Finalment cal dir que no disposem de cap indici que fes pensar que Euler coneixia la \textit{Geometria Magna in Minimis} de Saragossà, més si es té en compte que aquesta obra va restar pràcticament desconeguda en el seu temps.

3.- Bibliografia.


SARAGOSSÀ, Josep (1674) \textit{Geometria Magna in Minimis}, volums 1 i 2, Toledo.

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**EULER AND THE JESUITS IN RUSSIA**

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1.- Introduction.

In 1698 Denis Papin constructed the first steamboat in the Holy Roman Empire. He eventually achieved a favorable result with Savary’s steam engine on board. Did any Central European continue his achievements in order to pave the way for the success of the Western inventors Joffroy D’Abbanas, Fitch, Rumsay, and Fulton? Many Papin’s followers were simply forgotten and Gabriel Gruber (*1740 Vienna; † 1805 St Petersburg) was one of these.

Gruber was trained in the best Jesuit tradition with Rudjer Bošković, who visited Ljubljana at least three times. Gruber arrived in Ljubljana on June 4, 1768, and the following year he began to teach at the college. Nobody was surprised when Gruber was hired as an expert to build the Ljubljana canal, between March 9, 1771 and December 10, 1777, although he was still young at thirty years old. Between June 4, 1772 and May 1, 1781, from his head office at the Carniolan capital Ljubljana he directed navigation on half the rivers of the Habsburg Empire. At the same time he taught at the Ljubljana mechanical school, instructing craftsman and ship’s captains. He was in charge of the best ship modeling department in all the Habsburg Monarchy.

As a navigational director, Gruber had the opportunity of constructing his machine ship model in his late thirties. His work is well documented at the Styrian provincial archive (\textit{Landesarchiv}). It is our claim that he built one of the forgotten forerunners of the later steamboats. He was not just an extremely able physicist, but also developed the rare ability to hire the very best available experts for his navigational projects. Jurij Vega was one of his most distinguished students.

2.- Euler’s influence on Gruber and Vega’s Steamboats.

Daniel Bernoulli and his St. Petersburg collaborator Leonhard Euler developed several improvements of the steamship idea. In 1738, Daniel compared
the water reaction force drive with the drive of the common sail. In 1752, he was one of the first to suggest the screw drive, which Ressel later developed successfully. In 1753, as the foreign member Daniel was awarded the Paris Academy prize for a paper dealing with boats propelled without sails called: “La manière la plus avantageuse de supléer à l’action du vent sur les grands Vaisaux, soit en y appliquant les rames, soit en employant quelqu’autre moyen que ce puisse être”. Besides Daniel, his friend Leonhard Euler, Mathon de Lacour, and Gauthier also competed.

At that time, Daniel Bernoulli was carrying out research on magnets and compasses. In 1769 for the Paris Academy, he researched oceanic currents, the use of winds, paddles, and different ship propulsion including steam engines, crews, and reactive forces, which later influenced Benjamin Franklin and Rumsey. Bernoulli calculated the effects of gunnery powder, hot water and Newcomen’s steam engine. He declared all of them as unfit for boat drives, because he preferred paddles and screws. In 1771, at the request of the Paris Academy, Bernoulli tried to develop a water-tight ship.

In 1760, the Bern preacher Jean Alexandre Genevois published his ideas in London for the spring stretching using steam and other forces. The spring loosening drove the fins for boat navigation at his system called palmipède. Italian physicist Serafino Serrati probably tried his steamboat on the Arno River. In collaboration with Leonhard Euler, the Slovakian physicist of German origin, Segner, did research into turbines at Göttingen and Halle. L. Euler’s son, Johann Albert Euler, continued his father’s boating research, and he described the reaction drive of windmill-shaped wheels without wind in the Proceedings of Berlin Academy (1764). He compared the force of the paddle blades and the reactive force of the water. He followed D. Bernoulli’s research path and did not consider reaction force as inferior to paddle drives. He calculated the force transmission for man-power drive, and he followed his father’s ideas without mentioning the steam engine. In 1776, L. Euler and the Jesuits in Russia...
Illustration 2. The first group of illustrations in Johann Albert Euler’s paper on navigation without wind: the design of drive wheels at the side of the boat (EULER, 1764-1766, Plate III).

Illustration 3. The second group of illustrations in Johann Albert Euler’s paper on navigation without wind: toothed wheels carrying the force from the horizontal wheel of the boat to the horizontal paddle wheel axis (EULER, 1764-1766, Plate IV).
published a complete navigational theory without discussing steam or horse-drawn vessels, but relying just on general mathematical navigational theory.

3.- Early Viennese Steamboats.

Among other duties, Gruber had to provide long distance supply transports along the Sava River from the Ljubljana area to the Habsburg army encamped at Zemun (S Semlin) near Beograd. He used sailboats for this job, but the navigation upstream always caused his engineers trouble. Gruber's mariners usually had to sail 1,000 km in one direction.

The Empress Maria Therese widely supported Gruber's upstream navigation improvements. On August 1, 1777, she issued a patent stimulating better ship building. She approved the Gruber-Happe\(^9\) hardwood designs borrowed from Happe's native Rhine River experiences. They used oak and other hardwoods, and put their superior physics and mechanical knowledge into practice\(^10\).

Many candidates, both expert and non-expert, sought to profit from the Empress’ support of research into upstream navigation. The Habsburg monarchy did not have the Anglo-Saxon-type capitalistic structure necessary for the rapid commercialization of such ideas, because the Habsburg rulers used state-regulated approaches that were quite different.

At the end of 1778, a few months before Gruber made his “machine boat” model, Maria Theresa received an “anonymous” letter from a foreigner living in Leopoldstadt. This “anonymous correspondent” entitled his French pamphlet “Mémoir sur la remorque des Batteaux par les machines à feu”. It was certainly not unusual to use the French language in such research. French was recognized as the universal language of diplomacy, and even Euler’s Berlin and St. Petersburg Academies published articles in French. In Gruber and Euler’s technical world, Frenchmen were still highly esteemed, but after the debacle during the Seven Years War French artillery was forced to copy some better Habsburg and Prussian ideas.

Some rumors circulated about the real identity of the pamphlet’s author. The Empress knew who he was and came to dislike the invention because she had misgivings about the author’s “doubtful morals”\(^11\). The author, probably of French origin, described himself as “not having the honor to be Empress’ employee”\(^12\). The court salary was usually quite considerable and “Anonymous” was not one of its beneficiaries. He probably hadn’t enough connections necessary for such an eminent position at the Schönbrunn Court.

The writer of the anonymous proposal described his navigation research in the Viennese suburb on the banks of the Danube River. He spent a small fortune on his research during the last two years; one could read between the lines that he did not obtain any state support. His last achievement at least partially resolved the problematic distribution of steam engine power to the rotation of the paddle wheels. He did not clearly explain his wheel site: it was not clear whether he preferred the horizontal or the vertical axis position. He begged the authorities for a considerable sum of money, because he wanted to test a ship of navigable dimensions equipped with Newcomen’s steam engine. He certainly planned a pretty big boat to carry the heavy engine. “Anonymous” knew the circumstances of the Habsburg Monarchy very well and he particularly asked for Newcomen’s machine, which had been used at the Banská Štiavnica (Schemnitz) mine for several decades. Gabriel Gruber was also familiar with this mine, because his university teacher Poda and his own brother Tobias Gruber described Joseph Karl Hell’s\(^13\) machines at the Banská Štiavnica mine. Joseph Karl Hell was the elder brother of the famous Jesuit astronomer Maximilian. Their father, Mathias Cornel Hell, was a descendant of an old craftsmen family. The formation of ice at the valve of Joseph Hell’s pump prompted several research papers. The famous Erasmus Darwin published his opinions but Tobias Gruber rejected them\(^14\). A half-century later the effect was explained in terms of Joule-Thomson expansion.

For many years Maria Theresa supported the Banská Štiavnica mine school and employed the best available professors there. In spite of her great care for that Slovakian mine, she agreed to place an expensive Banská Štiavnica Newcomen engine at Anonymous’ disposal! She must have known “Anonymous” identity, and he certainly had some influence at her court.

\(^9\) Johann Matthias Happe (Hopp, * Mainz).

\(^10\) NEWEKLOWSKY, 1952: 50.


\(^12\) “…pas le bonheur d’être employé au service de Leur Majestés Impériales et royales…” (KURZEL-RUNTSCHIEINER, 1928: 69-71).

\(^13\) Joseph Karl Hell (* 1713; † 1789).

\(^14\) PODA, 1771; DARWIN, 1788; GRUBER, 1791.
Maria Therese admitted that Banská Štiavnica miners did not use their Newcomen engines. “Anonymous” was probably aware of this fact when he made his proposal. The first Newcomen engines were transferred to Banská Štiavnica when Joseph Karl Hell was a still teenager; he was in his late seventies when “Anonymous” put forward his proposal, and was probably too old to help with the negotiations for the proposed steamboat.

Joseph Emanuel Erlach was the son of Johann Bernhard Erlach, the Viennese designer of the St. Karl church. After studying in London, Joseph Emanuel accompanied Potter and his assistant Pierre Sabathery from England to Vienna in July 1720. The Englishman spent 6,000 gld for the very first Habsburg Newcomen steam engine at the Königsberg mineshaft near Banská Štiavnica. Erlach himself built the steam engines in 1721-1722 at Cassel and in 1722-1723 at Vienna. The Habsburg experts were very well informed about the British inventions, although Erlach’s mine pumps had no direct influence on the development of upstream navigation. Joseph Karl Hell eventually used Potter’s design (1733-34) for his own steam engine, built at Banská Štiavnica in 1758. PODA (1771), Gabriel Gruber’s professor at Graz, described Hell’s success and analyzed other Habsburg monarchy steam engines. Gruber examined the steam engines during his student years and eventually noticed the steamer’s navigational applicability. Gruber’s father had previously used windmill power at his Viennese armory, which helped to stimulate his son’s early technical curiosity.

The Empress Maria Therese did not pretend to be an expert on navigational problems. Instead, she forwarded the “Anonymous” letter to her secret councilor Count Franz Kolowrat (November 1, 1779), and she also notified the chancellor Prince Kaunitz. Kolowrat described the Newcomen engine as big and also very heavy. He certainly knew what he was talking about: Newcomen’s steam engine was not very convenient for steamers before Watt’s inventions, and it scarcely propelled the rotation.

“Anonymous” did not seriously consider Watt’s improvements, although they were already known at Vienna. Newcomen’s engine was available in Banská Štiavnica, while Watt’s lighter model was probably not so easily obtainable at Habsburg monarchy even decades later.

The Anonymous’ model was built in Lepoldstadt, the oldest Vienna suburb on the banks of the Danube Canal. Today this district is known as Obere und Untere Donaustrasse in the downtown area. He designed the cylinder to be 10 feet high. The court officers calculated that two metal cylinders, weighing altogether 100 cents, (5,600 kg) would suffice for the job. The lowest price was 50 florints per cent (56 kg) of metal, and they predicted an expenditure of at least 5,000 fl. This was no small amount and therefore Kolowrat counselled prudence. Maria Therese mentioned the extra transportation expenses from Banská Štiavnica to Vienna in her letter to Kaunitz. There is no existing documentation to indicate whether they planned water or land transport, but it was certainly not an easy task to organize such heavy long distance travel along the very bad mainland roads in those times.

The “Anonymous Foreigner” of Leopoldstadt certainly built the steamer “Maschine ohne Pferde”. He used the Newcomen atmospheric steam engine with the wooden cylinder in 1777 and 1778. The eventual fate “Anonymous” steamer is still unknown. It’s also not quite certain if “Anonymous” constructed the bigger steam boat with the government’s help in the early 1780s. Gruber certainly knew about “Anonymous” efforts, although we can only guess about his possible connections.

Several men tried to solve the problem of Habsburg Monarchy upstream navigation. The mine councillor Josef Tlustos built a ship 16 fathoms long and 9 feet broad. He left Vienna and sailed for twenty-seven days before finally reaching the port of Linz on July 10, 1780. The enormous crowd awaiting his expedition is a reflection of the favorable public opinion. Tlustos used the specially anchor-shaped sticks to overcome the Danube currents, but nobody ever repeated his experiments. He probably did not use a Newcomen
steam engine, which was considered too heavy and unsuitable for traditional boats.

4.- Gruber's Boat Models.

The Viennese Entnersfeld developed a boat called Maschinenschiffe. He became a well respected self educated researcher, court councillor, and an active member of the Styrian Agricultural Society. The Bohemian-Austrian court office hired him in 1764 and he was ennobled a year later. As the Empress’ employee he could not be identical with “Anonymous”.

In 1782, Entnersfeld was a member of Agricultural Societies in Graz, Klagenfurt, Vienna, and St. Petersburg, counsellor at Passau Prince’s court, and a member of the Vienna Economic Society. He joined the Agricultural Society of Carniola in Ljubljana as one of its founding members (1767), just before Gruber’s appointment to the Ljubljana chair for mechanics. He certainly made Gruber’s acquaintance at Agricultural Society of Carniola, where both were very active members.

In 1770 the Agricultural Society of Carniola tested the special device for pulling the roots from the ground. The designer was probably Entnersfeld, who described and drew a similar device for the Styrian Agricultural Society in 1782. Entnersfeld published two articles in the Agricultural Society of Carniola weekly in 1776.

In 1779 Entnersfeld wrote an article about foddering and stables at Sammlung zusätzlicher Unterrichte of Carniolan Agricultural Society. He quoted the court counsellor Raab, mentioned the Dutch use of salt for livestock curing, and presented some Russian experiences. In 1765 Entnersfeld visited the Idrija Mine in the company of the professor of mineralogy and metallurgy. His companion was Scopoli, an Idrija physicist (1754-1769), professor of chemistry, and director of the local metallurgy and chemistry school between September 23, 1763 and 1769. Scopoli became a professor of mineralogy and metallurgy at the Schemnitz (Banská Štiavnica) Mine Academy (1769-1776), and later left for Pavia University. Hacquet came to Idrija only on September 20, 1776 and became an influential member of the Carniola Agricultural Society.

In 1777, the Styrian Agricultural Society reawarded Entnersfeld’s forestry essay and published it (1782) together with his essay about stoves. In the 1780s Entnersfeld published books on politics and economy and slowly abandoned his research on new technological developments. His career also followed the same direction: he published an economy textbook (1791), and became the Viennese University assistant professor of economy (1794). At that time Gabriel Gruber was already in Russia and their mutual cooperation probably ended soon after 1780.

The Styrian Agricultural Society backed Entnersfeld’s plan and negotiated with the Graz Navigation Commission. They did not waste any time, and immediately hired Gruber to help them. Gruber had a lot of experiences with all sorts of ship models at his Ljubljana School. He first built the wooden “base” model and only later developed a more useful (and expensive) metal one. Gruber probably did not make the experiments with a navigable boat, as far as we are able to learn from the preserved documents.

The Styrian Agricultural Society secretary, Karl von Haibe, described the Entnersfeld-Gruber boat to the other Styrian Agricultural Society members.

24 Friderich Franz Edler von Entnersfeld (Entressfeld, Entnersfeld, * 1731 Vienna; † December 6, 1797 Vienna (http://www.koeblegerhard.de/juristen/tot/toteSeite112.html)).
25 Die Landwirtschaftliche Gesellschaft was established in Vienna only in 1802 (http://www.scholarly-societies.org/cgi-bin/public/soc/).
27 Ökonomische Gesellschaft Wien (http://www.koeblegerhard.de/juristen/tot/toteSeite112.html).
28 UMEEK, 2006, 6, 11, 12, 21.
31 ENTNERSFELD, 1779, 145. Franc Anton von Raab (* December 21, 1722 St. Leonhard in Carinthia; † April 20, 1783 Vienna).
32 ENTNERSFELD, 1779: 146, 150.
33 Janez Anton Scopoli (* 1723; † 1788).
34 Baltazar Hacquet de La Motte (* 1739-1740; † 1815) Vienna.
35 StLA, R-K, K 83. Wasser Sachen, fasc. 34, Aug 33 (November 3, 1779) 1; 3.
36 TREMEL, 1946: 41; StLA, Misselen K 393 briefe 419. Old signature: Landes Regirungs Archive, Navigationsakten im Kleinen Archiv, Sch. 473, fasc. 419.
On November 3, 1779, Haibe put forward the advantages of the new invention with a comparatively cheap paddle-wheel motoring device which could be placed at either the prow or stern of the boat. He did not consider the sideways position of motor wheel, which the later American inventors preferred. Haibe listed three positive features of the "machine boat" proposed by Gruber:

1. It could carry a large cargo upstream without considerable trouble.
2. A ship could replace numerous men and horses, especially in areas of the difficult soft river banks.
3. It avoided unwanted stopping and guaranteed punctual arrivals.

Point 2 refers to the problem of Mura (Mur) River soft banks where towing was especially troublesome. Punctuality was considered particularly important because upstream sailing was almost never on time in those days.

The bottom of the "machine boat" was not flat but conic. Such a design was later considered unstable at sea. It was certainly suitable only for deep river navigation.

Haibe asked the Empress and the Styrian Land Diet to form a special commission of experts for the proposed invention exploration. He begged for the Gubernium’s Navigation Commission expert opinion, and for the boat sailing test at the “nearby” Mura River. The boat model was certainly Gruber’s, although Haibe did not specifically mention his name. It may be assumed that their planned sailing up the Mura River was not a particularly arduous task in the mild winter weather, given the very slow currents of the Mura in the Graz area.

Haibe thought that the highest authorities ought to help the inventor because he was a member of the Styrian Agricultural Society. Entnersfeld gave the sketch of his invention to the Styrian Agricultural Society, and the expert artist engraved the copper-plate of the boat. Haibe claimed that Entnersfeld should calculate the expenses expected to be incurred from the model building for the Land Gubernium. Entnersfeld eventually selected Gruber for the job.

Gruber finished a useful wooden model before the report was mailed to the Graz area. The report did not state clearly where Gruber made his model: whether at Graz, at his Ljubljana nautical school, or elsewhere. Haibe asked the Gubernium to accept Gruber’s model as a gift. It is easy to imagine how the wily Gruber personally suggested the gift as the best way of gaining official support.

On December 7, 1779, the report informed the Gubernium how the navigation director Abbé Gruber followed the order of the Waters Commission and finished Entnersfeld’s boat model. Sauer signed the acceptance form on the next day (December 8, 1779) without indicating where Gruber made his model.

Haibe answered the letter (November 11, 1779) with a report in the name of Commission presented at the June 10, 1780, Styrian Agricultural Society’s meeting. He described the model of “machine boat” for upstream as well as downstream transport. Haibe obliviously wished to use the boat in the way in which Hulls, Leopoldstadt Anonymous, and later Englishmen used their canal steamers. Haibe stated that the machine boat could pull the rope fixed at the stern of the sailboat. The bottom of the machine ship was shaped into a cone to reduce water resistance, as Haibe stated once more. The machine propelled a paddle-wheel and there was one additional sail. The position of the paddle-wheel was again unclear and a sail was an auxiliary power supply.

The Styrian Agricultural Society paid 51 fl 12 kr for the metal model, but after the subtraction of the taxes the bill was only 40 fl 46 kr. The Navigation Commission also provided some money.

Gruber and his team spent a comparatively small sum, just the equivalent of two engineer’s monthly salaries. The amount could not cover the expensive steam engine of Watt or Newcomen’s type. Even during the later Ressel’s era, steam engines were seldom developed in the Habsburg monarchy, and were mostly imported from England. The small required amount was again probably one of Gruber’s clever tactical ploys. During his engineering career

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40 Wenzel grof Sauer von und zu Ankenstein (Borl Castle at Lower Styria) Baron Kosiai (* 1742; † 1799).
41 StLA, R+K, K 83, Wasser Sachen, fasc. 34, Dec 38 (December 7, 1779) 2; StLA, R+K, K 83, Wasser Sachen, fasc. 34, Aug 33 (November 11, 1779) 1; StLA, R+K, K 83, Wasser Sachen, fasc. 34, Aug 33 (August 1, 1780) 2, 3.
42 StLA, Protokoll Buch (1779) fol. 805.
43 Johnatan Hulls (* 1669).
44 StLA, R+K, K 83, Wasser Sachen, fasc. 34, Nov 11 (November 3, 1779) 1 (Point 1).
45 StLA, R+K, K 83, Wasser Sachen, fasc. 34, Nov 11 (November 3, 1779) 1 (Point 3).
46 Thomas Newcomen (* 1663; † 1729).
he always used the same business procedure: he first offered the cheapest possible plan to gain the support and frustrate any undesired rivals. Afterwards, as his work advanced, he raised his prices because of the “unexpected” extra expenditures. Such a method was usually successful, but caused unsolvable troubles during his Ljubljana Canal work.

At the March 17, 1780 meeting, the Styrian Agricultural Society discussed the specification of the “machine boat”, its use, and economy. Haibe specially mentioned Entnersfeld’s important research into the pressure of the paddle-wheels. It is not known what instrument he used for the pressure measurements. Prony\textsuperscript{48} invented his famous water-speed measure-brake somewhat later, but a similar design could have been known earlier to practical engineers of Gruber’s kind.

The members of the Styrian Agricultural Society and other involved persons certainly expected considerable profits from the faster navigation and better transport. As landowners and merchants they welcomed a chance to make some additional money.

Unlike the early American models of John Fitch or James Rumsey, Gruber engineers certainly used paddle-wheels for their “machine boat” model\textsuperscript{49}. No preserved document explains the position of Gruber’s paddle-wheel axis, and it is not known whether it was horizontal or vertical.

Haibe mentioned several of the machine ship’s features: It used wood fuel more economically. The strong iron plates protected the device from fire. Cooking could be done without any extra expenses for wood. Haibe’s more economical use of wood suggests that wood was used to fuel a steam engine. Haibe suggested that one could actually cook vegetables on the engine of “machine boat”, which was greeted with acclamation\textsuperscript{50}.

Such ideas were not really new for friends of French cuisine. In 1753 the Canon of Nancy, Abbé Gauthier, proposed Newcomen’s steam machine for navigation propulsion, but also for cooking. It was certainly not a bad idea as some cooking was needed anyway during long distance journeys.

On August 8, 1780, Sauer ended the correspondence with the Styrian Agricultural Society\textsuperscript{51}. On August 25, 1780, Gruber’s first engineer Kunsti\textsuperscript{52} reported on the model of machine boat which Gruber eventually finished on March 29, 1780\textsuperscript{53}. This time he was probably speaking about the metal model, since the first wooden one was completed four months earlier according to Haibe’s report. Young George Vega’s role in the development of the new ship is unclear because he was subordinate to Gruber and Kunsti. The descendants of Vega’s family at his native Zagorica still remember the story about Vega’s feelings being hurt by his superiors by not paying the due recognition to the projects he developed. The story is usually connected with Ljubljana Canal, but Vega was still on Gruber’s payroll several years after Gruber lost his Canal job. Vega could have derived some extraordinary merits from “machine boat” project, but lack of support from the authorities eventually led him to tender his resignation.

Vega changed his original family name Veha for Vega to sound more “Spanish”, and started his Viennese career. He resigned Gruber’s job and left for Vienna on April 7, 1780, just a week after the second “machine ship” model was officially finished. The quarrel with his boss was not the main motive. He was probably well aware that the golden age of navigational work would come to an abrupt end after Maria Therese’s death. As a Viennese artillery officer, he quickly developed an extremely successful military career.

5.- River Routes after Gruber.

Vega’s foresight proved to be accurate. Maria Therese supported Gruber’s work, but after her death Josef II quickly stopped all financial support. His decision proved to be a disaster for Habsburg inland navigation. After a few years of neglect, river transport returned to the same sad condition as before Gruber’s improvements.

Several years passed before Count Theodor Batthyány\textsuperscript{54} eventually used his boat “Bucintoro” for Danube River upstream transportation on September 17, 1787\textsuperscript{55}. A century and a half later his descendant Count Ladislaus Batthyány reported that Theodor used no steam engines but rather four animals

\begin{footnotesize}
\begin{itemize}
\item[47] Josef Ressel (1793; † 1857).
\item[48] Gaspar Claire François Maria Riche de Prony (* July, 22, 1755; † July 28, 1839).
\item[49] TREMEL, 1946: 41.
\item[50] StLA, R+K, K 83, Wasser Sachen, fasc. 34, Nov 11 (November 3, 1779) 2', 3'.
\item[51] StLA, R+K, K 83, Wasser Sachen, fasc. 34, Aug 33 (August 1, 1780) 2'.
\item[52] Ignaz von Kunsti (* 1748; † April 1810 Graz).
\item[53] TREMEL, 1946: 41; StLA, Miszéllen K 393 briefe 419. Old signature: Landes Regirungs Archive, Navigationsakten im Kleinen Archiv, Sch. 473 (August 1, 1780) fasc. 419.
\item[54] Theodor Batthyány (Bacani, * 1729 Németh Ujvár; † 1812).
\item[55] Gilfillan, 1936, 77.
\end{itemize}
\end{footnotesize}
Euler and the Jesuits in Russia

6.- Gruber and Euler in Russia.

After his machine-boat experiments, Gruber achieved success with his major Russian scientific and technical contributions. He used superior West-

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56 GILFILLAN, 1936: 77; HINKEL, 1995: 121.
58 TREMEL, 194: 46.
59 Andrija Ljudevit Adamić (* 1767 Rijeka; † 1828).
ern scientific achievements to prove the supposed superiority of the Catholic faith.

Besides Gruber’s abilities in mathematical sciences, his virtuosity in languages gained him diplomatic and scientific successes in Russia. He was able to conduct Jesuit correspondence worldwide by writing in many native tongues. As a Slovene, he understood Russian very well and his command of the language gave him an advantage over other Western diplomats. The Slovene Gruber was much more acceptable to Russian authorities and the common people, compared with the Polish majority among Russian Jesuits.

The new Jesuit provincial Kareu stayed at St. Petersburg for two months, accompanied by two other Jesuits. They visited Academicians, one of whom was Leonhard Euler, who was already completely blind and whose home again became a center of St. Petersburg social life after Euler’s return from Berlin in 1766. These social relations paved the way for Gruber’s later scientific and political success in St. Petersburg after he became Kareu’s right hand man. The Jesuit Gruber displayed his scientific and technological inventions made in Polock, Russia, to the St. Petersburg Academy and soon became Emperor Paul’s chief political advisor.

During Gruber and Euler’s time, the Russian Academy was known as the Imper. Akademija nauk i hudožestv (1743-1803) with Leonhard Euler (*1707; †18. 9. 1783, a member between 1727-1741 and 1766-1783), Daniel Bernoulli (*1700; †1782, a member after 1733), and his cousin Nicholas Bernoulli (*1687; † 1759) as its chief scientists. During Gruber’s stay at St. Petersburg, several mathematicians were full academy members, among them Leonhard Euler’s son Johann Albrecht Euler (*1734; †1800, a member after 1766) who was the conference secretary after 1769. J.A. Euler’s son-in-law (1784), Nikolai Ivanovič Fuss (*1755; †1825/6, 1783), became the department secretary in 1800.

7.- Euler’s Influence on Vega’s Gunnery and Optics.

Euler influenced Gruber’s students, especially Jurij Vega. Gruber bought Euler’s Berlin (1746) Opuscula varii argumenti soon after he began his Ljubljana lectures, and wrote on the title page the bookplate: Inscription Bibli. Philos. Col- legii Labacensis S. J. 1768. Euler’s anthology contained four physical and two astronomical (2nd and 4th) dissertations, the last one in French. The book was suitable for teaching new developments to Gruber’s pupils. Gruber’s private student, Baron Žiga Zois, bought Euler’s Dioptrice at Ljubljana for 7 ft. Vega learned enough at Gruber’s school to use Euler’s gunnery books for his own Viennese military research, and eventually achieved the rank of colonel.

In 1760 Bošković visited London. He bought achromatic lenses and mailed them to his native Dubrovnik, despite the fact that it was supposed to be a war secret. During the same year, he visited the London astronomer Robert Smith. Bošković was among the first to report on Dollond’s achromat olive invention at the Bologna Academy (1763). Žiga Zois bought the Viennese translation of Bošković’s paper (1767) for his Ljubljana library. In early June 1763 Bošković visited the Ljubljana Jesuits for the third time and told them about the English inventions. Gruber entered the Ljubljana College a few years later, after finishing his studies with Bošković’s Viennese friends.

Gruber bought several books for his Ljubljana College department, without strict connection with his hydrodynamic governmental work. He was obliviously interested in optical phenomena connected with his pioneering laboratory studies of the fata morgana. He bought his teacher Scherffer’s translation of Bošković’s telescopic improvements for his Ljubljana astronomical lectures on orientation on the high seas. Gruber also wrote his Ljubljana College chair bookplate into the old works of the Catalan scientist Ramon Lull, *c.1232, Palma de Mallorca; OFM; †1316), and the German translation of the Catalan Bernard Forest de Belidor’s (Belidor, *1693; †1761 Paris) water architecture works. Gruber probably bought these Catalan works in 1772 or 1773, when his Ljubljana rector was the former Madrid professor of mathematics and cosmographer (1762-1765), Christian Rieger (*May 14 1714 Vienna; SJ October 17, 1731 Vienna; †March 26, 1780 Vienna).

Gruber’s teachings enabled Vega to build an achromatic telescope with four lenses. In his second letter to the St. Petersburg Academy Secretary J.A. Euler, which Vega mailed from the battlefield near the Petrovaradin castle, today the Serbian Srem (July 13, 1789), Vega corrected several errors in his previous letter. While awaiting the battle against the Turks he certainly had enough time, as well as the required experimental equipment, and probably even some of his military subordinates to act as collaborators. Two month

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61 ZOIS, 1817: 9.

later, Vega underwent his baptism of fire at the Kalemegdan fortress. His St. Petersburg correspondents certainly followed the fortunes of the Habsburg-Turkish war, and read Vega’s letters with great care.

Vega’s reports on achromatic telescopes interested the Russian Academics, because in 1784 Aepinus had just finished the very first Russian achromatic microscope with a little help from Kulibin, who became the Academy technician in May 1767. The secretary J.A. Euler thanked Vega for his mail and assured him that Academy would publish his paper on the calculations of \( \pi \) in their *Nova Acta*. Euler’s promise was eventually fulfilled some 6 years later. Euler proudly stated that his Academy always gladly accepted the research of foreign authors. He received Vega’s published works into the Academic Library. In 1755, J.A. Euler was awarded the St. Petersburg Academy price for research into electricity, and in 1769 he measured the transit of Venus.

Nearly five years after receiving Vega’s letter, St. Petersburg Academicians discussed Vega’s manuscript with 140 calculated number \( \pi \) decimals. At the same session (June 23, 1794), they discussed other recently received papers. Among these was the manuscript of Linné and Scopoli’s collaborator, Baron Karl von Meidinger, the Emperor’s Secretary at the Viennese court. Meidinger researched the “New and unmistakable way of testing the value of silver and gold in metallurgy and banking”. Vega certainly knew Scopoli very well, since he had been working at Carniola for a long time.

On July 3, 1794, the St. Petersburg Academy also received Jean Tembley’s Switzerland paper. However, the St. Petersburg Academicians doubted the advantages of Vega’s method compared with L. Euler’s. In 1794, J.A. Euler was still the permanent Academy Secretary. Other eminent academics also joined the debate about Vega’s and other letters designed for publication. Among the participants were academy members Stepan Jakovlevič Rumovski and Wolfgang Ludwig Kraft. Kraft became a professor (1771) and later replaced L. Euler as professor of physics. He was the son of the St. Petersburg hydrodynamic researcher, the Academician Georg Wolfgang Kraft of German origin. L. Euler’s student Rumovski observed the passage of Venus (1761) in Siberia and became an academy member (1767).

Vega collaborated with the St. Petersburg Academy until his death. In 1802, the Academy secretary Fuss read the letter that Vega mailed to the Academy President. Vega supplied his manuscript with copies of his pub-

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Illustration 4. Vega’s Viennese Sun Eclipse observation (January 1787) (HELL, 1787).

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lished works: 1790 (Beylage zum dritten Bande der Vorlesungen), 1800 (Anleitung zur Hydrodinamik), and 1801 (Anleitung zur Zeitkunde, and Disquisitio de supputatione massarum).

8.- L. Euler’s Influence on Vega’s Gravitational Theory.

Vega used Bošković’s theory to discuss the ballistic pendulum and the collision of solid bodies. He cited Robin’s Gunnery in L. Euler’s translation\(^64\). In 1788, in the 3\(^{rd}\) part of his mathematical lectures Vega proved that a body flying with infinite velocity would reach the Earth’s centre, but that it would stop there without any speed left. In 1788 he reconsidered the problem in paragraphs number 229 and 230, under the title: “Real and indirect anomaly\(^65\), equation for the solution of Kepler’s exercise, and the report on a point of L. Euler’s Scientia Motus”.

Vega described the free fall of a body towards the Earth’s centre without taking into account air resistance\(^66\) and added the note on central movement.\(^67\) At the Earth’s centre (z=0) the body was assumed to reach infinite velocity. The negative values for z, velocity, and time were not allowed. Vega asked: “What is the body’s next movement”?

Euler stated in his Scientia Motus\(^68\) that a body would continue to move along the very narrow ellipse with the Earth’s centre as one of the focal points. Therefore, the body would return to its initial position. In 1743, Bošković objected by stating that a body will oscillate around the Earth’s centre, and Bošković also criticized Euler’s (1736) opinion\(^69\). Vega (1788) later criticized Euler’s publication and claimed that the body would lose all its velocity at the Earth’s centre\(^70\). Vega did not mention Bošković’s opinion, although he usually cited Bošković’s theory in his books.

The Frenchman Simon Antoin Jean L’Huillier, a professor at German and Swiss Universities, a Prussian Academy prize-winner (1786) and tutor to the Polish royal family\(^71\), rejected any infinitely small or infinitely great quantity. L’Huillier claimed that the body would never reach Earth’s centre, but Vega did not agree. Nobody was able to provide any experimental verification.

Vega tackled the problem in the appendix to his work\(^72\). He even allowed some discrepancies of Newton’s gravitational law. He cited Hindenburg’s work published in the Leipzig Magazine, which was an approach to Lagrange’s ideas\(^73\).

In 1800 Vega found the computational error in his own 1788 publication. He published a new result with the body passing through the Earth’s centre and eventually reaching its initial distance on the opposite side of the Earth\(^74\).

9.- Conclusion.

Gruber, Kunsti, and Vega’s work in Styria employed several practical aspects of L. Euler’s theories. Gruber used new techniques and recent inventions, as well as Dutch and Euler’s books to attain the old goal of comfortable upstream navigation. Gruber and his employers crowned their efforts with the machine boat models at the same time as L. Euler and his son were researching upstream navigation problems more theoretically. Initially, Emperor Josef II backed Gruber’s work, but after his mother’s death he abolished Gruber’s Navigation Directory and terminated financial support for the Mura River and other inland navigation works. George Vega certainly predicted those events and hurried to secure his new Viennese artillery job. The Mura River navigation work was brought to a standstill for many years and even Gruber himself was forced to plan his own emigration. After four more years in Ljubljana he left Central Europe for good, and eventually become a Jesuit General in Russia. He never returned to his native Habsburg lands, nor was he ever again involved so deeply in machine boat experiments, although he successfully continued his work as a Russian professor, engineer, architect, and, last but not least, a General in the Jesuit order. He established close con-

\(^{64}\) VEGA, 1788: 491, 493.
\(^{65}\) VEGA, 1788: 524.
\(^{66}\) VEGA, 1788: 220, 526.
\(^{67}\) VEGA, 1788: 230, 527.
\(^{68}\) EULER, 1765: 1, 268.
\(^{69}\) BOŠKOVIĆ, 1763, 4\(^{th}\) appendix, picture 10; BOŠKOVIĆ, 1755; EULER, 1736; THIELE, 1982, 45; MARTINOVIC, 1992: 285.
\(^{70}\) VEGA, 1788: 527; VEGA, 1800: 30.

\(^{71}\) VEGA, 1800: 17, 30.
\(^{72}\) VEGA, 1788: 42.
\(^{73}\) KLEIN, 1989: 130.
\(^{74}\) ČERMELJ, 1954: 19-21.
tacts with L. Euler’s Russian academic circles, while Gruber’s student, Vega, corresponded with L. Euler’s son.

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11.- Abbreviations and unpublished sources.

StLA – Steiermärkischen Landesarchiv, Karmeliterplatz 8, Graz.
R + K, K 83, Kommission in wassersachen (= Navigationskommission = Commission for navigation = Waters Commission)
A. Kusti, Familia, K1 H1.
Protokoll Buch (1774-1780).
Miszélken K 393 (Old Call Number: Landes Regirungs Archive, Navigationsakten im Kleinen Archiv, Sch. 473).

12.- Bibliography.

BELIDOR, Bernard Forest de (1743-1771) Architectura Hydraulica. Oder die Kunst das Gewässer zu denen verschiedentlichen Notwendigkeiten des menschlichen Lebens zu leiten, in die Höhe zu bringen und vortheilhaftig anzuwenden.

BERNOULLI, Daniel (1771) “Quelle est la meilleure manière de diminuer le roulis et le tanage d’un navire”, Recueil des pièces qui ont remporté le prix l’Académie royale des sciences, Paris.
BOŠKOVIĆ, Rudjer Josip (1755) De lege virium un natura existentium, Roma, Salomon.
BOŠKOVIĆ, Rudjer Josip (1763) De motus corporis attracti in centrum immobile viribus decrescentibus in ratione distantiarum reciproca duplicata in spatii non resistentibus Dissertatio habita in Collegio Romano a Patribus Societatis Jesu..., Roma.
ENTNER VON ENTNERSFELD, Friedrich Franz (1776) “Weizensteinbrand...” Sammlung nützlicher Unterrichte (Laybach), vol. 1.


EULER, Leonhard (1746) L. Euleri Opuscula varii argumenti, Berolini.


EULER, Leonhard (1765) Theoria motus corporum solidorum, Rostochii, Gryphiswaldiae.


LLULL, Ramon; BRUNS, Jordanus; ALSTED, Johann Heinrich (1652) Clavis Artis Lilliana, Argentorati, Zetzner.


TREMEL, Ferdinand (1946) “Schiffhart und Flösserei auf der Mur” Jahresbericht des Akademischen Gymnasiums in Graz. (Graz), 1-51.


VANĚČEK, Jan; SUTNAR, Ladislav (ed.) (1938) Počátky paroplavby v význam Reslové vrtule pro její výboj, Praha, Archiv pro dejiny prumyslu, obchodu a technické praxe.