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(*b*. Landsberg an der Warthe, Germany [now Gorźw, Poland], 17 April 1853; *d*. Frankfurt am Main, Germany, 27 May 1928)

mathemtics, crystallography.

Schoenflies studied with Kummer at the University of Berlin from 1870 to 1875 and received the Ph.D. in 1877. From 1878 he taught at a Gymnasium in Berlin and then, from 1880, in Colmar, Alsace. In 1884 he earned his *Habilitation as Privatdozent* at the University of Göttingen, where, in 1892, he was named professor extraordinarius and was given the chair of applied mathematics. (This chair had been created thanks to Felix Klein's initiative.) In 1899 Schoenflies was appointed professor ordinarius at the University of Königsberg and then, in 1911, at the Academy for Social and Commercial Sciences in Frankfurt am Main; this school became a university in 1914. He was later professor ordinarius (1914–1922) at the University of Frankfurt and in 1920–1921 served as rector of the university.

Schoenflies produced an extensive mathematical *oeuvre* consisting of about ninety papers and many reports and books. He started his scientific work with rather traditional geometry and kinematics. This research was published in 1886 (1) and was later translated into French (1*a*). In the same year, under Klein's influence, Schoenflies turned to Euclidean motion groups and regular space divisions. His investigations culminated in 1891 in his magnum opus (2). The result of this book, the 230 crystallographic groups, was at the same time obtained independently by E. S. Fedoroy. During the last phase of this research, Schoenflies corresponded with Fedorov and was thus able to correct some minor errors that he had originally made in his classification. In 1923 Schoenflies reedited his 1891 publication under another title (2*a*). He also wrote a textbook on crystallography (9).

In the mid-1890's Schoenflies, by then in his forties, turned to topology and set theory. In 1898 he published an article (5) on this subject in the *Encyklopädie der mathematischen Wissenschaften*. He also published extensive reports in *Deutsche Mathematiker-Vereinigung*, which appeared in 1900 and 1908 (6) and were reedited in 1913 (6*a*). These reports were totally eclipsed by Hausdorff's *Grundzüge der Mengenlehre* (1914). The greater part of Schoenflies' original contributions to topology is contained in three papers (7) and is devoted to plane topology. He proved the topological invariance of the dimension of the square, and he invented the notions and theorems that are connected with the characterization of the simple closed curve in the plane by its dividing the plane into two domains of which it is the everywhere attainable boundary. There are numerous gaps and wrong statements in this part of Schoenflies' work, and these errors led L. Brouwer to some of his startling discoveries.

Schoenflies published four articles in the *Encyklopädie der mathematischen Wissenschaften* (on set theory, kinematics, crystallography, and projective geometry), in part with others (5). With W. Nernst, he wrote a textbook (1895) on calculus (3) that went through at least eleven editions and two Russian translations. He also wrote textbooks on descriptive geometry (8) and analytic geometry (10). In 1895 he edited the work of Julius Plücker (4). Schoenflies was elected a fellow of the Bayerische Akademie der Wissenschaften in 1918.

BIBLIOGRAPHY

I. Original Works. Schoenflies' works are the following:

(1) *Geometrie der Bewegung in synthetischer Darstellung* (Leipzig, 1886), with French trans. by C. Speckel as (1*a*) *La géométrie du mouvement—expossynthétique* (Paris, 1893);

(2) *Kristallsysteme und Kristallstruktur* (Leipzig, 1891); the 2nd ed. appeared as (2*a*) *Theorie der Kristallstruktur* (Berlin, 1923);

(3) *Einführung in die mathematische Behandlung der Naturwissenschaften—Kurzgefasstes Lehrbuch der Differential- und Integralrechnung* (Munich, 1895; 11th ed., 1931), written with W. Nernst;

(4) Julius Plücker, *Gesammelte Mathematische Abhandlungen*, Schoenflies, ed. (Leipzig, 1895);

(5) "Mengenlehre," in *Encyklopaedie der mathematischen Wissenschaften*, 184–207; "Kinematik," *ibid*., **IV,** 190–278, written with M. Grübler; "Kristallographie," *ibid*., **V** , pt. 7, 391–492, written with T. Liebisch and O. Mügge; "Projektive Geometrie," *ibid*., **III,** pt. 5, 389–480;

(6) "Die Entwicklung der Lehre von den Punktmannigfaltigkeiten, **I,** " in *Jahresbericht der Deutschen Mathematiker-Vereinigung*, **8** (1900). 1–250; "Die Entwicklung ... **II,** " supp. 2 (1908), 1–331;

(6*a*) *Entwicklung der Mengenlehre und ihrer Anwendungen* (Leipzig, 1913), written with H. Hahn;

(7) "Beiträge zur Theorie der Punktmengen," in *Mathematische Annalen*, **58** (1903), 195–234; **59** (1904), 152–160; **62** (1906), 286–326;

(8) *Einführung in die Hauptgesetze der zeichnerischen Darstellungsmethoden* (Leipzig, 1908);

(9) *Einführung in die Kristallstruktur—ein Lehrbuch* (Berlin, 1923);

(10) *Einführung in die analytische Geometrie der Ebene und des Raumes*, Grundlehren der Mathematischen Wissenschaften no. 21 (Leipzig, 1925), with 2nd ed. by M. Dehn (Leipzig, 1931).

II. Secondary Literature. On Schoenflies and his work, see L. Bieberbach, "Arthur Schoenflies," in *Jahresbericht der Deutschen Mathematiker-Vereinigung*, **32** (1923), 1–6; J. J. Burckhardt, "Zur Entdeckung der 230 Raumgruppen," in *Archives for History of Exact Sciences*, **4** (1967), 235–246; "Der Briefwechsel von E. S. Fedorow mit A. Schoenflies, 1889–1908," *ibid*., **7** (1971), 91–141; R. von Mises, "Schoenflies," in *Zeitschrift für angewandte Mathematik und Mechanik*, **3** (1923), 157–158; A. Sommerfeld, "A. Schoenflies," in *Jahrbuch der bayerischen Akademie der Wissenschaften* (1928–1929), 86–87; and K. Spangenberg, "A. Schönflies," in *Handwörterbuch der Naturwissenschaften*, 2nd ed., VIII (1933), 1108–1109.

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