# List of Publications for John Willard Milnor

# 1950

- [a] On the total curvature of knots. Ann. of Math. (2), 52:248-257; [CP-1, 3-14]\*.
- [b] On a relationship between the Betti numbers of a hypersurface and an integral of its Gaussian curvature. First published in [CP-1, 15–26].

### 1953

- [a] Sums of positional games. In Contributions to the Theory of Games, vol.
  2, Annals of Math. Studies, no. 28, H. W. Kuhn and A. W. Tucker,
  editors, pages 291–301. Princeton University Press, Princeton, NJ.
- [b] The characteristics of a vector field on the two-sphere. Ann. of Math. (2), 58:253–257; [CP-6, 15–19].
- [c] On total curvatures of closed space curves. Math. Scand., 1:289–296;[CP-1, 27–36].
- [d] (with I.N. Herstein). An axiomatic approach to measurable utility. *Econometrica*, 21:291–297.

# 1954

- [a] Link groups. Ann. of Math. (2), 59:177–195; [CP-2, 7–25].
- [b] Games against nature. In *Decision Processes*, R. M. Thrall, C. H. Coombs and R. L. Davis, editors, pages 49–59, Wiley, New York; Chapman and Hall Ltd., London. (Reprinted in *Game Theory and Related Approaches to Social Behavior*, M. Shubik, editor, Wiley, New York.
- [c] (with G. Kalish, J. Nash, and E.D. Nering). Some experimental n-person games. In *Decision Processes*, R. M. Thrall, C. H. Coombs and R. L. Davis, editors, pages 301–327, Wiley, New York; Chapman and Hall Ltd., London.

### 1956

[a] Construction of universal bundles. I. Ann. of Math. (2), 63:272-284; [CP-4, 7-19].

<sup>\*</sup>Here CP-n stands for "Collected Papers Volume n." See: CP-1 [1994a], CP-2 [1995a], CP-3 [2007a], CP-4 [2009a], CP-5 [2010a], CP-6 [2012a].

- [b] Construction of universal bundles. II. Ann. of Math. (2), 63:430–436; [CP-4, 21–27].
- [c] On the immersion of n-manifolds in (n + 1)-space. Comment. Math. Helv., 30:275-284; [CP-4, 141-150].
- [d] On manifolds homeomorphic to the 7-sphere. *Ann. of Math.* (2), 64:399–405; [CP-3, 11–17].
- [e] On the relationship between differentiable manifolds and combinatorial manifolds. First published in [CP-3, 19–28].

- [a] The geometric realization of a semi-simplicial complex. Ann. of Math. (2), 65:357–362; [CP-4, 29–34].
- [b] Groups which act on  $S^n$  without fixed points. Amer. J. Math., 79:623-630; [CP-2, 97-104].
- [c] Isotopy of links. In Algebraic Geometry and Topology, a Symposium in Honor of S. Lefschetz, R. H. Fox, D. C. Spencer and A. W. Tucker, editors, pages 280–306. Princeton University Press, Princeton, NJ; [CP-2, 27–53].
- [d] (with L.S. Shapley). On games of survival. In Contributions to the Theory of Games, vol. 3, Annals of Math. Studies, no. 39, M. Dresher, A. W. Tucker and P. Wolfe, editors, pages 15–45. Princeton University Press, Princeton, NJ.

- [a] On the existence of a connection with curvature zero. Comment. Math. Helv., 32:215–223; [CP-1, 37–47].
- [b] The Steenrod algebra and its dual. Ann. of Math. (2), 67:150-171; [CP-4, 61-82].
- [c] (with R. Bott). On the parallelizability of the spheres. *Bull. Amer. Math. Soc.*, 64:87–89; [CP-3, 229–231].
- [d] Some consequences of a theorem of Bott. Ann. of Math. (2), 68:444-449; [CP-3, 233-238].
- [e] On the Whitehead homomorphism J. Bull. Amer. Math. Soc., 64:79-82; [CP-3, 239-242].
- [f] On simply connected 4-manifolds. In Symposium Internacional de Topología Algebraíca. (International Symposium on Algebraic Topology), J. Adem, editor, pages 122–128. Universidad Nacional Autónoma de México and UNESCO, Mexico City; [CP-4, 151–157].
- [g] Lectures on differential topology. Notes by J. Munkres. First published in [CP-3, 145–176].

[h] On the cobordism ring  $\Omega^*$ . Research announcement 547-26, *Notices* AMS 5, 457; [CP-3, 255].

### 1959

- [a] On spaces having the homotopy type of a CW-complex. Trans. Amer. Math. Soc., 90:272–280; [CP-4, 35–43].
- [b] Differentiable structures on spheres. Amer. J. Math., 81:962–972; [CP-3, 35–45].
- [c] Sommes de variétes différentiables et structures différentiables des sphères. Bull. Soc. Math. France, 87:439–444; [CP-3, 29–34].
- [d] Differentiable manifolds which are homotopy spheres. First published in [CP-3, 65–88].

#### 1960

- [a] (with E. Spanier). Two remarks on fiber homotopy type. Pacific J. Math., 10:585-590; [CP-4, 167-172].
- [b] On the cobordism ring  $\Omega^*$  and a complex analogue. I. Amer. J. Math., 82:505-521; [CP-3, 257-273].
- [c] (with M. A. Kervaire). Bernoulli numbers, homotopy groups, and a theorem of Rohlin. In *Proc. Internat. Congress Math. Edinburgh* 1958, pages 454–458. Cambridge Univ. Press, New York; [CP-3, 243–247].

- [a] A procedure for killing homotopy groups of differentiable manifolds. In *Proc. Sympos. Pure Math., vol.* III, pages 39–55. American Mathematical Society, Providence, RI; [CP-3, 47–63].
- [b] Two complexes which are homeomorphic but combinatorially distinct. *Ann. of Math.* (2), 74:575–590; [CP-2, 123–138].
- [c] (with M. A. Kervaire). On 2-spheres in 4-manifolds. Proc. Nat. Acad. Sci. U.S.A., 47:1651-1657; [CP-4, 159-165].
- [d] Variedades diferenciables con frontera. An. Inst. Mat. Univ. Nac. Autónoma México, 1:82–116. (Revised and augmented translation: "Smooth manifolds with boundary" first published in [CP-3, 191–222].
- [e] Lectures on differentiable structures. First published in [CP-3, 177–190].
- [f] Microbundles and differentiable structures. First published in [CP-4, 173–190].

- [a] (with M. G. Barratt). An example of anomalous singular homology. *Proc. Amer. Math. Soc.*, 13:293–297; [CP-4, 107–111].
- [b] A duality theorem for Reidemeister torsion. *Ann. of Math.* (2), 76:137–147; [CP-2, 139–149].
- [c] A unique decomposition theorem for 3-manifolds. *Amer. J. Math.*, 84:1–7; [CP-2, 237–243].
- [d] A survey of cobordism theory. *Enseignement Math.* (2), 8:16–23; [CP-3, 283–290]. (Erratum in [CP-3, 291–292].)
- [e] On axiomatic homology theory. *Pacific J. Math.*, 12:337–341; [CP-4, 101–105].
- [f] The work of J. H. C. Whitehead. In The Mathematical Works of J. H. C. Whitehead, vol. 1,, J. H. C. Whitehead and I. M. James, editors, pages xxi-xxxiii, Pergamon Press, Oxford; [CP-4, 261–278].

- [a] (with M. A. Kervaire). Groups of homotopy spheres. I. Ann. of Math. (2), 77:504-537; [CP-3, 89-122].
- [b] Spin structures on manifolds. Enseignement Math. (2), 9:198-203; [CP-3, 293-298].
- [c] Topological manifolds and smooth manifolds. In *Proc. Internat. Congr. Math.*, Stockholm 1962, pages 132–138, Inst. Mittag-Leffler, Djursholm; [CP-4, 191–197].
- [d] Morse Theory. Based on lecture notes by M. Spivak and R. Wells. Annals of Math. Studies, no. 51. Princeton University Press, Princeton, NJ. (Translated into Russian, Japanese, Korean).
- [e] The representation rings of some classical groups. First published in [CP-5, 143–154].

- [a] On the Betti numbers of real varieties. *Proc. Amer. Math. Soc.*, 15:275–280; [CP-1, 133–140].
- [b] Microbundles. I. Topology, 3 (suppl. 1):53–80; [CP-4, 199–226].
- [c] Eigenvalues of the Laplace operator on certain manifolds. *Proc. Nat. Acad. Sci.* U.S.A., 51:542; [CP-1, 49–51].
- [d] Most knots are wild. Fund. Math., 54:335–338; [CP-2, 55–58].
- [e] (with M. W. Hirsch). Some curious involutions of spheres. Bull. Amer. Math. Soc., 70:372–377; [CP-2, 105–110].

- [f] Differential topology. In Lectures on Modern Mathematics, vol. II, T. Saaty, editor, pages 165–183. Wiley, New York. Also available in Uspehi Mat. Nauk, 20(6(126)): 41–54, 1965 (in Russian); [CP-3, 123–141].
- [g] Some free actions of cyclic groups on spheres. In Differential Analysis, Bombay Colloq., 1964, International Mathematical Union, pages 37–42.
   Oxford Univ. Press, London; [CP-2, 111–116].

- (a) (with J. C. Moore). On the structure of Hopf algebras. Ann. of Math.
  (2), 81:211-264; [CP-5, 37-90]. An earlier version from 1959 is published in [CP-5, 7-36].
- [b] On the Stiefel-Whitney numbers of complex manifolds and of spin manifolds. *Topology*, 3:223–230; [CP-3, 307–314].
- [c] Remarks concerning spin manifolds. In Differential and Combinatorial Topology, a Symposium in Honor of Marston Morse, S. S. Cairns, editor, pages 55–62. Princeton Univ. Press, Princeton, NJ; [CP-3, 299–306].
- [d] Lectures on the h-cobordism theorem. Notes by L. Siebenmann and J. Sondow. Princeton University Press, Princeton, NJ. (Translated into Russian).
- [e] Topology from the Differentiable Viewpoint. Based on notes by David W. Weaver. The University Press of Virginia, Charlottesville, Va. (Translated into Russian, Japanese). Revised reprint, Princeton Landmarks in Mathematics, Princeton University Press, Princeton, NJ, 1997.
- [f] (with H. Bass) On unimodular groups over number fields. First published in [CP-5, 165–179].

#### 1966

- [a] Whitehead torsion. Bull. Amer. Math. Soc., 72:358-426; [CP-2, 151-219].
- [b] (with R. H. Fox). Singularities of 2-spheres in 4-space and cobordism of knots. Osaka J. Math., 3:257–267; [CP-2, 59–69].

#### 1967

[a] (with H. Bass and J.-P. Serre). Solution of the congruence subgroup problem for  $SL_n$  ( $n \ge 3$ ) and  $Sp_{2n}$  ( $n \ge 2$ ). Inst. Hautes Études Sci. Publ. Math., 33:59–137. Erratum: On a functorial property of power residue symbols. ibid. 44:241–244, 1974; [CP-5, 181–259] and 261–264].

- [a] On characteristic classes for spherical fibre spaces. *Comment. Math. Helv.*, 43:51–77; [CP-4, 227–253].
- [b] A note on curvature and fundamental group. J. Differential Geometry, 2:1-7; [CP-1, 53-61].
- [c] Singular Points of Complex Hypersurfaces. Annals of Math. Studies, no. 61. Princeton University Press, Princeton, NJ. (Translated into Russian, Japanese).
- [d] Infinite cyclic coverings. In Conference on the Topology of Manifolds (Michigan State Univ., E. Lansing, Mich., 1967), J. G. Hocking, editor, pages 115–133. Prindle, Weber & Schmidt, Boston, Mass; [CP-2, 71–89].
- [e] Growth of finitely generated solvable groups. J. Differential Geometry, 2:447–449; [CP-5, 155–157].
- [f] Uses of the fundamental group. First published in [CP-2, 221–225].

- [a] (with G. Lusztig and F.P. Peterson). Semi-characteristics and cobordism. *Topology*, 8:357–359; [CP-4,113–115].
- [b] On isometries of inner product spaces. *Invent. Math.*, 8:83–97; [CP-5, 331–345].
- [c] A problem in cartography. Amer. Math. Monthly, 76:1101–1112; [CP-1, 159–172].
- [d] Algebraic K-theory and quadratic forms. *Invent. Math.*, 9:318–344; [CP-5, 347–373].

- [a] (with O. Burlet). Torsion et type simple d'homotopie. In Essays on Topology and Related Topics (Mémoires dédiés à Georges de Rham), A. Haefliger and R. Narasimhan, editors, pages 12–17. Springer, New York; [CP-2, 227–232].
- [b] (with P. Orlik). Isolated singularities defined by weighted homogeneous polynomials. *Topology*, 9:385–393; [CP-1, 141–151].
- [c] Foliations and foliated vector bundles. First published in [CP-4, 279–320].
- [d] Symmetric inner products over a Dedekind domain. First published in [CP-5, 375-380].

- [a] Symmetric inner products in characteristic 2. In Prospects in Mathematics (Proc. Sympos., Princeton Univ., Princeton, NJ, 1970), H. Rossi, editor, pages 59–75. Annals of Math. Studies, no. 70. Princeton Univ. Press, Princeton, NJ; [CP-5, 381–397].
- [b] Introduction to Algebraic K-Theory. Annals of Math. Studies, no. 72. Princeton University Press, Princeton, NJ. (Translated into Russian).
- [c] On the construction FK. In Algebraic Topology: A Student's Guide, by J. F. Adams, pages 119–136; [CP-4, 45–53].

[a] (with D. Husemoller). Symmetric Bilinear Forms. Ergebnisse der Mathematik und ihrer Grenzgebiete, Band 73. Springer-Verlag, New York. (Translated into Russian).

#### 1974

[a] (with J.D. Stasheff). Characteristic Classes. Annals of Math. Studies, no. 76. Princeton University Press, Princeton, NJ. (Translated into Russian, Japanese).

# 1975

- [a] Isolated critical points of complex functions. In Differential Geometry (Proc. Sympos. Pure Math., vol. XXVII, Part 1, Stanford Univ., Stanford, Calif., 1973), S. S. Chern and R. Osserman, editors, pages 381–382. Amer. Math. Soc., Providence, RI; [CP-1, 153–156].
- [b] On the 3-dimensional Brieskorn manifolds M(p, q, r). In Knots, Groups, and 3-Manifolds (Papers dedicated to the memory of R. H. Fox), L. P. Neuwirth, editor, pages 175–225. Annals of Math. Studies, no. 84. Princeton Univ. Press, Princeton, NJ; [CP-2, 245–295].

- [a] Curvatures of left invariant metrics on Lie groups. Advances in Math., 21 (3): 293–329; [CP-1, 73–111].
- [b] Problems in differential geometry. In Mathematical Developments Arising from Hilbert Problems, pages 54–57, Proc. Symposia Pure Math. vol. XXVIII, F. Browder, editor, Amer. Math. Soc., Providence, RI; [CP-1, 63–71].

[c] Hilbert's problem 18: on crystallographic groups, fundamental domains, and on sphere packing. In Mathematical Developments Arising from Hilbert Problems, pages 491–506. Proc. Sympos. Pure Math., vol. XXVIII, F. Browder, editor. Amer. Math. Soc., Providence, RI; [CP-1, 173–187].

#### 1977

- [a] On deciding whether a surface is parabolic or hyperbolic. *Amer. Math. Monthly*, 84 (1): 43–46; [CP-1, 113–118].
- [b] On fundamental groups of complete affinely flat manifolds. *Advances in Math.*, 25 (2):178–187; [CP-1, 119–130].
- [c] (with W. Thurston). Characteristic numbers of 3-manifolds. Enseignement Math. (2), 23 (3-4): 249–254; [CP-2, 297–302].

#### 1978

- [a] (with L.S. Shapley). Values of large games. II. Oceanic games. *Math. Oper. Res.*, 3 (4): 290–307.
- [b] Analytic proofs of the "hairy ball theorem" and the Brouwer fixed-point theorem. *Amer. Math. Monthly*, 85 (7): 521–524; [CP-1, 235–242].
- [c] How to compute volume in hyperbolic space. First published in [CP-1, 189–212].
- [d] Euler characteristic and finitely additive Steiner measures. First published in [CP-1, 213–234].

# 1982

[a] Hyperbolic geometry: the first 150 years. Bull. Amer. Math. Soc. (N.S.), 6(1):9-24; [CP-1, 243-260].

- [a] On the homology of Lie groups made discrete. Comment. Math. Helv., 58 (1):72–85; [CP-4, 117–130].
- [b] On polylogarithms, Hurwitz zeta functions, and the Kubert identities. Enseign. Math. (2), 29 (3-4): 281–322; [CP-5, 265–306].
- [c] On the geometry of the Kepler problem. *Amer. Math. Monthly*, 90 (6): 353–365; [CP-1, 261–279].
- [d] The Schläfli differential inequality. First published in [CP-1, 281–295].

[a] Remarks on infinite-dimensional Lie groups. In *Relativity, groups and topology, II* (*Les Houches*, 1983), B. S. DeWitt and R. Stora, editors, pages 1007–1057. North-Holland, Amsterdam; [CP-5, 91–141].

#### 1985

[a] On the concept of attractor. Comm. Math. Phys., 99 (2):177–195. Correction and remarks, Comm. Math. Phys., 102 (3):517–519; [CP-6, 21–41 and 43–45].

#### 1986

[a] Directional entropies of cellular automaton-maps. In Disordered systems and biological organization (Les Houches, 1985), volume 20 of NATO Adv. Sci. Inst. Ser. F Comput. Systems Sci., E. Bienenstock, F. Fogelman Soulie and G. Weisbuch, editors, pages 113–115, Springer, Berlin; [CP-6, 47–49].

### 1987

[a] The work of M. H. Freedman. In Proc. Internat. Congr. Math., Berkeley, Calif. 1986, vol. 1, A. M. Gleason, editor, pages 13–15, Amer. Math. Soc., Providence, RI. Also published in Fields Medallists Lectures, volume 5 of World Sci. Ser. 20th Century Math., M. F. Atiyah and D. Iagolnitzer, editors, pages 405–408. World Sci. Publ., River Edge, NJ., 1997; [CP-4, 321–323].

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   Dekker, New York; [CP-6, 289–335].
- [b] (with S. Friedland). Dynamical properties of plane polynomial automorphisms. *Ergodic Theory Dynam. Systems*, 9 (1):67–99; [CP-6, 255–287].

#### 1992

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#### 1993

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- [c] Geometry and dynamics of quadratic rational maps, Experiment. Math., with an appendix by the author and Tan Lei. 2(1):37–83; [CP-6, 371–438].

#### 1994

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- [b] Thurston's algorithm without critical finiteness. *Linear and Complex Analysis Problem Book 3, Part 2,* Havin and Nikolskii editors, Lecture Notes in Math no. 1474, pp. 434–436, Springer, Berlin.
- [c] Problems on local connectivity. ibid. pp. 443-446.

#### 1995

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- [b] A Nobel Prize for John Nash. Math. Intelligencer, 17 (3):11-17. Also available in Pokroky Mat. Fyz. Astronom, 41 (4):169-179, 1996 (in Czech) and in Gac. R. Soc. Mat. Esp., 5 (3):560-577, 2002 (in Spanish).
- [c] (with S. P. Dawson, R. Galeeva, and C. Tresser). A monotonicity conjecture for real cubic maps. In Real and Complex Dynamical Systems (Hillerød, 1993), volume 464 of NATO Adv. Sci. Inst. Ser. C, Math. Phys. Sci., B. Branner and P. Hjorth, editors, pages 165–183. Kluwer Acad. Publ., Dordrecht; [CP-6, 157–175].
- [d] On the Steenrod homology theory. In Novikov Conjectures, Index Theorems and Rigidity, vol. 1 (Oberwolfach, 1993), volume 226 of London Math. Soc. Lecture Note Ser., S. C. Ferry, A. Ranicki and J. Rosenberg, editors, pages 79–96, Cambridge Univ. Press, Cambridge; [CP-4, 83–100].

[a] Fubini foiled: Katok's paradoxical example in measure theory. *Math. Intelligencer*, 19 (2): 30–32; [CP-6, 233–235].

# 1998

[a] John Nash and "A Beautiful Mind", Notices Amer. Math. Soc., 45 (10):1329–1332.

### 1999

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- [b] Growing up in the old Fine Hall. In Prospects in Mathematics (Princeton, NJ, 1996), H. Rossi, editor, pages 1–11. Amer. Math. Soc., Providence, RI.
- [c] Dynamics in One Complex Variable. Friedr. Vieweg & Sohn, Braunschweig. Second edition, 2000. Third edition, Annals of Math. Studies, no. 160, Princeton University Press, Princeton, NJ, 2006.

#### 2000

[a] (with C. Tresser). On entropy and monotonicity for real cubic maps. *Comm. Math. Phys.*, 209 (1):123–178. With an appendix by Adrien Douady and Pierrette Sentenac; [CP-6, 177–232].

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- [c] Periodic orbits, externals rays and the Mandelbrot set: an expository account. In Géométrie Complexe et Systèmes Dynamiques, colloque en l'honeur d'Adrien Douady (Orsay, 1995); Astérisque, 261: xiii, M. Flexor, P. Sentenac and J.-C. Yoccoz, editors, 277–333.
- [d] Local connectivity of Julia sets: expository lectures. In *The Mandelbrot Set, Theme and Variations, vol.* 274 of *London Math. Soc. Lecture Note Ser.*, Tan Lei, editor, pages 67–116. Cambridge Univ. Press, Cambridge.
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#### 2009

- [a] Collected Papers of John Milnor 4, Homotopy, Homology and Manifolds. American Mathematical Society, Providence, RI. Edited by John McCleary.
- [b] Cubic polynomial maps with periodic critical orbit. I. In *Complex Dynamics, Families and Friends, in Honor of John Hamal Hubbard*, D. Schleicher, editor, pages 333–411. A. K. Peters, Wellesley, MA.
- [c] Fifty years ago: topology of manifolds in the 50s and 60s. In Low Dimensional Topology, volume 15 of IAS/Park City Math. Ser., T. Mrowka and P. Osváth, editors, pages 9–20. Amer. Math. Soc., Providence, RI; [CP-4, 345–356].

### 2010

- [a] Collected Papers of John Milnor 5, Algebra. American Mathematical Society, Providence, RI. Edited by H. Bass and T.-Y. Lam.
- [b] (with A. Bonifant and J. Kiwi). Cubic polynomial maps with periodic critical orbit. II. Escape regions. Conform. Geom. Dyn., 14:68–112. Errata, Conform. Geom. Dyn., 14:190–193.

### 2011

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## 2012

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- [d] (with A. Bonifant and M. Dabija). Elliptic curves as attractors in  $\mathbb{P}^2$ , II, The transverse Lyapunov exponent. In preparation.