

References

- Ames, W.L., and Thorne, K.S. (1968), 'The optical appearance of a star that is collapsing through its gravitational radius', *Astrophys. J.* **151**, 659–70.
- Arnett, W.D. (1966), 'Gravitational collapse and weak interactions', *Can. J. Phys.* **44**, 2553–94.
- Auslander, L., and Markus, L. (1958), 'Flat Lorentz manifolds', Memoir 30, *Amer. Math. Soc.*
- Avez, A. (1963), 'Essais de géométrie Riemannienne hyperbolique globale. Applications à la Relativité Générale', *Ann. Inst. Fourier (Grenoble)*, **132**, 105–90.
- Belinskii, V.A., Khalatnikov, I.M., and Lifshitz, E.M. (1970), 'Oscillatory approach to a singular point in relativistic cosmology', *Adv. in Phys.* **19**, 523–73.
- Bergmann, P.G., Cahen, M., and Komar, A.B. (1965), 'Spherically symmetric gravitational fields', *J. Math. Phys.* **6**, 1–5.
- Bianchi, L. (1918), *Lezioni sulla teoria dei gruppi continui finiti trasformazioni* (Spoerri, Pisa).
- Bludman, S.A., and Ruderman, M.A. (1968), 'Possibility of the speed of sound exceeding the speed of light in ultradense matter', *Phys. Rev.* **170**, 1176–84.
- Bludman, S.A., and Ruderman, M.A. (1970), 'Noncausality and instability in ultradense matter', *Phys. Rev. D* **1**, 3243–6.
- Bondi, H. (1960), *Cosmology* (Cambridge University Press, London).
- Bondi, H. (1964), 'Massive spheres in General Relativity', *Proc. Roy. Soc. Lond. A* **282**, 303–17.
- Bondi, H., and Gold, T. (1948), 'The steady-state theory of the expanding universe', *Mon. Not. Roy. Ast. Soc.* **108**, 252–70.
- Bondi, H., Pirani, F.A.E., and Robinson, I. (1959), 'Gravitational waves in General Relativity, III. Exact plane waves', *Proc. Roy. Soc. Lond. A* **251**, 519–33.
- Boyer, R.H. (1969), 'Geodesic Killing orbits and bifurcate Killing horizons', *Proc. Roy. Soc. Lond. A* **311**, 245–52.
- Boyer, R.H., and Lindquist, R.W. (1967), 'Maximal analytic extension of the Kerr metric', *J. Math. Phys.* **8**, 265–81.
- Boyer, R.H., and Price, T.G. (1965), 'An interpretation of the Kerr metric in General Relativity', *Proc. Camb. Phil. Soc.* **61**, 531–4.
- Bruhat, Y. (1962), 'The Cauchy problem', in *Gravitation: an introduction to current research*, ed. L. Witten (Wiley, New York), 130–68.
- Burkill, J.C. (1956), *The Theory of Ordinary Differential Equations* (Oliver and Boyd, Edinburgh).
- Calabi, E., and Marcus, L. (1962), 'Relativistic space forms', *Ann. Math.* **75**, 63–76.
- Cameron, A.G.W. (1970), 'Neutron stars', in *Ann. Rev. Astronomy and Astrophysics*, eds. L. Goldberg, D. Layzer, J.G. Phillips (Ann. Rev. Inc., Palo Alto, California), 179–208.

- Carter, B. (1966), 'The complete analytic extension of the Reissner–Nordström metric in the special case $e^2 = m^2$ ', *Phys. Lett.* **21**, 423–4.
- Carter, B. (1967), 'Stationary axisymmetric systems in General Relativity', *Ph.D. Thesis*, Cambridge University.
- Carter, B. (1968*a*), 'Global structure of the Kerr family of gravitational fields', *Phys. Rev.* **174**, 1559–71.
- Carter, B. (1968*b*), 'Hamilton–Jacobi and Schrödinger separable solutions of Einstein's equations', *Comm. Math. Phys.* **10**, 280–310.
- Carter, B. (1969), 'Killing horizons and orthogonally transitive groups in space–time', *J. Math. Phys.* **10**, 70–81.
- Carter, B. (1970), 'The commutation property of a stationary axisymmetric system', *Comm. Math. Phys.* **17**, 233–8.
- Carter, B. (1971*a*), 'Causal structure in space–time', *J. General Relativity and Gravitation*, **1**, 349–91.
- Carter, B. (1971*b*), 'Axisymmetric black hole has only two degrees of freedom', *Phys. Rev. Lett.* **26**, 331–2.
- Choquet-Bruhat, Y. (1968), 'Espace-temps Einsteiniens généraux, chocs gravitationnels', *Ann. Inst. Henri Poincaré*, **8**, 327–38.
- Choquet-Bruhat, Y. (1971), 'Equations aux dérivées partielles-solutions C^∞ d'équations hyperboliques non-linéaires', *C. R. Acad. Sci. (Paris)*.
- Choquet-Bruhat, Y., and Geroch, R.P. (1969), 'Global aspects of the Cauchy problem in General Relativity', *Comm. Math. Phys.* **14**, 329–35.
- Christodoulou, D. (1970), 'Reversible and irreversible transformation in black hole physics', *Phys. Rev. Lett.* **25**, 1596–7.
- Clarke, C.J.S. (1971), 'On the geodesic completeness of causal space-times', *Proc. Camb. Phil. Soc.* **69**, 319–24.
- Colgate, S.A. (1968), 'Mass ejection from supernovae', *Astrophys. J.* **153**, 335–9.
- Colgate, S.A. and White, R.H. (1966), 'The hydrodynamic behaviour of supernovae explosions', *Astrophys. J.* **143**, 626–81.
- Courant, R., and Hilbert, D. (1962), *Methods of Mathematical Physics. Volume II: Partial Differential Equations* (Interscience, New York).
- Demianski, M., and Newman, E. (1966), 'A combined Kerr–NUT solution of the Einstein field equations', *Bull. Acad. Pol. Sci. (Math. Ast. Phys.)* **14**, 653–7.
- De Witt, B.S. (1967), 'Quantum theory of gravity: I. The canonical theory', *Phys. Rev.* **160**, 1113–48; 'II. The manifestly covariant theory', *Phys. Rev.* **162**, 1195–1239; 'III. Applications of the covariant theory', *Phys. Rev.* **162**, 1239–56.
- Dicke, R.H. (1964), *The theoretical significance of Experimental Relativity* (Blackie, New York).
- Dionne, P.A. (1962), 'Sur les problèmes de Cauchy hyperboliques bien posés', *Journ. d'Analyses Mathématique*, **10**, 1–90.
- Dirac, P.A.M. (1938), 'A new basis for cosmology', *Proc. Roy. Soc. Lond.* **A 165**, 199–208.
- Dixon, W.G. (1970), 'Dynamics of extended bodies in General Relativity: I. Momentum and angular momentum', *Proc. Roy. Soc. Lond.* **A 314**, 499–527; 'II. Moments of the charge–current vector', *Proc. Roy. Soc. Lond.* **A 319**, 509–47.
- Doroshkevich, A.G., Zel'dovich, Ya.B., and Novikov, I.D. (1966), 'Gravitational collapse of non-symmetric and rotating masses', *Sov. Phys. J.E.T.P.* **22**, 122–30.

- Ehlers, J., Geren, P., and Sachs, R.K. (1968), 'Isotropic solutions of the Einstein-Liouville equations', *J. Math. Phys.* **8**, 1344-9.
- Ehlers, J., and Kundt, W. (1962), 'Exact solutions of the gravitational field equations', in *Gravitation: an Introduction to Current Research*, ed. L. Witten (Wiley, New York), 49-101.
- Ehresmann, C. (1957), 'Les connexions infinitesimales dans un espace fibre différentiable', in *Colloque de Topologie (Espaces Fibres) Bruxelles 1950* (Masson, Paris), 29-50.
- Ellis, G.F.R., and Sciamia, D.W. (1972), 'Global and non-global problems in cosmology', in *Studies in Relativity* (Synge Festschrift), ed. L.O'Raiffeartaigh (Oxford University Press, London).
- Field, G.B. (1969), 'Cosmic background radiation and its interaction with cosmic matter', *Rivista del Nuovo Cimento*, **1**, 87-109.
- Foley, K.J., Jones, R.S., Lindebaum, S.J., Love, W.A., Ozaki, S., Platner, E.D., Quarles, C.A., and Willen, E.H. (1967), 'Experimental test of the pion-nucleon forward dispersion relations at high energies', *Phys. Rev. Lett.* **19**, 193-8, and 622.
- Geroch, R.P. (1966), 'Singularities in closed universes', *Phys. Rev. Lett.* **17**, 445-7.
- Geroch, R.P. (1967a), 'Singularities in the space-time of General Relativity', *Ph.D. Thesis* (Department of Physics, Princeton University).
- Geroch, R.P. (1967b), 'Topology in General Relativity', *J. Math. Phys.* **8**, 782-6.
- Geroch, R.P. (1968a), 'Local characterization of singularities in General Relativity', *J. Math. Phys.* **9**, 450-65.
- Geroch, R.P. (1968b), 'What is a singularity in General Relativity?', *Ann. Phys.* (New York), **48**, 526-40.
- Geroch, R.P. (1968c), 'Spinor structure of space-times in General Relativity. I', *J. Math. Phys.* **9**, 1739-44.
- Geroch, R.P. (1970a), 'Spinor structure of space-times in General Relativity. II', *J. Math. Phys.* **11**, 343-8.
- Geroch, R.P. (1970b), 'The domain of dependence', *J. Math. Phys.* **11**, 437-9.
- Geroch, R.P. (1970c), 'Singularities', in *Relativity*, ed. S.Fickler, M. Carmeli and L. Witten (Plenum Press, New York), 259-91.
- Geroch, R.P. (1971), 'Space-time structure from a global view point', in *General Relativity and Cosmology*, Proceedings of International School in Physics 'Enrico Fermi', Course XLVII, ed. R. K. Sachs (Academic Press, New York), 71-103.
- Geroch, R.P., Kronheimer, E.H., and Penrose, R. (1972), 'Ideal points in space-time', *Proc. Roy. Soc. Lond. A* **327**, 545-67.
- Gibbons, G., and Penrose, R. (1972), to be published.
- Gödel, K. (1949), 'An example of a new type of cosmological solution of Einstein's field equations of gravitation', *Rev. Mod. Phys.* **21**, 447-50.
- Gold, T. (1967), ed., *The Nature of Time* (Cornell University Press, Ithaca).
- Graves, J.C., and Brill, D.R. (1960), 'Oscillatory character of Reissner-Nordström metric for an ideal charged wormhole', *Phys. Rev.* **120**, 1507-13.
- Grischuk, L.P. (1967), 'Some remarks on the singularities of the cosmological solutions of the gravitational equations', *Sov. Phys. J.E.T.P.* **24**, 320-4.
- Hajicek, P. (1971), 'Causality in non-Hausdorff space-times', *Comm. Math. Phys.* **21**, 75-84.
- Hajicek, P. (1973), 'General theory of vacuum ergospheres', *Phys. Rev. D* **7**, 2311-16.

- Harrison, B.K., Thorne, K.S., Wakano, M., and Wheeler, J.A. (1965), *Gravitation Theory and Gravitational Collapse* (Chicago University Press, Chicago).
- Hartle, J.B., and Hawking, S.W. (1972*a*), 'Solutions of the Einstein–Maxwell equations with many black holes', *Commun. Math. Phys.* **26**, 87–101.
- Hartle, J.B., and Hawking, S.W. (1972*b*), 'Energy and angular momentum flow into a black hole', *Commun. Math. Phys.* **27**, 283–90.
- Hawking, S.W. (1966*a*), 'Perturbations of an expanding universe', *Astrophys. J.* **145**, 544–54.
- Hawking, S.W. (1966*b*), 'Singularities and the geometry of space–time', *Adams Prize Essay* (unpublished).
- Hawking, S.W. (1967), 'The occurrence of singularities in cosmology. III. Causality and singularities', *Proc. Roy. Soc. Lond. A* **300**, 187–201.
- Hawking, S.W., and Ellis, G.F.R. (1965), 'Singularities in homogeneous world models', *Phys. Lett.* **17**, 246–7.
- Hawking, S.W., and Penrose, R. (1970), 'The singularities of gravitational collapse and cosmology', *Proc. Roy. Soc. Lond. A* **314**, 529–48.
- Heckmann, O., and Schücking, E. (1962), 'Relativistic cosmology', in *Gravitation: an Introduction to Current Research*, ed. L. Witten (Wiley, New York), 438–69.
- Hocking, J.G., and Young, G.S. (1961), *Topology* (Addison-Wesley, London).
- Hodge, W.V.D. (1952), *The Theory and Application of Harmonic Integrals* (Cambridge University Press, London).
- Hogarth, J.E. (1962), 'Cosmological considerations on the absorber theory of radiation', *Proc. Roy. Soc. Lond. A* **267**, 365–83.
- Hoyle, F. (1948), 'A new model for the expanding universe', *Mon. Not. Roy. Ast. Soc.* **108**, 372–82.
- Hoyle, F., and Narlikar, J.V. (1963), 'Time-symmetric electrodynamics and the arrow of time in cosmology', *Proc. Roy. Soc. Lond. A* **277**, 1–23.
- Hoyle, F., and Narlikar, J.V. (1964), 'A new theory of gravitation', *Proc. Roy. Soc. Lond. A* **282**, 191–207.
- Israel, W. (1966), 'Singular hypersurfaces and thin shells in General Relativity', *Nuovo Cimento*, **44B**, 1–14; erratum, *Nuovo Cimento*, **49B**, 463 (1967).
- Israel, W. (1967), 'Event horizons in static vacuum space–times', *Phys. Rev.* **164**, 1776–9.
- Israel, W. (1968), 'Event horizons in static electrovac space–times', *Comm. Math. Phys.* **8**, 245–60.
- Jordan, P. (1955), *Schwerkraft und Weltall* (Friedrich Vieweg, Braunschweig).
- Kantowski, R., and Sachs, R.K. (1967), 'Some spatially homogeneous anisotropic relativistic cosmological models', *J. Math. Phys.* **7**, 443–6.
- Kelley, J.L. (1965), *General Topology* (van Nostrand, Princeton).
- Khan, K.A., and Penrose, R. (1971), 'Scattering of two impulsive gravitational plane waves', *Nature*, **229**, 185–6.
- Kinnersley, W., and Walker, M. (1970), 'Uniformly accelerating charged mass in General Relativity', *Phys. Rev. D* **2**, 1359–70.
- Kobayashi, S., and Nomizu, K. (1963), *Foundations of Differential Geometry: Volume I* (Interscience, New York).
- Kobayashi, S., and Nomizu, K. (1969), *Foundations of Differential Geometry: Volume II* (Interscience, New York).
- Kreuzer, L.B. (1968), 'Experimental measurement of the equivalence of active and passive gravitational mass', *Phys. Rev.* **169**, 1007–12.

- Kronheimer, E.H., and Penrose, R. (1967), 'On the structure of causal spaces', *Proc. Camb. Phil. Soc.* **63**, 481–501.
- Kruskal, M.D. (1960), 'Maximal extension of Schwarzschild metric', *Phys. Rev.* **119**, 1743–5.
- Kundt, W. (1956), 'Trägheitsbahnen in einem von Gödel angegebenen kosmologischen Modell', *Zs. f. Phys.* **145**, 611–20.
- Kundt, W. (1963), 'Note on the completeness of space-times', *Zs. f. Phys.* **172**, 488–9.
- Le Blanc, J.M., and Wilson, J.R. (1970), 'A numerical example of the collapse of a rotating magnetized star', *Astrophys. J.* **161**, 541–52.
- Leray, J. (1952), 'Hyperbolic differential equations', duplicated notes (Princeton Institute for Advanced Studies).
- Lichnerowicz, A. (1955), *Theories Relativistes de la Gravitation et de l'Electromagnétisme* (Masson, Paris).
- Lifschitz, E.M., and Khalatnikov, I.M. (1963), 'Investigations in relativistic cosmology', *Adv. in Phys. (Phil. Mag. Suppl.)* **12**, 185–249.
- Löbell, F. (1931), 'Beispiele geschlossener drei-dimensionaler Clifford-Kleinsche Räume negativer Krümmung', *Ber. Verhandl. Sächs. Akad. Wiss. Leipzig, Math. Phys. Kl.* **83**, 167–74.
- Milnor, J. (1963), *Morse Theory*, Annals of Mathematics Studies No. 51 (Princeton University Press, Princeton).
- Misner, C.W. (1963), 'The flatter regions of Newman, Unti and Tamburino's generalized Schwarzschild space', *J. Math. Phys.* **4**, 924–37.
- Misner, C.W. (1967), 'Taub-NUT space as a counterexample to almost anything', in *Relativity Theory and Astrophysics I: Relativity and Cosmology*, ed. J. Ehlers, Lectures in Applied Mathematics, Volume 8 (American Mathematical Society), 160–9.
- Misner, C.W. (1968), 'The isotropy of the universe', *Astrophys. J.* **151**, 431–57.
- Misner, C.W. (1969), 'Quantum cosmology. 1', *Phys. Rev.* **186**, 1319–27.
- Misner, C.W. (1972), 'Minisuperspace', in *Magic without Magic*, ed. J. R. Klauder (Freeman, San Francisco).
- Misner, C.W., and Taub, A.H. (1969), 'A singularity-free empty universe', *Sov. Phys. J.E.T.P.* **28**, 122–33.
- Müller zum Hagen, H. (1970), 'On the analyticity of stationary vacuum solutions of Einstein's equations', *Proc. Camb. Phil. Soc.* **68**, 199–201.
- Müller zum Hagen, H., Robinson, D.C., and Seifert, H.J. (1973), 'Black holes in static vacuum space-times', *Gen. Rel. and Grav.* **4**, 53.
- Munkres, J.R. (1954), *Elementary Differential Topology*, Annals of Mathematics Studies No. 54 (Princeton University Press, Princeton).
- Newman, E.T., and Penrose, R. (1962), 'An approach to gravitational radiation by a method of spin coefficients', *J. Math. Phys.* **3**, 566–78.
- Newman, E.T., and Penrose, R. (1968), 'New conservation laws for zero-rest mass fields in asymptotically flat space-time', *Proc. Roy. Soc. Lond. A* **305**, 175–204.
- Newman, E.T., Tamburino, L., and Unti, T.J. (1963), 'Empty space generalization of the Schwarzschild metric', *Journ. Math. Phys.* **4**, 915–23.
- Newman, E.T., and Unti, T.W.J. (1962), 'Behaviour of asymptotically flat empty spaces', *J. Math. Phys.* **3**, 891–901.
- North, J.D. (1965), *The Measure of the Universe* (Oxford University Press, London).
- Ozsváth, I., and Schücking, E. (1962), 'An anti-Mach metric', in *Recent Developments in General Relativity* (Pergamon Press – PWN), 339–50.

- Papapetrou, A. (1966), 'Champs gravitationnels stationnaires à symétrie axiale', *Ann. Inst. Henri Poincaré*, A IV, 83–105.
- Papapetrou, A., and Hamoui, A. (1967), 'Surfaces caustiques dégénérées dans la solution de Tolman. La Singularité physique en Relativité Générale', *Ann. Inst. Henri Poincaré*, VI, 343–64.
- Peebles, P. J. E. (1966), 'Primordial helium abundance and the primordial fireball. II', *Astrophys. J.* **146**, 542–52.
- Penrose, R. (1963), 'Asymptotic properties of fields and space-times', *Phys. Rev. Lett.* **10**, 66–8.
- Penrose, R. (1964), 'Conformal treatment of infinity', in *Relativity, Groups and Topology*, ed. C. M. de Witt and B. de Witt, Les Houches Summer School, 1963 (Gordon and Breach, New York).
- Penrose, R. (1965a), 'A remarkable property of plane waves in General Relativity', *Rev. Mod. Phys.* **37**, 215–20.
- Penrose, R. (1965b), 'Zero rest-mass fields including gravitation: asymptotic behaviour', *Proc. Roy. Soc. Lond. A* **284**, 159–203.
- Penrose, R. (1965c), 'Gravitational collapse and space-time singularities', *Phys. Rev. Lett.* **14**, 57–9.
- Penrose, R. (1966), 'General Relativity energy flux and elementary optics', in *Perspectives in Geometry and Relativity* (Hlavaty Festschrift), ed. B. Hoffmann (Indiana University Press, Bloomington), 259–74.
- Penrose, R. (1968), 'Structure of space-time', in *Battelle Rencontres*, ed. C. M. de Witt and J. A. Wheeler (Benjamin, New York), 121–235.
- Penrose, R. (1969), 'Gravitational collapse: the role of General Relativity', *Rivista del Nuovo Cimento*, **1**, 252–76.
- Penrose, R. (1972a), 'The geometry of impulsive gravitational waves', in *Studies in Relativity* (Synge Festschrift), ed. L. O'Raifeartaigh (Oxford University Press, London).
- Penrose, R. (1972b), 'Techniques of differential topology in relativity' (Lectures at Pittsburgh, 1970), A.M.S. Colloquium Publications.
- Penrose, R., and MacCallum, M. A. H. (1972), 'A twistor approach to space-time quantization', *Physics Reports (Phys. Lett. Section C)*, **6**, 241–316.
- Penrose, R., and Floyd, R. M. (1971), 'Extraction of rotational energy from a black hole', *Nature*, **229**, 177–9.
- Penzias, A. A., Schraml, J., and Wilson, R. W. (1969), 'Observational constraints on a discrete source model to explain the microwave background', *Astrophys. J.* **157**, L49–L51.
- Pirani, F. A. E. (1955), 'On the energy-momentum tensor and the creation of matter in relativistic cosmology', *Proc. Roy. Soc. A* **228**, 455–62.
- Press, W. H. (1972), 'Time evolution of a rotating black hole immersed in a static scalar field', *Astrophys. Journ.* **175**, 245–52.
- Price, R. H. (1972), 'Nonspherical perturbations of relativistic gravitational collapse. I: Scalar and gravitational perturbations. II: Integer spin, zero rest-mass fields', *Phys. Rev.* **5**, 2419–54.
- Rees, M. J., and Sciama, D. W. (1968), 'Large-scale density inhomogeneities in the universe', *Nature*, **217**, 511–16.
- Regge, T., and Wheeler, J. A. (1957), 'Stability of a Schwarzschild singularity', *Phys. Rev.* **108**, 1063–9.
- Riesz, F., and Sz. Nagy, B. (1955), *Functional Analysis* (Blackie and Sons, London).
- Robertson, H. P. (1933), 'Relativistic cosmology', *Rev. Mod. Phys.* **5**, 62–90.

- Rosenfeld, L. (1940), 'Sur le tenseur d'impulsion-énergie', *Mem. Roy. Acad. Belg. Cl. Sci.* **18**, No. 6.
- Ruse, H.S. (1937), 'On the geometry of Dirac's equations and their expression in tensor form', *Proc. Roy. Soc. Edin.* **57**, 97–127.
- Sachs, R.K., and Wolfe, A.M. (1967), 'Perturbations of a cosmological model and angular variations of the microwave background', *Astrophys. J.* **147**, 73–90.
- Sandage, A. (1961), 'The ability of the 200-inch telescope to discriminate between selected world models', *Astrophys. J.* **133**, 355–92.
- Sandage, A. (1968), 'Observational cosmology', *Observatory*, **88**, 91–106.
- Schmidt, B.G. (1967), 'Isometry groups with surface-orthogonal trajectories', *Zs. f. Naturfor.* **22a**, 1351–5.
- Schmidt, B.G. (1971), 'A new definition of singular points in General Relativity', *J. Gen. Rel. and Gravitation*, **1**, 269–80.
- Schmidt, B.G. (1972), 'Local completeness of the b -boundary', *Commun. Math. Phys.* **29**, 49–54.
- Schmidt, H. (1966), 'Model of an oscillating cosmos which rejuvenates during contraction', *J. Math. Phys.* **7**, 494–509.
- Schouten, J.A. (1954), *Ricci Calculus* (Springer, Berlin).
- Schrödinger, E. (1956), *Expanding Universes* (Cambridge University Press, London).
- Sciama, D.W. (1953), 'On the origin of inertia', *Mon. Not. Roy. Ast. Soc.* **113**, 34–42.
- Sciama, D.W. (1967), 'Peculiar velocity of the sun and the cosmic microwave background', *Phys. Rev. Lett.* **18**, 1065–7.
- Sciama, D.W. (1971), 'Astrophysical cosmology', in *General Relativity and Cosmology*, ed. R.K. Sachs, Proceedings of the International School of Physics 'Enrico Fermi', Course XLVII (Academic Press, New York), 183–236.
- Seifert, H.J. (1967), 'Global connectivity by timelike geodesics', *Zs. f. Naturfor.* **22a**, 1356–60.
- Seifert, H.J. (1968), 'Kausal Lorentzräume', *Doctoral Thesis*, Hamburg University.
- Smart, J.J.C. (1964), *Problems of Space and Time*, Problems of Philosophy Series, ed. P. Edwards (Collier-Macmillan, London; Macmillan, New York).
- Sobolev, S.L. (1963), *Applications of Functional Analysis to Physics*, Vol. 7, Translations of Mathematical Monographs (Am. Math. Soc., Providence).
- Spanier, E.H. (1966), *Algebraic Topology* (McGraw Hill, New York).
- Spivak, M. (1965), *Calculus on Manifolds* (Benjamin, New York).
- Steenrod, N.E. (1951), *The Topology of Fibre Bundles* (Princeton University Press, Princeton).
- Stewart, J.M.S., and Sciama, D.W. (1967), 'Peculiar velocity of the sun and its relation to the cosmic microwave background', *Nature*, **216**, 748–53.
- Streater, R.F., and Wightman, A.S. (1964), *P.C.T., Spin, Statistics, and All That* (Benjamin, New York).
- Thom, R. (1969), *Stabilité Structurelle et Morphogénèse* (Benjamin, New York).
- Thorne, K.S. (1966), 'The General Relativistic theory of stellar structure and dynamics', in *High Energy Astrophysics*, ed. L. Gratton, Proceedings of the International School in Physics 'Enrico Fermi', Course xxxv (Academic Press, New York), 166–280.

- Tsuruta, S. (1971), 'The effects of nuclear forces on the maximum mass of neutron stars', in *The Crab Nebula*, ed. R. D. Davies and F. G. Smith (Reidel, Dordrecht).
- Vishveshwara, C.V. (1968), 'Generalization of the "Schwarzschild Surface" to arbitrary static and stationary Metrics', *J. Math. Phys.* **9**, 1319–22.
- Vishveshwara, C.V. (1970), 'Stability of the Schwarzschild metric', *Phys. Rev. D* **1**, 2870–9.
- Wagoner, R.V., Fowler, W.A., and Hoyle, F. (1968), 'On the synthesis of elements at very high temperatures', *Astrophys. J.* **148**, 3–49.
- Walker, A.G. (1944), 'Completely symmetric spaces', *J. Lond. Math. Soc.* **19**, 219–26.
- Weymann, R.A. (1963), 'Mass loss from stars', in *Ann. Rev. Ast. and Astrophys.* Vol. 1 (Ann. Rev. Inc., Palo Alto), 97–141.
- Wheeler, J.A. (1968), 'Superspace and the nature of quantum geometrodynamics', in *Batelle Rencontres*, ed. C. M. de Witt and J. A. Wheeler (Benjamin, New York), 242–307.
- Whitney, H. (1936), 'Differentiable manifolds', *Annals of Maths.* **37**, 645.
- Yano, K. and Bochner, S. (1953), 'Curvature and Betti numbers', *Annals of Maths. Studies* No. 32 (Princeton University Press, Princeton).
- Zel'dovich, Ya.B., and Novikov, I.D. (1971), *Relativistic Astrophysics. Volume I: Stars and Relativity*, ed. K. S. Thorne and W. D. Arnett (University of Chicago Press, Chicago).