References

Adams, J. F.

1960 On the non-existence of elements of Hopf invariant one, *Ann. of Math.* **72**, 20–104.

1962 Vector fields on spheres, *Ann. of Math.* **75**, 603–632.

Adams, J. F., P. Lax and R. Phillips

1965 On matrices whose real linear combinations are nonsingular, Proc. Amer. Math. Soc. **16**, 318–322; **17** (1966), 945–947.

Adem, J.

1968 Some immersions associated with bilinear maps, *Bol. Soc. Mat. Mexicana* **13**, 95–104.

1970 On nonsingular bilinear maps. In: *The Steenrod Algebra and its Applications*, Lecture Notes in Math. **168**, Springer, 11–24.

1971 On nonsingular bilinear maps II, *Bol. Soc. Mat. Mexicana* **16**, 64–70.

1975 Construction of some normed maps, *Bol. Soc. Mat. Mexicana* **20**, 59–75.

1978a On maximal sets of anticommuting matrices, *Bol. Soc. Mat. Mexicana* **23**, 61–67.

1978b *Algebra Lineal, Campos Vectoriales e Inmersiones*, III ELAM, IMPA, Rio de Janeiro.

1980 On the Hurwitz problem over an arbitrary field I, II, *Bol. Soc. Mat. Mexicana* **25**, 29–51; **26** (1981), 29–41.

1984 On Yuzvinsky's theorem concerning admissible triples over an arbitrary field, *Bol. Soc. Mat. Mexicana* **29**, 65–69.

1986a On admissible triples over an arbitrary field, *Bull. Soc. Math. Belg. Sér. A* **38**, 33–35.

1986b Classification of low dimensional orthogonal pairings, *Bol. Soc. Mat. Mexicana* **31**, 1–28.

Adem, J., S. Gitler and I. M. James

1972 On axial maps of a certain type, *Bol. Soc. Mat. Mexicana* **17**, 59–62.

Adem, J., J. Ławrynowicz and J. Rembieliński

1996 Generalized Hurwitz maps of the type $S \times V \to W$, *Rep. Math. Phys.* **37**, 325–336.

Alarcon, J. I., and P. Yiu

1993 Compositions of hermitian forms, *Linear and Multilinear Algebra* **36**, 141–145.

Albert, A. A.

1931 On the Wedderburn condition for cyclic algebras, *Bull. Amer. Math. Soc.* **37**, 301–312.

1932 Normal division algebras of degree four over an algebraic field, *Trans. Amer. Math. Soc.* **34**, 449–456.

1939 *Structure of Algebras*, Amer. Math. Soc. Colloq. Publ. 24, Amer. Math. Soc., New York. Revised edition 1961.

1942a Quadratic forms permitting composition, *Ann. Math.* **43**, 161–177.

1942b Non-associative algebras, *Ann. Math.* **43**, 685–707.

1963 (ed.), *Studies in Modern Algebra*, vol. 2, Math. Assoc. America; Prentice-Hall, Inc., Englewood Cliffs, N. J.

1972 Tensor products of quaternion algebras, *Proc. Amer. Math. Soc.* **35**, 65–66.

Allen, H. P.

1969 Hermitian forms, I, *Trans. Amer. Math. Soc.* **138**, 199–210.

1968 Hermitian forms, II, *J. Algebra* **10**, 503–515.

Alon, N.

1996, Combinatorial Nullstellensatz, unpublished preprint.

Alpers, B.

1991 Round quadratic forms, *J. Algebra* **18**, 44–55.

Alpers, B., and E. M. Schröder

1991 On mappings preserving orthogonality of non-singular vectors, *J. Geom.* **41**, 3–5.

Althoen, S. C., and J. F. Weidner

1978 Real division algebras and Dickson's construction, *Amer. Math. Monthly* **85**, 368–371.

Altmann, S. L.

1986 *Rotations, Quaternions, and Double Groups*, Clarendon Press, Oxford.

1989 Hamilton, Rodrigues and the quaternion scandal, *Math. Mag.* **62**, 291–308.

Amitsur, S. A., L. H. Rowen and J. P. Tignol

1979 Division algebras of degree 4 and 8 with involution, *Israel J. Math.* **33**, 133–148.

Anghel, N.

1999 Clifford matrices and a problem of Hurwitz, preprint.

Arason, J. K., and A. Pfister

1982 Quadratische Formen über affinen Algebren und ein algebraischer Beweis des Satzes von Borsuk–Ulam, *J. reine angew. Math.* **331**, 181–184.

Artin, E.

1957 *Geometric Algebra*, Intersci. Tracts Pure Appl. Mathematics 3, Interscience Publishers, New York.

Atiyah, M.

1962 Immersions and embeddings of manifolds, *Topology* **1**, 125–132.

1967 *K-Theory*, W. A. Benjamin, New York??? .

Atiyah, M., R. Bott and H. Shapiro

1964 Clifford modules, *Topology* **3**, Suppl. 1, 3–38.

Au-Yeung, Y.-H., and C.-M. Cheng

1993 Two formulas for the generalized Radon–Hurwitz number, *Linear and Multilinear Algebra* **34**, 59–66.

Backelin,J., J. Herzog and H. Sanders

1988 Matrix factorizations of homogeneous polynomials. In: *Algebra – Some Current Trends*, (L. L. Avramov and K. B. Tchakerian, eds.), Lecture Notes in Math. 1352, Springer, Berlin, 1–33.

Baeza, R.
1978 *Quadratic Forms over Semilocal Rings*, Lecture Notes in Math. 655, Springer, Berlin.
1979 Über die Stufe von Dedekind Ringen, *Arch. Math.* **33**, 226–231.

Bayer, E., D. B. Shapiro and J.-P. Tignol
1993 Hyperbolic involutions, *Math. Z.* **214**, 461–476.

Beasley, L. B., and T. J. Laffey
1990 Linear operators on matrices: the invariance of rank-k matrices, *Linear Algebra Appl.* **133**, 175–184.

Becker, E.
1982 The real holomorphy ring and sums of 2^n-th powers. In: *Géometrie Algébrique Réelle et Formes Quadratiques*, (J.-L. Colliot-Thélène, M. Coste, L. Mahé and M.-F.Roy, eds.), Lecture Notes in Math. 959, Springer, Berlin, 139–181.

Behrend, F.
1939 Über Systeme reeller algebraischer Gleichungen, *Compositio Math.* **7**, 1–19.

Benkart, G., D. J. Britten and J. M. Osborn
1982 Real flexible division algebras, *Canad. J. Math.* **34**, 550–588.

Benkart, G., and J. M. Osborn
1981 Real division algebras and other algebras motivated by physics, *Hadronic J.* **4**, 392–443.

Bennett, A. A.
1919 Products of skew-symmetric matrices, *Bull. Amer. Math. Soc.* **25**, 455–458.

Berger, M., and S. Friedland
1986 The generalized Radon–Hurwitz numbers, *Compositio Math.* **59**, 113–146.

Berlekamp, E. R., J. H. Conway and R. K. Guy
1982 *Winning Ways for Your Mathematical Plays*, vol. 1, Academic Press, London.

Berrick, A. J.
1980 Projective space immersions, bilinear maps and stable homotopy groups of spheres. In: *Topology Symposium*, Siegen 1979 (U. Korschorke and W. D. Neumann, eds.), Lecture Notes in Math. 788, Springer, Berlin, 1–22.

Bier, T.
1979 *Geometrische Beiträge zur Homotopietheorie: Gerahmte Mannigfaltigkeiten, normierte und nichtsinguläre Bilinearformen*, doctoral dissertation, Univ. Göttingen.
1983 A remark on the construction of normed and nonsingular bilinear maps, *Proc. Japan Acad.* **56**, 328–330.
1984 Clifford-Gitter, manuscript (186 pages).

Bier, T., and U. Schwardmann
1982 Räume normierter Bilinearformen und Cliffordstrukturen, *Math. Z.* **180**, 203–215.

Blij, F. van der, and T. A. Springer
1960 Octaves and triality, *Nieuw Arch. Wisk.* (3) **8**, 158–169.

Blij, F. van der
1961 History of the octaves, *Simon Stevin* **34**, 106–125.

Bochnak, J., M. Coste and M.-F. Roy
1987 *Géométrie Algébrique Réelle*, Ergeb. Math. Grenzgeb. (3) 12, Springer, Berlin.

Boos, D.
1998 *Ein tensorkategorieller Zugang zum Satz von Hurwitz*, Diplomarbeit, ETH-Zürich/Universität Regensburg.

Bourbaki, N.
1958 *Algèbre*, Ch. 8, Modules et anneaux semisimples, Hermann, Paris.
1959 *Algèbre*, Ch. 9, Formes sesquilinéaires et formes quadratiques, Hermann, Paris.

Brauer, R., and H. Weyl
1935 Spinors in n dimensions, *Amer. J. Math.* **57**, 425–449.

Brown, R. B., and A. Gray
1967 Vector cross products, *Comment. Math. Helv.* **42**, 222–226.

Bruck, R. H.
1944 Some results in the theory of linear non-associative algebras, *Trans. Amer. Math. Soc.* **56**, 141–199.
1963 What is a loop?. In: [Albert, 1963], 59–99.

Buchanan, T.
1979 Zur Topologie der projektiven Ebenen über reellen Divisionsalgebren, *Geometriae Dedicata* **8**, 383–393.

Buchweitz, R.-O., D. Eisenbud and J. Herzog
1987 Cohen–Macaulay modules on quadrics. In: *Singularities, Representations of Algebras, and Vector Bundles*, Proc. Symp., Lambrecht/Pfalz/FRG 1985 (G.-M. Greuel and G. Trautmann, eds.), Lecture Notes in Math. 1273, Springer, Berlin, 58–95.

Calvillo, G., I. Gitler and J. Martínez-Bernal
1997a Intercalate matrices. I: Recognition of dyadic type. *Bol. Soc. Mat. Mexicana* (3) **3**, 57–67.
1997b Intercalate matrices. II: A characterization of Hurwitz–Radon formulas and an infinite family of forbidden matrices, *Bol. Soc. Mat. Mexicana* (3) **3**, 207–220.

Cartan, E.
1938 *Leçons sur la théorie des spineurs*, Hermann, Paris. Englist transl.: *The Theory of Spinors*, Dover Publ. Inc, 1981.

Cassels, J. W. S.
1978 *Rational Quadratic Forms*, Academic Press, ????.

Chang, S.
1998 On quadratic forms between spheres, *Geometriae Dedicata* **70**, 111–124.

Chevalley, C.
1946 *The Theory of Lie Groups*, Princeton Univ. Press.
1954 *The Algebraic Theory of Spinors*, Columbia Univ. Press.

1955 The construction and study of certain important algebras, Publ. Math. Soc. Japan 1.

Chisolm, J. S. R., and A. K. Common (eds.)
1986 *Clifford Algebras and Their Applications in Mathematical Physics*, Proceedings of the NATO and SERC Workshop, Canterbury, U.K., September 15–27, 1985, D. Reidel, Dordrecht.

Clifford, W. K.
1878 Applications of Grassmann's extensive algebra, *Amer. J. Math* **1**, 350–358. Reprinted in: *Collected Mathematical Papers*, Macmillan, 1882.

Conway, J. H.,
1980 private conversation.

Coxeter, H. S. M.
1946 Quaternions and reflections, *Amer. Math. Monthly* **53**, 136–146.

Crowe, M. J.
1967 *A History of Vector Analysis: The Evolution of the Idea of a Vectorial System*, Univ. of Notre Dame Press. Reprinted by Dover Publications, 1985.

Crumeyrolle, A.
1990 *Orthogonal and Symplectic Clfford Algebras: Spinor Structures*, Math Appl. **57**, Kluwer Acad. Publ., Dordrecht.

Curtis, C. W.
1963 The four and eight square problem and division algebras. In: [Albert 1963], 100–125.

Dai, Z. D., and T. Y. Lam,
1984 Levels in algebra and topology, *Comment. Math. Helv.* **59**, 376–424.

Dai, Z. D., T. Y. Lam and R. J. Milgram
1981 Application of topology to problems on sums of squares, *Enseign. Math.* **27**, 277–283.

Dai, Z. D., T. Y. Lam and C. K. Peng
1980 Levels in algebra and topology, *Bull. Amer. Math. Soc.* **3**, 845–848.

Davis, D. M.,
1998 Embeddings of real projective spaces, *Bol. Soc. Mat. Mexicana* (3) **4**, 115–122.

Dickson, L. E.
1914 *Linear Algebras*, Cambridge Tracts in Math. 16. (See p. 15.) Reprinted by Hafner Publ. Co., 1960.
1919 On quaternions and their generalizations and the history of the eight square theorem, *Ann. Math.* **20**, 155–171.

Dieudonné, J.
1953 A problem of Hurwitz and Newman, *Duke Math. J.* **20**, 381–389.
1954 Sur les multiplicateurs des similitudes, *Rend. Circ. Mat. Palermo* **3**, 398–408.

Dittmer, A.
1994 Cross product identities in arbitrary dimension, *Amer. Math. Monthly* **101**, 887–891.

Draxl, P. K.
1983 *Skew Fields*, London Math. Soc. Lecture Note Ser. 81, Cambridge Univ. Press.

Drazin, M. P.
1952 A note on skew symmetric matrices, *Math. Gazette* **36**, 253–255.

Dubisch, R.
1946 Composition of quadratic forms, *Ann. of Math.* **47**, 510–527.

Ebbinghaus, H.-D., et al.
1991 *Numbers*, Graduate Texts in Math. 123, Springer, Berlin. A translation into English of the 1988 edition of the book *Zahlen*.

Eckmann, B.
1943a Stetige Lösungen linearer Gleichungssysteme, *Comment. Math. Helv.* **15**, 318–339.
1943b Gruppentheoretischer Beweis des Satzes von Hurwitz–Radon über die Komposition der quadratischen Formen, *Comment. Math. Helv.* **15**, 358–366.
1968 Continuous solutions of linear equations – some exceptional dimensions in topology. In: *Battelle Rencontres, 1967 Lectures in Math. and Physics*, W. A. Benjamin, New York, 516–526.
1989 Hurwitz–Radon matrices and periodicity modulo 8, *Enseign. Math.* **35**, 77–91.
1991 Continuous solutions of linear equations – An old problem, its history, and its solution, *Exposition. Math.* **9**, 351–365.
1994 Hurwitz–Radon matrices revisited: from effective solution of the Hurwitz matrix equations to Bott periodicity, *The Hilton Symposium 1993* (G. Mislin, ed.), CRM Proc. Lecture Notes 6, Amer. Math Soc., Providence, 23–35.

Eddington, A.
1932 On sets of anticommuting matrices, *J. London Math. Soc.* **7**, 56–68; **8** (1933), 142–152.

Edwards, B.
1978 On classifying Clifford algebras, *J. Indian Math Soc. (N. S.)* **42**, 339–344.

Eels, J., and P. Yiu
1995 Polynomial harmonic morphisms between euclidean spheres, *Proc. Amer. Math. Soc.* **123**, 2921–2925.

Eichhorn, W.
1969 Funktionalgleichungen in Vektorräumen, Kompositionsalgebren und Systeme partieller Differentialgleichungen, *Aequationes Math.* **2**, 287–303.
1970 Funktionalgleichungen in reellen Vektorräumen und verallgemeinerte Cauchy–Riemannsche Differentialgleichungen, speziell die Weylsche Gleichung des Neutrinos, *Aequationes Math.* **5**, 255–267.

Elduque, A., and H. C. Myung
1991 Flexible composition algebras and Okubo algebras, *Comm. Algebra* **19**, 1197–1227.
1993 On flexible composition algebras, *Comm. Algebra* **21**, 2481–2505.

Elduque, A., and J. M. Pérez
1997 Infinite dimensional quadratic forms admitting composition, *Proc. Amer. Math. Soc.* **125**, 2207–2216

Eliahou, S., and M. Kervaire
1998 Sumsets in vector spaces over finite fields, *J. Number Theory* **71**, 12–39.

Elman, R.
1977 Quadratic forms and the u-invariant, III. In: [Orzech 1977], 422–444.

Elman, R., and T. Y. Lam
1973a On the quaternion symbol homomorphism $g_F : k_2F \to B(F)$. In: Algebraic K-Theory 2, Proc. Conf. Battelle Inst. 1972 (H. Bass, ed.), Lecture Notes in Math. 342, Springer, Berlin, 447–463.
1973b Quadratic forms and the u-invariant, I, *Math. Z.* **131**, 283–304.
1973c Quadratic forms and the u-invariant, II, *Invent. Math.* **21**, 125–137.
1974 Classification theorems for quadratic forms over fields, *Comment. Math. Helv.* **49**, 373–381.
1976 Quadratic forms under algebraic extensions, *Math. Ann.* **219**, 21–42.

Elman, R., T. Y. Lam, J.-P. Tignol and A. Wadsworth
1983 Witt rings and Brauer groups under multiquadratic extensions, I, *Amer. J. Math.* **105**, 1119–1170.

Elman, R., T. Y. Lam and A. Wadsworth
1977 Amenable fields and Pfister extensions. In: [Orzech 1977], 445–492.
1979 Pfister ideals in Witt rings, *Math. Ann.* **245**, 219–245.

Faillétaz, J.-M.
1992 *Compositions d'Espaces Bilinéaires par des Espaces Quadratiques*, doctoral dissertation, Univ. de Lausanne.

Freudenthal, H.
1952 Produkte symmetrischer und antisymmetrischer Matrizen, *Nederl. Akad. Wetensch. Proc. Ser. A* **55** = *Indag. Math.* **14**, 193–198.

Frobenius, G.
1910 Über die mit einer Matrix vertauschbaren Matrizen, *Sitzungsber. Preuss. Akad. Wiss.* 1910. Reprinted in *Ges. Abh.*, vol. 3, Springer, 1968, 415–427.

Fröhlich, A.
1969 Hermitian and quadratic forms over rings with involution, *Quart. J. Math. Oxford* **20**, 297–317.
1971 On the K-theory of unimodular forms over rings of algebraic integers, *Quart. J. Math. Oxford* **22**, 401–423.
1972 Orthogonal and symplectic representations of groups, *Proc. London Math. Soc.* **24**, 470–506.
1984 *Classgroups and Hermitian Modules*, Progr. Math. **48**, Birkhäuser, Basel.

Fröhlich, A., and A. McEvett
1969 Forms over rings with involution, *J. Algebra* **12**, 79–104.

Fulton, W.
1984 *Intersection Theory*, Ergeb. Math. Grenzgeb. (3) 2, Springer, Berlin.

Furuoya, I., S. Kanemake, J. Ławrynowicz and O. Suzuki
1994 Hermitian Hurwitz pairs, In: [Ławrynowicz 1994], 135–154.

Gabel, M.
1974 Generic orthogonal stably free projectives, *J. Algebra* **29**, 477–488.

Gantmacher, F. R.
1959 *The Theory of Matrices* (in 2 volumes), Chelsea, New York.

Gauchman, H., and G. Toth
1994 Real orthogonal multiplications in codimension two, *Nova J. Algebra Geom.* **3**, 41–72..
1996 Normed bilinear pairings for semi-Euclidean spaces near the Hurwitz–Radon range, *Results Math.* **30**, 276–301.

Gentile, E.
1985 A note on the u -invariant of fields, *Arch. Math.* **44**, 249–254

Geramita, A. V., and N. J. Pullman
1974 A theorem of Hurwitz and Radon and orthogonal projective modules, *Proc. Amer. Math. Soc.* **42**, 51–56.

Geramita, A. V., and J. Seberry
1979 *Orthogonal Designs*, Lecture Notes in Pure and Appl. Math. 45, Marcel Dekker, New York.

Gerstenhaber, M.
1964 On semicommuting matrices, *Math. Z.* **83**, 250–260.

de Géry, J. C.
1970 Formes quadratiques dans un corps quelconque, nulles sur un cône donné, *Bull. Soc. Math. France*, 2e série, **94**, 257–279.

Gilkey, P. B.
1987 The eta invariant and non-singular bilinear products in $\mathbb{R}^n$, *Canad. Math. Bull.* **30**, 147–154.

Ginsburg, M.
1963 Some immersions of projective space in Euclidean space, *Topology* **2**, 69–71.

Gitler, S., and K. Y. Lam
1969 The generalized vector field problem and bilinear maps, *Bol. Soc. Mat. Mexicana* (2) **14**, 65–69.

Gluck, H., F. Warner and C. T. Yang
1983 Division algebras, fibrations of spheres by great spheres and the topological determination of space by the gross behavior of its geodesics, *Duke Math. J.* **50**, 1041–1076.

Gluck, H., F. Warner and W. Ziller
1986 The geometry of the Hopf fibrations, *Enseign. Math.* **32**, 173–198.

Gordon, N. A., T. M. Jarvix, J. G. Maks and R. Shaw
1994 Composition algebras and $PG(m, 2)$, *J. Geom.* **51**, 50–57.

Gow, R., and T. J. Laffey
1984 Pairs of alternating forms and products of two skew-symmetric matrices, *Linear Algebra Appl.* **63**, 119–132.

Greenberg, M.
1967 *Lectures on Algebraic Topology*, W. A. Benjamin, New York.
1969 *Lectures on Forms in Many Variables*, W. A. Benjamin, New York.

Gude, U.-G.
1988 *Über die Nichtexistenz rationaler Kompositionsformeln bei Formen höheren Grades*, doctoral dissertation, Univ. Dortmund.

Guo Ruizhi
1996 Some remarks on orthogonal multiplication, *Acta Sci. Natur. Univ. Norm. Hunan.* **19**, 7–10.

Hähl, H.
1975 Vierdimensional reelle Divisionsalgebren mit dreidimensionaler Automorphismengruppe, *Geom. Dedicata* **4**, 323–333.

Hahn, A.,
1985 A hermitian Morita theorem for algebras with anti-structure, *J. Algebra* **93**, 215–235.

Halberstam, H., and R. E. Ingham
1967 Four and eight squares theorems, Appendix 3 to *The Math. Papers of Sir William Rowen Hamilton*, Vol. III, 648–656, Cambridge Univ. Press.

Hartshorne, R.
1977 *Algebraic Geometry*, Graduate Texts in Math. 52, Springer, Berlin.

Hefter, H.
1982 Dehnungsuntersuchungen an Sphärenabbildungen, *Invent. Math.* **66**, 1–10.

Hermann, R.
1974 *Spinors, Clifford and Cayley Algebras*, Interdisciplinary Mathematics, vol. 7, New Brunswick, NJ.

Herstein, I.
1968 *Noncommutative Rings*, Carus Math. Monographs, No. 15, Math. Assoc. America, Washington.

Hile, G. N., and M. H. Protter
1977 Properties of overdetermined first order elliptic systems. *Arch. Rational Mech. Anal.* **66**, 267–293.

Hirzebruch, F.
1991 Division algebras and topology, one chapter in [Ebbinghaus et al. 1991], 281–302.

Hodge, W., and D. Pedoe
1947 *Methods of Algebraic Geometry*, vol. 1, Cambridge Univ. Press.

Hoffmann, D. W., and J.-P. Tignol
1998 On 14-dimensional forms in I^3, 8-dimensional forms in I^2, and the common value property, *Doc. Math.* **3**, 189–214.

Hopf, H.
1931 Über die Abbildungen der dreidimensional Sphäre auf die Kugelfläche, *Math. Ann.* **104**, 637–714.
1935 Über die Abbildungen von Sphären auf Sphären niedrigerer Dimension, *Fund. Math.* **23**, 427–440.
1940 Systeme symmetrischer Bilinearformen und euklidische Modelle der projektiven Räume, *Vierteljahrsschr. Naturforsch. Ges. Zürich* **85**, Beibl. 32, 165–177.
1941 Ein topologischer Beitrag zur reellen Algebra, *Comment. Math. Helv.* **13**, 219–239.

Hornix, E. A. M.
1995 Round quadratic forms, *J. Algebra* **175**, 820–843.

Hughes, D., and F. Piper
1973 *Projective Planes*, Graduate Texts in Math. 6, Springer, Berlin.

Humphreys, J. E.
1975 *Linear Algebraic Groups*, Graduate Texts in Math. 21, Springer, Berlin.

Hurwitz, A.
1898 Über die Komposition der quadratischen Formen von beliebig vielen Variabeln, *Nachr. Ges. Wiss. Göttingen*, (Math.-Phys. Kl.), 309–316. Reprinted in *Math. Werke*, Bd. 2, Birkhäuser, 1962–3, 565–571.
1923 Über die Komposition der quadratischen Formen, *Math. Ann.* **88**, 1–25. Reprinted in *Math. Werke*, Bd. 2, Birkhäuser, 1962–3, 641–666.

Husemoller, D.
1975 *Fibre Bundles*, McGraw Hill 1966; second edition, Springer, 1975.

Isaacs, I. M.
1980 Roots of polynomials in algebraic extensions of fields, *Amer. Math. Monthly* **87**, 543–544.

Jacobson, N.
1939 An application of E. H. Moore's determinant of a hermitian matrix, *Bull. Amer. Math. Soc.* **45**, 745–748.
1958 Composition algebras and their automorphisms, *Rend. Circ. Mat. Palermo* (2) **7**, 55–80.
1964 Clifford algebras for algebras with involution of type D, *J. Algebra* **1**, 288–300.
1968 *Structure and Representation of Jordan Algebras*, Amer. Math. Soc. Colloq. Publ. 34, Amer. Math. Soc., Providence. See especially pp. 230–232.
1974 *Basic Algebra I*, W. H. Freeman, ???.
1980 *Basic Algebra II*, W. H. Freeman, ???.
1983 Some applications of Jordan norms to involutorial simple associative algebras, *Adv. Math.* **48**, 149–165. Corrected version appears in: *Coll. Math. Papers*, vol. 3, 251–267. Also see p. 235.
1992 Generic norms. In: Proc. Internat. Conf. in Algebra, Novosibirsk 1989 (L. A. Bokut, Yu. L. Ershov and A. I. Kostrikin, eds.), Contemp. Math. 131, part 2, Amer. Math. Soc., Providence, 587–603.
1995 Generic norms II, *Adv. Math.* **114**, 189–196.
1996 *Finite-Dimensional Division Algebras over Fields*, Springer, Berlin.

James, I. M.
1963 On the immersion problem for real projective spaces, *Bull. Amer. Math. Soc.* **69**, 231–238.
1971 Euclidean models of projective spaces, *Bull. London Math. Soc.* **3**, 257–276.
1972 Two problems studied by Heinz Hopf. In: *Lectures on Algebraic and Differential Topology*, by R. Bott, S. Gitler, and I. M. James, Lecture Notes in Math. **279**, Springer, Berlin, 134–160.

Janĭevskiĭ, V. I.
1974 Sfields with involution, and symmetric elements (in Russian), *Dokl. Akad. Nauk. BSSR* **18**, 104–107, 186.

Jordan, P., J. von Neumann and E. Wigner
1934 On an algebraic generalization of the quantum mechanical formalism, *Ann. of Math.* **2**, 29–64, particularly pp. 51–54.

Junker, J.
1980 Das Hurwitz Problem für quadratische Formen über Körper der Charakteristik 2, Diplom thesis, Univ. Saarbrücken.

Kanemaki, S.
1989 Hurwitz pairs and octonions. In: [Ławrynowicz 1989], 215–223.

Kanemaki, S., and O. Suzuki
1989 Hermitian pre-Hurwitz pairs and the Minkowski space. In: [L awrynowicz 1989], 225–232.

Kaplan, A.
1981 Riemannian nilmanifolds attached to Clifford modules, *Geom. Dedicata* **11**, 127–136.
1984 Composition of quadratic forms in geometry and analysis: some recent applications. In: Quadratic and Hermitian forms, Conf. Hamilton/Ont. 1983, CMS Conf. Proc. 4, 193–201.

Kaplansky, I.
1949 Elementary divisors and modules, *Trans. Amer. Math. Soc.* **66**, 464–491.
1953 Infinite-dimensional quadratic forms permitting composition, *Proc. Amer. Math. Soc.* **4**, 956–960.
1969 *Linear Algebra and Geometry*, Allyn and Bacon, ???1969. Reprinted by Chelsea, New York, 1974.
1979 Compositions of quadratic and alternate forms, *C. R. Math. Rep. Acad. Sci. Canada* **1**, 87–90.
1983 Products of symmetric and skew-symmetric matrices, unpublished manuscript.

Kasch, F.
1953 Invariante Untermoduln des Endomorphismenringes eines Vektorraums, *Arch. Math.* **4**, 182–190.

Kawada, Y., and N. Iwahori
1950 On the structure and representations of Clifford algebras, *J. Math. Soc. Japan* **2**, 34–43.

Kervaire, M. A.
1958 Non-parallelizability of the n-sphere for $n > 7$, *Proc. Nat. Acad. Sci. USA* **44**, 280–283.

Kestelman, M.
1961 Anticommuting linear transformations, *Can. J. Math.* **13**, 614–624.

Khalil, S.
1993 *The Cayley–Dickson Algebras*, M.Sc. Thesis, Florida Atlantic Univ.

Khalil, S., and P. Yiu
1997 The Cayley–Dickson algebras, a theorem of A. Hurwitz, and quaternions, *Bull. Soc. Sci. Lett. Łódź Sér. Rech. Déform.* **47**, 117–169.

Kirkman, T.
1848 On pluquaternions, and homoid products of sums of n squares, *Philos. Mag.* (ser. 3) **33**, 447–459; 494–509.

Kleinfeld, E.
1963 A characterization of the Cayley numbers. In: [Albert 1963], 126–143.

Knebusch, M.
1970 Grothendieck- und Wittringe von nichtausgeartete symmetrischen Bilinearformen, *Sitzber. Heidelberger Akad. Wiss.*, Math.-Naturwiss. Kl. 1969/70, 3. Abhdl.
1971 Runde formen über semilokalen Ringen, *Math. Ann.* **193**, 21–34.
1976 Generic splitting of quadratic forms, I, *Proc. London Math. Soc.* (3) **33**, 65–93.
1977a Generic splitting of quadratic forms, II, *Proc. London Math. Soc.* (3) **34**, 1–31.
1977b Some open problems. In: [Orzech 1977], 361–370.
1982 An algebraic proof of the Borsuk–Ulam theorem for polynomial mappings, *Proc. Amer. Math. Soc.* **84**, 29–32.

Knebusch, M., and W. Scharlau,
1980 *Algebraic Theory of Quadratic Forms: Generic Methods and Pfister Forms*, DMV Sem. 1, Birkhäuser, Stuttgart.

Kneser, M.
1969 *Lectures on Galois Cohomology of Classical Groups*, Tata notes, No. 47, Tata Instutute, Bombay.

Knus, M.-A.
1988 *Quadratic Forms, Clifford Algebras and Spinors*, Seminários de Matemática 1, UNICAMP, Campinas, Brasil.

Knus, M.-A., T. Y. Lam, D. B. Shapiro and J.-P. Tignol
1995 Discriminants of involutions on biquaternion algebras. In: *K-Theory and Algebraic Geometry: Connections with Quadratic Forms and Divisions Algebras*, (B. Jacobs and A. Rosenberg, eds.), Proc. Symp. Pure Math. 58.2, Amer. Math. Soc., Providence, 279–303.

Knus, M.-A., A. Merkurjev, M. Rost and J.-P. Tignol
1998 *The Book of Involutions*, Amer. Math. Soc. Colloq. Publ. 44, Amer. Math. Soc., Providence.

Knus, M.-A., and M. Ojanguren
1974 *Théorie de la Descente et Algèbres d'Azumaya*, Lecture Notes in Math. 389, Springer, Berlin.

Knus, M.-A., R. Parimala and R. Sridharan
1989 A classification of rank 6 quadratic spaces via Pfaffians, *J. Reine Angew. Math.* **398**, 187–218.
1991a Pfaffians, central simple algebras and similitudes, *Math. Z.* **206**, 589–604.
1991b Involutions on rank 16 central simple algebras, *J. Indian Math. Soc.* **57**, 143–151.
1991c On the discriminant of an involution, *Bull. Soc. Math. Belgique, Sér. A* **43**, 89–98.
1994 On compositions and triality, *J. reine angew. Math.* **457**, 45–70.

Knuth, D. E.
1968 *The Art of Computer Programming*, vol. 1, Addison-Wesley; revised 1973.

Koecher, M., and R. Remmert
1991 Real division algebras; four chapters in: [Ebbinghaus, et al., 1991] 181–280.

Köhnen, K.
1978 *Definite Systeme und Quadratsummen in der Topologie*, doctoral dissertation, Univ. Mainz.

Krüskemper, M.
1996 On systems of biforms in many variables, unpublished preprint.

Kuz'min, E. N.
1967 Division algebras over the field of real numbers, *Dokl. Akad. Nauk SSSR* **172**, 1014–1017 (in Russian). English translation: *Soviet Math. Dokl.* **8**, 220–223.

Lam, K. Y.
1966 *Non-singular bilinear forms and vector bundles over* P^n, doctoral dissertation, Princeton Univ.
1967 Construction of nonsingular bilinear maps, *Topology* **6**, 423–426.
1968 Construction of some nonsingular bilinear maps, *Bol. Soc. Mat. Mexicana* (2) **13**, 88–94.
1968 On bilinear and skew-linear maps that are nonsingular, *Quart. J. Math. Oxford* (2) **19**, 281–288.
1972 Sectioning vector bundles over real projective spaces, *Quart. J. Math. Oxford* (2) **23**, 97–106.
1977a Some interesting examples of nonsingular bilinear maps, *Topology* **16**, 185–188.
1977b Nonsingular bilinear maps and stable homotopy classes of spheres, *Math. Proc. Cambridge Philos. Soc.* **82**, 419–425.
1979 KO equivalences and the existence of nonsingular bilinear maps, *Pacific J. Math.* **82**, 145–154.
1984 Topological methods for studying the composition of quadratic forms, In: Quadratic and Hermitian forms, Conf. Hamilton/Ont. 1983, CMS Conf. Proc. 4, 173–192.
1985 Some new results on composition of quadratic forms, *Invent. Math.* **79**, 467–474.
1997 Borsuk–Ulam type theorems and systems of bilinear equations. In: *Geometry from the Pacific Rim* (A. J. Berrick, B. Loo and H.-Y. Wang, eds.), W. de Gruyter, Berlin, 183–194.

Lam, K. Y., and D. Randall

1995 Geometric dimension of bundles on real projective spaces. In: *Homotopy Theory and Its Applications*, a conference on algebraic topology in honor of Samuel Gitler, August 9-13, 1993, Cocoyoc, Mexico (A. Adem, R. J. Milgram and D. C. Ravenel, eds.), Contemp. Math. 188, Amer. Math. Soc., Providence, 129–152.

Lam, K. Y., and P. Yiu

1987 Sums of squares formulae near the Hurwitz–Radon range. In: *The Lefschetz Centennial Conference. Part II: Proceedings on Algebraic Topology* (S. Gitler, ed.), Contemp. Math. 58, 51–56.

1989 Geometry of normed bilinear maps and the 16-square problem, *Math. Ann.* **284**, 437–447.

1993 Linear spaces of real matrices of constant rank, *Linear Algebra Appl.* **195**, 69–79.

1995 Beyond the impossibility of a 16-square identity. In: *Five Decades as a Mathematician and Educator, On the 80th Birthday of Professor Yung-Chow Wong*, (K. Y. Chan and M. C. Liu, eds.), World Scientific, Singapore, 137–163.

Lam, T. Y.

1973 *The Algebraic Theory of Quadratic Forms*, W. A. Benjamin, New York. Revised Printing: 1980.

1977 Ten lectures on quadratic forms over fields. In: [Orzech 1977], 1–102.

1983 *Orderings, Valuations and Quadratic Forms*, CBMS Regional Conf. Ser. in Math. 52, Amer. Math. Soc., Providence.

1989 Fields of u-invariant 6 after A. Merkurjev. In: *Ring Theory 1989 in Honor of S. Amitsur* (L. Rowen, ed.), Weizmann Science Press, Jerusalem, 12–30.

Lam, T. Y., and T. Smith

1989 On the Clifford–Littlewood–Eckmann groups: a new look at periodicity mod 8, *Rocky Mountain J. Math.* **19**, 749–786.

1993 On Yuzvinsky's monomial pairings, *Quart. J. Math. Oxford (2)* **44**, 215–237.

Ławrynowicz, J.

1989 (ed.) *Deformations of Mathematical Structures. Complex Analysis with Physical Applications*, Kluwer, Dordrecht.

1992 The normed maps $\mathbb{R}^{11} \times \mathbb{R}^{11} \to \mathbb{R}^{26}$ in hypercomplex analysis and in physics. In: [Micali et al. 1992], 447–461.

1994 (ed.) *Deformations of Mathematical Structures II: Hurwitz-Type Structures and Applications to Surface Physics*, Kluwer, Dordrecht.

Ławrynowicz, J., and J. Rembieliński

1985 Hurwitz pairs equipped with complex structures. In: *Seminar on Deformations, Łódź–Warszawa 1982–84, Proceedings* (J. Ławrynowicz, ed.), Lecture Notes in Math. 1165, Springer, Berlin, 184–195.

1986 Pseudo-Euclidean Hurwitz pairs and generalized Fueter equations. In [Chisolm and Commons 1986], 39–48.

1990 On the composition of nondegenerate quadratic forms with an arbitrary index, (a) Inst. of Math. Polish Acad. Sci. Preprint no. 369 (1986); (b) *Ann. Fac. Sci. Toulouse Math.* **11** (1990), 141–168.

Ławrynowicz, J., E. Ramírez de Arellano and J. Rembieliński
1990 The correspondence between type-reversing transformations of pseudo-euclidean Hurwitz pairs and Clifford algebras, I, II, *Bull. Soc. Sci. Lett. Łódź* **40** (1990), 61–97; 99–129.

Lee, H.-C.
1945 On Clifford's algebra, *J. London Math. Soc.* **20**, 27–32.
1948 Sur le théoreme de Hurwitz–Radon pour la composition des formes quadratiques, *Comment. Math. Helv.* **21**, 261–269.

Leep, D. B., D. B. Shapiro and A. R. Wadsworth
1985 Sums of squares in division algebras, *Math. Z.* **190**, 151–162.

Leep, D. B., and A. R. Wadsworth
1989 The transfer ideal of quadratic forms and a Hasse norm theorem mod squares, *Trans. Amer. Math. Soc.* **315**, 415–432.

Lester, J. A.
1977 Cone preserving mappings for quadratic cones over arbitrary fields, *Can. J. Math.* **29**, 1247–1253.

Lewis, D. W.
1989 New proofs of the structure theorems for Witt rings, *Exposition. Math.* **7**, 83–88.

Lewis, D. W., and J.-P. Tignol
1993 On the signature of an involution, *Arch. Math.* **60**, 128–135.

Levine, J.
1963 Imbedding and immersion of real projective spaces, *Proc. Amer. Math. Soc.* **14**, 801–803.

Lex, W.
1973 Zur Theorie der Divisionsalgebren, *Mitt. Math. Sem. Giessen* **103**, 1–68.

Littlewood, D. E.
1934 Note on the anticommuting matrices of Eddington, *J. London Math. Soc.* **9**, 41–50.

Lucas, E.
1878 Théorie des fonctions numeriques simplement périodiques, *Amer. J. Math.* **1**, 184–240. See especially p. 230.

Mal'cev, A. I.
1973 *Algebraic Systems*, Grundlehren Math. Wiss. 192, Springer, Berlin. See especially pp. 91–94.

Mammone, P., and J.-P. Tignol
1986 Clifford division algebras and anisotropic quadratic forms: two counterexamples, *Glasgow Math. J.* **29**, 227–228.

Marcus, M.
1975 *Finite Dimensional Multilinear Algebra*, Part II, Marcel Dekker, New York.

Massey, W. S.
1983 Cross products of vectors in higher-dimensional Euclidean spaces, *Amer. Math. Monthly* **90**, 697–701.

Maurer, S.
1998 *Vektorproduktalgebren*, Diplomarbeit, Universität Regensburg.

McEvett, A.
1969 Forms over semisimple algebras with involution, *J. Algebra* **12**, 105–113.

McCrimmon, K.
1983 Quadratic forms permitting triple composition, *Trans. Amer. Math. Soc.* **275**, 107–130.

Merkurjev, A. S.
1981 On the norm residue symbol of degree 2 (in Russian), *Dokl. Akad. Nauk. SSSR* **261**, 542–547. English translation: *Soviet Math. Dokl.* **24**, 546–551.
1991 Simple algebras and quadratic forms (in Russian), *Izv. Akad. Nauk. SSSR Ser. Mat.* **55** , 218–224. English translation: *Math. USSR-Izv.* **38** (1992), 215–221.

Meshulam, R.
1990 On k-spaces of real matrices, *Linear Multilinear Algebra* **26**, 39-41.

Micali, A., R. Boudet and J. Helmstetter (eds.)
1992 *Clifford Algebras and Their Applications in Mathematical Physics*, Proceedings of second workshop held at Montpellier, France, 17-30 September, 1989, Kluwer, Dordrecht.

Micali, A., and P. Revoy
1979 *Modules Quadratiques*, Montpellier 1977. Also appeared in : *Bull. Soc. Math. France*, Mémoire 63.

Milgram, J.
1967 Immersing projective spaces, *Ann. of Math.* **85**, 473–482.

Milnor, J.
1965 *Topology from the Differentiable Viewpoint*, Univ. Press of Virginia.
1969 On isometries of inner product spaces, *Invent. Math.* **8**, 83–97.
1970 Algebraic K-theory and quadratic forms, *Invent. Math.* **9**, 318–344.

Milnor, J., and R. Bott
1958 On the parallelizability of the spheres, *Bull. Amer. Math. Soc.* **64**, 87–89.

Milnor, J., and D. Husemoller
1973 *Symmetric Bilinear Forms*, Ergeb. Math. Grenzgeb. 73, Berlin.

Milnor, J., and J. Stasheff
1974 *Characteristic Classes*, Ann. of Math. Stud. 76, Princeton Univ. Press.

Mneimné, R.
1989 Formule de Taylor pour le déterminant et deux applications, *Linear Algebra Appl.* **112**, 39-47.

Morandi, P. J.
1999 Lie algebras, composition algebras, and the existence of cross products on finite-dimensional vector spaces, *Exposition. Math.* **17**, 63–74.

Morel, F.
1988 Voevodsky's proof of Milnor's conjecture, *Bull. Amer. Math. Soc.* **35**, 123–143.

Moreno, G.

1998 The zero divisors of the Cayley–Dickson algebras over the real numbers, *Bol. Soc. Mat. Mexicana* (3) **4**, 13–28.

Muir, T.

1906 *The Theory of Determinants in the Historical Order of Development*, 2 vols., Macmillan, London.

Mumford, D.

1963 *The Red Book of Varieties and Schemes*, Lecture Notes in Math. **1358**, Springer, 1988. This is a reprint of the book *Introduction to Algebraic Geometry*, Chapters 1–3, Harvard Univ. 1963.

Myung, H. C.

1986 *Malcev-Admissible Algebras*, Progr. Math. 64, Birkäuser, Basel.

Nathanson, M.

1975 Products of sums of powers, *Math. Mag.* **48** (1975), 112–113.

Neumann, W. D.

1977 Equivariant Witt Rings, Bonner Math. Schriften 100, Bonn.

Newman, M. H. A.

1932 Note on an algebraic theorem of Eddington, *J. London Math. Soc.* **7**, 93–99. Correction p. 272.

Okubo, S.

1978 Pseudo-quaternion and pseudo-octonion algebras, *Hadronic J.* **1**, 1250–1278.

O'Meara, O. T.

1963 *Introduction to Quadratic Forms*, Springer, Berlin.

Ono,T.

1955 Arithmetic of orthogonal groups, *J. Math. Soc. Japan* **7**, 79–91.

1974a Hasse principle for Hopf maps, *J. Reine angew. Math.* **268/269**, 209–212.

1974b On some rationality properties of Hopf maps, *Nagoya Math. J.* **55**, 145–150.

1975a On the Hopf fibration over $\mathbb{Z}$, *Nagoya Math. J.* **56**, 201–207.

1975b On the Hopf fibration $S^7 \to S^4$ over $\mathbb{Z}$, *Nagoya Math. J.* **59**, 59–64.

1977a Hopf maps and quadratic forms over $\mathbb{Z}$. In: *Contrib. to Algebra*, Collect. Pap. dedic. to E. Kolchin, Academic Press, San Diego, 295–305.

1977b A note on spherical quadratic maps over $\mathbb{Z}$. In: *Algebr. Number Theory*, Pap. Kyoto Int. Symp. 1976, 157–161.

1980 On the group of automorphisms of a Hopf map, *Nagoya Math. J.* **79**, 131–140.

1994 *Variations on a Theme of Euler: Quadratic Forms, Elliptic Curves, and Hopf Maps*, Plenum Press, New York. (A translation and enlargement of the Japanese version originally published in 1980.)

Ono, T., and H. Yamaguchi

1979 On Hasse principle for division of quadratic forms, *J. Math. Soc. Japan* **31**, 141–159.

Orzech, G. (ed.)
1977 *Proceedings of the Conference on Quadratic Forms, August 1 - 21, 1976 at Queen's University, Kingston, Ontario*, Queen's Papers in Pure and Appl. Math. 46, Queen's University, Kingston, Canada.

Palacios, A. R.
1992 One-sided division absolute valued algebras, *Publ. Mat.* **36**, 925–954.

Parker, M.
1983 Orthogonal multiplications in small dimensions, *Bull. London Math. Soc.* **15**, 368–372.

Peng, C. K., and Z. Z. Tang
1997 On representing homotopy classes of spheres by harmonic maps, *Topology* **16**, 867–879.

Petersson, H. P.
1971 Quasi composition algebras, *Abh. Math. Sem. Univ. Hamburg* **35**, 215–222.

Petro, J.
1987 Real division algebras of dimension > 1 contain C, *Amer. Math. Monthly* **94**, 445–449.

Petrović , Z. Z.
1996 *On spaces of matrices satisfying some rank conditions*, doctoral dissertation, Johns Hopkins Univ.

Pfister, A.
1965a Zur Darstellung von -1 als Summe von Quadraten in einem Körper, *J. London Math. Soc.* **40**, 159–165.
1965b Multiplikative quadratische Formen, *Arch. Math.* **16**, 363–370.
1966 Quadratische Formen in beliebigen Körpern, *Invent. Math.* **1**, 116–132.
1979 Systems of quadratic forms, *Bull. Soc. Math. France*, Mémoire **59**, 115–123.
1987 Quadratsummen in Algebra und Topologie, Wiss. Beitr., Martin-Luther-Univ. Halle Wittenberg 1987/88, 195–208.
1994 A new proof of the homogeneous Nullstellensatz for p-fields, and applications to topology. In: *Recent Advances in Real Algebraic Geometry and Quadratic Forms* (W. B. Jacob, T. Y. Lam and R. O. Robson, eds.), Contemp. Math. 155, Amer. Math. Soc., Providence, 221–229.
1995 *Quadratic Forms with Applications to Algebraic Geometry and Topology*, London Math. Soc. Lecture Note Ser. 217, Cambridge Univ. Press.

Pfister, A., and S. Stolz
1987 On the level of projective spaces, *Comment. Math. Helv.* **62**, 286–291.

Pierce, R. S.
1982 *Associative Algebras*, Grad. Texts in Math. 88, Springer, Berlin.

A. Prestel, A.
1975 *Lectures on Formally Real Fields*, IMPA lecture notes, Rio de Janeiro 1975. Reprinted in: Lecture Notes in Math. 1093, Springer, Berlin 1984.

Prestel, A., and R. Ware
1979 Almost isotropic quadratic forms, *J. London Math. Soc.* (2) **19**, 241–244.

Procesi, C.
1976 The invariant theory of $n \times n$ matrices, *Adv. Math.* **19**, 306–381.

Putter, J.
1967 Maximal sets of anti-commuting skew-symmetric matrices, *J. London Math. Soc.* **42**, 303–308.

Quebbemann, H. G., W. Scharlau and M. Schulte
1979 Quadratic and hermitian forms in additive and abelian categories, *J. Algebra* **59**, 264–289.

Quéguiner, A.
1997 Cohomological Invariants of Algebras with Involution, *J. Algebra***194**, 299–330.

Racine, M. L.
1974 A simple proof of a theorem of Albert, *Proc. Amer. Math. Soc.* **43**, 487–488.

Radon, J.
1922 Lineare Scharen orthogonaler Matrizen, *Abh. Math. Sem. Univ. Hamburg* **1**, 1–14. Reprinted in *Collected Works*, vol. 1, Birkhäuser 1987, 307–320.

Rajwade, A. R.
1993 *Squares*, London Math. Soc. Lecture Note Ser. 171, Cambridge Univ. Press.

Riehm, C.
1982 The automorphism group of a composition of quadratic forms, *Trans. Amer. Math. Soc.* **269**, 403–414.

Rigas, A., and L. M. Chaves
1998 Hopf maps and triality. *Math. J. Okayama Univ.* **38**, 197–208.

Robert, E.
1912 *Composition des formes quadratiques de quatre et de huit variables indépendantes*, doctoral dissertation (under the direction of A. Hurwitz), ETH Zürich.

Romero, D.
1995 New constructions for integral sums of squares formulae, *Bol. Soc. Mat. Mexicana* (3) **1**, 87–90.

Rosenblatt, J., and D. B. Shapiro
1989 Homometric elements in semisimple rings, *Comm. Algebra* **17**, 3043–3051.

Rost, M.
1994 On 14-dimensional quadratic forms, their spinors and the difference of two octonion algebras, preprint.
1996 On the dimension of a composition algebra, *Doc. Math.* **1**, 209–214.

Rothaus, O. S.
1978 Choosing simple bases for subspaces of tensor products, *J. Pure Appl. Algebra* **12**, 129–135.

Rowen, L. H.
1978 Central simple algebras, *Israel J. Math.* **29**, 285–301.
1980 *Polynomial Identities in Ring Theory*, Pure Appl. Math. 84. Academic Press, New York.

Rowen, L. H.
1991 and D. Saltman, The discriminant of an involution, preprint.

Saltman, D.
1978 Azumaya algebras with involution, *J. Algebra* **52**, 526–539.
1990 A note on generic division algebras, unpublished manuscript.

Sánchez-Flores, A.
1996 A method to generate upper bounds for the sums of squares formulae problem, *Bol. Soc. Mat. Mexicana* (3) **2**, 79–92.

Sanderson, B. J.
1964 Immersions and embeddings of projective spaces, *Proc. London Math. Soc.* (3) **14**, 137–153.

Schafer, R. D.
1954 On the algebras formed by the Cayley–Dickson process, *Amer. J. Math.* **76**, 435–446.
1966 *An Introduction to Nonassociative Algebras*, Academic Press, ???.
1970 Forms permitting composition, *Adv. Math.* **4**, 127–148.

Scharlau, W.
1984 Involutions on simple algebras and orders. In: Quadratic and Hermitian forms, Conf. Hamilton/Ont. 1983, CMS Conf. Proc. 4, 141–158.
1985 *Quadratic and Hermitian Forms*, Grundlehren Math. Wiss. 270, Springer, Berlin.

Scheiderer, C.
1992 Real algebra and its applications to geometry in the last ten years: some major developments and results. In: *Real Algebraic Geometry*, Proceedings Conf., Rennes 1991 (M. Coste, L. Mahé and M. F. Roy, eds.), Lecture Notes in Math. **1524**, Springer, Berlin, 75–96.

Schneider, J. E.
1973 Orthogonal groups of nonsingular forms of higher degree, *J. Algebra* **27**, 112–116.

Shapiro, D. B.
1974 *Similarities, quadratic forms, and Clifford algebras*, doctoral dissertation, University of California, Berkeley.
1976 Cancellation of semisimple hermitian pairings, *J. Algebra* **41**, 212–223.
1977a Spaces of similarities I, II, *J. Algebra* **46**, 148–170; 171–181.
1977b Spaces of similarities IV, *Pacific J. Math.* **69**, 223–244.
1978a Hasse principle for the Hurwitz problem, *J. reine angew. Math.* **301**, 179–190.
1978b Similarities and isoclinic planes, *Geom. Dedicata* **7**, 479–497.
1984a Products of sums of squares, *Exposition. Math.* **2**, 235–261.
1984b On the Hurwitz problem over an arbitrary field, *Bol. Soc. Math. Mexicana* (2) **29**, 1–4.
1992 Symmetric and skew-symmetric linear transformations, unpublished notes.
1997 Compositions of codimension 2, in preparation.

Shapiro, D. B., and M. Szyjewski
1992 Product formulas for quadratic forms, *Bol. Soc. Mat. Mexicana* (2) **37**, 463–474.

Shaw, R.
1987 Ternary vector cross products, *J. Phys. A* **20**, L689–L694.
1988 Ternary composition algebras and Hurwitz's theorem, *J. Math. Phys.* **29** (11), 2329–2333.
1989 Ternary composition algebras: 8 dimensions out of 4?, *Nuovo Cimento B* **103**, 161–183.
1990 Ternary composition algebras. I, II, *Proc. Royal Soc. London Ser. A* **431**, 1–19; 21–36

Shaw, R., and F. J. Yeadon
1989 0n $(a \times b) \times c$, *Amer. Math. Monthly* **96**, 623–629.

Smith, L.
1978 Nonsingular bilinear forms, generalized J homomorphisms, and the homotopy of spheres I, *Indiana Univ. Math. J.* **27**, 697–737.

Smith, T. L., and P. Yiu
1992 Construction of sums of squares formulae with integer coefficients, *Bol. Soc. Mat. Mexicana* (2) **37**, 479–495.

Snaith, V. P.
1989 *Topological Methods in Galois Representation Theory*, Canad. Math. Soc. Ser. Monographs Adv. Texts, Wiley, New York.

Spanier, E.
1966 *Algebraic Topology*, McGraw Hill, ???.

Springer, T. A.
1954 An algebraic proof of a theorem of H. Hopf, *Indag. Math.* **16**, 33–35.

Stampfli-Rollier, C.
1983 4-dimensionale quasikompositions Algebren, *Arch. Math.* **40**, 516–525.

Stenzel, H.
1922 Über die Darstellbarkeit einer Matrix als Produkt von zwei symmetrischen Matrizen, als Produkt von zwei alternierenden Matrizen und als Produkt von einer symmetrischen und einer alternierenden Matrix, *Math. Z.* **15**, 1–25.

Stiefel, E.
1941 Über Richtungsfelder in den projektiven Räumen und einen Satz aus der reellen Algebra, *Comment. Math. Helv.* **13**, 201–218.

Storer, T.
1971 Hurwitz on Hadamard designs, *Bull. Austral. Math. Soc.* **4**, 109–112.

Swan, R.
1987 Vector bundles, projective modules and the K-theory of spheres. In: *Algebraic Topology and Algebraic K-theory* (W. Browder, ed.), Proc. of 1983 John Moore Princeton Conference, Ann. of Math. Stud. 113, Princeton Univ. Press

Sylvester, J. J.
1884 On quaternions, nonions, sedenions, etc., Johns Hopkins Univ. Circ. 3 (1884), 7–9. Reprinted in: *The Collected Mathematical papers of J. J. Sylvester*, vol. IV, 1912, (reprinted by Chelsea, New York, 1973), 122–132.

Sylvester, J.
1986 On the dimension of spaces of linear transformations satisfying rank conditions, *Linear Algebra Appl.* **78**, 1–10.

Szymiczek, K.
1977 Quadratic forms over fields, *Dissertationes Math. (Rozprawy Mat.)* 152, 63 pp.

Tamagawa, T.
1977 On quadratic forms and pfaffians, *J. Fac. Sci. Tokyo Sect. IA Math.*, **24**, 213–219.

Taussky, O.
1939 An algebraic property of Laplace's differential equation, *Quart. J. Math. Oxford* **10**, 99–103.
1966 A determinantal identity for quaternions and a new eight square identity, *J. Math. Anal. Appl.* **15**, 162–164.
1970 Sums of squares, *Amer. Math. Monthly* **77** (1970), 805–830.
1971 (1, 2, 4, 8)-sums of squares and Hadamard matrices. In: *Combinatorics*, Proc. Symp. Pure Math. 19, UCLA 1968, Amer. Math. Soc. 1971, 229–233.
1980a Pairs of sums of three squares of integers whose product has the same property. In: *General Inequalities 2*, (E. Beckenbach, ed.), Birkhäuser, Basel.
1980b Results concerning composition of sums of three squares, *Linear and Multilinear Algebra* **8** (1980), 231–233.
1981a History of sums of squares in algebra. In: *American Mathematical Heritage: Algebra and Applied Math.*, Texas Tech. Univ. Math. Ser. 13, 73–90.
1981b Composition of binary integral quadratic forms via integral 2×2 matrices and composition of matrix classes, *Linear and Multilinear Algebra* **10** (1981), 309–318.
1982 The many aspects of the Pythagorean triangles, *Linear Algebra Appl.* **43** (1982), 285–295.
1987 Radon's contributions to matrix theory. In: *J. Radon, Collected Works*, vol. 1, Birkhäuser, Basel, 302–306.

Taussky, O., and H. Zassenhaus
1959 On the similarity transformation between a matrix and its transpose, *Pacific J. Math.* **9**, 893–896.

Thong, N.-Q.-D.
1975 Structure de groupe de similitudes, *Linear Algebra Appl.* **12**, 241–246.

Tignol, J.-P.
1977 Sur les corps à involution de degré 8, *C. R. Acad. Sci. Paris Sér. A* **284**, 1349–1352.
1978 Sur les classes de similitude de corps à involution de degré 8, *C. R. Acad. Sc. Paris Sér. A***286**, 875–876.

Tits, J.
1968 Formes quadratiques, groupes orthogonaux et algèbres de Clifford, *Invent. Math.* **5**, 19–41.

Toth, G.
1990 *Harmonic Maps and Minimal Immersions Through Representation Theory*, Perspect. Math. 12, Academic Press, Boston.

Turisco,J.
1979 Quadratic mappings of spheres, *Linear Algebra Appl.* **23**, 261–274.
1985 A family of quadratic forms associated to quadratic mappings of spheres, *Linear Algebra Appl.* **65**, 249–260.

Tyrrell, J. A., and J. G. Semple
1971 *Generalized Clifford Parallelism*, Cambridge Univ. Press.

Urbanik, K., and F. B. Wright
1960 Absolute valued algebras, *Bull. Acad. Polon. Sci. Sér. Sci. Math. Astronom. Phys.* **8**, 285–286.

Veldkamp, F. D.
1991 Freudenthal and the octonions, *Nieuw. Arch. Wisk.* **9**, 145–162.

Voss, A.
1896 Symmetrische und alternierende Lösungen der Gleichung $SX = XS'$, *Sitzungsber. Math.-Phys. Cl. Akad. Wiss. München* **26**, 273–281.

Wadsworth, A.
1975 Similarity of quadratic forms and isomorphism of their function fields, *Trans. Amer. Math. Soc.* **208**, 352–358.
1990 16-dimensional algebras with involution, manuscript.

Wadsworth, A., and D. B. Shapiro
1977a Spaces of similarities III, *J. Algebra* **46**, 182–188.
1977b On multiples of round and Pfister forms, *Math. Z.* **157**, 53–62.

van der Waerden, B. L.
1976 Hamilton's discovery of the quaternions, *Math. Mag.* **49**, 227–234.
1985 *A History of Algebra: From al-Khwārizmī to Emmy Noether*, Springer, Berlin.

Waterhouse, W. C.
1987 Nonassociative quaternion algebras, *Algebras, Groups and Geoms.* **4**, 365–378.

Westwick, R.
1972 Spaces of linear transformations of equal rank, *Linear Algebra Appl.* **5**, 49–64.
1987 Spaces of matrices of fixed rank, *Linear and Multilinear Algebra* **20**, 171–174.

Whitehead, G. W.
1963 Note on cross-sections in Stiefel manifolds, *Comment. Math. Helv.* **37**, 239–240.

Witt, E.
1937 Theorie der quadratischer Formen in beliebigen Körpern, *J. reine angew. Math.* **176**, 31–44.

Wolf, J. A.
1963a Geodesic spheres in Grassmann manifolds, *Illinois. J. Math.* **7**, 425–446.
1963b Elliptic spaces in Grassmann manifolds, *Illinois. J. Math.* **7**, 447–462.

Wolfe, W.
1976 Amicable orthogonal designs – existence, *Canad. J. Math.* **28**, 1006–1020.
1977 Rational quadratic forms and orthogonal designs. In: *Number Theory and Algebra* (H. Zassenhaus, ed.), 339–348, Academic Press, ???.

Wonenburger, M. J.
1962a The Clifford algebra and the group of similitudes, *Canad. J. Math.* **14**, 45–59.
1962b Study of certain similitudes, *Canad. J. Math.* **14**, 60–68.

Wong, Y. C.
1961 Isoclinic n-Planes in Euclidean $2n$-space, Clifford Parallels in Elliptic $(2n-1)$-Space, and the Hurwitz Matrix Equations, *Mem. Amer. Math. Soc.* 41. Second printing with corrections and minor changes, 1971.

Wong,Y. C., and K.-P. Mok
1988 Isoclinic n-planes in $\mathbb{R}^{2n}$ and the Hopf–Steenrod sphere bundles $S^{2n-1} \to S^n$, $n = 2, 4, 8$, *Enseign. Math.* **34**, 167–204.
1990 Normally related n-planes and isoclinic n-planes in $\mathbb{R}^{2n}$ and strongly linearly independent matrices of order n, *Linear Algebra Appl.* **139**, 31–52.

Wood, R.
1968 Polynomial maps from spheres to spheres, *Invent. Math.* **5**, 163–168.

Yabe, T.
1976 On a certain quadratic form, *Mem. Defense Acad. Japan* **16**, 71–74.

Yanchevskiĭ, V. I., see V. I. Janĭevskiĭ.

Yang, C. T.
1981 Division algebras and fibrations of spheres by great spheres, *J. Differential Geom.* **16**, 577–593.

Yiu, P.
1985 *Topological and combinatoric methods for studying sums of squares*, doctoral dissertation, Univ. of British Columbia.
1986 Quadratic forms between spheres and the non-existence of sums of squares formulae, *Math. Proc. Cambridge Philos. Soc.* **100**, 493–504.
1987 Sums of squares formulae with integer coefficients, *Canad. Math. Bull.* **30**, 318–324.
1990a On the product of two sums of 16 squares as a sum of squares of integral bilinear forms, *Quart. J. Math. Oxford* (2) **41**, 463–500.
1990b Strongly regular graphs and Hurwitz–Radon numbers, *Graphs Combin.* **6**, 61–69.
1993 Maximal normal sets of n-planes in $\mathbb{R}^{2n}$, *Linear Algebra Appl.* **181**, 241–249.
1994a Composition of sums of squares with integer coefficients. In: [Ławrynowicz 1994], 7–100.
1994b Quadratic forms between euclidean spheres, *Manuscripta Math.* **83**, 171–181 .
1994c Tables of nonsingular bilinear maps, unpublished notes.
1996 Some upper bounds for composition numbers, *Bol. Soc. Mat. Mexicana* (3) **2**, 65–78.

Yuzvinsky, S.
1981 Orthogonal pairings of Euclidean spaces, *Michigan Math. J.* **28**, 131–145.
1983 On the Hopf condition over an arbitrary field, *Bol. Soc. Mat. Mexicana* (2) **28**, 1–7.
1984 A series of monomial pairings, *Linear and Multilinear Algebra* **15**, 109–119.

1985 Composition of quadratic forms and tensor product of quaternion algebras, *J. Algebra* **96**, 347–367.

Zassenhaus, H., and W. Eichhorn

1966 Herleitung von Acht-und Sechzehn Quadrate-Identitäten mit Hilfe von Eigenschaften der verallgemeinerten Quaternionen und der Cayley-Dicksonschen Zahlen, *Arch. Math.* **17**, 492–496.

Zhevlakov, K. A., A. M. Slin'ko, I. P. Shestakov and A. I. Shirshov

1982 *Rings that are Nearly Associative*, Pure Appl. Math. 104. Academic Press, New York.

Zorn, M. A.

1930 Theorie der alternative Ringe, *Abh. Math. Sem. Hamburg Univ.* **8**, 123–147.

1933 Alternativkörper und quadratische Systeme, *Abh. Math. Sem. Hamburg* **9**, 395–402.

1935 The automorphisms of Cayley's non-associative algebra, *Proc. Nat. Acad. Sci.* **21**, 355–358.

Züger, R.

1995 *Kompositionen von quadratischen Formen mit quadratischen, bilinearen oder hermiteschen Formen*, doctoral dissertation, Univ. Bern.

Zvengrowski, P.

1966 A 3-fold vector product in $\mathbb{R}^8$, *Comment. Math. Helv.* **40**, 149–152.

1968 Canonical vector fields on spheres, *Comment. Math. Helv.* **43**, 341–348.