Chapter 12
The Vienna School of Descriptive Geometry

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Abstract The *Vienna School of Descriptive Geometry* played a leading role in the development of all branches in the field, including freehand drawing, the construction of machines, projective geometry, and, of course, theoretical descriptive geometry, as well. Extensive teaching combined with thorough drawing training as well as high level research characterizes the institution for more than 100 years. Emphasis was always given to practical applications and to geometric imagination. We shall describe the early years, beginning with the founding of the Vienna *Polytechnicum* in 1815, the school's slow start, the first chair, and the first institute in 1843. We shall also describe—by introducing the chief characters and their role—the growing importance of descriptive geometry in the subsequent years due to industrial development and the introduction of studies for future teachers at *Realschulen*. Because of the increasing number of students the institute was divided into two parts in 1870, and a second institute was established in 1896 (see also Stachel, Chap. 11, and Moravcová, Chap. 16, this volume).

Keywords Descriptive geometry · Nineteenth century · Twentieth century · Vienna · Vienna University of Technology · Johann Hönig · Rudolf Staudigl · Rudolf Niemtschik · Gustav Peschka · Emil Müller · Theodor Schmid · Erwin Kruppa · Ludwig Eckhart · Josef Krames · Walter Wunderlich

1 First Years

The needs of the growing industries and trades led to the founding of various special schools and proposals for new organizations (see, for example, Lechner 1940) until the *Polytechnicum* of Vienna was founded in Vienna in 1815 modeled on the *École polytechnique* in Paris. From the beginning, geometric drawing

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was an important topic since it was needed for most studies, including building, engineering, architecture, and so on. But contrary to the Paris *École polytechnique*, there was no chair devoted to it. The necessary courses—"machine drawing" and "preliminary technical drawing"—were held as part of the normal curricula. Soon this situation was considered as unsatisfactory, and in 1834 Johann Hönig,[1] an assistant at the Faculty for Mechanical Engineering (*Maschinenlehre*), voluntarily offered to give courses on descriptive geometry and drawing. In 1839, he left Vienna to become a professor for *Darstellende Geometrie und Zivilbaukunst* at the *Berg- und Forstakademie* in Schemnitz[2] where he stayed until 1843. From 1843 to 1870, he was a professor for descriptive geometry at the *Polytechnicum* in Vienna and a rector from 1868 to 1869 (Ottowitz 1992, p. 499, Obenrauch 1897).

The situation in Vienna was considered to be very bad, and the board of professors repeatedly (1827, 1835, and 1839) demanded the installation of a chair for descriptive geometry, and—with Hönig away—the situation became even worse. In 1841, another application was made "auf das Dringlichste" (most urgent) with reference to Germany where similar chairs had already been installed and were very successful (see Benstein, Chap. 9, this volume).

In April 1842, a *Konkurs* was announced, and Hönig—having already successfully passed such an exam in Schemnitz—was declared to be the best candidate, and he became a professor of Descriptive Geometry in 1843.

In order to show the importance of this new chair, three assistants and nine rooms for drawing were assigned to it.

Hönig had to teach a course of 3 h (5 h from 1850) and 10 h of construction practice per week.

In addition, he gave a 2-h popular course on Sundays. For many years, his book *Anleitung zum Studium der Darstellenden Geometrie* (Hönig 1845) was also used at the other *Polytechnica* of the Austro-Hungarian Empire (Graz, Prague, Brno, and Budapest—all of them German-speaking *Polytechnica*, also in Lemberg (Lvuv) where also some courses were taught in German). Another influential book was written by a professor of the Military Academy (Stampfl 1845).

A big step forward happened in the middle of the nineteenth century caused by the growing importance of the *Realschulen*. In the middle of the nineteenth century, more than 60 such schools were founded and also many special schools for the military, mining, arts, and trade, which all needed descriptive geometry.

Their curricula contained a great deal of geometrical drawing and ornaments and descriptive geometry (much more than in the corresponding schools in the other German-speaking countries (see Benstein, Chap. 9, this volume)). The teachers needed for this were educated at the *Polytechnicum* (for more details about the teaching of descriptive geometry in Austria, see Stachel, Chap. 11, this volume).

[1] Johann Hönig (March 9, 1810, Karlsbrunn–October 26, 1886, Pressbaum).

[2] The Academy of Mining and Forestry in Schemnitz (Germany), later Selmecb'anya (Hungary), and now Bansk'a Štiavnica in Slovenia. The academy moved to Sopron in 1919 (Hungary).

2 Second Half of the Nineteenth Century

Hönig was a professor for 27 years until 1870. He was supported by Rudolf Niemtschik[3] as his assistant from 1857 to 1861 and then by Rudolf Staudigl as *Privatdozent*. Rudolf Niemtschik worked in the building industry and studied at the Polytechnicum Vienna from 1852 to 1856. He was also an assistant at the Polytechnicum Vienna from 1857 to 1861 and was a professor for descriptive geometry at the Joanneum in Graz from 1861 to 1870. He was a professor and chair of the First Institute for Descriptive Geometry at the TH (formerly *Polytechnicum*) Vienna until 1877. Rudolf Staudigl[4] studied in Vienna with Hönig and was his assistant from 1861 to 1867; in 1865, he obtained a teacher's degree for descriptive geometry, mechanics, and theory of machines at the *Oberrealschulen*. In 1866, he received the *Habilitation* for technical and freehand drawing, and in 1868, he was promoted in absentia at the University of Rostock (the Vienna Polytechnicum had not yet the right to promote), and he obtained the *Habilitation* for ornamentics and newer geometry in Vienna in 1869. From 1870 to 1877, he was *extraordinarius* and a professor and chair at the Institute for Descriptive Geometry at the TH Vienna from 1877 to 1891 (Ottowitz 1992, pp. 499–500).

In 1870, the chair in Vienna was divided into two, and Niemtschik followed Hönig as chair of the institute until his early death in 1877. He became a professor, and Staudigl was *extraordinarius ad personam*.

Niemtschik took over the courses for mechanical engineering students and Staudigl for the various building students, and both taught courses for future teachers of descriptive geometry. Both were also very much engaged in scientific publishing, often in competition as they considered the same kind of problems. While Staudigl used projective geometry for his solutions, Niemtschik used more original methods in the field of elementary descriptive geometry (Niemtschik 1866a,b).

Teachers for descriptive geometry spread all over the Austro-Hungarian Empire and most were also very interested in the field of research. They could publish their results in various journals, for example, in the so-called *Schulprogramme*, which were edited yearly by the schools. The Austrian Academy of Sciences (founded in 1848) also provided the possibility to publish and promote the field of descriptive geometry—each mentioned professor was a member of the academy.

After Niemtschik's death, Staudigl took over all his courses and became chair of the institute.

In 1872, the *Polytechnicum* became the Technical High School of Vienna (*Technische Hochschule*, abbreviated as TH), and it was granted the right to promote students in 1903 (Neurath 1915).

[3] Rudolf Niemtschik (Němčik) (April 28, 1831, Frýdek–March ?, 1877, Vienna).

[4] Rudolf Staudigl (November 11, 1838, Vienna–February 2, 1891, Vienna).

The Staudigl's courses had a very tight structure and combined various methods, and he always had practical applications as his goal. It was Staudigl, for sure, who laid the foundation for what later became the famous Vienna School of Descriptive Geometry. For his students, he distributed the first collections of reproduced examples. From 1884 on, the training of teachers took 6 years (instead of 4 years as before), and Staudigl taught courses on modern geometry and selected fields of modern geometry (Staudigl 1868, 1870, 1875).

Staudigl was responsible for both parts of the chair and the following list of his courses in 1890/1891 is a good example of the extent and the contents:

> Descriptive geometry: orthogonal, axonometric, skew and perspective projection of points, lines and planes; exercises on the relations between these elementary fundamental elements, first by orthogonal projection and then by all other methods of projection; drawings of simple technical objects, bounded by planes including shadows; pyramids and prisms, curves and curved surfaces, mainly cones and cylinders; rotational surfaces, regulated, skew and envelopes surfaces. 4 hours per week, 4 hours for a seminar, and 10 hours for construction drawings (Vorlesungsverzeichnis der TH Wien, translated by the author).
>
> Newer Geometry: basic figures (*Grundgebilde*) of the first degree (*Stufe*), their projective relationship, confocal and involutory basic figures of the first degree, products (*Erzeugnisse*) of these figures, curves of the second degree, *collinear* and *reciprocal* figures of the second degree, their relationship and products, surfaces of the second degree, and space curves of the third degree, *collinear* and *reciprocal* systems in space. For engineers, mechanical engineers and building engineers: 2 semesters, 4 hours per week, and 10 hours for construction drawings (Vorlesungsverzeichnis der TH Wien, translated by the author).

After the death of Staudigl in 1891 a second chair was installed and Gustav Peschka became his successor. Peschka studied at the *Polytechnicum* and the University of Prague, and worked as a constructor in a factory for machines. Then, he had positions at the *Polytechnicum* in Prague (from 1852 to 1857, he was "Adjunct" for mechanics, drawings of machines, and physics), at the TH Lemberg (from 1857 to 1863, he was a professor for mechanics, mechanical engineering and drawings of machines, and descriptive geometry), and at the German TH Brno (from 1863 to 1891, he was a professor for mechanics, mechanical engineering, and constructive drawing), Peschka (1877, 1882) he was dean from 1880 to 1882. From 1891 to 1901, he was chair for descriptive geometry at the TH in Vienna. Gustav Peschka[5] was the successor of Staudigl though he was only ranked second place by the committee. He is said to have been a "favorite of the court" (and the ministry). He was, in fact, not a good choice since Peschka had no interest in the practical applications, and he gave no courses for the teacher students. His main scientific contributions were in steam machines and their construction and safety (Einhorn 1985, pp. 565–571) (Lechner 1940, pp. 154–155).

In Vienna, Peschka taught courses for mechanical engineers, and it was said that he—contrary to his colleagues before and after—graded the student's works only by their size and number, and not by their content. It was also said that he was a master in drawing on the blackboard. He did most of his scientific work during his

[5]Gustav Peschka (August 30,1830, Joachimsthal–August 29, 1903, Vienna).

stay in Brno, including the four volumes of *Darstellende und projektive Geometrie* (Peschka 1883–1885, 1899). This book had an important influence, and his book (Peschka 1868, 1882) was famous for the excellent typography and its 336 wood carvings.

The second chair was first held by Franz Ruth (1850–1905) from 1891 until 1895 and then from 1897 until 1899 by Jan Sobotka (1862–1931)—both as extraordinarius, and both later went to the Czech countries: Ruth to Prague and Sobotka to Brno.

3 The Era Emil Müller–Theodor Schmid

At the turn of the century, both chairs were vacant, and excellent mathematicians were found for both: Emil Müller[6] and Theodor Schmid. Both were students of Staudigl and followed his tradition, thereby making Vienna the center of descriptive geometry in the German-speaking countries. Both were interested in various fields of mathematics, in applications for all engineering studies, and in the education of student teachers. They were dominating the field for many years and solidified the reputations of the *Wiener Schule der Darstellenden Geometrie* (Vienna School of Descriptive Geometry). Müllers interests were widespread. He made many contributions to Grassmannian methods—he was considered to be one of the main experts in this field (*Grassmannsche Ausdehnungslehre*)—and he applied these methods to different aspects of geometry. He also developed the theory itself, and introduced the calculation of "Faltprodukte" (inner products), stressing the advantage of his methods for the theory of invariants.

During his long career at the TH in Vienna, he continued to work in different fields, but, of course, his main interest became descriptive geometry. He taught the introductory courses for building engineers and architects and enlarged the curriculum for the student teachers. Up till then the student teachers had to take the general introductory courses for the engineers and some specialized courses. Müller changed this situation and introduced a special seminar and a four semester cycle of courses: methods of projections in descriptive geometry, cyclographic and stereographic projection, constructive treatment of regulated surfaces, and

[6]Müller, Emil Adalbert (April 22, 1861, Landskron–September 1, 1927, Vienna). He studied mathematics and descriptive geometry at the TH and the University of Vienna and obtained teacher's degree in 1885. He was assistant to Staudigl, from 1890 to 1892 "Supplent" (a substitute) at the *Technologisches Gewerbemuseum*, and from 1892 to 1902 at the Baugewerksschule in Königsberg (where he was promoted and obtained "Habilitation" in 1898–1899 on Grassmannian methods). From 1902 to 1927, he was a professor and the first chair for descriptive geometry at the TH Vienna and in 1912/1913, he was a rector. He received many honors, and was a founding member of the Vienna Society of Mathematics (Einhorn 1985, pp. 572–587, Kruppa 1928, Schmid 1928).

constructive treatment of *Schraub- und Schiebflächen* (helicoidal and translation surfaces) Müller 1908, 1918, 1920 and Müller 1916, 1919, 1923.

His goal was not only to produce good teachers—with great success because teachers of descriptive geometry from the TH Vienna spread all over the whole Austro-Hungarian Empire—but also to further the scientific treatment of the field. His goal was to establish descriptive geometry as a part of geometry, in combination with projective geometry, non-Euclidean geometry, group theory, and so on. Müller was a very inspiring teacher with many students and followers. He also expressed his ideas in lectures given at the *Versammlung der Naturforscher* (the predecessor of the German Mathematical Society) in Germany (Müller 1910), where he also organized an exposition of his students' drawings. These construction exercises were always very important and much time was devoted to them. In order to provide examples from which the students could choose, he edited collections of sample drawings (Müller 1910, 1911, 1920, 1926).

Figures 12.1 and 12.2 show the level of complexity. The first one uses trimetric projection, a parallel projection with three different scale factors on the three orthogonal axes. The second one uses perspective drawing. You also should keep in mind that they had to be done with Indian ink; thus, one wrong line or a single splash would ruin it, and you would have to do it all over again.

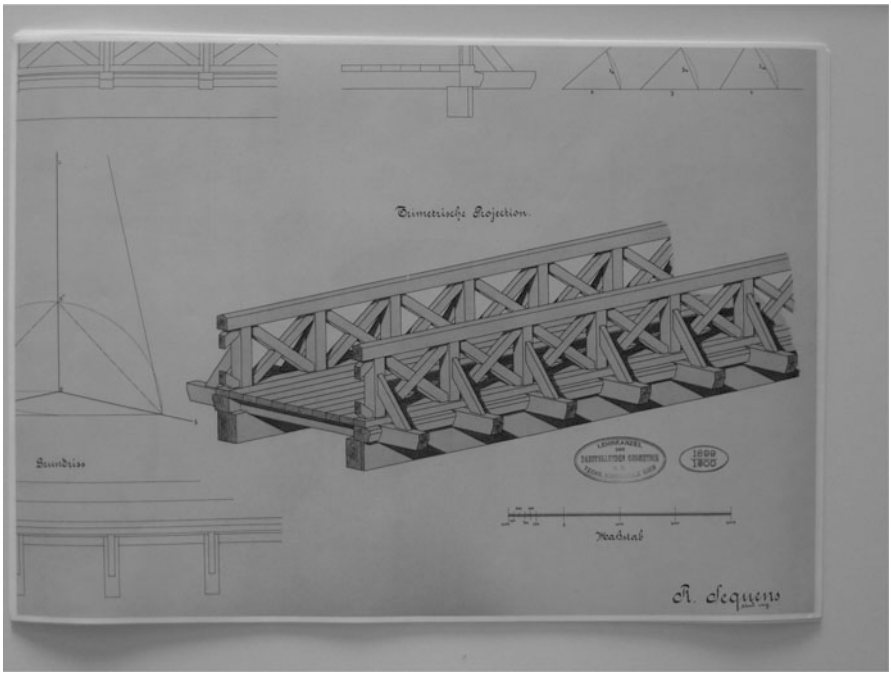

Fig. 12.1 Bridge, by H. Sequenz, student of architecture in his first year under Peschka, in 1899/1900[7]

[7] All figures in the present chapter are in the possession of the Institute of Algebra and Geometry, University of Technology Vienna.

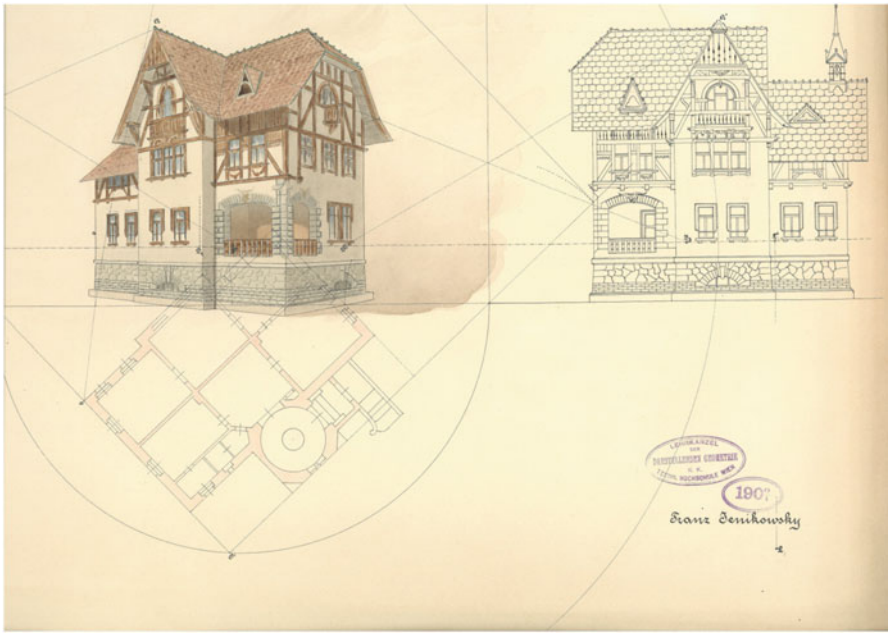

Fig. 12.2 House, by J. Jenikowski, student of architecture 1900/1901

Theodor Schmid[8] held the Second Chair for Descriptive Geometry for 29 years. He regularly delivered the introductory courses in descriptive geometry for future mechanical engineers and on projective geometry for the student teachers. His examples of machine drawings (Schmid 1911, 1925) were very highly regarded in many places. Figures 12.3 and 12.4 show drawings by his students.

Schmid worked on transmission devices (*Getriebe*)—very important for machines—on the construction of various curves and on the building of geometrical models. He was also interested in the shape of the earth and in photogrammetry. His goal was to combine descriptive geometry with projective geometry (Schmid 1912, 1919, 1922 and 1921, 1923).

He often complained about having too many students, so he was not able to write down his ideas on projective geometry. He was a very inspiring teacher, but he always remained a bit in the shadow of his charismatic colleague Emil Müller.

[8]Theodor Schmid (December 6, 1859, Erlau–October 30, 1937, Vienna). He studied in Vienna at the TH and the university and got his teacher's degree for mathematics and descriptive geometry in 1882 and for physics in 1886. After some difficult years as teacher at various schools, he got the Second Chair of Descriptive Geometry at the TH Vienna, from 1900 to 1906 as extraordinarius and from 1906 to 1929 as ordinarius (Einhorn 1985, pp. 633–643; Sequenz 1965, pp. 137–138; Dolezal 1937/1938, pp. 85–94).

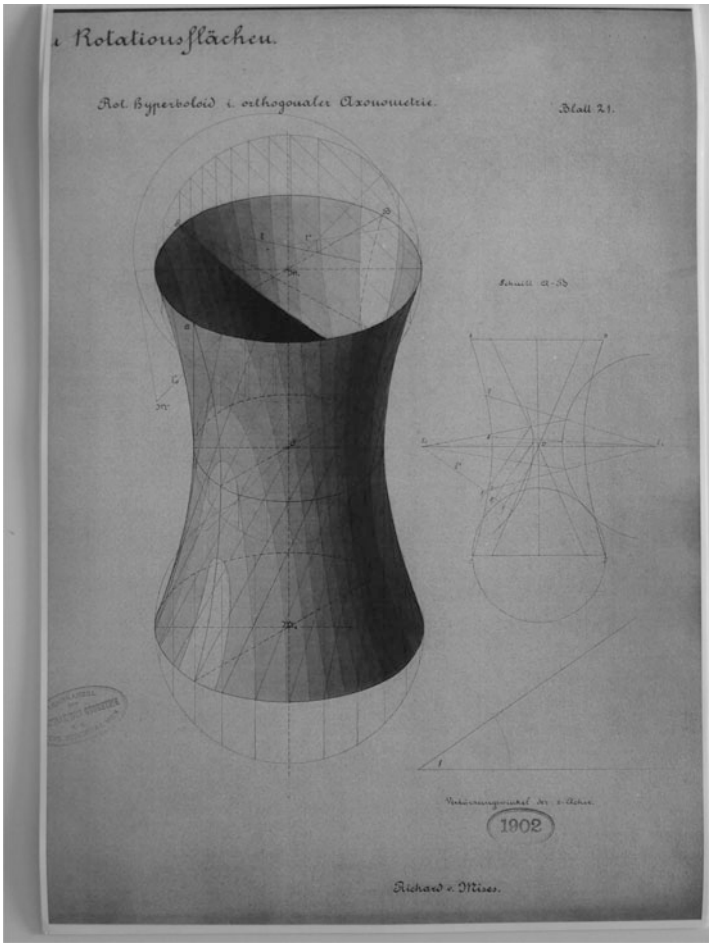

Fig. 12.3 Surfaces of revolution: the hyperboloid in axonometric projection. The drawing is from 1902 and by Richard von Mises (1883–1953), who was studying mechanical engineering in his first year

Nevertheless, he received many honors, including that of dean. He was also elected to be a rector of the TH but could not accept this honor because of health problems.

4 The Era Erwin Kruppa–Ludwig Eckhart–Josef Krames

After Müller's death in 1927 and Schmid's retirement in 1929, both chairs were vacant. Müller's assistant Josef Krames substituted the chair of the First Institute

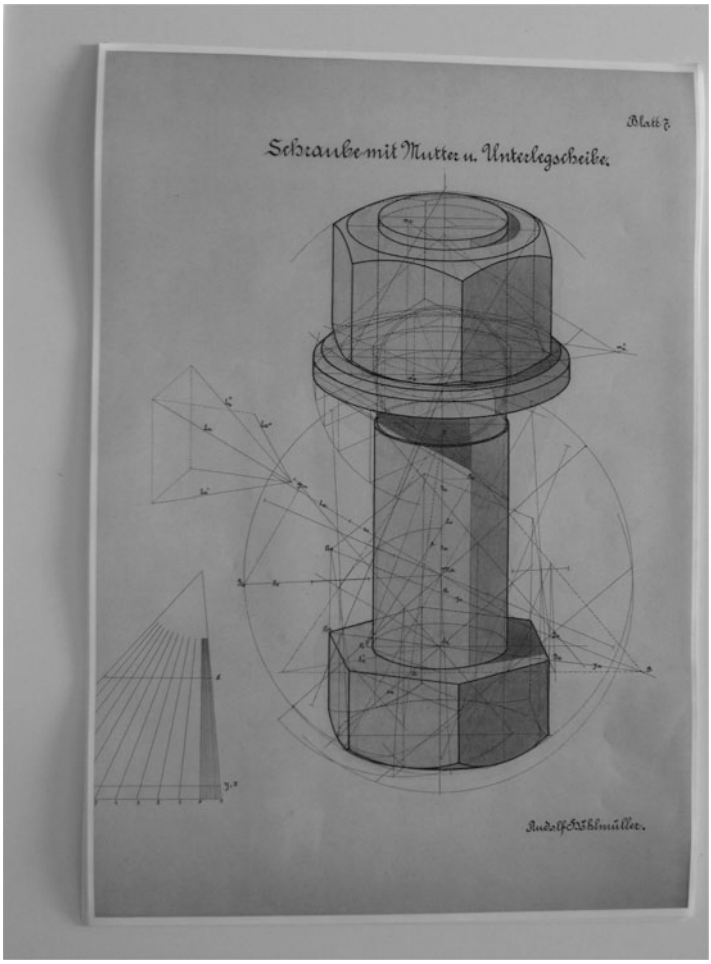

Fig. 12.4 Reproduction of a screw by R. Höhlmüller, a student of Schmid

for 2 years until Erwin Kruppa[9] became successor of Müller. Kruppa succeeded in maintaining the international reputation of the Vienna School of Descriptive Geometry.

[9]Erwin Kruppa (August 11, 1885, Biala, Galicia–January 26, 1967, Vienna). He studied mathematics and descriptive geometry in Graz and Vienna; in 1911, he was promoted in Graz and obtained his *Habilitation* in Czernowitz. From 1911 to 1918, he was a *Privatdozent* in Czernowitz and a teacher at a German-speaking *Realschulen*. During his war service from 1914 to 1918, he was wounded and then became a teacher in the Infanterie-Kadettenschule in Wien-Breitenlee. From 1918 to 1921 he was a *Privatdozent* at the TH Graz, then from 1921 to 1922 extraordinarius in Graz, from 1922 to 1929 a professor for mathematics at the TH Vienna, from 1929 to 1957 a professor and chair of the First Institute of Descriptive Geometry at the TH Vienna, and in 1953/1954 a rector (Einhorn 1985, pp. 588–603, Krames 1968).

His education and former occupation as a professor of mathematics and his knowledge of modern analysis influenced his treatment of descriptive geometry (Kruppa 1932, 1933, 1936). He introduced exact limits instead of an intuitive treatment of neighboring elements, he also treated non-Euclidean geometry and geometry in higher dimensions. He edited and enlarged Müller's book (Müller 1923), which consisted of three volumes, had at least four editions, and was very popular (Kruppa 1936, 1948, 1961).

In his later years, he also worked on differential geometry (Kruppa 1957).

Ludwig Eckhart[10] became chair of the Second Institute of Descriptive Geometry in 1929. He had already found a new *Schrägrissverfahren* (a particular form of axonometry), which soon found its way into many text books. He introduced cinematics as a basis for *Getriebelehre* into the courses for mechanical engineers and *Ausdehnung des Einschneideprinzips* in die *schiefe Axonometrie* (extension of the method of sections in skew axonometry). He was dismissed from office in 1937, a decision he could not understand and that hit him very hard. It seems that the reasons for this dismissal were political since he was active in the *Vaterländische Front* (Fatherland Front),[11] and one of his assistants was Jewish. He committed suicide in 1938.

Krames[12] was always very much engaged in teaching student teachers and he played a major role in introducing courses on selected topics in descriptive and projective geometry in Brno. In Graz, he was also responsible for the final examinations of teachers in descriptive geometry. But, in spite of his many duties, he

[10]Ludwig Eckhart (March 28, 1890, Selletitz bei Znaim–October 5, 1938, Vienna). He studied building engineering, mathematics, and descriptive geometry at the University and the TH in Vienna and he was in war service from 1914 to 1917 (Reseveoffizier des Infanterieregiments Nr. 99, Znaim, getting many honors as: silberne Tapferkeitsmedaille Signum laudis mit den Schwertern, Karl-Truppenkreuz, and Verwundetenmedaille). He was teacher at the military academy, and at various schools. He was promoted in 1918 and got his *Habilitation* in 1924 at the TH Vienna in descriptive geometry; from 1924 to 1929, he was a *Privatdozent*; and from 1929 to 1937 a professor and chair of the Second Institute of Descriptive Geometry, TH Vienna, and the dean from 1935 to 1937.

[11]The Fatherland Front (*Vaterländische Front*) was the ruling political organization of "Austro-fascism". It aimed to unite all the people of Austria, overcoming political and social divisions. Established on 20 May, 1933, by the Christian Social Chancellor Engelbert Dollfuss, advocating a one-party system along the lines of Italian Fascism, it advocated Austrian nationalism and independence from Germany on the basis of protecting Austria's Catholic religious identity from what they considered a Protestant-dominated German state. The Fatherland Front was immediately banned after the "Anschluss" (annexation) of Austria to Germany in 1938.

[12]Josef Krames (October 7, 1897, Vienna–August 30, 1986, Salzburg). He studied, at the TH Vienna, mathematics and descriptive geometry to became a teacher. He was promoted with Müller and in 1923 he obtained the "Habilitation" at the TH Vienna. From 1924 to 1929, he was an assistant at the TH (during that time he edited (Müller 1929) and (Müller 1931)), and from 1929 to 1932 extraordinarius at the German Technical High School of Brno, from 1932 to 1939 a professor at the Technical Highschool Graz, from 1939 to 1945 and from 1957 to 1969 a professor of descriptive geometry at the TH Vienna, and he was a rector in 1961/1962. From 1948 to 1956, he worked in the *Bundesamt für Eich- und Vermessungswesen* (Einhorn 1985, pp. 604–622; Wunderlich 1987).

continued to work scientifically. He published a series of articles on *symmetrische Schrotungen* (a type of symmetric motions in space), which were much valued by his French colleagues. From 1937 on, he studied the so-called *gefährliche Flächen* (dangerous surfaces), a problem in photogrammetry, and solved it using purely geometrical methods.

Descriptive geometry lost its importance after 1938: The hours required in engineering studies were reduced, and descriptive geometry was dropped in schools. Krames protested against this. In 1939, after the death of Eckhart, he became chair of the Second Institute of Descriptive Geometry at the TH Vienna. His main duties were the courses for machine engineering (Krames 1947, 1952). After the war in 1945, he was dismissed for political reasons and for the next years he worked at the *Bundesamt für Eich-und Vermessungswesen* (Federal Office of Metrology and Surveying), mostly in photogrammetry and improving instruments.

In 1946, the chair of the second institute was given to Walter Wunderlich[13] as extraordinarius. He was a pupil of Kruppa and had been working as an assistant and a *Privatdozent* during the war. In 1955, he became a professor.

He had many interests in all areas of geometry, especially in kinematics, *höhere Radlinien* (higher cycloidal curves), wobbly structures, and much more generally solving them in a very original way using intuitive geometric arguments.

In 1957, Krames was back at the TH Vienna succeeding Kruppa as chair in the First Institute of Descriptive Geometry. In the same year, both institutes changed their names to the First and the Second Institute of Geometry and became open to other fields of geometry such as differential geometry and computer aided design.

Together with his colleague Wunderlich, Krames reorganized the studies for teachers. Alternatingly they gave courses on projective geometry I and II. They also introduced two new seminars; Krames gave a 2-year course on *Konstruktive Abbildungsmethoden* (constructive methods of representation) and *Konstruktive Strahlgeometrie* (constructive line geometry), whereas Wunderlich taught *Konstruktive Differentialgeometrie* (constructive differential geometry) and *Nichteuklidische und mehrdimensionale Geometrie* (non-Euclidean and higher dimensional geometry) (Wunderlich 1966, 1967).

With Krames' retirement in 1969 and Wunderlich's in 1980, we come to the end of the classical period of descriptive geometry in Vienna. In 1975, the TH became the University of Technology of Vienna (Technische Universität Wien, TU).

[13] Walter Wunderlich (March 6, 1910, Vienna–November 3, 1998, Vienna). He first studied building engineering at the TH Vienna, then in 1933 he also obtained the teacher's degree of mathematics and descriptive geometry, and since there was no possibility to get a teacher's position, he also obtained the teacher's degree for stenography in 1935, which helped a bit. In 1934 he graduated in descriptive geometry. In 1938 he was an assistant, and in 1940 he got the *Habilitation*; during the war he served at the *Physikalische Versuchsanstalt* of the marine. In 1946, back in Vienna, he got the chair of the Second Institute of Descriptive Geometry as extraordinarius and since 1955 till 1980 as a professor, he was a rector in 1964/1965 (Sequenz 1965, pp. 139–140; Binder 2016, p. 119, Stachel 1999).

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