



George D. Burkhoff

GEORGE D. BIRKHOFF

Nato il 21 marzo 1884 ad Overisel (Michigan) da David e Zane Gertrude Droppers. Professore di Matematica nella Harvard University di Cambridge, Mass. (U. S. A.). Accademico Pontificio dal 28 ottobre 1936.

Studiò a Chicago ed in quell'Università si addottorò nel 1907 in Filosofia. In precedenza (1905, 1906) aveva ottenuto all'Università di Harvard i gradi A. B. ed A. M. Dal 1907 al 1909 insegnò Matematica all'Università del Wisconsin, dal 1909 al 1911 fu professore straordinario di Matematica all'Università di Princeton e nel 1911-1912 fu ordinario nella stessa Università. Nel 1912 passò all'Università di Harvard ove fu straordinario fino al 1919, ordinario 1919-1933; dal 1933 è Perkins Professor. Nel 1935 fu nominato decano della facoltà di Arti e Scienze all'Università di Harvard. Nel 1930 tenne un corso al Collège de France.

Per varie volte fu direttore di riviste matematiche degli Stati Uniti.

È dottore *honoris causa*: della Brown University (Presidence, R. I., 1923), della Università del Wisconsin (Madison 1927), della Harvard (Cambridge, Mass., 1933), nonchè delle Università di Poitiers (1933) e di Parigi (1936).

È membro (ordinario, corrispondente od onorario) delle seguenti Accademie: National Academy of Sciences; American Philosophical Society; American Academy of Arts and Sciences; Ame-

rican Mathematical Society (Presidente dal 1924 al 1926); Circolo Matematico di Palermo; Royal Danish Academy of Sciences and Letters; Göttingen Gesellschaft der Wissenschaften; Institut de France; Reale Accademia dei Lincei; Reale Istituto di Bologna; Edinburgh Mathematical Society.

Nel 1918 il Reale Istituto di Scienze, Lettere ed Arti di Venezia gli conferiva il premio Querini-Stampalia; nel 1923 ottenne il premio Bôcher della Società Matematica Americana per ricerche sulla dinamica; nel 1926 il premio annuale dell'Associazione Americana per il Progresso delle Scienze e nel 1933 il premio del concorso bandito dalla Pontificia Accademia delle Scienze « I Nuovi Lincei » per ricerche sui sistemi di equazioni differenziali.

È Ufficiale della Legione d'Onore (1936).

INDIRIZZO :

Cambridge (Massachusset, U. S. A.) - 20, University Hall

PUBBLICAZIONI

Collected Mathematical Papers, vol. I, 1904-1919.

A general remainder theorem (Abstract), « Bull. Amer. Math. Soc. », vol. 10, 280, May, 1904.

On the integral divisors of $a_n - b_n$ by G. D. BIRKHOFF and H. S. VANDIVER, « Annals Math. », Second series, vol. 5, 173-180, July, 1904.

A theorem concerning uniform convergence, « Annals Math. », second series, vol. 5, 90-92, April, 1905.

General mean value and remainder theorems with applications to mechanical differentiation and quadrature, « Trans. Amer. Math. Soc. », vol. 7, 107-112, January, 1906.

Note on certain quadratic number systems for which factorization is unique, « Amer. Math. Mo. », vol. 13, 156-159, August-September, 1906.

On a certain class of sets of normed orthogonal functions (Abstract), « Bull. Amer. Math. Soc. », vol. 13, 62, November, 1906.

Boundary value problems of ordinary linear differential equations (Abstract), « Bull. Amer. Math. Soc. », vol. 13, 439-440, June, 1907.

On a certain existence and oscillation theorem (Abstract), « Bull. Amer. Math. Soc. », vol. 14, 266, March, 1908.

On the asymptotic character of the solutions of certain linear differential equations containing a parameter, « Trans. Amer. Math. Soc. », vol. 9, 219-231, April, 1908.

Asymptotic properties of the solutions of ordinary linear differential equations containing a parameter with application to boundary value and expansion problems (Thesis), reprinted from, « Trans. Amer. Math. Soc. », vol. 9, 219-231, 373-395, April and October, 1908.

Irregular integrals of ordinary linear differential equations (Abstract), « Bull. Amer. Math. Soc. », vol. 14, 421-422, June, 1908.

Existence and oscillation theorem for a certain boundary value problem, « Trans. Amer. Math. Soc. », vol. 15, 259-270, April, 1909.

- Singular points of ordinary linear differential equations*, « Trans. Amer. Math. Soc. », vol. 10, 436-470, October, 1909.
- On the theory of stability* (Abstract), « Bull. Amer. Math. Soc. », vol. 16, 65, November, 1909.
- The stable solutions of the problem of three bodies* (Abstract), « Bull. Amer. Math. Soc. », vol. 16, 288, March, 1910.
- A simplified treatment of the regular singular point*, « Trans. Amer. Math. Soc. », vol. 11, 199-202, April, 1910.
- A simplified treatment of the regular singular point. Some oscillation and comparison theorems* (Abstracts), « Bull. Amer. Math. Soc. », vol. 16, 396, May, 1910.
- General theory of linear difference equations* (Abstract), « Bull. Amer. Soc. », vol. 17, 69, November, 1910.
- Poincaré's Göttingen lectures*, « Bull. Amer. Math. Soc. », vol. 17, 190-194, January, 1911.
- On the solutions of ordinary linear homogeneous differential equations of the third order*, « Annals Math. », second series, vol. 12, 103-127, April, 1911.
- General theory of linear difference equations*, « Trans. Amer. Math. Soc. », vol. 12, 243-284, April, 1911.
- The New Haven Colloquium Lectures*, « Bull. Amer. Math. Soc. », vol. 17, 414-428, June, 1911.
- A direct method for the summation of developments in Lamé's functions and of allied developments* (Abstract), « Bull. Amer. Math. Soc. », vol. 17, 392, May, 1911.
- New proof of a theorem concerning matrices of analytical functions. On the simplest type of irregular singular point* (Abstracts), « Bull. Amer. Math. Soc. », vol. 18, 64, November, 1911.
- Note on the Expansion of the Green's Function*, « Math. Annalen », vol. 72, 292-294.
- The reducibility of maps* (Abstract). *A determinant formula for the number of ways of coloring any map* (Reference), « Bull. Amer. Math. Soc. », vol. 18, 489-490, July, 1912.
- A determinant formula for the number of ways of coloring a map*, « Annals Math. », vol. 14, 42-46, September, 1912.

- Quelques théorèmes sur le mouvement des systèmes dynamiques*, « Bull. Soc. Math. de France », vol. 40, 305-323, December, 1912.
- Proof of Poincaré's geometric theorem* (Reference), « Bull. Amer. Math. Soc. », vol. 19, 171, January, 1913.
- Proof of Poincaré's geometric theorem*, « Trans. Amer. Math. Soc. », vol. 14, 14-22, January, 1913. French translation by M. JANET, 1914; see below.
- A theorem on matrices of analytic functions*, « Math. Annalen », vol. 74, 122-133, 1913.
- Equivalent singular points of ordinary linear differential equations*, « Math. Annalen », vol. 74, 134-139, 1913.
- Berichtigung zu dem Aufsätze von George D. Birkhoff, A theorem on matrices of analytic functions'*, « Math. Annalen », vol. 74, 461, 1913.
- The reducibility of maps*, « Amer. Journ. Math. », vol. 35, 115-128, April 1913.
- Note on the expansion problems of ordinary linear differential equations*, « Rend. Circ. mat. », vol. 36, 115-126, April 1913.
- Note on the gamma function*. (Reference); *Solution of the generalized Riemann problem for linear differential equations, and of the analogous problem for linear difference and q -difference equations*. (Abstract), « Bull. Amer. Math. Soc. », vol. 19, 508-509, July, 1913.
- Note on the gamma function*, « Bull. Amer. Math. Soc. », vol. 20, 1-10, October, 1913.
- The generalized Riemann problem for linear differential equations and the allied problems for linear difference and q -difference equations*, « Proc. Amer. Acad. Arts and Sci. », vol. 49, 521-568, October 1913.
- On a simple type of irregular singular point*, « Trans. Amer. Math. Soc. », vol. 14, 462-476, October, 1913.
- Démonstration du dernier théorème de géométrie de Poincaré*. (Translated from « Trans. Amer. Math. Soc. », January, 1913); « Bull. Soc. Math. de France », tome 42, 1-12, 1914.
- The restricted problem of three bodies*. (Abstract), « Bull. Amer. Math. Soc. », vol. 20, 292-293, March, 1914.
- The restricted problem of three bodies*, « Rend. Cir. Mat. », vol. 39, 265-334, August, 1915.

- Review of O. Blumenthal's Principes de la theorie des fonctions entieres d'ordre infini*, « Bull. Amer. Math. Soc. », vol. 21, 36-37, October, 1914.
- The iterated transformation of a plane into itself.* (Abstract), « Bull. Amer. Math. Soc. », vol. 21, 71, November, 1914.
- The functions of several variables defined by linear difference and differential equations* (Reference). *Note on the reducibility of maps* (Reference), « Bull. Amer. Math. Soc. », vol. 21, 278, March, 1915.
- An elementary double inequality for the roots of an algebraic equation having greatest absolute value*, « Bull. Amer. Math. Soc. », vol. 21, 494-495, July, 1915.
- An aspect of the linear congruence with applications to the linear theory of Fermat's quotient*, by H. S. Vandiver. *Announces a theorem communicated to the author by G. Birkhoff*, « Bull. Amer. Math. Soc. », vol. 22, 61, November, 1915.
- Theorem concerning the singular points of ordinary linear differential equations*, « Proc. Nat. Acad. », vol. 1, 578-581, December, 1915.
- A theorem concerning the singular points of ordinary linear differential equations* (Abstract), « Bull. Amer. Math. Soc. », vol. 22, 170, January, 1916.
- On dynamical systems with two degrees of freedom; Infinite products of analytic matrices.* (Abstracts), « Bull. Amer. Math. Soc. », vol. 22, 270-271, March, 1916.
- Infinite products of analytic matrices*, « Trans. Amer. Math. Soc. », vol. 17, 386-404, July, 1916.
- Dynamical system with two degrees of freedom*, second paper. (Abstract), « Bull. Amer. Math. Soc. », vol. 23, 71, November, 1916.
- A class of series allied to Fourier series; Note on linear difference equations.* (Abstract), « Bull. Amer. Math. Soc. », vol. 23, 274, March, 1917.
- Dynamical systems with two degrees of freedom*, « Proc. Nat. Acad. », vol. 3, 314-316, April, 1917.
- Dynamical systems with two degrees of freedom*, « Trans. Amer. Math. Soc. », vol. 18, 199-300, April, 1917.
- Sur une généralisation de la série de Taylor*, « Comptes Rendus », vol. 164, 942-945, June, 1917.

A theorem on series of orthogonal functions with an application to Sturm-Liouville series, « Proc. Nat. Acad. », vol. 3, 656-659, November, 1917.

On a theorem concerning closed normalized orthogonal sets of functions with an application to Sturm-Liouville series (Abstract), « Bull. Amer. Math. Soc. », vol. 24, 172, January, 1918.

Sur la démonstration directe du dernier théorème de Henri Poincaré par M. Dantzig, « Bull. Sci. Math. », vol. 62, 1-3, February, 1918.

On stability in dynamics. (Abstract), « Bull. Amer. Math. Soc. », vol. 25, 57, November, 1918.

The scientific work of Maxime Bocher, « Bull. Amer. Math. Soc. », vol. 25, 197-215, February, 1919.

Boundary value and expansion problem for differential systems of the first order; Note on the closed curves described by a particle moving on a surface in a gravitational field; Note on the problem of three bodies. (Abstracts), « Bull. Amer. Math. Soc. », vol. 25, 442-443, July, 1919.

Collected Mathematical Papers, vol. II, 1920-1928.

The work of Poincaré on automorphic functions, « Bull. Amer. Math. Soc. », vol. 26, 164-172, January, 1920.

Recent Advances in dynamics, « Science », vol. 51, 51-55, January, 1920.

Note on stable periodic orbits (Abstract), « Bull. Amer. Math. Soc. », vol. 26, 146, January, 1920.

Note on the ordinary linear differential equation of the second order (Abstract), « Bull. Amer. Math. Soc. », vol. 26, 436, July, 1920.

A treatise on the analytical dynamics of particles and rigid bodies; with an introduction to the problem of three bodies. (Review), « Bull. Amer. Math. Soc. », 183, January, 1920.

Surface transformations and their dynamical applications, « Acta Mathematica », vol. 43, 1-119, 1920.

Dynamical systems. (Abstract), « Bull. Amer. Math. Soc. », vol. 27, 67 (See book below), November, 1920.

An extension of Poincaré's geometric theorem. (Abstract), « Bull. Amer. Math. Soc. », vol. 27, 265, March, 1921.

- Invariant points under transformations in function space.* (Abstract), « Bull. Amer. Math. Soc. », vol. 27, 307, April, 1921.
- An elementary treatment of Fourier's Series,* « Amer. Math. Monthly », vol. 28, 200, May, 1921.
- Invariant points in function space,* by G. D. Birkhoff, and O. D. Kellogg, « Trans. Amer. Math. Soc. », vol. 23, 96-115, January, 1922.
- General-mean-value relations.* (Abstract), « Bull. Amer. Math. Soc. », vol. 28, 5, January-February, 1922.
- On plates of variable thickness.* (Abstract), « Bull. Amer. Math. Soc. », vol. 28, 5, January-February, 1922.
- Books on relativity,* « Bull. Amer. Math. Soc. », vol. 28, 215-221, April-May, 1922.
- Circular plates of variable thickness,* « Philosophical Magazine », vol. 43, 953-962, May, 1922.
- Invariant points in function space,* by G. D. Birkhoff and O. D. Kellogg (Abstract), « Bull. Amer. Math. Soc. », vol. 28, 236, June, 1922.
- The boundary problems and developments associated with a system of ordinary linear differential equations of first order.* By G. D. Birkhoff and R. E. Langer. (Abstract), « Bull. Amer. Math. Soc. », vol. 28, 236, June, 1922.
- Celestial mechanics,* « Bull. National Research Council », vol. 4, Part 1, September, 1922. *Report of the Committee on Celestial Mechanics of Research Council,* by E. W. Brown, G. D. Birkhoff, and A. O. Leuschner, and H. N. Russell.
- The boundary problems and development associated with a system of ordinary linear differential equations of first order.* By G. D. Birkhoff and R. E. Langer, « Proc. Amer. Acad. Arts and Sciences », vol. 58, 49-128, April, 1923.
- The origin, nature and influence of relativity,* « The Scientific Monthly », vol. 18, 225, 239; 408-421, 517-528, 616-624, March- June, 1924; vol. 19, 18-29, 180-187, July-August, 1924. (Lowell Institute Lectures, autumn, 1923; revised and reprinted in book form - see below).
- On the structure of matter.* (Abstract), « Bull. Amer. Math. Soc. », vol. 31, 116, March-April, 1925.
- An extension of Poincaré's geometric theorem,* « Acta Mathematica », vol. 27, 297-311, 1925.

- Stabilità e periodicità nella dinamica*, « Periodico di Matematiche », vol. 6, 262-271, s. 4, March, 1926. (Address before the Mathematical Seminary, University of Rome, 6 March, 1926).
- Dynamique: Sur la signification des equations canoniques de la dynamique*, « Comptes rendus des séances de l'Académie des Sciences » vol. 183, 516-519, 20 September, 1926, « errata », 1144, 26 December, 1926.
- Über gewisse Zentralbewegungen dynamischer Systeme*, « K. Gesellschaft der Wissenschaft zu Göttingen, Mathematisch-physikalische Klasse, Nachrichten », 81-92, 1926.
- A mathematical critique of some physical theories* (Abstract), « Science », vol. 65, 94-95, n. s., 28 January, 1927.
- A mathematical critique of some physical theories* (Abstract), « Science », vol. 65, 147-149, n. s., 11 February, 1927.
- Stability and the equations of dynamics*, « American Journal of Mathematics », vol. 49, 1-38, January, 1927. (A preliminary note on the subject of this paper was printed in Comptes rendues..., 20 September, 1926, see above).
- On one-to-one transformations of surfaces*. (Abstract), « Bull. Amer. Math. Soc. », vol. 33, 10-11, January-February, 1927.
- A theory of matter and electricity*, « Proc. Nat. Acad. Sciences », vol. 13, 160-165, March, 1927.
- The hydrogen atom and the Balmer formula*, « Proc. Nat. Acad. Sciences », 165-169, March, 1927.
- Stability and the equations of dynamics*. (Abstract), « Bull. Amer. Math. Soc. », vol. 33, 124, March-April, 1927.
- A mathematical critique of some physical theories*. Presidential address before the American Mathematical Society, December, 30, 1926, « Bull. Amer. Math. Soc. », vol. 33, 165-181, March-April, 1927.
- A gratifying computation*. Princeton, reckoned among country's three chief mathematical centers, faces opportunity of assuming lead in this field, « Princeton Alumni Weekly », vol. 27, 882, 6 May, 1927.
- Reversibility in dynamics* (Abstract), « Bull. Amer. Math. Soc. », vol. 33, 656-660, September-October, 1927.
- The Periodic motions near a stable periodic motion of a dynamical system*. (Abstract), « Bull. Amer. Math. Soc. », vol. 33, 660, September-October, 1927.

- On the periodic motions of dynamical systems*, « Acta Mathematica », vol. 50, 359-379, October, 1927.
- Stabilità e periodicità nella dinamica*. (Abstract). Seminario Matematico, Facoltà di Scienze, Università Roma. Rendiconti, vol. 4, 94, 1927. (The complete paper was printed in *Periodico di Matematiche*, see above, 1926).
- The Choice of a Field of Concentration*, « Physics and Mathematics », by T. LYMAN and G. D. BIRKHOFF, 24-25, 1927; also in second edition, 38-39, 1929.
- A remark on the dynamical role of Poincaré's last geometric theorem*, « Acta Litt. Ac. Scientiarum, sect. Scientiarum mathematicarum Szeged », vol. 4, 6-11, 15 August, 1928.
- A new criterion for stability*. (Abstract). Congresso Intern. d. Matematici, Bologna, 3-10 settembre 1928 (VI), Diario delle Sedute, Bologna, 53, 1928.
- Structure analysis of surface transformations*. and P. A. SMITH, « Journal de Mathématiques Pures et Appliquées » vol. 7, 345-379, s. 9, 1928.
- Newton's philosophy of gravitation with special reference to modern relativity ideas from Sir Isaac Newton 1727-1927, A Bicentenary Evaluation of his Work*, 51-64, Baltimore, 1928.

Books published during the period 1920-1928.

- Relativity and Modern Physics* (with the cooperation of R. E. LANGER), Cambridge, Harvard University Press, 1923, 11+283 p. (14,8 × 21,9 cm.).
- The Origin, Nature and Influence of Relativity* (Lowell Institute Lectures), New York, Macmillan Co., 1925, 10+185 p. (12,7 × 18,7 cm.). (See above, the articles in *The Scientific Monthly*, 1924).
- Dynamical Systems* (American Mathematical Society Colloquium Publications, vol. 9). New York, Amer. Math. Soc., 1927, 8+295 p. (15,1 × 22,6 cm.). See abstract above, 1920).
- Collected Mathematical Papers*, vol. 3, 1929-1934.
- Einige Probleme der Dynamik*, « Jahresbericht der Deutschen Mathematiker Vereinigung », vol. 38, 1-16, 1929.

- A theorem on the singular points of ordinary differential equations* (Abstract), « *Boll. Amer. Math. Soc.* », vol. 35, 153, March-April, 1929.
- (and THEODORE LYMAN), *Physics and Mathematics*. Harvard Professors Write about their own Departments. (Supplement to « *The Harvard Alumni Bulletin* », vol. 31, 23 May 1929), 38-39, 1929.
- Landau on number theory* (Review), « *Bull. Amer. Math. Soc.* », vol. 35, 401-403, May-June 1929.
- Science and spiritual perspective*, « *The Century Magazine* », vol. 118, 156-165, June 1929.
- (and F. R. BAMFORTH), *Divergent series and singular points of ordinary differential equations*, « *Bull. Amer. Math. Soc.* », vol. 35, 435, July-August 1929.
- Quelques éléments mathématiques de l'art*, « *Atti del Congresso Internazionale dei Matematici, Bologna, 3-10 settembre 1928-VI* », vol. 1, 315-333, 1929.
- Démonstration d'un théorème élémentaire sur les fonctions entières*, « *Comptes rendus des séances de l'Académie des Sciences* », 30 September 1929, vol. 189, 473-475.
- Divergente Reihen und singuläre Punkte gewöhnlicher Differentialgleichungen*, « *Sitzungsberichte der Preussischen Akademie der Wissenschaften, Phys.-Math. Klasse* », 171-183, 1929.
- Formal theory of irregular linear difference equations*, « *Acta Mathematica* », vol. 54, 205-246, 1930.
- (and F. R. BAMFORTH), *Divergent series and singular points of ordinary differential equations*, « *Trans. Amer. Math. Soc.* », vol. 32, 114-146, 1930.
- On the number of ways of colouring a map*, « *Proc. Edinburgh Math. Soc.* », s. 2, vol. 2, 83-91, 1930.
- (and RALPH BEATLEY), *A new approach to elementary geometry*, « *Yearbook of The National Council of Teachers of Mathematics* », 86-95, 1930.
- Une généralisation à n dimensions du dernier théorème de géométrie de Poincaré*, « *Comptes rendus des séances de l'Académie des Sciences* », vol. 192, 196-198, 26 January 1931.
- A mathematical approach to aesthetics*, « *Scientia* », 133-146, September 1931.

Proof of a recurrence theorem for strongly transitive systems. Proof of the ergodic theorem, « Proc. Nat. Acad. Sciences », vol. 17, 650-655, 656-660, December 1931.

Polygonal forms, « Yearbook of the National Council of Teachers of Mathematics », 165-195, 1931.

A new criterion of stability, « Atti del Congresso Intern. dei Matem., Bologna, 3-10 settembre 1928-VI », vol. 5, 5-13, 1931.

Sur quelques courbes fermées remarquables, « Bull. de la Soc. Mathém. de France », vol. 60, 1-26, 1932.

Sur l'existence de régions d'instabilité en Dynamique, « Annales de l'Institut Henri Poincaré », vol. 2, 369-386, 1932.

(and B. O. KOOPMAN), *Recent contributions to the ergodic theory*, « Proc. Nat. Acad. Sciences », vol. 18, 279-282, March 1932.

A set of postulates for plane geometry, based on scale and protractor, « Annals of Math. », s. 2, vol. 33, 329-345, April 1932 (See « Note on a preceding paper » below).

(and W. J. TRJITZINSKY), *Analytic theory of singular difference equations* (Abstract), « Bull. Amer. Math. Soc. », vol. 38, 350, May 1932.

Probability and physical systems, « Bull. Amer. Math. Soc. », vol. 38, 361-379, 1932.

A mathematical theory of aesthetics and its applications to poetry and music - A course of lectures; I. *Relation of the theory to earlier aesthetic theories*; II. *The musical quality in poetry*; III. *The diatonic chords*; IV. *Harmony*; V. *Melody*, « The Rice Institute Pamphlet », vol. 19, 189-342, July 1932.

Note on a preceding paper, « Annals of Math. », s. 2, vol. 33, 788, October 1932.

Dynamarhythmic Design: A Book of Structural Pattern (Review), « Technical Studies in the Field of Fine Arts », vol. 1, 94-95, October 1932.

(J. L. COOLIDGE and G. W. PIERCE), *Minute on the life and services of Professor Oliver Dimon Kellogg*, « Harvard University Gazette », vol. 28, 38-39, 12 November 1932.

(and W. J. TRJITZINSKY), *Analytic theory of singular difference equations*, « Acta Mathematica », vol. 60, 1-89, 1933.

- Some remarks concerning Schrödinger's wave equation*, « Proc. Nat. Acad. Sciences », vol. 19, 339-344, March. 1933 (See « Correction » below).
- The mathematical work of Oliver Dimon Kellogg*, « Bull. Amer. Math. Soc. », vol. 39, 171-177, March 1933.
- A Correction*, « Proc. Nat. Acad. Sciences », vol. 19, 475, April 1933.
- Quantum mechanics and asymptotic serie* (Abstract), « American Mathematical Society, Abstracts of addresses, Thirty-Ninth Summer Meeting, Chicago, Illinois, June 19-24 », 3, 1933.
- Quantum mechanics and asymptotic serie*, « Bull. Amer. Math. Soc. », vol. 39, 681-700, October 1933.
- (and D. C. LENCA, Jr.), *On the periodic motions wear a given periodic motions of a aynamical orgatem*, « Annali di matematica pura ed applicata », lez. 4, vol. 12, 117-133, 1933-34.
- Sur le problème restreint des trois corps* (Première Mémoire), « Annali della R. Scuola Normale Superiore di Pisa », s. 2, vol. 4, 267-306, 1935.
- (and M. R. HESTENES), *Generalized minimax principle in the calculus of variations; Natural isoperimetric conditions in the calculus of variations*, « Proc. Nat. Acad. Sciences », 96-99, 99-102, February 1935.
- (and M. R. HESTENES), *Oscillation, separation, and comparison theorems in the calculus of variations* (Abstract), « Bull. Amer. Math. Soc. », vol. 41, 193, March 1935.
- (and M. R. HESTENES), *Natural isoperimetric conditions for variable end point problems in the calculus of variations* (Abstract), « Bull. Amer. Math. Soc. », vol. 41, 200, March 1935.
- (and M. R. HESTENES), *Boundary value problems and the calculus of variations* (Astract), « Bull. Amer. Math. Soc. », vol. 41, 203 March 1935.
- (and M. R. HESTENES), *Natural isoperimetric conditions in the calculus of variations*, « Duke Math. Journal », vol. 1, 198-286, June 1935.
- (and D. C. LEWIS, Jr.), *Stability in causal systems*, « Philosophy of Science », vol. 2, 304-333, July 1935.
- (and M. R. HESTENES), *Generalized minimax principle in the calculus of variations*, « Duke Math. Journal », vol. 1, 413-432, December 1935.

Nouvelles recherches sur les systemes dynamiques, « *Memoriae Pont. Acad. Scient. Novi Lyncaei* », s. 3, vol. 1, 82-216, 1935.

(and THEODORE LYMAN), *The choice of a field of concentration*, 2 ed. 1929 published by Harvard Crimson, Committee on choice of electives; « *Physics and mathematics* », pag. 38-39; in vol. 2 of « *Birkhoff's Collected Mathematical Papers* » with 1st. ed. of 1927.

Books published during the period 1929-1935

Aesthetic measure, « *Harvard University Press* », 13+225 p. illus. (incl. music) 23 pl. (part col.) diagrams ($21\frac{1}{2} \times 29$ cm.), Cambridge, 1933.

(and RALPH BEATLEY), *Geometry*, 5+159 p. diagrams ($21\frac{1}{4} \times 28$ cm.) Planographed (Boston, 1933).

Mathematic: Quantity and order, pag. 293-317 of *Science Today: The scientific outlook on world problems explained by leading exponents of modern scientific thought planned and arr. lytho late Sir J. Arthur Thomson...* ed. by J. G. Crowther. Lond. Tyr & Spoetis words 1934. Amer. ed. *Science for a new Uoved. The scientific outflask*, N. Y., Harpers, 1934.