico cronologico*, Bettoni, Padua, 1821-22; *Dizionario biografico compendiato*, Bettoni, Padua, 1822; *Nuovo dizionario storico ovvero biografia classica universale nella quale sono registrati per ordine alfabetico i nomi degli uomini celebri d'ogni nazione dal principio del mondo infino a noi, e si narrano in compendio i fatti principali della lor vita. compilazione di una società di dotti francesi pubblicata nel 1830. prima versione italiana con aggiunte*, Giuseppe Pomba, Turin, 1831-1837; *Dizionario delle scienze matematiche pure ed applicate compilato da una società di antichi allievi della scuola politecnica d Parigi sotto la direzione di A.S. de Montferrier membro dell'antica società reale accademica delle scienze di Parigi, dell'Accademia di Marsilia, di quella di Metz ec. ec. prima versione italiana con numerose aggiunte e correzioni*, Battelli e compagni, Florence, 1838-1841; *Dizionario delle date dei fatti, dei luoghi ed uomini storici o repertorio alfabetico di cronologia universale contenente un cenno caratteristico di tutti gli storici avvenimenti, la nascita, le avventure principali della vita, e la morte di tutti gli uomini illustri, la fondazione delle città, degli stati, dei regni e delle repubbliche; le rivoluzioni e le particolarità delle loro durate; la genealogia di tutte le case storiche e sovrane; le origini, le invenzioni e le scoperte di tutti i popoli; le istituzioni, le sette, le tradizioni, gli scismi, le eresie, i concilii, i sinodi; i monumenti di tutte le nazioni; finalmente la indicazione di tutti i nomi dei luoghi che hanno qualche storica celebrità*, Antonelli G., Venice, 1842-1847; De Feller S.S., *Dizionario storico ossia storia compendiata degli uomini memorabili per ingegno, dottrina, virtù, errori, delitti, dal principio del mondo fino ai nostri giorni. Prima traduzione italiana sulla settima edizione francese, con notabili correzioni ed aggiunte, tratte dai migliori biografi*, Girolamo Tasso edit. Tip. Calc. Lit. Lib, Venice, 1830-1836; Olivier-Poli G., *Continuazione al nuovo dizionario istorico degli uomini che si sono renduti più celebri per talenti, virtù, scelleratezze, errori ...*, Marotta e Vespandoch, Naples, 1824; Vanzon A., *Dizionario universale della lingua italiana ed insieme di geografia (antica e moderna); mitologia; storia (sacra, politica ed ecclesiastica); biografia; antiquaria; storia naturale; e di tutti i vocaboli di origine greca, usati nella medicina, chirurgia, farmacia, chimica, fisica, astronomia, teologia e giurisprudenza, preceduto da una esposizione grammaticale ragionata della lingua italiana*, Tipografia Giovanni Sardi e figlio, Livorno, 1828-1842; Zendrini A., *Biografia universale antica e moderna. Supplimento, ossia continuazione*

della storia per alfabeto della vita pubblica e privata di tutte le persone ch'ebber fama per azioni, scritti, ingegno, virtù, o delitti. Opera affatto nuova compilata in Franca da una società di dotti e per la prima volta recata in italiano, Gian Battista Missiaglia, Venice, 1834-1841.

2) Baldassarre Boncompagni of Princes of Piombino, the most important historian of Italian mathematics (his first work, when he was only 22 years old, was published in the prestigious «Journal de Crelle»), dedicated his life and his money to evaluate the role that Italian mediaeval mathematicians had in the develop of this science.

3) Publication of holographic will of Pietro Cossali from the court of civil justice and examined in Padua, Padua, 1816, Civic Library of Verona, ms 1512^{37} sheets 10-16.

4) Letters of Francesco Soave to PC, Milan, 10 April 1802 (MSS 1512^{1} sheet 83)

5) Panegyric of S. Gaetano, continuation of the panegyric of S. Gaetano, Novena of S. Gaetano, Civic Library of Verona, MSS 1512^{33} sheets 53-132, 193-314; Hymn of Coffino for S. Gaetano, Civic Library of Verona, MSS 1512^{21} sheets 19-28; Sonnet hand written "Madonna innamorata del S. Bambino", Civic Library of Verona, MSS 1512^{34} sheets 27-28), theological considerations about Christ (Predica sopra i vantaggi della confessione conciliandone la istituzione con la dolcezza del giogo di Gesù Cristo), Civic Library of Verona, MSS 1512^{33} sheets 169-193.

Aknowledgements

I am gratful to Paolo Aceto for his help given in the translation.

REFERENCES

Avanzini G., 1821, Elogio di Pietro Cossali, *Memorie della Società Italiana delle Scienze* (Serie Matematica), **19**, first part, CXI, Modena

Baldini U., 1973, Cagnoli, Antonio, in *Dizionario biografico degli italiani*, **16**, 325, Treccani, Rome

Baldini U., 1980, Cesaris, Angelo Giovanni, in *Dizionario Bbografico degli Italiani*, **24**, 213, Treccani, Rome

Baldini U., 1984, Cossali, Pietro, in *Dizionario biografico degli italiani*, **30**, 104, Treccani, Rome
Bernardi J., 1844, Riccati Giordano, in *Biografia d'italiani illustri*, a cura di E. De Tipaldo, **9**, 310, Cecchini, Venice
Biadego G., 1884, *Carteggio inedito d'una gentildonna veronese*, Stab. Tip. Coll. Artigianelli, Verona
Biadego G., 1892, Catalogo descrittivo dei manoscritti della biblioteca comunale di Verona, Civelli, Verona
Biadego G., 1903, *Accademie veronesi: Accademia d'Agricoltura, Scienze, Lettere, Arte e Commercio*, Franchini, Verona
Boncompagni B., 1857, *Scritti inediti del p. P. Cossali chierico regol. teatino*, Tip. Belle Arti, Rome
Cappelli A., 1985, *Dizionario di Abbreviature latine ed italiane*, Hoepli, Milan
Cagnoli O., 1840, Cagnoli Antonio, in *Biografia degli italiani illustri*, a cura di E. De Tipaldo, **1**, 57, Alvisopoli, Venice
Cossali P., 1797, *Origine, trasporto in Italia, primi progressi in essa dell'algebra. Storia critica di nuove disquisizioni analitiche e metafisiche*, 2 Voll., Stamperia Reale, Parma
Cossali P., 1805, *Sonetti VII ad Anna Cecilia sua sorella monaca*
Curtoni Verza S., 1807, *Ritratti d'alcuni illustri amici di S. Curtoni Verza in Arcadia Flaminda Caritea*, Tipografia Gambaretti, Verona
Cossali P., 1811, *Elogio di S. Stellini professore d'etica nella Univ. di Padova*, Padua
Cossali P., 1812, *Li baratti mercantili ridotti e dimostrati per algebra. Memoria*, Mainardi, Verona
Cossali P., 1813, *Elogio di G. Poleni*, Padua
Cossali P., 1813, *Elogio di L. Lagrange*, Padua
Favaro A., 1922, Saggio di bibliografia dello studio di Padova, I, in *Misc. di Storia Veneta*, s. 3, XVI
Foderà Serio G., 1981, L'Osservatorio astronomico di Palermo, in *Coelum*, **I** (11-12), 250
Franci R., 1987, Pietro Cossali: storico dell'algebra, in Atti del Convegno *Pietro Riccardi (1828-1898) e la storiografia delle matematiche in Italia*, p. 199
Gamba B., 1824, Pietro Cossali, in *Galleria dei Letterati ed Artisti illustri delle Provincie Veneziane nel secolo decimottavo*, Alvisopoli, Venice
Gliozzi M., 1975, Canterzani, Sebastiano, in *Dizionario biografico degli italiani*, **18**, 280, Treccani, Rome
Grugnetti L., 1989, Aspetti della matematica italiana tra i secoli XVII e XIX, in *La storia delle scienze*, a cura di Carlo Maccagni e Paolo Freguglia, Bramante, Milan, p. 193

Labus G., 1851, Vita di Antonio Cagnoli, in *Notizie astronomiche adattate all'uso comune dal cavaliere Antonio Cagnoli, premessavi la vita dell'autore*, Tipografia Silvestri, Milan

N.N., 1837, Ruffini Paolo, in *Biografia d'italiani illustri*, a cura di E. De Tipaldo, **4**, 225, Alvisopoli, Venice

Orlandi A., 1979, La ricerca e la letteratura scientifica, in *Cultura e vita civile a Verona*, Banca Popolare di Verona, Verona

Palladino D., 1989, La matematica italiana dall'inizio dell'Ottocento alla seconda guerra mondiale, in *La storia delle scienze*, a cura di Carlo Maccagni e Paolo Freguglia, Bramante, Milan, pp. 216-261

Pallavicini R. (Ed.), **1988**, Osservatorio Astronomico di Brera, *Memorie della SAIt*, **60**, 401

Pellizzari A., 1802, Elogio di Giordano Riccati, in *Memorie della società italiana delle scienze*, **IX**, XLIX, Modena

Rambelli G. E., 1841, Canterzani Sebastiano, in *Biografia degli italiani illustri*, a cura di E. De Tipaldo, **8**, 87, Alvisopoli, Venice

Tinazzi M., 1994, Pietro Cossali; a veronese astronomer, in *Memorie della SAIt*, **65**, 601

Tinazzi M., 1994, Pietro Cossali and the eclipses of 1791 and of 1803, in *Memorie della SAIt*, **65**, 611

Tinazzi M., 1995, Pietro Cossali and the Parma Observatory between the end of the 18th century and the beginning of the 19th century. Mathematical contributions to the dynamics in the solar system, in *Memorie della SAIt*, **66**, 833

Tinazzi M., 1996, Il fondo dei manoscritti del matematico e astronomo veronese Pietro Cossali presso la biblioteca civica di verona, *Bollettino della Biblioteca Civica di Verona*, n. 2,

Treves P., 1973, Caluso da Valperga, Tommaso, in *Dizionario Biografico degli Italiani*, **16**, 827, Treccani, Rome

Uglietti S., 1983., *Una gentildonna veronese tra rivoluzione e restaurazione. Silvia Curtoni Verza (1751-1835)*, Archivio Storico Curia Vescovile, Verona

Vezzosi A.S., 1780, *I scrittori de' Cherici Regolari detti Teatini parte prima*, Stamperia della sacra congregazione di propaganda fede, Rome

Zendrini A., 1834-1841, *Biografia universale antica e moderna. Supplimento, ossia continuazione della storia per alfabeto della vita pubblica e privata di tutte le persone ch'ebber fama per azioni, scritti, ingegno, virtù, o delitti. Opera affatto nuova compilata in Franca da una soicetà di dotti e per la prima volta recata in italiano*, Gian Battista Missiaglia, Venice