Österreichische Gesellschaft für Wissenschaftsgeschichte

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XV. Österreichisches Symposion zur Geschichte der Mathematik

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Längs- und Querschnitte

Vertical and horizontal cross sections

Tagung, 12. Juni bis 18. Juni 2022, Miesenbach (Niederösterreich)

Anhang

Langfassungen gekürzter Beiträge

A N H A N G

Der Anhang zur digitalen Version enthält Beiträge, die wegen ihrer Länge für den gedruckten Band gekürzt werden mußten.

Seligmann Kantor from Sobědruhy

Martina Bečvářová

Kantor's childhood

Seligmann Kantor was born on 6 December 1857 in Judengasse no. 30 in a small North Bohemian village of Soborten (today Sobědruhy) located in a picturesque landscape near the famous spa town Teplice in Bohemia.[1]

Seligmann's father was Moritz Kantor, a businessman from a family living in Sobědruhy Jewish ghetto for several generations. Moritz was born on 4 March 1823 in Sobědruhy as the second son of the merchant Isak Kantor (1788–1867) and his wife Sara Kantor, née Gans. Seligmann's mother was Charlotte Kantor (1830–1906), née Wiener, who came from Eidlitz (today Údlice) near Chomutov. She was born on 19 November 1830 in Eidlitz as the daughter of Seligmann Wiener (1797–?) and Katharina Wiener, née Löwy. For several generations, the family lived in Eidlitz, professed the Jewish faith and ran a business. Seligmann's parents married on May 16, 1854 in Sobědruhy. In marriage on June 11, 1855 they had their first child, a daughter Amalia Kantor whose fate is unknown. The family claimed German nationality and Jewish faith and was one of the less wealthy members of the Jewish community of Sobědruhy.

It is not clear where Seligmann Kantor received elementary education. It is possible that he was educated at school in his native Sobědruhy or he went to nearby Teplice.

Kantor's secondary education in Litoměřice – step into a new world

In September 1872, Kantor was enrolled as a full-time student of the sixth grade of the municipal high school in Litoměřice. He studied religion, German, Czech, mathematics, descriptive geometry, freehand drawing, physics, chemistry, science, geography, history, optional physical training and stenography. His class teacher was strict and demanding Theodor Lauda who taught mathematics and descriptive geometry. According to the annual school report, Kantor did not receive any scholarship or support for poor pupils. From the first days he excelled in almost all subjects. He was the first pupil in the class at the end of the year.

[1] Details of Kantor's life and work, including references to all studied archive sources, are stated in the article [1].

In the school year 1873/1874 Kantor continued his studies in the final year. The composition of compulsory and non-compulsory courses has not changed. The class teacher was still Theodor Lauda, who probably had a significant influence on Kant, as did Ludwig Schlesinger (1838–1899), the headmaster of the secondary school, a renowned historian and politician who taught him German. Kantor again did not receive any scholarship or support.

In the summer of 1874 Kantor underwent a difficult graduation exam. He passed it with honors and as the best student at school. However, no details are given on the course of the examination in the annual school report, so it is not possible to ascertain what questions were given for written tasks in German, Czech, mathematics and descriptive geometry.

Kantor's university studies in Vienna – journey to the world

In October 1874 Kantor enrolled as a full-time student of the general department at recognized Technical University in Vienna which was considered the first school of technical focus in the monarchy. Since his first year he was totally exempt from paying school fees as a poor student. He studied six semesters at the Technical University in Vienna. He took various lectures, exercises and laboratory exercises in mathematics, physics and descriptive geometry. But he was almost not interested in technical subjects. He passed the exams properly (he was usually rated Excellent).

Among his teachers were leading figures of Technical University in Vienna, namely professor of mathematics Josef Kolbe (1825–1897), professor of descriptive geometry Rudolf Staudigl (1838–1891), professors of physics Viktor Pierre (1819–1886), Leander Ditscheiner (1939–1905) and Edmund Reitlinger (1830–1882), professor of structural mechanics and statics, Georg Rebhann von Aspernbruck (1824–1892) and professor of geodesy and astronomy Josef Phillip Herr (1819–1884).

At the beginning of the summer of 1877, Kantor completed his studies at the Technical University in Vienna. From 1877 till 1878, he stayed in turns in Vienna and Sobědruhy and self-studied. In the reports of the meeting of the Academy of Sciences in Vienna he published the first mathematical results and looked for possibilities of his further professional application.

Kantor's stays abroad – meeting with world mathematics

In early January 1879 Kantor left for his first stay abroad in Rome where he encountered modern mathematics (especially geometry, combinatorics and configuration theory). He made friends with the famous and world-renowned Italian mathematician Luigi Cremona (1830–1903). For a large part of his life they maintained relatively lively professional and personal

correspondence from which 25 letters from 1878 to 1892 (written in German, Italian or French) have been preserved.

The correspondence shows that Kantor went to Rome on the recommendation of Emil Weyr (1848–1894), Viennese professor of mathematics who had been in close professional and personal contact with Cremona since 1870. Kantor's semester stay in Italy was funded by the Vienna Ministry of Cult and Education. Kantor's main goal was to deepen his geometrical knowledge and broaden his insight into the new directions of the modern Italian school of geometry. He therefore attended Cremona's lectures, attended professional meetings in Cremona's household, in Accademia dei Lincei and discussions with various Italian mathematicians [we know that he met e.g. Giuseppe Battaglini (1826–1898), Francesco Brioschi (1821–1897), Felix Casorati (1835–1890)]. At the end of spring 1879 he left Italy because he had to report in Vienna on the results of his stay.

In the spring of 1879 Kantor spent a period of study at the University of Strasbourg. We could not find more information about this stay. It seems to have been funded again by the Vienna Ministry of Cult and Education. However, it is not clear from the preserved correspondence whether it was a second scholarship or whether Kantor distributed the funds received for two shorter stays with the approval of the Ministry. Kantor probably attended lectures of Carl Theodor Rey (1838–1919). In 1879 he traveled between Italy, Teplice and Strasbourg.

It is clear from the correspondence with Cremona that in the winter of 1880 Kantor visited Rome again and stayed there for at least two months on study stay. He perfected his Italian language, consulted Cremona on his mathematical ideas, completed manuscripts for articles for Austrian and Italian magazines, attended Cremona lectures, and even asked him to draw up a report for the Ministry of Cult and Education to be part of Kantor's report on the benefits of his study stay. In spring of 1880 he was again on a study stay, this time in Paris. We could not find out from what sources it was financed and whom Kantor was in contact with. We know, however, that he dealt with quadratic, biquadratic, rational and periodic transformations.

The above-mentioned stays had a decisive influence on Kantor's professional growth. Between 1878 and 1882 he dealt with the issue of configuration theory, which was a completely new and relatively unusual topic in our countries. In several articles published at the Vienna Academy of Sciences he studied the incidental relationships between points and straight lines in a plane.[2] He came to a discrete grouping of points and lines, where each point is passed through the same number of lines and on each line there is the same number of points, i.e. he studied the so called *Reyeovy geometrické konfigu-*

[2] Interesting are works for example [7], [8] and [9].

race (Reye's Geometric Configurations), at a time when they were not yet widely known. These are probably the most important and still cited Kantor's mathematical results.[3]

Let us recall that the problem of configurations was brought to the geometry of the 19th century by German mathematician Carl Theodor Reye who dealt with configurations in the scheme (p_r, l_k) in his monograph *Geometrie der Lage I*.[4] He came to this subject through a generalization of the famous Desargues theorem. Studied configurations could be defined in modern language as follows: By configuration of type (p_r, l_k) we understand the final incident structure of p points and l lines meeting the following conditions:

i) On each line lies *k* of points and through each point passes *r* of lines ,
ii) there is at most one straight line passing through two given points.

In 1877 Reye asked, how many different type configurations $(10_3,10_3)$, i.e. configuration of 10 different points and 10 different lines, while each point must be passed by exactly 3 lines and each line must have exactly 3 points, in the second edition of the monograph *Geometrie der Lage*. Only planar configurations should have been considered.

Cantor in 1881 found three different configuring of type $(9_3,9_3)$ and ten different configurations of type $(10_3,10_3)$ in the work titled *Die Configurationen* $(3,3)_{10}$ (see [9]). He noted that he also knew the configuration of type $(11_3,11_3)$, however, it did not indicate their number or shape. He approached the issue in a purely combinatorial way. He did not use Reye's standard symbolism but his symbolism which he created in 1879 and 1880.[5]

Reye dealt with the issue of configuration in more detail in 1882 in an article titled *Das Problem der Configurationen*,[6] in which he reminded that in case of type $(8_3,8_3)$ there is no real configuration and mentioned Kantor's results of configurations of type $(9_3,9_3)$ and type $(10_3,10_3)$. He tried to answer more general question: how to find a method to determine the number of all different configurations of type (n_i,n_i) for small natural *n*. He approached the whole issue in a geometric way.

[3] In the *Zentralblatt für Mathematik* database are stated 78 of Kantor's works and 51 citations of his 12 works. The highest number of citations is from 1990 to 2018. For more see [17]. In the database of *MathSciNet Mathematical Reviews* 19 Kantors works are stated (one more work is assigned to Kantor by mistake) and 5 citations of his works (from 1997, 2008, 2010, 2015, 2018; these are articles linking group theory with the theory of plane transformations, resp. curve theory, resp. transformation theory). For more see [16].

[4] C. Rümpler, Hannover, 1866, xii + 146 pages (second edition 1877).

[5] This is Kantor's most cited work (cited seventeen times, see [17]). For Kantor's contribution to configuration theory, see [15]; for Kantor's results, see page 484, 486–489, 491 and 494.

[6] Acta Mathematica 1(1882), pp. 93–96.

In 1887, the problem of configurations caught the attention of the Italian mathematician Vittorio Martinetti (1859–1936) who tried to study configurations from the perspective of combinatorics in an article titled *Sulle configurazioni piane* μ_3. He successively found a recursive method of creating all configurations of type (n_3,n_3) from the knowledge of all constructions of type $(n\text{-}1_3,n\text{-}1_3)$.[7] He showed his method on the example of configurations of type $(11_3,11_3)$ – he found 31 different configurations. Instead of terms *points* and *lines* he used terms *numbers* (numeri) and *columns* (colonne).

Martinetti's work became the basic inspiration for the German mathematician Heinrich Eduard Schröter (1829–1892) who undertook a critical study of existing configurations and replaced the combinatorial methods with geometric methods in 1888 in an article titled *Ueber lineare Constructionen zur Herstellung der Configurationen* n_3. He strictly distinguished cases of "real configurations" and "theoretical configurations".[8] One year later he proved that one of Kantor's configurations $(10_3,10_3)$ is not feasible in the plane, i.e. it is a theoretical configuration in his work *Ueber die Bildungsweise und geometrische Construction der Configuration* 10_3.[9]

At the end of the 19th century and at the beginning of the 20th century, Italian and German mathematicians began to deal more deeply with configuration issues, e.g. V. de Pasquale, F.W. Levi, D. Hilbert and S. Cohn-Vossen For more information see, [14], [13], [6].[10]

Kantor's work at the German Technical University in Prague – a short life episode

Probably at the end of 1880 Kantor began work on the habilitation thesis which he submitted in the spring of 1881 to German Technical University in Prague. There was no information about the course of his habilitation procedure at the Archive of the Czech Technical University in Prague.

At the beginning of the winter semester of the school year 1881/1882, Kantor was appointed a private associate professor for geometry, more precisely *Privatdozent für geometrische Theorie der Curven und Oberflächen*, i.e. he obtained habilitation in a very narrow and not very important field for technology. At the age of less than 24, he began his academic career. He immediately announced a three-hour special selection lecture entitled *Geometrische Theorie der Curven und Oberflächen*. Since the summer semester 1881/1882,

[7] Annali di matematica pura ed applicata 15(1887), pp. 1–26.

[8] Nachrichten von der Königlichen Gesellschaft der Wissenschaften und der Georg-Augusts-Universität zu Göttingen 1888, pp. 237–253.

[9] Nachrichten von der Königlichen Gesellschaft der Wissenschaften und der Georg-Augusts-Universität zu Göttingen 1889, pp. 193–236.

[10] About the history of configuration theory see for exemple [2], [4], [5]. On the history of configuration theory in Austria-Hungary see [3].

he did not lecture at the German Technical University in Prague anymore. His pedagogical work at this school was the only episode.

Kantor was the only mathematician who tried to pursue a career in the German Technical Univeristy in Prague but neither studied there, passed there a few years of poorly honored assistant positions, nor was he in a long-term contact with the professor's corps of the German Technical University in Prague or the German University in Prague. He believed that his professional qualifications, enough publications and experience gained abroad were all that was needed to obtain the post of an honorary associate professor and later extraordinary or full professor. Apparently, he did not feel comfortable with the teaching staff and resigned from this school. Note that the right venia legendi has never been revoked to him at the German Technical University in Prague.

Kantor's work at the German University in Prague – disappointment and frustration

In autumn of 1882, Kantor initiated a habilitation procedure at the German University in Prague where he wanted to become a private associate professor and later hopefully take a position as a professor. On October 19, 1882, the College of the Philosophical Faculty established a Habilitation Committee consisting of professor of mathematics Heinrich Jacob Karl Durège (1821–1893) and professors of physics Carl Ferdinand Lippich (1838–1913) and Ernst Mach (1838–1916). During October and November, the committee went through Kantor's materials and recommended the usual procedure of the habilitation procedure.

On November 17, 1882, however, professor of astronomy Karl Hornstein (1824–1882) wrote a separate votum in which he expressed his disagreement with the conclusions of the Habilitation Committee. He empahsized that habilitation could not be granted for purely formal reasons, since Kantor had not passed a regular school-leaving examination at a classical grammar school, so he could not study at university but only at "the technical university" and therefore did not and could not have a doctorate from the Austrian or Hungarian universities which was seen as a precursor to the habilitation procedure. However, he did not question Kantor's professional and pedagogical qualities or his mathematical results. Nevertheless, Kantor's habilitation procedure was not discontinued as the professors' committee recommended that it should have continued by a majority vote.

On December 14, 1882, Kantor underwent a so-called habilitation colloquium in front of the habilitation committee and a habilitation lecture in front of the teaching staff. In December 1882, Kantor was nominated by a professorship to be appointed a private associate professor of mathematics with the right of venia legendi at the German University in Prague. The appointment took place at the beginning of 1883.

From the summer semester 1882/1883 to the winter semester 1886/1887, Kantor gave interesting, thematically modern and non-traditional selective lectures on mathematics. He focused on a relatively broad spectrum of mathematics. He lectured on theory of functions, theory of differential equations, solvability of equations, invariant theory, substitution theory, number and form theory, basics of multidimensional geometry, probability calculus and the smallest squares theory.

In 1887 Seligmann Kantor terminated his work at the German University in Prague after numerous disagreements with the management of the university and misunderstanding with the Vienna Ministry of Cult and Education. He did not give a lecture for the summer semester 1886/1887. He seemed to have been disappointed by the slow ranking procedure, the lack of paying students, the lack of interest of students in his lectures and colleagues about his professional work and, above all, the strange treatment of his person in Prague.

Kantor's personal file has been preserved in the National Archives of the Czech Republic in Prague which preserve his letter dated 26 October, 1887, written in the village of Schallan (today Žalany u Teplic) and addressed it to the Vienna Ministry of Cult and Education. He asked the ministry to disregard the procedure of the professorship of the Faculty of Arts of the German University in Prague and to annul their proposal for Kantor's appointment as an honorary associate professor or extraordinary professor. He pointed out that he did not know the content of the proposal at all. He also pointed out that the professors refused to refer his new request to the Ministry for purely formal defects. At the same time, he informed the Ministry that injustice in Prague is happening to him that he was publicly scandalized, that he was dragged into the street scandal by arrogant students – provocateurs and subsequent police investigation.

At the beginning of January 1888, the Dean of the Faculty of Arts of the German University in Prague announced to the Ministry that Kantor was no longer giving lectures and was living outside Prague for the second semester, so according to Ministerial Decree Nr. 12527 ai 86 has lost his right venia legendi. Kantor was informed about the loss and reportedly took note of it. The Dean's office added that Kantor's appointment as an extraordinary professor continued to be supported. He stressed that Kantor had written his request that his appointment should not be dealt with, apparently in a morbid mindset (*als von Kantor in Krankhafter Gemutsaufregung verfasst*). The Dean's office asked the ministry to still be considered. In September 1888, the Dean's office again dealt with Kantor's venia legendi. It resent to the ministry that Kantor had not announced any lecture (for four consecutive semesters). His venia legendi was once again declared by The Faculty of Arts as "expired". Kantor was neither appointed associate professor nor extraordinary professor and his right of venia legendi had never been restored.

In 1883, Kantor sought further support from the Ministry of Cult and Education to enable his third scholarship in Italy. Unfortunately, he failed. Preserved correspondence with Cremona shows that he was interested in the competition prize announced in 1882 by the Academy of Sciences in Naples for 1883.[11] In several letters he consulted with Cremona about his intention to apply and enthusiastically informed him of the progress of his professional work. At the same time, however, he showed some impatience and exaggerated fears (press corrections of his work dragged on, he worried about the priority of his result, the committee was deciding slowly, etc.). In 1883, in the work *La transformazione birazionale*, he solves the above-mentioned task given by the Neapolitan Academy of Sciences. He directly linked to the works of Arthur Cayley (1821–1895), William Kingdon Clifford (1845–1879) and Max Noether (1844–1921) that generalized Cremona's famous transformations. In December 1883, he responded enthusiastically to Cremona's report that the Academy Award in Naples was won by his work. At the same time, he asked Cremona for language consultation on his award-winning work which was eventually printed at the expense of the Academy of Sciences in Naples.

Kantor's career seemed to develop well, as he was the only mathematician in the Czech lands to receive such a prestigious award. However, as we already know, the situation turned out differently. In the spring of 1886, Kantor again spent several months in Italy, in Naples and Rome. He perfected his Italian language, devoted himself to mathematics and planned a radical change in his life.

From 1877 to 1885, Seligmann Kantor published 40 articles written in German (31), Italian (2) and French (7). They dealt with the theory of special curves and surfaces, point configurations and special geometric transformations. Usually it was a shorter statement of interesting results, approaches or methods and classical studies not exceeding 10 pages long and rarely appeared works of around 25 pages. Note that Kantor's works show that he carefully followed German, French and Italian magazines, often responding very quickly to the works of his contemporaries. He had an overview of contemporary mathematical production and an estimation of core and interesting topics.

Kantor's life after 1887– one big unknown

Almost no information has been found about Kantor's life stories. The only sources are his letters addressed to Cremona in 1884, 1886 and 1892. They are quite long, very gloomy, and sometimes incoherent. They fully re-

[11] Find in the plane of periodic Cremona's transformations, which after *n*-times use convert the object to itself. See Rendiconto della R. Accademia delle Scienze Fisiche e Matematiche (Napoli) 22(1883), p. 314.

flect the state of Kantor's mind, his despair, depression, and the desire to leave his homeland at all costs.

In a letter dated 25 December 1884, Kantor referred to Cremona as his only friend who had always stood by him. He reminded him of his stays in Italy and described them as the most beautiful years of his life. At the same time, he appreciated the help and goodness of Emil Weyer. He also described his situation in Prague and the reasons why he decided to take a radical step – to immigrate to Italy.

He depicted Prague as evil, full of hatred and envy. He wrote that he was surrounded by opposing colleagues who had never accepted him into their ranks. He thought he was always overlooked and mocked for his Jewish background, his poverty, his poor clothes and his modest way of life, that he did not go to restaurants, had no property, had only one dress and one shoe, lived in poor sublets and eventually far beyond Prague.

Since 1880, Kantor is said to have encountered only envy and evil in Prague. He understood the whole habilitation process at the German University in Prague as a profound and unfair humiliation. He considered that the proceedings were deliberately stretched and complicated (let's recall that it lasted from October 1882 until the beginning of January 1883 and followed exactly the rules then in force). He found no friends either among the Germans, the Czechs, or the Prague Jewish community. What is more, he was not supported or understood by his family. All this supposedly took him the power to focus on scientific work.

Although he won the famous Naples Academy Award in 1883 and hoped that the situation would improve, the opposite was true. As the price became known, even more evil and hatred broke out. Students apparently started at the instigation Kantor's colleagues to boycott his lectures, moreover, rumors began to spread that he had a serious contagious disease (a strange rash, possibly syphilis). Some had allegedly parodied his manner, speech and walking, mocked his problems with poverty and red feet, questioning his professional results and calling him a plagiarist. Various disgusting scenes were said to have been done to him during classes, at school, in library and on streets. His colleagues Anton Puchta (1851–1903) and Emil Waelsch (1863–1927) as he said were most against him who he blamed directly and then an unnamed Prague professor, that Cremona was supposed to know well personally and helped him at the beginning of his career.[12]

In 1883, for the first time, he decided to leave his native country and seek happiness abroad. He turned to an American mathematician Jamese Jo-

[12] It could probably had been Eduard Weyr (1852–1903), professor of mathematics at the Czech Technical University in Prague who was in contact with Cremona at the beginning of his career, thanks to his brother Emil Weyr. However, the causes of such Weyr's actions are unclear.

seph Sylvestr (1814–1897) and asked him to help with the provision of a suitable post in America. Everything is said to have been very promising and Kantor was already looking forward to a new location across the sea. However, he was deceived when looking for a travel loan, got into another financial distress and had no funds to travel to America. He was then saved by the financial reward associated with the prize of the Naples Academy of Sciences. Perhaps thanks to it he had paid his debts and could live and work throughout 1884.

At the end of 1884 another crisis came and Kantor turned to Cremona to ask him to help him immigrate to Italy because he would soon be expelled from the university, students had no longer taken his lectures and colleagues avoided him and mocked him. In addition, he was running out of funds, his relatives did not recognize his scientific work and had no understanding of science. At this time he saw only two hopes – to obtain a subsidy from the Ministry of Cult and Education for a one-year stay in Italy (for year 1886) or immediately emigrate to Italy where he was willing to work as a private teacher, librarian, clerk, servant, etc. In his native country, he saw no chance for another life, he suspected that he would never reach the career of a university professor and would not have peace and financial support for his professional work. He hated his country, his colleagues, and his relatives. In this letter, thoughts of death repeatedly appeared.

It is not possible to find out how Cremona responded to this very emotional letter because his letters were not preserved. Nor is it clear whether Kantor's information was true, resp. to what extent they were true. We do not know whether Kantor suffered from any mental illness or was too egocentric and conflicting. None of the surviving memories of Prague mathematicians, nor their correspondence, has been able to prove the situation described by Kantor.

We know that Kantor eventually obtained a ministerial subsidy and he really lived in Italy in the spring of 1886. He contacted Cremona by a letter dated 26 March 1886 written in Naples. He told him that he was again in Italy and that he was improving in Italian. He reaffirmed that his determination to settle in Italy was firm and lasting that he no longer wanted to return to his birthplace. He begged Cremona to help him to get any post.

How has the situation evolved cannot be reconstructed sufficiently convincingly and accurately. The other two surviving letters of Kantor are up from 1892. More than half of the first letter touches on a delicate matter. Kantor identified two Italian mathematicians Giuseppe Veronese (1854–1917) and Guide Castelnuovo (1865–1952) for the plagiarists of his works that discussed the configuration, resp. transformations of periodic curves. He demanded the printing of an apology, analyzed the individual passages of works, pointed out their shortcomings and misconduct and taking results without cit-

ing resources. He begged Cremona to help in this situation and to defend his scientific priority. At the end of the letter he reported on what had happened in his life since 1886 when Cremona talked him out from the emigration to Italy for lack of knowledge of language, culture and traditions.

At the end of 1887, Kantor was forced to terminate his teaching at the German University in Prague. He found himself without a job, without resources and without hope for another life. Since he had no proficiency tests, he could not become a high school teacher. He reluctantly went to his relatives to his birthplace where he had to engage in a family business, i.e. an activity he hated. He started working as an accountant in a family business, occasionally privately continued to study, researched and attempted to publish. But he was surrounded by misunderstanding, he had no one to share his thoughts with and above all he was completely cut off from the latest literature. He hated his life and regarded it as suffering. He saw only darkness, envy, dishonesty, vulgarity, brutality, ignorance and deception around him. He was probably more and more deeply depressed. He still wanted to leave for Italy, Switzerland or America. He wanted to start a new and better life away from his home country, relatives and former colleagues.

From 1887 to 1891, Kantor as a mathematician paused completely. He was probably expanding and improving his monograph for the Academy of Sciences of Naples published in French in 1891 under the title *Premièrs fondaments pour une théorie des transformations périodiques univoques* (see [10]). It was published at the expense of the Naples Academy. He returned to scientific work in 1891. Between 1891 and 1903 he published 2 monographs and 36 articles written in German (24), Italian (7) and French (5). Let us emphasize that Kantor was the first mathematician from the Czech lands to be able to get on the pages of the magazine *American Journal of Mathematics* (he published five extensive works). In addition to the aforementioned monograph from 1891, he published a monograph in 1895 *Theorie der endlichen Gruppen von eindeutigen Transformationen in der Ebene* (see [11]), which belongs to his results cited to this day.[13] Kantor's work dealt with the problems of group theory, with the theory of special curves and surfaces, special geometric transformations, solving systems of linear differential equations and special determinants. Usually these were longer studies (range from 20 to 93 pages) and just a few shorter messages of interesting results. It is apparent from the individual works that Kantor carefully read German, French, American and Italian mathematical journals, often responding quickly to articles published in them.

From the introduction or conclusions of some of Kantor's works published between 1894 and 1901, it appears that his personal and financial situation has probably improved that he could have devoted himself fully to

[13] This is Kantor's second most cited work (it is cited fifteen times, see [17]).

mathematical research and, moreover, he could have also travel. In 1894 he completed some works in Paris, in 1895 they were drafted in Calais, Reims, Innsbruck or Venice, and he worked in Dover in 1896, spent 1899 in Venice and Innsbruck, and 1901 in Vienna. The causes of this change could not be identified. One can only speculate whether it was inheritance, property acquired by marriage, work for a wealthy family or support from a patron. From this period, we have no longer preserved Kantor's correspondence clarifying his new situation.

In the article [5], it is stated that Kantor moved to Italy after finishing his academic career. It is not clear how the author came to this information. From Kantor's preserved correspondence with Cremona in the early 90s of the 19th century he stayed in his native Soběd ruhy.

From 1909 to 1920 and again from 1939 to 1945, Gerhard Hermann Waldemar Kowalewski (1876–1950) who worked as a professor of mathematics at the German Technical University in Prague, resp. at the German University in Prague, wrote these words in his memorial book about Kantor:

Einmal erzählte ich auch einem Fanta-Abend von dem berühmten Prager Dozenten Seligmann Kantor, der sich zuerst an der deutschen Technik, dann an der Universität habilitiert hatte. Das war vor meiner Prager Zeit. Kantor war so arm, daßer keine Strümpfe besaß. Um sein einziges Paar Schuhe zu schonen, ging er auf der Straße barfuß und trug die Schuhe behutsam in der Hand. Irgendeinmal hat ein Droschkenkutscher, der auf seinem Bock thronte, über ihn gelacht, vielleicht weil er dachte: „Das ist einer, der nie mit mir fahren wird." Seitdem betrachtete Kantor alle Kutscher als seine Feinde und fürchtete, sie würden ihm einmal etwas antun. Man stelle sich nun vor, welchen Eindruck es machte, wenn er, mit den Schuhen in der Hand, barfußins Auditorium kam, aufs Podium stieg und die Schuhe behutsam neben das Katheder stellte. Er soll ausgezeichnet vorgetragen haben. Später wohnte er nicht in Prag, sondern in Leitmeritz, wo eine Brauereibesitzerstochter sich für ihn interessierte, so daßer nun weniger Sorgen um seine Existenz hatte. Nun gruben die Prager Professoren aus den Statuten einen längst vergessenen Paragraphen über das Wohnen am Hochschulsitz aus und drohten Kantor mit der Aberkennung der Venia legendi. Das Wiener Ministerium trat ihm, so gut es ging, schützend zur Seite. Schließlich aber siegte die Kleinlichkeit der Fakultät, die den bedauerlichen Schritt tat, einen so großen Mathematiker zum Rücktritt zu zwingen. Er zog nach Italien und ist dort wenige Jahre später gestorben. Die italienischen Kollegen haben ihn in einem schönen Nekrolog eingehend gewürdigt. ([12], p. 251)

It is not clear from what sources Kowalewski drew his information, because he came to Prague only 6 years after the Kantor's death and more than 20 years after his departure from Prague. Therefore, he could hardly remember

him and many witnesses were no longer among the living. He certainly did not describe what he had experienced but rather rumors from Prague's German cultural, academic and Jewish community. Information about Kantor's poor financial situation and economics was certainly no secret, as we know from the protocols of the professorial staff of the Faculty of Arts of the German University in Prague that he had repeatedly asked for a reimbursement of the salary for substituting teaching, referring to his poor financial situation. Details of his marriage to the daughter of Litoměřice brewer failed to either be confirmed or denied. Despite all their efforts, the obituary of the Italian mathematicians could not be traced.

Kantor's image

Today, the only poorly accessible Kantor's photograph is known taken around the 1870s. It is a typical cabinet business card accompanied by the text *Dem Herrn Prof. Dr. Weyr zur Bürgschaft freundlicher Erinnerung. In Verehrung und Dankbarkeit. S. Kantor* It depicts a young, dark-haired, confident man with a penetrating, even evil gaze. It was preserved in the album of Emil Weyer whose basis was created during Weyer's study stay in Italy in the school year 1870/1871. It contained photographs of various Italian, French, German, Austrian and Czech mathematicians. Note that the exchange of small cardboard cards with donor portraits was a fashion thing in the last third of the 19th century.

It is unclear when and on what occasion Kantor gave his cabinet business card to Emil Weyr. Obviously, they became acquainted in Vienna where Weyr had worked as a recognized university professor of mathematics since 1875. Kantor could have attended his mathematical lectures. We know that he was directed by him due to his interest in the Italian school of geometry or algebra.

There is no evidence that Kantor was interested in the activities of the Czech mathematical community and that he was in contact with Czech mathematicians at the university or in technology. Nor does he seem to have maintained close contacts with Prague's German academics and cultural circles. Rather, he avoided personal relations and friendships. This could have been due to his Jewish faith, feeling of low social origin, long-term lack of funds, or just because of his personality.

End of life

Seligmann Kantor died on 21 March 1903 in the hospital in Teplice, not in Italy, as G.H.W. Kowalewski and others supposed. The cause of death is listed in the registry office as a "hemiplegia contra myocar cardis", i.e. paralysis (probably due to a stroke, brain tumor, or brain injury) in combination with

a heart attack. He was buried in the Jewish cemetery in Sobědruhy on 23 March 1903.

Kantor's monument has been preserved to this day. It is a massive black granite tombstone of a modern type overwritten by a little "talkative" inscription in Hebrew and German (*Hier ruht in Frieden Herr Seligmann Kantor, gewesener Docent an der k.k. technischen Hochschule in Prag. Gest. 21. März 1903 im 44. Lebensjahre.*). It is located near the grave of his father Moritz made in the "classic" shape of old Jewish tombstones but of poor-quality sandstone. It is unclear who funded the building of the cantor's rather ostentatious and expensive tombstone and why there was only mentioned his private lectureship at German Technology in Prague, only a short episode in his life, and his much more important lectureship and work at the German University in Prague was omitted.

At the beginning of the 21th century, Kantor's tombstone was damaged (probably was loosened by its own weight and collapsed from a small pedestal, fortunately it did not get damaged by the fall). Thanks to the Teplice Jewish community and its cooperation with the German foundation of Dresden, it was re-erected and statically secured during the recent extensive reconstruction of the cemetery.

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Thema: »Längs- und Querschnitte« - »Vertical and horizontal cross sections«
in Miesenbach, Niederösterreich, von Sonntag, dem 17. Mai bis Samstag, dem 23. Mai 2020
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Running with Nonlinear Dynamics

The memory of scientist
Hans Troger (March 11, 1943–February 22, 2010),
Full member of the Austrian Academy of Sciences and Professor of the Technical University of Vienna

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Abstract: It's been half a century since I've been running around with Theoretical and Applied Mechanics, as well as Non-linear Dynamics. I received my guidance from the wonderful scientists of my professors, Danilo Rašković and academician of Yu.A. Mitropolski. In this commitment to Nonlinear Dynamics, I was a "marathon runner", targeting more than half a century on the course, meeting many scientists with more or less significant scientific legacies. They left us numerous scientific articles, monographs, as well as memories of the lectures and presentation releases they gave. Also, more or less numbers of participants, but subjectively selected creators in the field of Nonlinear Dynamics, were or are still organizers of exceptionally good scientific gatherings at which they gathered. It depends on the world reputation and architecture of the city, or the state and region, even its political reputation and the situation in which the scientific gatherings are organized. The impressive symposia and congresses of the International Union of Theoretical and Applied Mechanics (IUTAM), EurMeh Sociery, as well as the ICNO Conferences of the states of the former Eastern Bloc, or the Conference Series on Nonlinear Mechanics in Shanghai, China, should be noted. Also, must to listed following important Congressed: ICTAM Haifa 1993, Warsaw 2004, Adelaide 2008, Beijing 2012, Montreal 2016, World Congress of Nonlinear Analysts (IFNA WCNA) Orlando 2004 in America, et al.

The last of these, of course, are NODYCON 2019 in Rome (400 participants) organized by W. Lacaebinara, and the All-Russian Congress TAM UFA 2019 (1000 participants) in the Russian Federation.

The series of symposiums of Non-linear Mechanics, Non-linear Sciences and Nonlinear Dynamics held in Serbia and Yugoslavia, starting at 1984m, certainly lag behind the number of participants, but not by the scientific results presented there.

Running with Nonlinear Dynamics, I met and now known many outstanding non-linear creators, researchers and felt honored, not only to know them, but also because they showed my attention as well as respect for my scientific results to TAM and Nonlinear Dynamics, and if I come from Yugoslavia is still today a small state of Serbia, which has long been a villa under groundless aggression, bombing and blockades. I ran to "catch up", the annexes steadily walked and innovated and contributed their scientific results to Science Nonlinear Dynamics, to which we were all devoted and loving, and our meetings with colleagues inspired us to come up with new results. In this “marathon” course for more than half a century, I would single out the encounters with: V. Matrosovв, B. Lashmikantham, G. Reg, S.T. Ariaratnam, V. Rumyantcev, R. Hetnarsky, Hans Trager, V. Beletski, I. Blekhman, Ali Nayfeh, P. Harlamov, Jam Awrejcewicz, Tenreiro Machado, O.A. Goroshko and others. Of the younger generation, I am certainly honored to have met the remarkable Walter Lacarbonara, a NODUCON 2019 organizer.

I dedicate this historical paper to Hans Troger (March 11, 1943–February 22, 2010), a scientist, outstanding persson and academician at the Austrian Academy of Sciences, and on the occasion of the decade since his untimely departure, a vicious illness that interrupted his considerable work and research in the field of nonlinear dynamics, and in particular, Nonlinear stability and bifurcation theory, as well as in Heteroclinic cycles in the three-dimensional postbifurcation motion of O (2) -symmetric fluid conveying tubes together with colleague Alois Steindl, and Dynamics of Tethered Space Systems co-authored with Vladimir Beletski between other.

Keywords: Nonlinear Dynamics, Scientific meetings, History, Hans Troger, Svientific legates, Nonlinear stability, Bifurcation, Tethered Space Systems

1. Introduction to Nonlinear dynamics scientific events

Let us begin this running with elements of the history of the emergence of a special field of Mechanics called Nonlinear Dynamics, whose methods and phenomena have been extended to all fields of science. Thus, the Nonlinear Dynamics has grown into an independent science, and today its findings are applied in almost all fields of science, both, natural-mathematical, engineering, bio-medical, and social sciences.

Here's how G. Rega writes initially in her article [1] on Nonlinear dynamics in mechanics and engineering:

“Interest toward nonlinear oscillations in mechanics started with Huygens’ studies on pendulum dynamics and with the *n*-body problem in celestial mechanics (which goes back to Kepler, Newton, Lagrange and Poincaré), and continued with the observation of nonlinear phenomena in a number of nineteenth-century industrial applications, for which particular methods fitted to the analytical solution of specific problems were elaborated. In the early twentieth century, there was an important phase of growth, marked by the achievements of two eminent engineers.

Georg Düffing [2] is the mechanical engineer who, moved by the interest to solve practical vibration problems, formulated a nonlinear equation later on generalized to represent archetypal oscillators of reference for the analysis of a great variety of dynamical systems [3]. In turn, Balthasar van der Pol is the electrical engineer who obtained important results on self-sustained, and in particular relaxation, oscillations [4] in connection with radio engineering applications, where he also observed "an irregular noise" in certain frequency ranges, likely making the first experimental observation of deterministic chaos. Van der Pol's equation has become another classical equation in nonlinear vibrations. In parallel and more general terms, dynamical system theory originated in the late nineteenth century with Henri Poincaré [5,6], who is considered the father of modern nonlinear dynamics, and later on developed mostly within the mathematical community".


Figure 1. Professor Giuseppe Rega in Niš (Serbia, 2008), at the exhibition of Leonardo da Vinli legare and Katica (Stevanovic) Heather (picture left) and with Professor Fabrizio Vestrone in Maastricht (2005) during the ENOC Eidhoven 2005 European Nonlinear Oscillation Conference (picture right)

Here, we will look at the achievements of scientists from Ukraine and Russia, and in particular *The stability theory of Alexander Mikhailovich Lyashunov* (June 6 [O.S. May 25] 1857 - November 3, 1918) [7]. At the time of his work at Kharkov Polytechnic, in present-day Ukraine, Former Kievan Russia, at the Kharkov Polytechnic Museum, we encounter a galaxy of Kharkiv scientists, whose monographs on oscillations of discrete and continuous systems have played a significant role in transferring knowledge of oscillation theory. Among the most magnificent scholars and scientists, whose scientific legates are hidden, in this some important certainly is Alexander Lyashunov with his Theory of Stability, without whose application in studies of nonlinear dynamics of the system is

impossible, as well as physicist Lav Landau (rus. Lev Davidovich). Landau; Baku, January 22, 1908 - Moscow, April 2, 1968) Nobel Prize winner, who studied the dynamics and properties of superfluidic materials.

Figure 2. Memorial plaque dedicated (2007) to Alexander Mikhailovich Lyapunov at the Kharkov Polytechnic Institute (picture left), participants and organizers of the Conference of Nonlinear Dynamics 2097 in Kharkov (picture in the middle) and at the Muzeum of the Kharkov Polytechnic Scientists (picture right).

Our contemporary, important scientist and prominent organizer of numerous scientific events Professor G. Rega in Reference [1] writes:

”Another early giant was Alexander Lyapunov, who gave the basis of the theory of motion stability [7] which is important in all critical situations (i.e., bifurcations) of nonlinear dynamics marking the passage between different qualitative behaviors. ...

Following Poincaré’s insight into local and global analysis of nonlinear differential equations, [6,7] and his earlier ‘detection’ of chaos in ‘simple’ mechanical systems, fundamentals of the science of nonlinear and complex systems were established in the first half of the twentieth century by the efforts of a great number of outstanding mathematicians”.

Here, we highlight a monograph entitled *Theory of Oscillations* [8] by three authors *Andronov, A.A., Witt, A.A., Khaïkin, S.E.*, who contributed to the development of science in this field by their content of scientific results of these authors. We emphasize the importance of finding solutions to nonlinear differential equations with solution analysis and stability, as well as numerous graphical and qualitative parameter analyzes of the dynamics of nonlinear systems. For example, especially of electrically nonlinear systems, the phenomena of solution bifurcations are pointed out. For me, in my developmental pie of stepping and running with Nonlinear Dynamics, the contents of this monograph represented the basis from which I set out for Nonlinear Dynamics. To this I add the excellent monograph by Kauderer [9] Nonlinear Mechanics in German and also monograph Theory of

Oscillations [10] written by my Professor of all area of Mechanics Danilo P. Rašković

Asymptotic methods of nonlinear mechanics Krylov – Bogoliubov – Mitropolski [11-17] and the school of the same name in Kiev, to the knowledge of my Professor, Dr. Ing and Mathematics Degree Damilo P. Rašković [10] was evaluated in 1967 as the most promising for the education and guidance of a young and talented researcher and teaching assistant, who should be directed toward Nonlinear Oscillations and Nonlinear Dynamics. So, to me, Professor Rašković suggested that I do graduate work in Mechanical Engineering from nonlinear oscillations, and I suggested the topic: *"Nonliear oscillations and applications to nonlinear system with automatic control*" [18]. I successfully defended my diploma and received the award of Electronic Industry for the best diploma thesis done that year at the Technical and Natural-Mathematical Faculties of Yugoslavia.

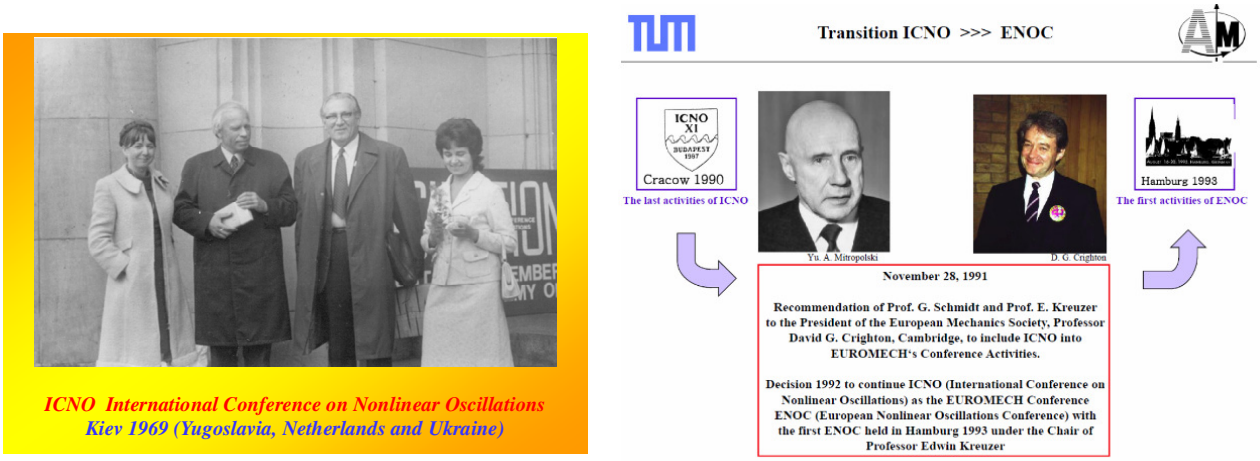


Figure 3. Professor Daničo Rašković with assistant (left) and colleagues at the ICNO Kiev 1969 Conference (photo left) and Slide from Professor Pfeifer's Lecture about half a century since the first ICNO Kiev 1961 Conference presented at ENOC Rome in 2011 (Picture right)

Here is how, today, Professor G. Rega in reference [1] evaluates asymptotic methods of KBM:

"The Krylov–Bogoliubov–Mitropolski school (at Kiev) [11-17] searched for the solution of equations of nonlinear systems via *analytical* (i.e., quantitative) methods, mostly dealing with problems in nonlinear mechanics [10]. Around the middle of the twentieth century and mostly in the 1960s and 1970s, novel theoretical ideas and perspectives (e.g., the topological one), and the innovative contributions of computer science, determined an 'explosion' of dynamical system theory, with the strong affirmation of the role of models and the importance of the nonlinear domain, along with intense interactions developed throughout physical

and mathematical sciences. Distinct, yet interconnected, theories sciences. Distinct, yet interconnected, theories were developed (of bifurcation, catastrophe, complexity, chaos, fractals, turbulence), with applications to a wide variety of disciplines including not only physics and engineering but also chemistry, biology, neurology, astronomy, geophysics, meteorology and economics".

Figure 4. Founders of the School of Asymptotic Methodes of Nonlinear Mechanics (Picture left up), Academician Mitropoljski in Niš in 1984 and Professor Katica (Stevanovic) Heather with teachung assistants (Picture above right up) and two Monographs of Yuri Alekseevich Mitropolskii (pictured below)

I point out here two original monographs by Yuri Alekseevich Mitropolski [14, 15], which are not sufficiently World known between scientists and researchers, in my opinion, and neither is the theory of asymptotic methods of unsteady-non-stationary oscillations known in application, which represents the original contribution of Yu.A. Mitropolski to this famous, world-renowned, scientific school. On the occasion of Mitropolski's Life Jubillee 90th birthday anniversary, I was honored to be enrolled as an adjuster of that famous scientific school of asymptotic methods of nonlinear mechanics, and on the basis of a well-placed Candidate Minimum of the specialty of Theoretical and Mathematical Physics, which is a postgraduate course, which I authorized for 11 months of

training under mentorship Metropolitan and with the assistance of A. Lapatom at the Institute of Mathematics of the National Academy of Sciences of Ukraine in Kiev during 1971.

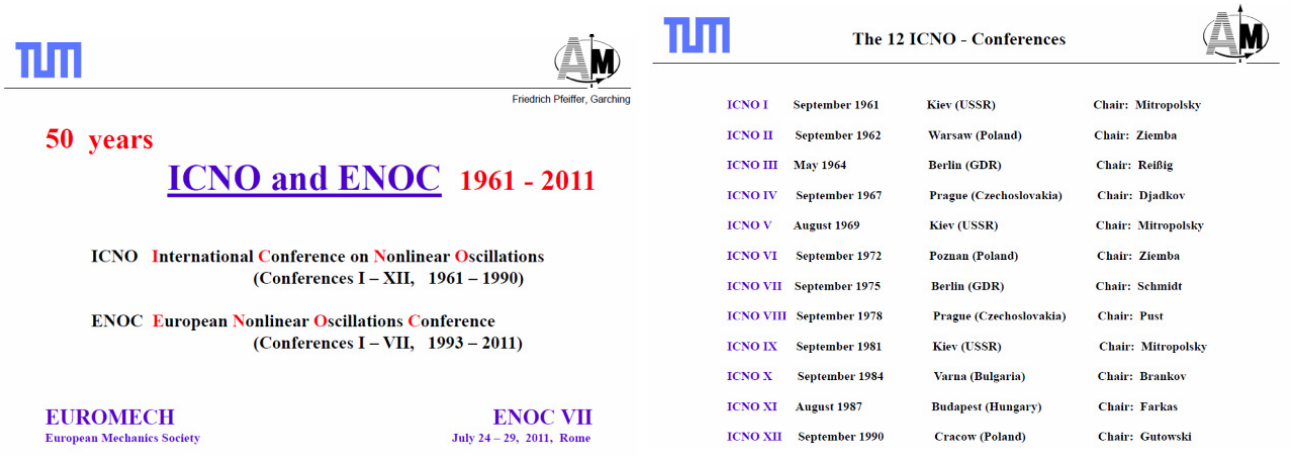


Figure 5. Two slides from Professor Pfeifer's lecture, held in Rome in ENOC 2011 at the European Conference of Nonlinear Oscillations, on the occasion of half a century since the first ICNO 1061 - International Conference of Nonlinear Oscillations held in Kiev in 1961.

This series of ICNO conferences was held every third year, and continued into the series of conferences of the International European Conferences of Nonlinear Oscillations ENOC. See details in Figure 5.

The first series of ICNO conferences was founded by my professor Academician Yu.A. Mittropoljski from Kiev. The first of these series of conferences was held in Kiev in 1961, and I first participated in 1969, as a young assistant, brought with me by Professor Danilo Rašković with the intention of introducing me to Academician Mitropolsky and obtaining his consent to accept me for training. to study asymptotic methods of nonlinear mechanics. As a result of the acquired knowledge and further research, references [18-20] and [31-34] have emerged, among others. Later, in my research, I used a monograph by two authors, Aly Nayfeh, Dean T. Mook, (1976), Nonlinear oscillations [22], in which my reference [19] was cited, published in the Polish Journal Nonlinear Oscillations, and presented at ICNO Conference in Poznan 1972.

Professor G. Rega in Reference [1] writes:

"International Conferences on Nonlinear Oscillations (ICNO) was organized in Kiev in 1961 by Yu. A. Mitropolski, the third scientist-founder of the asymptotic nethids of nonlinear mechanics referred to in the KBM acronym of the powerful method(s) for the analysis of nonlinear oscillations initiated by N. Krylov

and N. Bogoliubov; and the series of ICNO events held every 3 years in different cities of those countries lasted for 30 years, until the last one organized in 1990 in Krakow by W. Gutowski.

Based on a recommendation of G. Schmidt and E. Kreuzer to the chairman of the European Mechanics Council D. Crighton to include ICNO into the society's conference activities, with the full support of Yu. Mitropolski, the relevant scientific tradition and the underlying patrimony of knowledge were inherited by EUROMECH, which started the new series of ENOC events at Hamburg, 1993". For details see Figure 5.

Series of the Conferences (ICNO) I attend:
ICNO Kiev 1969, ICNO Poynanj 1972, ICNO Kiev 1981, ICNO Varna 1984, ICNO Kracow 1990;

Series of Conferences (ENOC) I attend:
ENOC 1996, Prague, L. Pust (F. Peterka); ENOC 1999, Copenhaghen, H. True; ENOC 2002, Moscow, D.M. Klimov; ENOC 2005, Eindhoven, D. van Campen; ENOC 2011, Rome G., Rega; ENOC 2014, Wien H. Eckerl; ENOC 2017, Budapest G., Stépan;

Researchers of my team of Project ON174001 "Dynamics of hybrid systems with complex Structures" (2011-2019) was participants of the Series of Conferences (ENOC) ; ENOC 2011, Rome G. Rega; ENOC 2014, Wien H. Eckerl; ENOC 2017, Budapest G. Stépan;

The Yugoslav Society of Mechanics was one of the first founders of the International Union of Theoretical and Applied Mechanics (IUTAM). Professor Vlarko Brčić was among the Representative Members in the IUTAM General Assembly and highly regarded for his scientific results, well known outside Yugoslavia. I have participated in the following International Congresses of Theoretical and Applied Mechanics (ICTAM) organized by the International Union of Theoretical and Applied Mechanics: IUTAM ICTAM Haifa 1992, IUTAM ICTAM Warsaw 2004, IUTAM ICTAM Adelaide 2008, IUTAM ICTAM Beijing 2012, IUTAM ICTAM Montreal 2016. From my former students and researchers participants of IUTAM ICTAM were: Julijana Simonović IUTAM ICTAM Adelaide 2008, Anđelka Hedrih IUTAM ICTAM Beijing 2012 and IUTAM ICTAM Montreal 2016, Vladimir Stojanovic IUTAM ICTAM Beijing 2012.

We will, also, include here some basic information about scientific conferences organized in Serbia in the field of nonlinear mechanics, nonlinear sciences, and nonlinear dynamics.

Series of the Nonlinear Mechanics scientific meetings started with *International Symposia on Nonlinear Dynamics* in Arandjelovac 1984, organized

by Serbian Society of Mechanics under the Yugoslav Society of Mechanics. Invited Plenary Lecturer was academician Yuri Alekseevich Mitropolski, and late was elected as a honor member of Serbian Society of Mechanics. All the members of the Chair for Mechanics and the Chair for Hydraulic Engineering of the Faculty of Mechanical Engineering University of Niš took part in this and other symposiums; they were co-organizers as well.

Figure 6. Incited Lecturer William Nash (MTI, USA) in Niš1991 (Figure left) and Hiroshi Yabuno (Invited Lecturer as Symposium Nonlinear Dynamics Belgrade 2011), Katica (Stevanović) Hedrih and Kazuyuki Yagasaki (Invited Lectirer at Nonlinear Conference Niš 1991) ar random meeting in Maastricht during excursion of ENOC Eindhoven 2005 (Figure Right)

Next scientific meetings in nonlinear mechanics held as a International Conference on Nonlinear Mechanics 1991 in Niš, titled "*The First Yugoslav Conference on Nonlinear Deterministic and Stochastic Processes in Dynamical Systems with Applications YCNP Niš'91*", organized by the Faculty of Mechanical Engineering of University of Niš was held in Niš. The Chairman of the Organizing Committee was *Prof. Katica (Stevanović) Hedrih*. Invited Plenary Lecturer was William Nesh from MTI USA and first Editor-in-Chief and founder of International Journal of Non-Linear Mechanics published by Elsevier. Invited Plenary Lecturer was, also, young scientist Kazuyuki Yagasaki from Japan (see Figure 6.). Proceedings of Abstracts was published; the papers and invited lectures which were approved were publisheed in the first and the following issues of the University Journal – Facta Universitatis, new Series – Mechanics, Automatic Control and Robotics.

The *Third Yugoslav Symposium on Nonlinear Mechanics* was held in the form of a *Minisymposium*, as a part of the *XXII Yugoslav Conference on Mechanics in Ni*š in 1995. The Faculty of Mechanical Engineering in Niš, with co-organization by the Faculty of Civil Engineering organized this Congress as well. The Chairman of the Organizing Committee was Prof. *Katica (Stevanović) Hedrih*;

Academicians *Yu. A. Mitropolskiy, V.V. Rumyantsev, Felix Chernousko, and professors Anatoliy Martinyuk, Valentina Filchakova, Dan Stamatiu*, ... were guest at this symposium.

The *Fourth Symposium on Nonlinear Mechanics* was held in 1997, again in the form of a *Minisymposium*, as a part of the *XIII Yugoslav Congress on Theoretical and Applied Mechanics.* This Congress, held in the Congress Center – Zvezda in *Vrnjacka Banja*, was organized by the Yugoslav Society for Mechanics. The organization of this Symposium was helped by the Mathematica; Institute of Serbian Academy of Sciences and Arts and the Faculty of Mechanical Engineering in Niš and in Belgrade. The Chairman of the Scientific Committee was the academician *Nikola Hajdin*, and the Chairman of the Organizing Committee was Prof. *Katica (Stevanović) Hedrih*. Professors *Anthony Kounadis, Giuseppe Rega, Anton Baltov,* ... were guest at this symposium.

Niš 2000 Niš 2003 Niš 2003

Niš 2000 Niš 2000

Figure 7. Photo Gallery: Participants of two International Synposiums in Niš 2000 and 2003.

The *Fifth Symposium on Nonlinear Mechanics – "Nonlinear Sciences at the Threshold of the Third Millenium"* was organized in 2000, with the wish for it to become a tradition and to gather the connoisseurs of nonlinear phenomenology from disparate sciences and dynamic systems and for it to become renown all over

the world. Academicians *N. Hajdin, V.V. Rumyantsev and M. Prvanović and Professors D.S. Sophianopoulos, G.T.Michaltos, Ji Huan He, I. Finogenko, P.S. Krasil'nikov* ..... were guests at this symposium (see Figure 7.).

The year of the *Sixth Symposium* was the year of the 10 th Jubilante issue of the University Journal – *Facta Universitatis, new Series – Mechanics, Automatic Control and Robotics in Niš 2003*. These symposium and the Journal Facta Universitatis are a permanent characteristic of the University of Niš, Faculty of Mechanical Engineering in Niš and scientific achievements of Yugoslav and Serbian scientists in international relations. Invited participants were scientists: Giuseppe Rega (member of IUTAM Scientific Committee), Tomoaki Kawaguchi (President of Tensor Society), V. Lasmikantham (President of International Federaion of Nonlinear Analysists IFNA), Ftrantishek Peterka, Jirzi Waerminski, Ulriht Gabert, Professor Leela, Anagaya Vatsala, Liviu Barreyeu and othjer (see Figure 7.)..

Figure 8. Participants of International Symposium Nonlinear Dynamics Belgrafe 2011 in organization of Serbian Scientific Sociery and Project ON174001, LINKS: http://afrodita.rcub.bg.ac.rs/~nds/ and http://www.mi.sanu.ac.rs/novi_sajt/research/projects/174001a.php.

Figure 9. Participants of International Symposium Nonlinear Dynamics Belgrafe 2019 ib organization of Mathematical Institure if Serbian Academy od Sciences and Atys and Projecy ON174001
LINKS: http://www.mi.sanu.ac.rs/novi_sajt/research/conferences/ksh/default.htm
and http://www.mi.sanu.ac.rs/novi_sajt/research/projects/174001a.php

Next five Minisymposia on Nonlinear Dynamics held as a parts included in the programs of the Series of International Congresses of the SSM (YUTAM): Vlasina Lake 2011, Vranjačka Banja 2013, Aranđelovac 2015, Tara 2017 and Sremski Karlovci 2019l. Invired Lecturer was aboard scientists and researchers of team of Project ON174001 "Dynamics of hybrid systems with complex stryctures (2011-2019).

Next and last two International Symposia on **Nonlinear Dynamics** were organized in Belgrade: First is dedicated to Great Word known Serbian Scientist Milutin Milanković in 2011 organized by Serbian Scientific Society and Project ON174001 "Dynamics of hybrid system with complex structures" (2011-2019) (see links [35]). And second was dedicated to 53 working years of scientific activity and 75th years Life Jubilee of Profesor Katica (Stevanović) Hedrih 2019 in

Figure 10. The Covers of Booklet of abstracts of International Mini-symposiims: MS-Integrity of Dynamical Systems at IFNA World Congress of Nonlinear Analysists WCNA Orlando 2004; MS-Integrity of Dynamical Systems – European Fracture Conference E FC16-Alexandoupolis Greece 2006; MS-Integrity of Dynamical Systems into APM Saint Petersburg 2007; MS – Analytical Mechanics at Nonlinear Dynamics Shanghai 2007, MS – Kinetic Control and Vibrorheology at ESMC Lisbon 2009 and MS- Nonlinear dynamics ICDVC Hangzhou 2010m and other.).

Mathematical Institute of Serbian Academy of Sciences and Arts and researchers ream of Project ON174001 "Dynamics of hybrid system with complex structures" (see links [36]). Between invited Lecturers of these two Symposia are: in 2011 Hiroshi Yabuno, Alber Lui, Marina Shitikova, Pavel Krasilnikoc and other (see Figure 8.) ; in 2019 Alexander Naskonechniy, Jan Arejcewicz, Marina Shitikova, Miloš Kojić, Vladimir Gelertiy, Pavel Krasilnikov, Ray Sarbary Giha,

Fotis Georgiades, Andrea Arena, Tanara Nestorović, Livija Cvetićanin, Ivana Kovačić and other (see Figure 9.).

Katica (Stevanović) Hedrih was the organizer of Series of Minisymposia included in the program of international scientific Conferences and Meetings: MS-Integrity of Dynamical Systems at IFNA World Congress of Nonlinear Analysists WCNA Orlando 2004; MS-Integrity of Dynamical Systems – European Fracture Conference E FC16-Alexandoupolis Greece 2006; MS-Integrity of Dynamical Systems into APM Saint Petersburg 2007; MS – Analytical Mechanics at Nonlinear Dynamics Shanghai 2007, MS – Kinetic Control and Vibrorheology at ESMC Lisbon 2009 and MS- Nonlinear dynamics ICDVC Hangzhou 2010m and other.). (see Figure 10.).

2. Two figures of participants of two IUTAM Symposiums and my first encounter with Hans Troger

Figures 11 and 12 show the participants of two IUTAM Symposiums. These are scientific symposia:

The first is the IUTAM Symposium "*Non-linearity and Chaos in Engineering Dynamics*" UCL 1993 London UK and
it was organized by J.M.T. Thompson, S.R. Bishop. (see Figure 11).

The second is the IUTAM Symposium "*Chaotic Dynamics and Control of Systems and Processes in Mechanics*", held in Rome 2003, at SAPIENZA University of Rome. The organizers of this symposium are Professors G. Rega, F. Vestroni. (see Figures 1 right and 12).

I attended both of these IUTAM symposia. I applied for the first one late, so my work was briefly included in the program, and the work was announced, but the abstract was subsequently distributed to the participants, because the Abstract Book was published earlier. But I'm in both pictures 11 and 12 among the participants. I also have one fond and fond memory from my first participation in the IUTAM Symposium from Professor J.M.T. Thompson. It was his latest, just-published Monograph "*Elastic Instability Phenomenon*", Wiley, with his dedication.

These two photographs are remarkable scientists, my contemporaries, with whom I first met and saw them for the first time, and late met frequently at scientific meetings over the next decades, some even today. Among the participants in the two IUTAM Symposium, I will mention only some scholars and scientists, whom I met for the first time, and later were participants in scientific conferences in Yugoslavia and Serbia, which I organized, or later developed

scientific communications with them or used their monographs. For example, in these pictures are the professors and imprtant scientists: G. Pera, A. Kiunadus, S.T. Ariaratnam, Filip Holms, Francis Moon, Vladimir Beletski, Hans Troger, Dick von Campen and others.

Figure 11. Participants of IUTAM Symposium Non-linearity and Chaos in Engineering dynamics UCL 1993 London UK

Here, I personally single out Professor Hans Trogirer, whom I have met many times later, and had the opportunity to give a lecture at his Seminar at the Technical University of Vienna. This year marks the decade since his untimely death. I also dedicate this work to the memory of the outstanding scientist, academician of the Austrian Academy of Sciences and professor at the Technical University of Vienna, and especially one of the permanent participants in numerous scientific meetings in Nonlinear Dynamics.

Many running and walked with Nonlinear Dynamics, and I also walked my half a century with Nonlinear Dynamics. Many have incorporated their scientific results into the newly emerged landmark science Nonlinear Dynamics. Some more,

some less, some more significant and some less significant. Sometimes less is more and less is greater. In these non-linear dynamics, some are more visible and others less visible, and some, when they leave us, take decades to discover the knowledge of the important scientific legates that have left to next generations of scientists and Civilization itself. Along these paths of running with Nonlinear Dynamics, encounters and interactions and one-on-one communications between scientists occur.

Figure 12. Participants of IUTAM Symposium Chaotic Dynamics and Control of Systems and Processes in Mechanics Rome 2003 SAPIENZA University of Rome

Among the many I met this time, running with Nonlinear Dynamics, I would like to mention scientist Hans Trogirer, who left us early, and this year, when it is a decade since his untimely death.

I want to remember him and remind his colleagues of his scientific legacy, which can be an inspiration to younger colleagues.

It is possible that some of younger colleagues dedicates his research to the scientific problems Hans Troger has dealt with and adopts his style of dedication to the Nonlinear Dynamics of Spacecraft.

In the following essays, I will present biographical data information about Hans Troger, then a selection of a number of his references with an overview of his scientific results, as well as colleagues' memories of Hans Trogirer's personality.

3. Basic bibliographical data about scientist Hans Troger (March 11, 1943-February 22, 2010).

Hans Troger was born on March 11, 1943, as youngest of three children in Villach, Carinthia. His father died in Second World War and his mother had to take care of the whole family. As a war widow, his mother had to care forthe living of the family of four. Troger explains that his sister participated in the education of her significantly younger brother Hans.

Hans visited the grammar school in Villach and studied Mechanical Engineering at Vienna University of Technology. In 1966, he graduated from Vienna University of Technology to Dipl.-Ing. of Mechanical Engineering.

He also defended his doctoral dissertation in Technical Sciences at Vienna University of Technology. The title of his dissertation reads "*Investigation of thedriving stability of a semitrailer unit".* Graduation to Dr. of Technical Sciences, followed in 1970.

From 1970 to 1972, Hans Troger was an Assistant at the Institute of Rational Mechanics in the Department of Civil Engineering of Vienna University of Technology. In 1979 he became Professor at the Institute for Mechanics following Professor Heinz Parkus.

In the Reference [21] cited as basic source of the Biography of prominent scientist Hans Troger we learn:

"At that time, the late Prof. Gerhard Heinrich, Full Member of the Austrian Academy of Sciences, was Head of this Institute. From 1972–1977, Hans Troger worked as an Assistant at the Institute for Mechanics in the Department of Mechanical Engineering, the Head of which then was the late Prof. Heinz Parkus, also a Full Member of theAustrian Academy of Sciences. Hans Troger spent the academic year 1975/76 as a Max Kade Fellow, selected by the Austrian Academy of Sciences, at the University of California at Berkeley. In 1977, he obtained the Venia Docend for Mechanics. As of October 1, 1979, he was appointed to Full Professor of Mechanics at the Institute for Mechanics in the Department of Mechanical Engineering of Vienna University of Technology, succeeding Prof. Parkus".

Hans Troger held guest professorships at the Universities of Metz (1988), Pavia (1994), and Rome (1995), the Technical University of Hamburg-Harburg (1997), the University of Illinois at Urbana Champaign (1998), and at the Pontifical Catholic University of Rio de Janeiro (PUC-RIO) (1999).

These numerous and prestigious guest proffessorships document the international character of Prof. Troger's scientific activities.

Hans Troger was an internationally highly distinguished scientist in the World wide area of Mechanics of Solids with large Scientific communications. Since 1998, he servedas Chairman of the Austrian National Committee for Theoretical and Applied Mechanics, a delegation of the Austrian Academy of Sciences in the frame of the International Council for Science (ICSU).

In recognition of the numerous important achievements, Hans Troger received an honorary doctorate from the Budapest Uni-versity of Technology and Economics, at the comparatively young age of 47 years. In 1993.

Hans Troger was electedto Corresponding Member of the Austrian Academy of Sciences and in 2002 to Full Member.

For his excellent contributions to the nonlinear stability theory and bifurcation theory, he received, in the year 2000, the Erwin-Schrödinger Prize of the Austrian Academy of Sciences.

He was also a longstanding co-editor of ActaMechanica (1980–2005) and a member of the Editorial Board of several leading international journals in the scientific area of Mechanics of Solids.

The heavy illness, to which Hans Troger finally fell victim, had broken out approximately 20 years ago.

Inaddition to it, in the last years of his life, his health was progressively impaired. In spite of a nearly 6-month stay in hospital, which he terminated a few weeks before his death, his will to live remained unbroken. Itwas Ash Wednesday 2010, five days before his passing away, when Alois Stendtl visited Hans Troger for the last time.

In the Reference [21] we read:

"Albeit physically already very weakened, he showed great interest in science and research, in general, andin scientific activities in his narrower scientific area, in particular. He was indeed a scientist with heart andsoul!Hans Troger was a dedicated academic teacher and researcher at Vienna University of Technology and avery active member of the Austrian Academy of Sciences. He regularly attended meetings of the Academy and participated in several committee and board meetings of Academy Institutes. By Hans Troger's death, his sister, who is living in Germany, now has also lost her younger brother, to whose sickbed she hurried as often as possible and at whose death bed she stayed. Vienna University of Tech-

nology and the Austrian Academy of Sciences, however, have lost not only an outstanding representative of the worldwide highly respected Austrian School of Mechanics, but also a wonderful, modest person who always subordinated his personal state of mind to the cause and never created fuss about himself."

Hans Troger, Professor of Mechanics at the Faculty of Mechanical and Industrial Engineering, passed awayon February 22, 2010, after a long and painful illness, shortly before his 67th birthday.

4. Scientific Legate, monographs, references of scientist Hans Troger and scientific-ships with scientist around the World

The research activities of Hans Troger are characterized by a strong reference to the scientific fundamentals of his scientific field and the brilliant use of the current mathematical tools required for the treatment of demandingmechanical problems.

He was particularly concerned with the application of bifurcation theory, with chaos theory and with methodsof dimension reductions in engineering.

An excellent overview of applications of the local bifurcation theoryis contained in the book "*Nonlinear Stability and Bifurcation Theory*", jointly authored by Hans Troger and his Associate Alois Steindl, published by Springer-Wien, in 1991.

Essentially, three classes of nonlinear stability problems are treated in this book. The first one consists of problems of vehicle dynamics (road vehicles, railvehicles, and ships), robotics, and of vibrations of liquid cross-flow hoses. The second class is concernedwith the postbuckling behavior of statically loaded thin-walled structures. The third one is with applica-tions of dimension reduction of dynamic as well as static systems by means of an extension of the classical Galerkin method.

Such dimensional reductions represent an important area for applications in mechanicalengineering. Nowdays is very actual research in reduction pg number of coordinates in modeling and abstraction real engineering system dynamic to the model with minimal number of degrees of freedoms.

In the Reference [21] cited as basic source of the evaluation of scientific legate of prominent scientist Hans Troger, as well as from the content of the corresponding published references [22-28], we learn:

"Since the beginning of the nineties of the last century, Hans Troger was occupied intensely with the simula-tion of the dynamics of tethered satellites. In the frame of several research projects supported by the European Space Agency (ESA), his group developed a computer program for numerical simulation of the

dynamic behavior of such satellites. They consist of two or more satellites connected by thin cables, revolving around a planet. In addition to the development of the simulation program, the problem of the stability of tethered satellites was treated with the so-called energy–momentum method. Not only does this problem represent a great theoretical challenge, but it is also of great practical importance".

It is normally to point out that it is large visible that Hans Troger's equally broad and deep knowledge about tethered satellites was of benefit to the book "*Dynamics of Tethered Space Systems*", co-authored by him and published by CRC Press, that appearedshortly after his death.

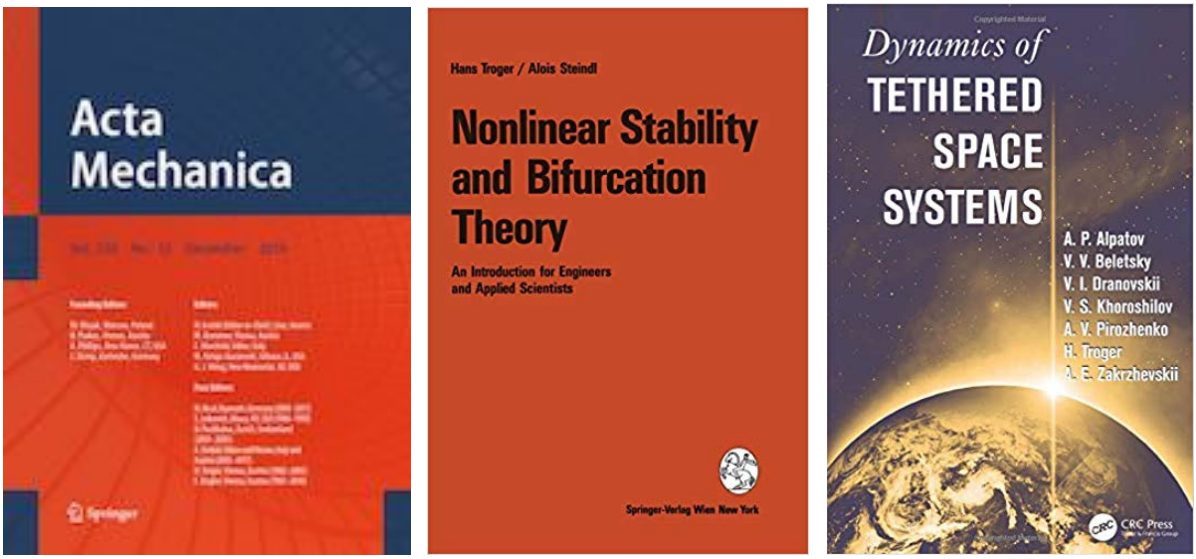


Figure 13. The cover of the Journal of the Acta of Mechanica [23] and the Cover of Monograph [24] and the Book [25] by Academician Hans Troger

On the internet, a decade after the early death of Hans Troger, a large number of articles and multi-volume monographs and books [23-30] that he has edited with other scholars can be found.

Here we point to his editorial work on editing the leading scientific journal of the Acta of Mechanica in the Springer edition, which is referenced by the Web of Sciences (red cover in picture 13).

We pay special attention to the monograph [24] in the co-authorship of Hans Troger and Steindl A. under the heading (red cover in picture 13):

Hans Troger and Steindl A. , Nonlinear stability and bifurcation theory: an introduction for engineers and applied scientists September 1991, Springer-Verlag, Berlin, Heidelberg, ISBN:978-3-211-82292-0

https://www.amazon.in/Books-Hans-Troger/s?rh=n%3A976389031%2Cp_27%3AHans+Troger

Prof. Hans Troger's latest scientific book [25] is co-authored with a group of scientists. Among them we pay attention to Vladimir Beletsky. The title of the book is:

Hans Troger (Author), A.P. Alpatov (Author), V.V. Beletsky (Author), V.I. Dranovskii (Author), V.S. Khoroshilov (Author), A.V. Pirozhenko (Author), A.E. Zakrzhevskii (Author), Dynamics of Tethered Space Systems (Advances in Engineering Series) Paperback – Import, 5 May 2010

Using abstract of book presentation on the Springer publisher, we select the following text:

"During many of the earliest American and Russian space missions, experiments were performed using cables to connect people and objects to spacecraft in orbit. These attempts generated considerable information about the formation of tethered systems and basic problems with tether orientation and gravity-gradient stabilization. During the 1970s, interest in tethered space systems (TSS) came to the forefront with an international project that involved the hanging of a probe from a low-orbit satellite to collect data on the Earth and its atmosphere. Since that time, TSS has grown to become its own area of research".

Group of leading scientists: Hans Troger (Author), A.P. Alpatov (Author), V.V. Beletsky (Author), V.I. Dranovskii (Author), V.S. Khoroshilov (Author), A.V. Pirozhenko (Author), A.E. Zakrzhevskii (Author) published important scientific book [25] as collection of their research results under the title **Dynamics of Tethered Space Systems.** The book brings together the work and scientific legates of previous listed seven leading researchers working at the forefront of Tethered Space Systems. Together, they provide a brief yet thorough introduction to Tethered Space Systems. Then, combining theory with experimental approaches important to industry, they cover the dynamics of the mechanical, physical, and mathematical modeling approaches involved in tethered satellite deployment.

These seven scientists present several models from the literature, focusing on the simplest, but most important system: two satellites in orbit around the Earth. Part containing discussion expands possibility to cover and application of knowledge to more complex examples.

Content of this book shown multidisciplinary results and that Hans Troger is a leading scientist with nt only strong personality, but with personality to work with other leading scientists, and between them Vladimir Beletski, for obtaining in results complex multidisciplinary higher scientific level fundamental monograph valuable for next generation of researchers ub area of Tethered Space Systems and complex systems.

This fundamental Book contain a number of important topics, such as energy production resulting from interaction between the system and Earth's magnetic field and momentum transfer in relation to satellites, microgravity laboratories, energy dissipation. The text of book includes theoretical models and experimental methods, and a wealth of essential equations and detailed analyses of forces acting on tethered objects in motion.

Figure 14. a * Two academicians Vladimir Beletski and Hans Troger (picture left) engrossed in scientific discussion and **b** * Academician Vladimir Beletski and Katica (Stevanović) Hedrich at ENOC 2006 Euidhoven (picture right)

In Figure 14.a *, two prominent academics Vladimir Belezski and Hans Troger are engrossed in scientific discussions, and the topics are not lacking. During many of the earliest American and Russian space missions, experiments were conducted using cables to connect humans and objects to orbiting spacecraft. This is one of the topics to which Hans Troger devoted much of his research. Vladimir Beletski (May 2, 1930 - July 21, 2017) was a top scholar in the field general theory of the attitude of motion of natural and artificial celestial bodies under the influence of various disturbs. Troger and Beletsky had a common interest in studying spacecraft.

In this jubilee 2020 year, 90 years have passed since the birth of Vladimir Beletsky (May 2, 1930 - July 21, 2017) and a decade since the untimely death of Hans Trogirer (March 11, 1943-February 22, 2010). Beletsky published more than 200 scientific papers and 11 monographs. His book "Essays on the Motion of Celestial Bodies", written in unusual way when mathematical fragments are

combined with publicistic comments, was translated into many languages. Asteroid 14790 Beletskij was named after V. Beletsky in 2001.

Although he lived relatively briefly, at only 65, he had struggled with the sick for a long time, leaving behind an imposing scholarly and scientific legacy behind Hans Trogir, containing a large number of scientific articles, book and monograph, plenary lectures and scientific reports. Although he lived and worked in a country that did not have spacecraft programs, his scientific work was of interest to both the USA and the Soviet Union, which had spacecraft strong and large programs in orbit.

5. Memories of the personality of fellow professor and academician Hans Troger

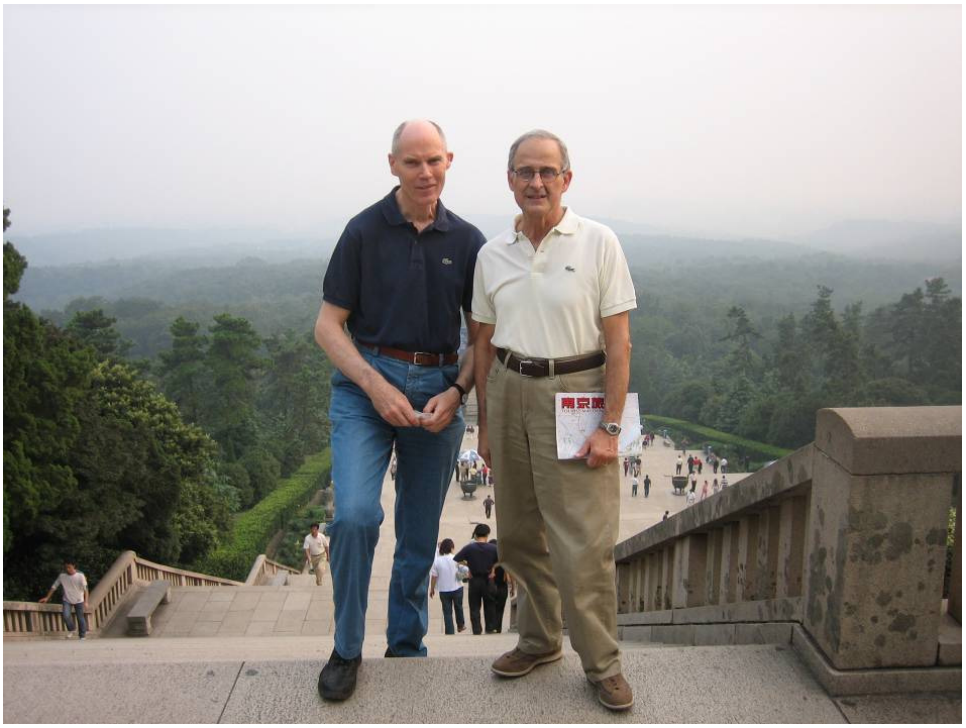


Figure 15. Professors Hans Troger and Giuseppe Rega, scientists stepping with Nonlinear Dynamics gave her significant nominal dynamics legacies

Professor Giuseppe Rega, who was also a close friend of Professor Hans Troger, remembers:

" I met Hans Troger in the second half of the 80s at CISM in Udine and then at an IUTAM Symposium in Stuttgart. I start appreciating his great knowledge of mechanics and nonlinear dynamics, along with his equally important personal qualities, which also include a remarkably reserved and respectful attitude. We were good friends for two decades, with many occasions to pleasantly meet each

other and discuss on both research and general issues, not only in scientific events but also during my visits in Vienna and his visits in L'Aquila, Rome and my sea-side home on the Adriatic sea. His premature death in 2010 was a major loss for the community of nonlinear dynamics. I remind him with respect and great regret".

Professor Alois Steindl of the Technical University of Vienna very warmly describes the knowledge of Hans Troger's personality:

"Hans Troger was very much interested in Natural Sciences and all new developments in Mathematics. When Bifurcation Theory and Catastrophe Theory flourished, he organized seminars at the Institute together with colleagues from mathematics and physics, to learn the new ideas and methods and to apply these ideas to various mechanical problems. He felt committed to learn the proper mathematical vocabulary and formalism and translate it into the engineers' language so that they can understand and apply successfully to their own problems. Whenever he got aware of some new mathematical theory, he was looking for a corresponding engineering problem, where this theory could be applied. As Michael Païdoussis called it, he was intensively interested in "curiosity driven research". When our group investigated the stability of a periodically driven robot arm, he was fond to find all possible types of stability loss and cases of emerging dynamics.

The different topics in this special issue also reflect his wide range of interests. Hans Troger combined a rigor mathematical treatment of bifurcation problems and case studies in different areas of engineering in the book "Nonlinear Stability and Bifurcation Theory" (Springer-Verlag Wien, 1991). For his excellent research in this area the Austrian Academy of Science awarded him the Erwin Schrödinger prize in the year 2000.

Hans Troger not only acted as mediator between Mathematics and Engineering Science, he also brought together people from all over the world. When the iron curtain restricted the contact with colleagues from eastern countries, he tried hard to invite them to Vienna and get into contact with them. For his engagement he was awarded the honorary doctorate from the Technical University of Budapest. Of course, we had also many guests from many other countries and had many opportunities to learn about the latest developments in different scientific fields. Hans also took care, that his co-workers had plenty of opportunities to visit conferences and other institutes.

Despite his professional achievements and his academic positions Hans Troger was a very modest and kind person with a sense of humour, which was never offensive. He was a very sportive person, played excellent tennis and made ski and climbing tours in the mountains".

Figure 16. Discreet smiley of the well-meaning scientist and academician Hans Troger

Professor Alois Steindl goes on to describe the power of the personality of Hans Troger, which captivating and admiring his commitment to science:

"In summer 2009 metastases from an old malignant melanoma recurred and he had to stay in hospital for several months. Also in this time he was very interested in the scientific development and co-organized a minisymposium at a GAMM meeting. During a 3 week leave from the hospital he came to his office and gave his lectures. He got extremely weakened and had to return to the hospital, from which he was finally released two weeks before he died. During the last months of his life his elder sister took care for him.

With Hans Troger we lost an enthusiastic scientist, an important advisor and, above all, a good friend. His achievements and the memory of his outstanding personality will be with us forever".

Katica (Stevanović) Headrih's memories of Professor Hans Troger are as follows:

"I first saw Professor Hans Troger at the University College of Kinds (UCL) in London, when I first participated in a IUTAM symposium "Non-linearity and Chaos in Engineering dynamics" UCL 1993 London UK, as a subsequently

submitted abstract and accepted participant. Abstract of my presetation was not inkuded in the book of abstracts, because I applied for the later, but my presentation was realized in scientific program of TUTAM symposium and I am in a joint symposium photo of all the participants of this IUTAM Symposium. Professor Hans Troger is also pictured here. Later we met, as we regularly participated in conferences of the European Society for Nonlinear Oscillations.

Figure 17. Academician Hans Troger and Professor Katica (Stevanović) Hedrih at the European Conference on Nonlinear Dynamics ENOC Eindhoven 2005.

Later, when I met with Professor Hans Troger and met many paths at European Conferences ENOC and IUTAM Symposia, communication of random encounters began among us. Since 1993, republics have broken up into separate states in Yugoslavia, and Serbia has been under blockade, and as a finale under aggression that ended in bombing 1999. Scientists from Serbia were not favorite, but Professor Hans Troger always showed sympathy and affection for me at every chance encounter. He was interested in asymptotic methods of nonlinear mechanics, which I was doing at the time, so I got a call from him and I stayed for a few days in Vienna, where I gave a lecture at his Seminar at the Technical

University. That was 2003. He was an exceptional host, he waited for me at the Vienna airport, provided me with a hotel accommodation, and drove me to the airport on departure.

During my stay in Vienna, he instructed me what to see. So I took a look at a vowel at the Under Vienne Theater, as well as the Magic Flute at the Vienne Opera, in addition to the other sights of Vienna, where I first stayed. My last stay in Vienna was 2014, when the ENOC-the European Conference of Nonlinear Oscillations was held, but then Professor Hans Troger was absent. In 2010, he was killed by a vicious cancer disease".

Next description of personality of Professor Hans Troger by **Katica (Stevanović) Hedrih** follows:

"He remembers the remarkable scientist, Professor Hans Trogirer, as a tall, sophisticated person, always sportily trained with a backpack, quick movements and warm friendly eyes, ready to always accept scientific communication with a lot of benevolence, a person open to new knowledge and information. It was an honor to know him and to be under his care. Rarely do they meet such persons, who are in communication with scientists from both the west and the east. For Hans Troger, the whole world was an area of easy movement and he had friends around the world. I was honored to have had the opportunity, at his invitation, to participate in a 2003 scientific lecture at a scientific seminar at the Technical University of Vienna".

6. Concluding considerations

World Science Nonlinear Dynamics is the loser of a remarkable creator dedicated to finding the right results, able to interact with scholars from all over the world, not only through literature but also through personal communication, and to overcome the linguistic barriers of the East and West, as well as large between different area of sciences.

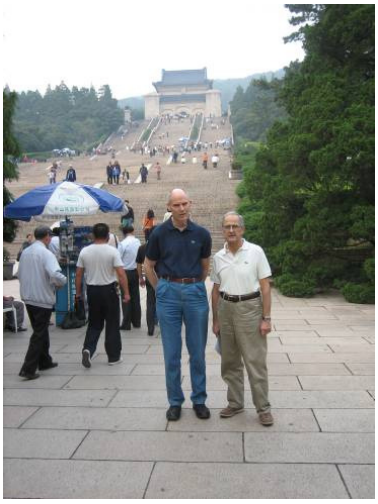
Hand Troger was am unique scientist and a person who was pleased to meet at scientific conferences, IUTAM and EuroMeh Symposiums, as well as university seminars. He also liked to host the TU in Vienna and to repay the gregarious hospitality. He has delivered many plenary lectures on the aforementioned skips. It should be noted here that he was a unique scientist, an engineer who constantly monitored new mathematical achievements, had the talents and knowledge, and the ability to adapt them to applications and introduce new trends in the nonlinear dynamics of mechanical systems. There are few such scientists who can a new mathematical concept of transmission for applications in the dynamics of abstraction models of engineering systems. In my opinion, this contribution by

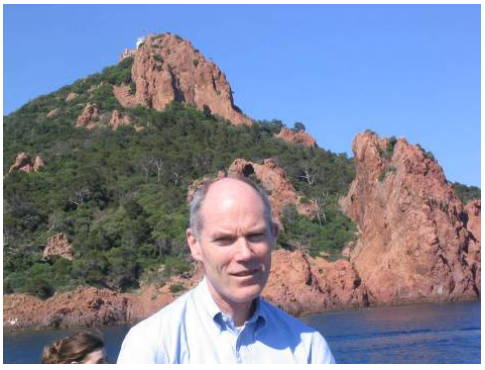
Hans Troger to scepter science in the field of Nonlinear Dynamics puts him at the top of his generation.

The great number of scientific papers that appeared in the best international journals in the field of solid mechanics (see the attached List of Publications [21] in Acta Mechanics 218, 1–8) bears witness to Hans Troger's truly outstanding scientific achievements in all of the aforementioned subfields of the mechanics of solids and beyond them.

8. Photo gallery of the memory of academician Hans Troger

IUTAM Symposium - Stuttgart 1989 (?)





These few photos are very telling about Professor Hans Troger as an athlete, a sociable person, as well as friendly relations with contemporary top researchers and scientists un Nonlinear Dynamics and Mechanics, such as Russian academician Vladimir Beletsky, American Professor Ali Nayfeh, who are no longer among us, but whose scientific results are still among moms. In these pictures, Hans Troger is with outstanding nonlinear dynamics scientists with Professors Giuiseppe Rega, Francis Moon, Alois Stendl and others

Acknowledgment: The content of this work was based on texts published in the Journal of the Act of Mechanica, as an obituary in a special issue of this journal, documentation provided to me by Professor Giuseppe Rega, La Sapinźa University of Rome and Professor Aloiź Steindtl, Technical University of Vienna, as well as photographs provided to me submitted, as well as based on my own documentation and photos from my own archive. Also, by searching the internet, I found information about Professor Troger's published monographs and articles, the largest of which was in Springer's edition.

To professors Giuseppe Rega and Alois Steindl, I warmly thanks about the well-intentioned help in collecting the documentation for this article, which has got him better into the much richer content.

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Cyparissos Stephanos' unsuccersful attempt to translate Erlanger Programm

Christine Phili

I. Cyparissos Stephanos as a member and archivist of the French Mathematical Society.

Just before the Franco-Prussian War Chasles in his official report regarding the progress of geometry in France[1] expressed the imperative need to create a learned Society exclusively devoted to the mathematical sciences.

After the defeat of 1870 the French scientists understood that it was German Science that had won the war. Louis Pasteur in a newspaper article in March 1871 stresses this German superiority.

«... I believe, to France's lack of interest, over the past half century, in the great works of thought, particularly in the exact sciences... Whereas Germany has increased its universities, established a more beneficial rivarly between them, bestowed]its teachers and its professors with honor and consideration, created vast laboratories endowed with the finest instruments, France... has given only sporadic attention to its establishments of higher education»[2].

Thus, after the revolutionary events of the Commune of Paris which were violently suppressed, French mathematicians quicly move to create the French Mathematical Society[3], officialy founded in 1872. In the first article of

1 M. Chasles, *Rapport sur les progrès de la géométrie* Paris. Imprimerie Nationale 1870, pp. 378-379.
2 L. Pasteur, *Le Salut Public* Lyon March 1871. See. H. Gispert, «The Effects of War on France's International Role in Mathematics, 1870-1914» in *Mathematics Unbound: the Evolution of an International Mathematical Research community, 1800-1945* (eds) K. Hunger Parshall, A. C. Rice A.M.S., L.M.S. 2000, p. 107.
3 For more details see H. Gispert, La France Mathématique: La Société mathématique de France (1870-1914). Paris *Cahiers d'Histoire et de Philosophie des Sciences. Société Mathématique de France et Société française d'Histoire des Sciences et Techniques* 1991.

its statutory we can read that the society is open, without restriction, to all those with an interest in the advanument and dissemination of mathematics. Moreover the second artcele forbid any commication or discussion regarding topics irrelevant to mathematics.

Thus, the foundation of the French Mathematical Society in 1872 as well as the establishment its *Bulletin des Sciences mathématiques* created in 1873 organized and reinforce the French mathematical community.

So, when in automn 1878 Cyparissos Stephanos (1857-1917) with his Ph. D from Athens university, mastering French and German, arrived to Paris in order to prepare his Thèse d'État under Ch. Hermite's supervision, h found this atmosphere of scientific enphoria and national exaltation.

On the 14th of February 1879 the young Greek mathematician presented his first communication in the French Mathematical Society[4] regarding a remarkabre property of irrational numbers, which was published in the Bulletin of the French Mathematical Society[5].

During the next session, on the 28th of February 1879, Stephanos was introduced by Halphen and Laguerre to this newly established scientific Society[6] and in the next session, this of 14 March 1879, was elected member of the rench Mathematical Society[7].

In this same year Stephanos showed evidence of his mathematical talent and presented six interesting papers mainly focused on geometry[8]. All this scientific activity became his modus viventi for the young Greek mathematician during his Parisian sejourn (1878-1884).

Under Laguerre's presidency (1880-1881) Stephanos was appointed archivist of the French Mathematical Society. At that epoch the Society was located in a historical building, in the hôtel particulier de Savoie, in the street

4 Twice in month from November to July took place the sessions of the French Mathematical Society.
5 C. Stéphanos, «Sur une propriété remarquable des nombres incommensurables». *Bulletin de la Société Mathématique de France.* Vol. 7, Paris 1879, pp. 81-83.
6 *Bull. S.M.F.* Vol. 7 1879, p. 205.
7 IDEM.
8 See f. ex. C. Stéphanos, sur une généralisation de la théorie des groupes projectifs de staudt (session of 28 March 1879); sur la correlation dans le plan (session of 13 June 1879); sur le système de trois tétraèdres dont deux quelconques sont en perspective, par rapport à chacun de sommets du trosième (session of 11 July 1879); sur un certain covariant relatif à une courbe de la classe met à une conique (session of 25 July 1879) etc.

Φωτο. του κτιριου απο το file ο κ. Στεφανος και η Γαλλική Μαθημ. εταιρεια

of Grands Augustins n° 7, near the French Academy of Sciences. From this administrative post Stephanos tried to develop the international scientific relations as well as the scientific contacts. In must be stressed that the administrative duties didn't put behind his scientific activities[9], which increased side by side with the esteem of his milien.

From his new post of archivist he tried to develop the scientific relations as well as the exchange of the *Bulletin of the Mathematical Society* with other well known mathematical journals.

Thus, following Schlömlichs proposal the *Bulletin of the French Mathematical Society* .... be exchanged[10] by the *Zeitschrift für Mathematik und Physik* founded in 1856 in Dresden by Dirichlet's disciple[11].

His first letters to Klein and to Mittag-Leffler reflected his concern to contribute to the regular exchanges of the *Bulletin* with *Mathematische Annalen*[12] and *Acta Mathematica*[13].

His reputation as researchworker as well as the post of archivist gave him the great opportunity to attend the milien of the distinguished mathematicians of his epoch.

9 See f. ex. C. Stéphanos, «Sur les faisceaux de formes binaires ayant une jacobienne donnée» *C. R. Ac. Sc.* Paris T 93 1881, pp. 994-997; «Sur une généralisation de la théorie de M. Laguerre sur la Géométrie de direction» *Bull. S.M.F.* Vol. 9 1880-1881. Paris 1881, p. 91; «Sur quelques propriétés de formes binaires» idem p. 93; «See certaines figures déterminées par six points d'une concique» idem, p. 174; «sur la rotation des corps solides autom d'un point». *Bull. S.M.F.* Vol. 10, 1881-1882. Paris 1882, p. 102 etc.

10 During the session of the 19th January 1883 Halphen and Stephanos introduced Ohrtmann, editor of *Jahrbuch. Bull S.M.F.,* Vol. 1882-1883, Paris 1883, p. 109.

11 *Bull. S.M.F.* Vol. 12 1883-1884. Paris 1884, p. 145.

12 From his post at the Erlangen University Klein accepted to exchange *Mathematische Annalen with the Bulletin de la Société Mathématique de France.* See *Bull. S.M.F.*, Vol. 1, 1872-1873, Paris 1873, p. 121.

13 See his letter to F. Klein (4 March 1882) as well as to Mittag-Leffler (19 March 1883). Ch. Phili Stephanos' eight unpublished Letters to Felix Klein». *Proceedings of the Academy of Athens* Vol. 87 A΄ 2012, p. 38. «Six unpublished Letters of Cyparissos Stephanos to Gösta Mittag-Leffler» *Proceedings of the Academy of Athens.* Vol. 91, A΄ 2016, pp. 93-94.

Characteristic is the following fragment of Lie's to Klein in a letter on October 1882:

«... In the Academy I met with Halphen, Darboux, Poincaré, Levy and Stephanos, all of whom were very obliged»[14]. Continuing his letter he added: *«Halphen, Darboux and Stephanos spoke with the higst praise about you»*[15].

We must stress that during his sejourn in Paris (October-November 1882) Sophus Lie had the opportunity to meet Picard, Poincaré, Halphen who already appreciated his theory regarding the *Transformationsgruppen.* Thus, the Parisian mathematical community invited him to give a lecture in the French Mathematical Society. On the 3rd November 1882 the Norwegian mathematician exposed his ideas on the differential equations which admit infinitesimal transformations[16].

At this same session Stephanos[17] presented his communication on the representation of cercles by points of the space[18].

So, we consider that during his Parisian sejourn Lie had many occasions to meet the Greek mathematician.

Two years later Lie's exprissed his favorable opinion regarding Stephanos' research in his letter on the 1st February 1884 to E. Holst, where he expressed that the acquaintance of the young Greek mathematician gave him great pleasure *«who as a gifted mathematician seems to win the esteem of all»*[19].

As D.H. Row revealed in another letter from Paris Lie trying to satisfy Klein's question regarding the evaluation of contemparary geometers of course. The Norwegian mathematician expressed his esteem for the distinguished

14 D. E. Row, «Three Letters from Sophus Lie to Felix Klein on Parisian Mathematics during the early 1880's» *The Mathematical Intelligencer* Vol. 7 (3) 1985, p. 76. Letter of October 1882, *Niedersächsische Staats und universitätsbibliothek.* Göttingen Cod. Ms. Klein 10. Nr. 685.
15 Idem.
16 *Bull S.M.F.,* Vol. 1882-1883. Paris 1883, p. 107.
17 It might be noticed that Lie's research attracted Stephanos attention. Thus, on the session of 20 May 1881 he presented his paper, «On the relation regarding the theory of directions fo Mr. Laguerre and the Geometry of Spheres of Mr. Lie». *Bull. S.M.F.,* Vol. 9, 1880-1881, Paris 1881, p. 94.
18 See not. .....
19 A. Stubhaug, *The Mathematician Sophus Lie. It was the Audacity of my thinking.* (transl. from the Norwegian by R. H. Doly) Springer Verlag 2002, p. 292.

mathematicians as Möbius, Darboux, Clebsch, Sturum, Weingarten but stressed that especially Stephanos do important work as geometer[20].

However Stephanos' activities were not only focused on his publications and on his administrative duties. He tried also to enrich the French Mathematical Society with new members. So, he became the godfather (*parrain* in French) of two great mathematicians of his epoch. And moreover in spite all the existent prejudices against the mathematical qualifications[21] of S. kowaleskay who at that period lived in Paris, he «dared» to present her in the French Mathematical Society.

Φωτο. του σπιτιού της (Κ. Στ. και η Γαλλ. Μαθ. Εταιρεία)

Thus, on the 21th of April 1882 Henri Poincaré was introduced by Halphen and Stephanos[22] to goin the French Mathematical Society and from that period started the friendship between these two young mathematicians.

Φωτο. με mail εσταλη στις 16.2.2020

Two months later during the session of the 21th of June 1882, Stephanos and Picquet introduced Madame Sophie de Kowalewski, to become member of the Society[23]. Once more time the esteem of the Parisian mathematicians was concretized as they permit to the archivist to preside the session of the 6 July 1883[24].

20 D. H. Row, *op. cit.,* p. 77.
21 Ch. for example the letter of the 15th October 1882 of Charles Hermite to Gösta Mittag Leffler. Lettres de Charles Hermite à Gösta Mittag Leffler éditées par P. Dugac. *Cahiers du Séminaire d'Histoire des Mathématiques* 5, 1984, p. 177.
22 According to the status of the society still valid until today any new member must be introduced by two members of the society. *Bull. S.M.F.,* Vol. 12 1882-83, p. 251.
23 *Bull. S.M.F.,* Vol. 12, 1882-1883, Paris 1883, p. 254.
24 *Bull. S.M.F.,* Vol. 12 1882-83. Paris 1883, p. 202.

«Mr. S. Lie, professor at the University of Christiania was introduced by M.M. Halphen and Stephanos and was elected member of the Society»[25] during the session of the 18th of January 1884.

II. F. Klein's Erlanger Programm

F. Klein (1849-1925) only 23 years old was appointed to a full professorship at the Erlanger University. On this occasion on the 7th of December 1872 gave a lecture[26], his Erlangen *Antrittstede*[27] which was not the famous *«Vergleichende Betrachtungen ueber neure geometrische Forschungen».*

However the newly appointed professor at the University in order to introduce himself to his colleagues was obliged to submit a published program[28], which was distributed as a pamphlet.

Φωτο. το εξωφ., θα μπουν οι δυο φωτογρ. ˝˝˝˝˝˝˝˝˝˝˝˝

According to his own account, the *Erlanger Programm* was composed in October 1872 and its source can be traced back to ideas presented in his paper *«Ueber die sogennantenicht. Euklidische Geometrie, zweiter Aufsatz»*[29].

And Klein continuing to unveil the details concerning the composition of *Erlanger Programm,* indicates that: *«Two circumstances are relevant First, that Lie visited me for two months beginning September 1. Lie, who on October 1 accompagnied me to Erlangen... had daily discussions with me about his new theory of first order partial differential equations (edited by me and published in the Göttingen Nachrichetn of October 30). Second, Lie entered eagerly into*

25 *Bull. S.M.F.,* Vol. 12, 1883-1884, Paris 1884, p. 146.
26 D. E. Row, «A forgotten chapter in the History of Felix Klein's Erlanger Programm» *Historia Mathematica.* Vol. 10, 1983, pp. 448-457.
27 The topic of his lecture was the pedagogical principles and goals of his future academic activity.
28 F. Klein, *Gesammelte Mathematische Abhandlungen* Bd. I, R. Fricke und A. Ostrowski (hersg) Berlin J. Springer 1921, p. 411.
29 Idem.

my idea of classifying the different approaches to geometry on group theoretic basis»[30].

Klein, who had as target to stress the unity for the fragmented geometry, started this historical essay identifying each of the continuous groups of geometric transformations that was associated with some branch of geometry[31]. Firstly he disussed the principal group (Hauptgruppe) and there he presented *«a larger project group. the conformal group generated by inversions, the group of birational transformations leaving invariant the singularities of algebrace varieties, which contained all of the preceding, groups, and the (still more general) group of all homeomorphisms leaving the topology of a manifold or space invariant»*[32].

Later Max Noether, in his obituany article stresses the connections between *Erlanger Programm* and Lie's works:

«In the Erlanger Programm for the first time [we find unveil] *the central role of the transformation group for all geometrical investigations... and that, with invariant properties, there is always associated such a group... Lie, who worked with most varied groups, ut to whom the meaning of clanification had remained foreign, found the idea congenial from then on»*[33].

At that period Klein's dominance in geometry was indiscutable and quickly he became the only heir of the German «school» of geometers: Möbiuis, Steiner, von Standt, Plücker and Clebsch.

30 F. Klein, *op. cit.,* p. 413.

31 Progessor R. Tobies stressed that the *Erlanger Programm «bildete... eine entscheidenende Zäsur für die Geometrie des 19. Jahrlunderts. Die Verwedung des Gruppenbegriffes durch Klein unterstützte die Ansätze strukturellen mathematischen Deukens, die sich gegen Ende des 19. Jahrhunderts heranseebildeten».* R. Tobies, *Felix Klein* 1981. Leipzig: BSB, B. G. Teubner Verlagsgesellschaft, pp. 36-37.

32 G. Birkhoff and M. K. Bennet, «Felix Klein and his «Erlanger Programm»» in *History and Philosophy of modern mathematics,* ed. W. Aspray and P. Kitcher, Minnesota studies in the Philosophy of science. Vol. 11 Minneapolis: university of Minnessota Press, p. 151.

33 M. Noether, Sophus Lie, *Mathematische Annalen* Bd. 53. 1900, p. 23 and G. Birkhoff and M. K. Bennet, *op. cit.,* p. 153.

III. Stephanos' relationship with Klein and the refusal of a translation

In the session of the 1st June 1883 of the French Mathematical Society, Stephanos presented his communication on the geometrical representation of quaternions[34]. In this same year this work was published in *Mathematische Annalen*[35].

In reality this paper constitutes a letter which Stephanos sent to Klein. Professor Arild Stubhaug in his book on Lie, unveiled that *«Lie praises Stephanos' paper, which was published in Mathematische Annalen»*[36].

In his unpublished letter[37] of the 4th March 1882, Stephanos addressed his thanks for the eventual presentation of his paper regarding the quatermions[38].

«I am very happy for your concern regarding my presentation related to the theory of quatermions. In this paper one of the starting point was the fact that you have notice it and in your letter[39] *you have already indicate.*

Actually the study of Mr. Laguerre's article regarding the calculus of linear systems (Journal de l'École Polytechnique, 42 Cahier) fertilized another former idea of mine, which contains quaternion's representations from spacevs points having weights (thus the quaternion $a + bi_1 + ci_2 + di_3$ *could be represented from a point* ***a*** *of mars having as orthogonal coordinates* $\left(\frac{b}{a}, \frac{c}{a}, \frac{d}{a}\right)$ *and in order to justify the introduction of vectors to Möbius' barycentric calculus.*

34 *Bull. S.M.F.* Vol. 10, 1882-1883. Paris 1883, p. 203.
35 C. Stéphanos, «Sur la théorie des quaternions» *Math. Annalen.* Bd. 22 1883, pp. 589-592.
36 A. Stubhang, *The Mathematician Sophus Lie. It was the audacity of my thinking* (trad. from Norwegian by R. H. Daly) Springer Verlag 2002, p. 304.
37 We would like to exper our warmest thanks to Professor Al. N. Parshin, member of the Russian Academy of Sciences, who had the kindners to indicate us Stephanos' letters.
38 In his Autobiographical Notes Klein's didn't hide his interest on the theory of quaternions. F. Klein, *Gesammelte Mathematische Abhandlungen* Bd. I (hersg) R. Fricke and A. Ostrowski Berlin Springer 1921, p. 52. For more details see Ch. Phili, «Kyparissos Stéphanos and his paper on quaternions» *Acta historiae rerum naturalium necnon technicarum.* New series Vol. 3, 1999, pp. 35-46.
39 Stephanos died heirless and her cousins who ignored the value of his correspondance as well as this of his precions library, one week after his death (27 December 1917) sold the library and through away all his manscripts, including his correspondance.

For all these, after a completely laborous study I attended to the following result that in a prejective relation the quaternions' theory from the points of space, ended to represent binary hamographies»[40].

In his preface regarding Henri Poincaré's correspondance, professor Philippe Nabounand stresses that Poincaré and Klein were convinced on *Acta Mathematica's* important vole and mainly for its task to diffuse new ideas in mathematics[41]. So according to this policy *i.e.* to publish German articles probably iniciated by Stephanos' idea to present *Erlanger Programm,* Poincaré on the 14th August 1883 sent a letter to Mittag-Leffler, where among others underlying that: *«some publicity would be useful to many geometers, and especially to the French»*[42].

We must take into consideration that in spite their scientific revarly concerning the theory of Fuchsian fonctions the relations between Poincaré and Mittag-Leffler were good.

Let us permit to present the follouring fragment from Poincaré's letter of the 14 August 1883:

«... I am sending you a pamphlot by Mr. Klan. Stephanos thought that a translation of thus little known booklet would be of interest to readers of Acta and he has offered to translate it. I also believe that this pamphlet, though written a somewhat obscure style contains ideas that are very justified and unfortunately not very widespread. I thus believe that giving these ideas some publicity would be useful to many geometers, and especially to the French»[43].

As *Acta's* unexpected success suprised even its editor, Mittag-Leffler very quickly abandoned his idea regarding translations as at his office were already accumulate so many original papers waiting to appear in *Acta's* pages[44].

40 Ch. Phili, *op. cit.,* p. 38.
41 *La correspondance d'Henri Poincaré.* Vol. 1. *La correspondance entre Henri Poincaré and Gösta Mittag Leffler* présentée et annotée par Philippe Nabonnand. Birkhäuser Verlag Basel-Boston-Berlin 1999. Préface, p. 7.
42 IDEM.
43 H. Poincaré to G. Mittag-Leffler 14 August 1883 *Archives Henri Poincaré* Nancy. See *La Correspondance entre Henri Poincaré et Gösta Mittag-Leffler* présentée et annotée par Philippe Nabonnand. Birkhäuser Verlag Basel - Boston - Berlin 1999, p. 129. See D. E. Row, *A Richer Picture of Mathematics. The Göttingen Tradition and Beyond.* Springer International Publishing 2018, p. 129.
44 *La correspondance entre Henri Poincaré et Gösta Mittag-Leffer* Vol. 11. Birkhäuser Verlag. Préface p. 8, note 11.

Thus, the position of the Swedish mathematician to Poincaré's appeal remains firm and irrevocable:

«25 August 1883 Sma-Dalzö.

I am very grateful for Mr. Stephanos' kind offer to translate into French the work you sent me by Mr. Klein. It will, however, very difficult for me to publish this translation. In my hands I have so many original papers or essays which I expect to receive in the future. So it is almost impossible to publish new translations»[45].

However in 1883 Mittag Leffler published in *Acta* six French translations of Cantor's work[46] regarding set theory[47].

Mittag Leffler's excuse was a pretext or a new reality? We will never know.

Stephanos knowing that Poincaré's appeal remained unsuccessful, informed his mentor regarding Mittag-Leffler's refusal. So, having full acquaintance about the context of Poincaré's letter of the 14 August, he decided to mite asking further advices.

Thus, in one of his unpublished letters to Klein, this of the 29 September 1883 appeared his unknown attempt to translate *Erlanger Programm,* which unfortunately was never realized. Moreover through his letter appeared Stephanos' good will to collaborate with Klein in order to enrich this pamphlet with additions and notes making its study more accessible.

Though Klein's disciple, Walther von Dyck, Stephanos transmit his vivid interest to publish in *Acta* the French translation of *Erlanger Programm.* Did this translation constitute a common project with Poincaré, as later Lie's unveiled? We don't have sufficient proofs for that.

45 G. Mittag Leffer to H. Poincaré, 25 August 1883. *Archives Henri Poincaré.* Nancy. See Ph. Nabonnand *op. cit.,* p. 128. See also D. E. Row, *op. cit.,* idem.

46 It must be stressed that thanks to Mittag-Leffer's initiative the French mathematicians could have access to Cantor's new theory. Poincaré himself revise the translations. Thus, on 16 March 1883 Appell announces to Mittag-Leffler that Cantor's translations are ready to be publish. Ph. Nabbound, *op. cit.,* p. 7, note 9.

47 G. Cantor, «Extension d'un théorème de la théorie des séries trigonométriques» *Acta Mathematica* Vol. 2, 1883, pp. 336-348; «Fondements d'une théorie générale des ensembles» *idem,* pp. 381-408; «Sur divers théorèmes de la théorie des ensembles infinis et linéaires de points: i-iv» *idem,* pp. 349-380; «Sur les séries trigonométriques» *idem,* pp. 329-335; «Sur une propriété du système de tous les nombres algébriques réels» *idem,* pp. 305-310; «Une contribution à la théorie des ensembles» *idem,* pp. 311-328.

Let us permit to present the following fragments from Stephanos' letter:

«... Mr Dyck must inform you about my interest to publish in French your booklet Vergleichende Betrachtungen but unfortunately all my efforts[48] *frecitful remain unsuccessful.*

For this reason recently I ask Mr Poincaré to write...» [a letter] *to Mr Mittag-Leffler. For this reason Mr. Poincaré* [already] *sent him a letter.*

[Through his lines] *it seems that Mr Leffler could eventually in the future*[49] *publish your article. However he didn't appeared hasty to precise how long we can wait... regarding the translations he established a general measure, although he had already published many translations of German papers*[50].

Do you consider that could be an another way to overcome this difficulty. I think that now we must be coordinated on the additions which you intend to embed in your essay Vergleichende Betrachtungen in a systematic plan, in order that the publication of this new work could improve[51] *the reedition of your former essay.*

Do you have another idea in order to obtain more quickly a concreter result?»[52].

In his Letter (1st February 1884) to P. L. Sylow it appears that Lie by Chance had come to know that Poincaré and Stephanos would translate *«an old Programme of Klein's into French for Acta, and that Klein would consequently add new notes, a submission that Mittag Leffler had refused, and after that the work was put aside»*[53]. *Lie comments that he too had encouraged Klein to publish this work.* However it might be stressed that at the period where the *Erlanger Programm* was published, Kleine's vision regarding group's concept as an unifying tool for mathematics, was also, also share by Lie and Poincaré. *«All three were impressed by the work of Jordan, particularly his Traité des substitutions (1870), where groups were applied to geometry as well as to the*

48 We ignore Stephanos' former efforts.
49 In reality in his letter to Poincaré Mittag-Leffer excluded any hope or expectation.
50 Direct reference regarding Cantor's translations.
51 Stephanos understood the obscure style of Klein's booklet.
52 Göttingen, Nachlass Felix Klein, Cod Ms. F. Klein 11: 1154. See Ch. Phili, *op. cit.,* p. 41-42.
53 A Stubhang, *op. cit.,* pp. 486-487.

theory of equations»[54]*. This work «which stands in intimate relationship with my old Themes in a very effective Manner»*[55]*. (i.e. Erlanger Programm),* stressed Lie.

And Lie contimes *«As for the rest, I have taken no part in Poincare's proposal, apart from the fact that* P[oincaré] *and I talked about the work in question, which in my eyes is the most significant mathematical-Philosophical work in my time»*[56].

Lie felt that Mittag-Leffler's refusal was a *«Blunder»* and that accordingly this was due to his desire to follow *«in Berlin's Footsteps»* and the eminent Norwegian mathematician concluded *«But what irritates me is that this Man*[57] *could, as it were, pass over a Writer and a Work, both of whom I am so close, without me knouring anything about it»*[58].

Two years after Poincaré's appeal and Stephanos' letter on the 21th June 1885 Klein on is turn sent a letter to Mittag Leffler having as target to bent his colleague's objections regarding *Erlanger's Programm* translation and to convince him to reconsider this proposal. Moreover he proposed that the competition between the two journals should be transformed to a collaboration[59].

«... Recently, as far as I know, Mr. Poincaré wrote you at the instigation of Mr. Stephanos about my Erlanger Programm (1872). I was gratified by the idea of the Parisian' mathematician that a translation might be published in Acta because I am intensted that the general ideas underlying my program be disseminated as widely as possible. Now, however, having heard that for the time being, you do not wish to publish any translations I gladly accede to this. Would you please take my acceptance as proof that I would like as much as

54 Th. Hawkins, «Erlanger Programm of Felix Klein». *Historia Mathematica.* Vol. 11, p. 445.
55 IDEM.
56 IDEM.
57 It might be stressed that in this same letter revealed that he is the only responsible for this refusal, stressing that *«Mittag-Leffler is a strange person ... He is also extremely arrogant. For him Weierstrass, Hermite, Poincaré and Leffler are the four great mathematicians of an epoch and the two last are the greatest of the future. For him all the other mathematicians most of them are non existent».*
58 IDEM.
59 *«Wollen sie in meiner bereitwilligkeit den Beweis dafür erblicken, dass ich die naturgemässe Concurenz zwischen den Acta und den Annalen möglichst zu einer Cooperationen umgestalten möchte».* Mittag-Leffeler Institute Djurshold. See Ph. Nabonnand, *op. cit.,* p. 8.

possible to turn the natural competion between Acta and the Annalen into a form of cooperation»[60].

It might be stressed that Stephanos was quite incorporated into the French mathematical community, so Klein utilized the adjective Parisian[61] [*die Idee der Pariser Mathematiker*].

However this famous cooperation which Klein had hoped to establish between *Acta Mathematica* and *Mathematische Annalen* would never realized. And Klein never submit any of his work to be published in *Acta.*

IV. After twenty years

Almost at the same period in which Stephanos took the iniative to translate into French the Erlanger Programm, Lie in Jannuary 1884 adviced Klein to republish it.

«If you intend to let your older works appear successively in Mathematische Annalen, then don't you want to publicize your programmschrift there? It is surely your most important work from the period 1872, and would now be better understood than at that time»[62].

Lie had right. Klein's *Erlanger Programm* was published as a *Programmschrift* had a limited distribution, so during a period of twenty years (1872-1892) was not nidely known. Even Poincaré who desired to be published Stephanos' translation, as revealed Lie in his letter to Klein, on October 1882, didn't know it:

60 Klein to Mittag Leffler, 8 October 1883 Mittag Leffler papers. Institute Mittag-Leffler Djursholm. See D. H. Row, *op. cit.,* idem.

61 Stephanos quite often was designated as Parisian mathematician. See f. ex. E. Müller's paper «Die Geometrie der punktpaare und Kreise im Raume nach Grassmann'schen prinzipien» *Monatshefte für Mathematik und Physik.* Bd. 7 (1) 1896, p. 77 *«welche die französischen Mathematiker Stephanos».* Müller refers to Stephanos' papers, «sur une configuration remarquable de cercle dans l'espace» and «Sur une cofiguration de quinze cercles et sur les congruences linéaires de cercles dans l'espace». *C. R. Ac. Sc.* T. 93, 1881, pp. 578-580 and pp. 633-636.

62 Lie to Klein, 20 January 1884, Klein Nachlass X, 695 SUB Göttingen. See A. Stubhang, *op. cit.,* p. 301. On the relation between Klein-Lie see L. M. Yaglom, *Felix Klein and Sophus Lie: Evolution of the idea of symmetry in the nineteenth century.* Basel, Boston Birkhäuser Verlag 1988.

«I told him about your [Erlanger] *Programm which he did not know»*[63], thus, he described it to him[64].

The unexpected death of his mentor, A. Clebsch as well as Lie's puplications regarding his theory of continuous transformations groups probably return Klein to develop the ideas of the *Erlanger Programm.*

In the first lines of *Erlanger Programm's* translation in English, Klein unvealed this situation:

«My 1872 Programme, appearing as a separate publication... had but a limited circulation at first with this I could be satisfied more easily, as the vieus developed in the Programme could not be expected at first to receive much attention. But now that the general development of mathematics has taken, in the mean while, the direction corresponding precisely to these views, and particularly since Lie has begeen to publish in extended form his thoerie der Transformations grupper... it seems proper to give a wider circulation to the expositions in my Programme»[65].

However *Erlanger Programm*[66] was firstly translate into Italian. Klein agreed with segre's proposal of a translation. As at that period, the first volume of Lie's *Theorie des Transformations gruppen* was published in 1888, he though that it was about time that the ideas of his programm should be develop and diffuse. Segre opted for his student G. Fano to translate *Erlanger Programm,* which was published in *Annali di Matematica*[67] un 1890.

After Stephanos' unsuccesful attempt, the *Erlanger Programm* was finally translated into French by H. Padé, who in the next year will defend his thesis, sen la représentation approchée d'une fonction par des fractions rationnelles, under Hermite's supervision.

63 D. H. Row, «Three Letters from Sophus Lie to Felix Klein on the Parisian mathematics» *The Mathematical Intelligencer* 7 (3) 1985, p. 75.
64 Th. Hawkins, *op. cit.,* p. 448.
65 F. Klein, «A Comparative Review of Recent Resenches in Geometry. *Bulletin of the New York Mathematical Society* Vol. 2 1892-93, p. 215.
66 For more details see H. Wussing, zun Enstehungsgeschichte des Erlanger Programmes. *Mitteilungen der Mathematischen Gesellschaft der DDR.* Bd. 1 1968, pp. 23-40; *Die Genesis des abstrakten Gruppenbegriffes.* Berlin VEB. Deutcher Verlag der Wissenschaften 1969.
67 F. Klein, «Considerazioni compartive intorno a la ricerche geometrici recenti» *Annali di Matematica.* (2) t. XVIII 1889, pp. 307-343.

This translation was insert into the *Annales Scientifiques de l'École Normale supérieure*[68].

As he reveals in the French translation Klein added some notes and made a certain member of modifications *«After the publication in the Annali di Matematica of the Italian translation of my Erlangen Programm, a year ago, I accepted with greater pleasure. Mr. Pade's proposal... In the Italian translation I made some corrections and added some corrective notes»*[69].

He also expressed his satisfaction since *«actually the theory of graps seems... to atract the attention in France... and afterwards maybe my programm will provoke a certain interest»*[70].

However *Erlanger Programm* didn't provoke any interest as differential geometry as well kinematics cultivated by Darboux and his disciples dominated in France.

In this same epoch Klein finally decided to republish *Erlanger Programm* in his own journal, in *Mathematische Annalen*[71].

In the preface of his pamphlet he revealed his desise that this essay «*must be contain all the applications of the theory of manifolds... not only in geometry but in mechanics and in mathematical physics»*[72].

Moreover it must function *«in many branches... which during the last 20 years were added, especially the thoery of Lie's continuous groups»*[73].

In 1890 Mellen Woodman Haskell defended his thesis in Göttingen University under Klein's supervision. Returning in U.S.A. he prepares *Erlanger Programm's* translation which was published in 1893 in *the Bulletin of New York Mathematical Society*[74].

68 F. Klein, «Considérations comparatives sur les recherches géométriques modernes» *Annales scientifiques de l'École Normale supérieure* Paris (3) 1891, pp. 87-102 and pp. 173-189. In our days *Erlanger Programm* was edited by Gauthier-Villars in 1974 having J. Diendonné's preface.
69 F. Klein, *op. cit.,* p. 87, n. I.
70 IDEM.
71 F. Klein, «Vorgleichende Betrachtungen über neue Geometrie». *Math. Ann.* Bd. 43 1893, pp. 63-100.
72 F. Klein, *op. cit.,* p. 63.
73 IDEM.
74 F. Klein, «A Comparative Review of Recent Researches in Geometry» Bulletin of New York Mathematical Society, pp. 215-249.

Finally Klein's ambition regarding the diffusion of his booklet will be completed by the almost simultaneous translations into Russian and into Polish by D. Sintzov[75] and S. Dickstein[76];;;; respectively.

We must take into consideration that at the last years of Lie at Leipzig University D. Sintsov[77] attended his lectures.

V. Conclusion

We consider that Stephanos confronted the rivarly of two distinguished mathematicians who having as shield their own journals fight in order to dominate over the mathematical nulien. Klein with his *Mathematische Annalen* and Mittag-Leffler with his recently established *Acta Mathematica.*

However according professor Nabonnand this competition between *Acta* and *Annalen* was only in Klein's mind. The desère of *Acta's* editor was to create an international journal, while Klein's *Annalen* were mainly addressing to German mathematicians[78].

Stephanos forgot Mittag-Leffler's refusale and didn't maintain any hard feelings for the Swedish mathematician. Thus, when in 1897 the mathematical community desiring to honor the 20th volume of *Acta Mathematica* addressed their unanimous recognition to its editor. In their tribute the most famous mathematicians of that epoch expressed their gratitude to Mittag-Leffler[79], who founding the *Acta Mathematica* offered *«a service of the highest importance...*

... In the name of friends of Analysis, we express the hope that the Acta Mathematica will pursue for the good of science a career begun with brilliance and encouraged by the universal fellings of mathematicians»[80].

This tribute «letter» was signed by the mathematical élite. Among them we can quote: Weierstrass, P. du Bois-Reymond, Fuchs, Weyr, Lord Kelvin, J.

75 *Kazan Izv. Fis. Mat.* Ob 2. 5, 1895-96, pp. 1-16, 6 (1896), pp. 17-44.
76 *Prac Mat Fiz* Narszawa 6, 1895, pp. 27-61.
77 E. Strom, Sophus Lie, *The Sophus Lie Memorial Conference Oslo 1992.* Scand. Univ. Press Oslo 1994, p. XXVIII.
78 Ph. Nabonnand, *op. cit.,* p. 8, note 12.
79 A. Stubhang, transl. from Norwegian T. Tunnally) *Gösta Mitta-Leffler. A Man of convinction.* Springer 2010.
80 N. E. Norlund, «G. Mittag-Leffler» *Acta Mathematica* Vol 50 1927, p. iv. see also J. E. Barrow-Green, «Gösta Mittag-Leffler and the Foundation and Administration of Acta Mathematica» in *Mathematics unbound: The Evolution of an International Mathematical Research community, 1800-1945.* K. Hunger Parshall, A. C. Rice (eds). A. M. S., L. M. S. 2002, p. 160.

J. Sylvester, J. Bertrand, Hermite, Jordan Darboux, Poincaré, Picard, Appell, Brioschi, Cremona, Beltrami, A. Markov, Cyparissos Stephanos, Texeira and others.

However Felix Klein declined to pay tribute to his colleague.

Later when in 1900 Mittag-Leffler arrived in Athens after his sejoum in Egypt Stephanos tried to make confortable his visit. He gave a reception on his honor and introduced him to the Athenian élite. Thus, the swedish mathematician was invited by Sophia Schliemann, by the director of the German Archeological Institut, Dr. Wilhelm Dörpfeld. He also attended the session of the French Archeological School where he met Dr. Théophile Homolle, well known for his research on Delos' island.

During Stephanos' reception at the prestigious Grande Bretagne hotel he made the acquaintance of Professor at Athens University Ioannis Hadzidakis[81] and professor of the National Technical University, Petros Protopapadakis[82], as well as the cheef of the Greek army, general Konstantinos Sapountzakis and the minister of Education, Athanassios Eftaxias.

Moreover as a protegé of the King of Sweden and Norway, Oscar II, he was invited by king George I, by the crown prince Konstantine I and he spent an entire day with the Royal family at their secondary residence, at Tatoi.

After Mittag Leffler's departure to Italy Stephanos changed by the swedish mathematica intervened to offer a volume of *Acta Mathematica* to the Sovereign[83].

In spite an advanced research we couldn't find any document which could respond to our question. Why Stephanos had the firm idea to publish his stranslation in *Acta Mathematica.* Why he didn't try to publish his translation, apparently existent, in the well known and prestigious French journals, *Journal de mathématiques pures et appliquées* or *Bulletin de la Société Mathématique*

81 I. Hatzidakis attended the lectures of Weierstrass, Kummer and Krouecker at Hamboldt University (1871-74) Elected in 1884 professor of Analysis at Athens University, he cuated a complete serie of mathematical manuels for the university as well as for the secondary education.

82 He attended the lectures of the Ecole Polytechnique and graduated from the Ecole des Mines, he was appointed professor at the School of Industrial Arts (former name of the National Technical University.

83 For more details see Ch. Phili, «Six unpublished letters of Cyparissos Stephanos to Gösta Mittag-Leffler» *Proceedings of the Academy of Athens,* Vol. 91, A΄ 2016, pp. 85-122.

de France. Or why he had excluded the collaboration with the famous editorial house of Gauthier-Villars?

Did all these alternative solutions are in reality included in his former efforts which mentioned in his first lines of his letter of the 29th September 1883 *«... but unfortunately until now all my efforts did not attend a fruitfull result».*

We don't know. However Stephanos' obsession, supporting by Poincaré and Klein, to publish his translation in *Acta Mathematica* could not attend its target.

As it concerus Mittag-Leffler's refusal we consider that the name of Stephanos wasn't the main problem. May be Mittag-Leffler couldn't understand that from now the geometrical transformations will expressed the profound substance of geometry. He couldn't understand that the invariant theory relates geometry to algebra? Or he couldn't understand that from now geometry ceased to by the study of geometrical figures'properties and it will be transformated to a study of various transformation groups, where every group corresponds to a space. Maybe the «unification» regarding the research of standt, Riemann, Lobatehevskii, Bolyai, Cayley, Poncelet, Beltranni could bother the analyst Mittag-Leffler or simply his refusal's reflected only Mittag-Leffler's antipathy for Klein. Naturally, all these are pure conjectures and probably we will never know the deeper cause of this refusal.

However the discovery of Stephanos' attempt, who very young pad this gentle ambition to publish in the first issues of *Acta Mathematica* his translation of *Erlanger Programm*[84]*,* the greatest guiding principle[85] (*Richtlinie*) for Klein subsequent research constitutes un important unknown fact concerning the history of mathematics of the 19th century.

84 For the significance of Erlanger Programm see C. Carathéodory, «Die Bedeutung des Erlanger Programms». Naturmisseuschaften Bd. 7, 1919, pp. 297-300; *Gesammelte mathematische Schriften* Bd. 5, München 1957, pp. 45-51.

85 F. Klein, Göttinger Professoren. Lebensbilder von eigener Hand U. Felix Klein *Mitteilungen des Univestitätsbundes* Göttingen 5, 1923, p. 18.