

6. References

- Abbot, S.D., Rowe, M., Cadwallader, K., Ricksten, A., Gordon, J., Wang, F., Rymo, L. & Rickinson, A.B. (1990) Epstein-Barr virus nuclear antigen 2 induces expression of the virus-encoded latent membrane protein. *J. Virol.*, **64**, 2126–2134
- Abdel-Hamid, M., Chen, J.-J., Constantine, N., Massoud, M. & Raab-Traub, N. (1992) EBV strain variation: Geographical distribution and relation to disease state. *Virology*, **190**, 168–175
- Ablashi, D.V., de Thé, G., Easton, J.M., Liabeuf, A., Levine, P.H. & Armstrong, G.R. (1974) Antibodies to Epstein-Barr virus (EBV) antigens in sera of American Burkitt lymphoma patients. *Biomedicine*, **20**, 288–293
- Ablashi, D.V., Easton, J.M. & Pearson, G.R. (1977) Transformation of squirrel monkey lymphocytes by Epstein-Barr virus: Effect of donor age. *Cancer Lett.*, **3**, 319–324
- Ablashi, D.V., Glaser, R., Easton, J.M., Nonoyama, M. & Armstrong, G.R. (1978) Athymic nude mice: Induction of tumors containing Epstein-Barr virus using Burkitt's-related cell lines. *Exp. Hematol.*, **6**, 365–374
- Abo, W., Takada, K., Kamada, M., Imamura, M., Motoya, T., Iwanga, M., Aya, T., Yano, S., Nakao, T. & Osato, T. (1982) Evolution of infectious mononucleosis into Epstein-Barr virus carrying monoclonal malignant lymphoma. *Lancet*, **i**, 1272–1276
- Abramson, J.H., Pridan, H., Sacks, M.I., Avitzour, M. & Peritz, E. (1978) A case-control study of Hodgkin's disease in Israel. *J. natl Cancer Inst.*, **61**, 307–314
- Adams, A. & Lindahl, T. (1975) Epstein-Barr virus genomes with properties of circular DNA molecules in carrier cells. *Proc. natl Acad. Sci. USA*, **72**, 1477–1481

- Adams, J.M., Gerondakis, S., Webb, E., Corcoran, L.M. & Cory, S. (1983) Cellular *myc* oncogene is altered by chromosome translocation to an immunoglobulin locus in murine plasmacytomas and is rearranged similarly in human Burkitt lymphomas. *Proc. natl Acad. Sci. USA*, **80**, 1982–1986
- Aderale, W.I., Seriki, O. & Osunkoya, B.O. (1975) Pleural effusion in Burkitt's lymphoma. *Br. J. Cancer*, **32**, 745–746
- Addinger, H.K., Delius, H., Freese, U.K., Clarke, J. & Bornkamm, G.W. (1985) A putative transforming gene of Jijoye virus differs from that of Epstein-Barr virus prototypes. *Virology*, **141**, 221–234
- Afonso, L.C.C., Scharton, T.M., Vieira, L.Q., Wysocka, M., Trinchieri, G. & Scott, P. (1994) The adjuvant effect of interleukin-12 in a vaccine against *Leishmania major*. *Science*, **263**, 235–237
- Agathangelou, A., Niedobitek, G., Chen, R., Nicholls, J., Yin, W. & Young, L.S. (1995) Expression of immune regulatory molecules in Epstein-Barr virus-associated nasopharyngeal carcinomas with prominent lymphoid stroma. Evidence for a functional interaction between epithelial tumor cells and infiltrating lymphoid cells. *Am. J. Pathol.*, **147**, 1152–1160
- Agrba, V.Z., Yakovleva, L.A., Lapin, B.A., Sangulija, I.A., Timanovskaya, V.V., Markaryan, D.S., Chuvirov, G.N. & Salmanova, E.A. (1975) The establishment of continuous lymphoblastoid suspension cell culture from hematopoietic organs of baboon (*P. hamadryas*) with malignant lymphoma. *Exp. Pathol.*, **10**, 318–332
- Ahearn, J.M., Hayward, S.D., Hickey, J.C. & Fearon, D.T. (1988) Epstein-Barr virus (EBV) infection of murine L cells expressing recombinant human EBV/C3d receptor. *Proc. natl Acad. Sci. USA*, **85**, 9307–9311
- Aitken, C., Sengupta, S.K., Aedes, C., Moss, D.J. & Sculley, T.B. (1994) Heterogeneity within the Epstein-Barr virus nuclear antigen 2 gene in different strains of Epstein-Barr virus. *J. gen. Virol.*, **75**, 95–100
- Albeck, H., Nielsen, N.H., Hansen, H.E., Bentzen, J., Ockelmann, H.H., Bretlau, P. & Hansen, H.S. (1992) Epidemiology of nasopharyngeal and salivary gland carcinoma in Greenland. *Arct. med. Res.*, **51**, 189–195
- Albeck, H., Bentzen, J., Ockelmann, H.H., Nielsen, N.H., Bretlau, P. & Hansen, H.S. (1993) Familial clusters of nasopharyngeal carcinoma and salivary gland carcinomas in Greenland natives. *Cancer*, **72**, 196–200
- Albrecht, J.-C., Nicholas, J., Biller, D., Cameron, K.R., Biesinger, B., Newman, C., Wittmann, M.A., Craxton, M.A., Coleman, B., Fleckenstein, B. & Honess, R.W. (1992) Primary structure of the herpesvirus saimiri genome. *J. Virol.*, **66**, 5047–5058
- Alexander, F.E., McKinney, P.A., Williams, J., Ricketts, T.J. & Cartwright, R.A. (1991a) Epidemiological evidence for the 'two-disease hypothesis' in Hodgkin's disease. *Int. J. Epidemiol.*, **20**, 354–361
- Alexander, F.E., Ricketts, T.J., McKinney, P.A. & Cartwright, R.A. (1991b) Community lifestyle characteristics and incidence of Hodgkin's disease in young people. *Int. J. Cancer*, **48**, 10–14
- Alfieri, C., Birkenbach, M. & Kieff, E. (1991) Early events in Epstein-Barr virus infection of human B lymphocytes. *Virology*, **181**, 595–608
- Al-Idrissi, H.Y. (1990) Head and neck cancer in Saudi Arabia: Retrospective analysis of 65 patients. *J. int. med. Res.*, **18**, 515–519

- Alkan, S., Ross, C.W., Hanson, C.A. & Schnitzer, B. (1995) Epstein-Barr virus and bcl-2 protein overexpression are not detected in the neoplastic cells of nodular lymphocyte predominance Hodgkin's disease. *Mod. Pathol.*, **8**, 544–547
- Allan, G.J., Inman, G.J., Parker, B.D., Rowe, D.T. & Farrell, P.J. (1992) Cell growth effects of Epstein-Barr virus leader protein. *J. gen. Virol.*, **73**, 1547–1551
- Allday, M.J., Crawford, D.H. & Griffin, B.E. (1989) Epstein-Barr virus latent gene expression during the initiation of B cell immortalization. *J. gen. Virol.*, **70**, 1755–1764
- Allday, M.J. & Farrell, P.J. (1994) Epstein-Barr virus nuclear antigen EBNA3C/6 expression maintains the level of latent membrane protein 1 in G₁-arrested cells. *J. Virol.*, **68**, 3491–3498
- Allday, M.J., Crawford, D.H. & Thomas, J.A. (1993) Epstein-Barr virus (EBV) nuclear antigen 6 induces expression of the EBV latent membrane protein and an activated phenotype in Raji cells. *J. gen. Virol.*, **74**, 361–369
- Allday, M.J., Sinclair, A., Parker, G., Crawford, D.H. & Farrell, P.J. (1995) Epstein-Barr virus efficiently immortalizes human B cells without neutralizing the function of p53. *EMBO J.*, **14**, 1382–1391
- Allison, A.C. (1963) Inherited factors in blood conferring resistance to protozoa. In: Garnham, P.C.C., Pierce, A.E. & Roitt, I., eds, *Immunity to Protozoa*, Oxford, Blackwell Scientific Publications, p. 109
- Allison, A.C. & Byars, N.E. (1986) An adjuvant formulation that selectively elicits the formation of antibodies of protective isotype and of cell-mediated immunity *J. immunol. Meth.*, **95**, 157–168
- Allison, A.C. & Byars, N.E. (1987) Vaccine technology: Adjuvants for increased efficiency. *Biotechnology*, **5**, 1041–1045
- Althoff, J., Mohr, U., Page, N. & Reznik, G. (1974) Carcinogenic effect of dibutyl nitrosamine in European hamsters (*Cricetus cricetus*). *J. natl Cancer Inst.*, **53**, 795–800
- Altiock, E., Klein, G., Zech, L., Uno, M., Henriksson, B.E., Battat, S., Ono, Y. & Ernberg, I. (1989) Epstein-Barr virus-transformed pro-B cells are prone to illegitimate recombination between the switch region of the mu chain gene and other chromosomes. *Proc. natl Acad. Sci. USA*, **86**, 6333–6337
- Åman, P., Lewin, N., Nordström, M. & Klein, G. (1986) EBV-activation of human B-lymphocytes. *Curr. Top. Microbiol. Immunol.*, **132**, 266–271
- Ambinder, R.F., Shah, W.A., Rawlins, D.R., Hayward, G.S. & Hayward, S.D. (1990) Definition of the sequence requirements for binding of the EBNA-1 protein to its palindromic target sites in Epstein-Barr virus DNA. *J. Virol.*, **64**, 2369–2379
- Ambinder, R.F., Mullen, M.A., Chang, Y.-N., Hayward, G.S. & Hayward, S.D. (1991) Functional domains of Epstein-Barr virus nuclear antigen EBNA-1. *J. Virol.*, **65**, 1466–1478
- Ambinder, R.F., Browning, P.J., Lorenzana, I., Leventhal, B.G., Cosenza, H., Mann, R.B., MacMahon, E.M.E., Medina, R., Cardona, V., Grufferman, S., Olshan, A., Levin, A., Petersen, E.A., Blattner, W. & Levine, P.H. (1993) Epstein-Barr virus and childhood Hodgkin's disease in Honduras and the United States. *Blood*, **81**, 462–467
- Ambinder, R.F., Robertson, K.D., Moore, S.M. & Yang, J. (1996) Epstein-Barr virus as a therapeutic target in Hodgkin's disease and nasopharyngeal carcinoma. *Sem. Cancer Biol.*, **7**, 217–226

- d'Amore, F., Johansen, P., Houmand, A., Weisenburger, D.D. & Mortensen, L.S. (1996) Epstein-Barr virus genome in non-Hodgkin's lymphomas occurring in immunocompetent patients: Highest prevalence in nonlymphoblastic T-cell lymphoma and correlation with a poor prognosis. *Blood*, **87**, 1045-1055
- Anagnostopoulos, I., Herbst, H., Niedobitek, G. & Stein, H. (1989) Demonstration of monoclonal EBV genomes in Hodgkin's disease and Ki-1-positive anaplastic large cell lymphoma by combined Southern blot and in situ hybridization. *Blood*, **74**, 810-816
- Anagnostopoulos, I., Hummel, M., Kreschel, C. & Stein, H. (1995) Morphology, immunophenotype, and distribution of latently and/or productively Epstein-Barr virus-infected cells in acute infectious mononucleosis: Implications for the interindividual infection route of Epstein-Barr virus. *Blood*, **85**, 744-750
- Anagnostopoulos, I., Hummel, M., Kaudewitz, P., Korbjuhn, P., Leoncini, L. & Stein, H. (1996) Low incidence of Epstein-Barr virus presence in primary cutaneous T-cell lymphoproliferations. *Br. J. Dermatol.*, **134**, 276-281
- Anderson, E.N., Jr, Anderson, M.L. & Ho, H.C. (1978) Environmental backgrounds of young Chinese nasopharyngeal carcinoma patients. In: de Thé, G. & Ito, Y., eds, *Nasopharyngeal Carcinoma: Etiology and Control* (IARC Scientific Publications No. 20), Lyon, IARC, pp. 231-239
- Andersson, J. & Ernberg, I. (1988) Management of Epstein-Barr virus infections. *Am. J. Med.*, **85** (Suppl. 2A), 107-115
- Andersson, M.L., Klein, G., Ziegler, J.L. & Henle, W. (1976) Association of Epstein-Barr viral genomes with American Burkitt lymphoma. *Nature*, **260**, 357-359
- Andersson, M.L., Stam, N.J., Klein, G., Ploegh, H.L. & Masucci, M.G. (1991) Aberrant expression of HLA class-I antigens in Burkitt lymphoma cells. *Int. J. Cancer*, **47**, 544-550
- Angel, C.A., Slater, D.N., Royds, J.A., Nelson, S.N.P. & Bleehen, S.S. (1996) Absence of Epstein-Barr viral encoded RNA (EBER) in primary cutaneous T-cell lymphoma. *J. Pathol.*, **178**, 173-175
- Anon. (1982) The non-Hodgkin's lymphoma pathologic classification project. National Cancer Institute sponsored study of classifications of non-Hodgkin's lymphomas: Summary and description of a working formulation for clinical usage. *Cancer*, **49**, 2112-2135
- Anwar, N., Kingma, D.W., Bloch, A.R., Mourad, M., Raffeld, M., Franklin, J., Magrath, I., El Bolkainy, N. & Jaffe, E.S. (1995) The investigation of Epstein-Barr viral sequences in 41 cases of Burkitt's lymphoma from Egypt. Epidemiologic correlations. *Cancer*, **76**, 1245-1252
- Araujo, I., Foss, H.-D., Bittencourt, A., Hummel, M., Demel, G., Mendonca, N., Herbst, H. & Stein, H. (1996) Expression of Epstein-Barr virus gene products in Burkitt's lymphoma in Northeast Brazil. *Blood*, **87**, 5279-5286
- Arber, D.A., Weiss, L.M., Albújar, P.F., Chen, Y.-Y. & Jaffe, E.S. (1993) Nasal lymphomas in Peru. High incidence of T-cell immunophenotype and Epstein-Barr virus infection. *Am. J. surg. Pathol.*, **17**, 392-399
- Arber, D.A., Kamel, O.W., van de Rijn, M., Davis, R.E., Medeiros, L.J., Jaffe, E.S. & Weiss, L.M. (1995) Frequent presence of the Epstein-Barr virus in inflammatory pseudotumor. *Hum. Pathol.*, **26**, 1093-1098

- Armitage, J.M., Kormos, R.L., Stuart, R.S., Fricker, F.J., Griffith, B.P., Nalesnik, M., Hardesty, R.L. & Dummer, J.S. (1991) Posttransplant lymphoproliferative disease in thoracic organ transplant patients: Ten years of cyclosporine-based immunosuppression. *J. Heart Lung Transplant.*, **10**, 877–886
- Armstrong, R.W. & Armstrong, M.J. (1983) Environmental risk factors and nasopharyngeal carcinoma in Selangor, Malaysia: A cross-ethnic perspective. *Ecol. Dis.*, **2**, 185–198
- Armstrong, D., Henle, G. & Henle, W. (1966) Complement fixation tests with cell lines derived from Burkitt's lymphoma and acute leukemias. *J. Bacteriol.*, **19**, 1257–1262
- Armstrong, R.W., Kannan Kutty, M. & Armstrong, M.J. (1978) Self-specific environments associated with nasopharyngeal carcinoma in Selangor, Malaysia. *Soc. Sci. Med.*, **12D**, 149–156
- Armstrong, R.W., Kannan Kutty, M., Dharmalingam, S.K. & Ponnudurai, J.R. (1979) Incidence of nasopharyngeal carcinoma in Malaysia, 1968–1977. *Br. J. Cancer*, **40**, 557–567
- Armstrong, R.W., Armstrong, M.J., Yu, M.C. & Henderson, B.E. (1983) Salted fish and inhalants as risk factors for nasopharyngeal carcinoma in Malaysian Chinese. *Cancer Res.*, **43**, 2967–2970
- Armstrong, A.A., Weiss, L.M., Gallagher, A., Jones, D.B., Krajewski, A.S., Angus, B., Brown, G., Jack, A.S., Wilkins, B.S., Onions, D.E. & Jarrett, R.F. (1992) Criteria for the definition of EBV association in Hodgkin's disease. *Leukemia*, **6**, 869–874
- Arrand, J.R. & Rymo, L. (1982) Characterization of the major Epstein-Barr virus-specific RNA in Burkitt lymphoma-derived cells. *J. Virol.*, **41**, 376–389
- Arribas, J.R., Clifford, D.B., Fichtenbaum, C.J., Roberts, R.L., Powderly, W.G. & Storch, G.A. (1995) Detection of Epstein-Barr virus DNA in cerebrospinal fluid for diagnosis of AIDS-related central nervous system lymphoma. *J. clin. Microbiol.*, **33**, 1580–1583
- Arvanitakis, L., Yaseen, N. & Sharma, S. (1995) Latent membrane protein-1 induces cyclin D2 expression, pRb hyperphosphorylation, and loss of TGF-beta 1-mediated growth inhibition in EBV-positive B cells. *J. Immunol.*, **155**, 1047–1056
- Asada, H., Okada, N., Hashimoto, K., Yamanishi, K., Sairenji, T., Hirota, S., Nomura, S., Kitamura, Y. & Yoshikawa, K. (1994) Establishment and characterization of the T-cell line, EBT-8 latently infected with Epstein-Barr virus from large granular lymphocyte leukemia. *Leukemia*, **8**, 1415–1423
- Askew, D.S., Ashmun, R.A., Simmons, B.C. & Cleveland, J.L. (1991) Constitutive *c-myc* expression in an IL-3-dependent myeloid cell line suppresses cell cycle arrest and accelerates apoptosis. *Oncogene*, **6**, 1915–1922
- Austin, P.J., Flemington, E., Yandava, C.N., Strominger, J.L. & Speck, S.H. (1988) Complex transcription of the Epstein-Barr virus *Bam*HI fragment H rightward open reading frame 1 (BHRF1) in latently and lytically infected B lymphocytes. *Proc. natl Acad. Sci. USA*, **85**, 3678–3682
- Axelsen, S.M. & Stamp, I.M. (1995) Lymphoepithelioma-like carcinoma of the vulvar region. *Histopathology*, **27**, 281–283
- Bacchi, M.M., Bacchi, C.E., Alvarenga, M., Miranda, R., Chen, Y.-Y. & Weiss, L.M. (1996a) Burkitt's lymphoma in Brazil: Strong association with Epstein-Barr virus. *Mod. Pathol.*, **9**, 63–67

- Bacchi, C.E., Bacchi, M.M., Rabenhorst, S.H., Soares, F.A., Fonseca, L.E., Jr, Barbosa, H.S., Weiss, L.M. & Gown, A.M. (1996b) AIDS-related lymphoma in Brazil. Histopathology, immunophenotype, and association with Epstein-Barr virus. *Am. J. clin. Pathol.*, **105**, 230-237
- Baer, R., Bankier, A.T., Biggin, M.D., Deininger, P.L., Farrell, P.J., Gibson, T.J., Hatfull, G., Hudson, G.S., Satchwell, S.C., Séguin, C., Tuffnell, P.S. & Barrell, B.G. (1984) DNA sequence and expression of the B95-8 Epstein-Barr virus genome. *Nature*, **310**, 207-211
- Bai, M.C., Jiwa, N.M., Horstman, A., Vos, W., Kluin, P.H., Van Der Valk, P., Mullink, H., Walboomers, J.M.M. & Meijer, C.J.L.M. (1994) Decreased expression of cellular markers in Epstein-Barr virus-positive Hodgkin's disease. *J. Pathol.*, **174**, 49-55
- Baichwal, V.R. & Sugden, B. (1988) Transformation of Balb 3T3 cells by the BNLF-1 gene of Epstein-Barr virus. *Oncogene*, **2**, 461-467
- Baichwal, V.R. & Sugden, B. (1989) The multiple membrane-spanning segments of the BNLF-1 oncogene from Epstein-Barr virus are required for transformation. *Oncogene*, **4**, 67-74
- Baikie, A.G., Kinlen, L.J. & Pike, M.C. (1972) Detection and assessment of case clustering in Burkitt's lymphoma and Hodgkin's disease. *Recent Results Cancer Res.*, **39**, 201-209
- Balakrishnan, V. (1975) An additional younger-age peak for cancer of the nasopharynx. *Int. J. Cancer*, **15**, 651-657
- Ballerini, P., Gaidano, G., Gong, J.Z., Tassi, V., Saglio, G., Knowles, D.M. & Dalla-Favera, R. (1993) Multiple genetic lesions in acquired immunodeficiency syndrome-related non-Hodgkin's lymphoma. *Blood*, **81**, 166-176
- Banchereau, J. & Rousset, F. (1991) Growing human B lymphocytes in the CD40 system, *Nature*, **353**, 678-679
- Banchereau, J., de Paoli, P., Vallé, A., Garcia, E. & Rousset, F. (1991) Long-term human B cell lines dependent on interleukin-4 and antibody to CD40. *Science*, **251**, 70-72
- Bashir, R.M., Hochberg, F.H., Harris, N.L. & Purtle, D. (1990) Variable expression of Epstein-Barr virus genome as demonstrated by in situ hybridization in central nervous system lymphomas in immunocompromised patients. *Mod. Pathol.*, **3**, 429-434
- Bashir, R., McManus, B., Cunningham, C., Weisenburger, D. & Hochberg, F.H. (1994) Detection of EBER-1 RNA in primary brain lymphomas in immunocompetent and immunocompromised patients. *J. Neuro-Oncol.*, **20**, 47-53
- Baskies, A.M., Chretien, P.B., Yang, C.-S., Wolf, G.T., Makuch, R.W., Tu, S.-M., Hsu, M.-M., Lynn, T.-C., Yang, H.-M., Weiss, J.F. & Spiegel, H.E. (1979) Serum glycoproteins and immunoglobulins in nasopharyngeal carcinoma: Correlations with Epstein-Barr virus associated antibodies and clinical tumor stage. *Am. J. Surg.*, **138**, 478-488
- Bayliss, G.J. & Wolf, H. (1980) Epstein-Barr virus-induced cell fusion. *Nature*, **287**, 164-165
- Bayliss, G.J. & Wolf, H. (1981) An Epstein-Barr virus early protein induces cell fusion. *Proc. natl Acad. Sci. USA*, **78**, 7162-7165
- Beaufils, P., Choquet, D., Mamoun, R.Z. & Malissen, B. (1993) The (YXXL/I)₂ signalling motif found in the cytoplasmic segments of the bovine leukaemia virus envelope protein and Epstein-Barr virus latent membrane protein 2A can elicit early and late lymphocyte activation events. *EMBO J.*, **12**, 5105-5112
- Beigel, A., Peulen, J.F. & Westphal, E. (1983) The spectrum of histocompatibility antigens (HLA) in tumours of the nasopharynx. *Arch. Otorhinolaryngol.*, **237**, 285-288 (in German)

- Beisel, C., Tanner, J., Matsuo, T., Thorley-Lawson, D., Kezdy, F. & Kieff, E. (1985) Two major outer envelope glycoproteins of Epstein-Barr virus are encoded by the same gene. *J. Virol.*, **54**, 665–674
- Bejarano, M.T., Masucci, M.G., Morgan, A., Morein, B., Klein, G. & Klein, E. (1990) Epstein-Barr virus (EBV) antigens processed and presented by B cells, B blasts and macrophages trigger T-cell-mediated inhibition of EBV-induced B-cell transformation. *J. Virol.*, **64**, 1398–1401
- Bell, R.B. & Maguda, T.A. (1970) Nasopharyngeal carcinoma in Caucasian siblings: Report of two cases. *J. Tennessee med. Assoc.*, **63**, 753–754
- Benjamin, D., Magrath, I.T., Maguire, R., Janus, C., Todd, H.D. & Parsons, R.G. (1982) Immunoglobulin secretion by cell lines derived from African and American undifferentiated lymphomas of Burkitt's and non-Burkitt's type. *J. Immunol.*, **129**, 1336–1342
- Benjamin, D., Magrath, I.T., Triche, T.J., Schroff, R.W., Jensen, J.P. & Korsmeyer, S.J. (1984) Induction of plasmacytoid differentiation by phorbol ester in B-cell lymphoma cell lines bearing 8;14 translocations. *Proc. natl Acad Sci USA*, **81**, 3547–3551
- Ben-Sasson, S.A. & Klein, G. (1981) Activation of the Epstein-Barr virus genome by 5-azacytidine in latently infected human lymphoid lines. *Int. J. Cancer*, **28**, 131–135
- Beral, V., Peterman, T., Berkelman, R. & Jaffe, H. (1991) AIDS-associated non-Hodgkin lymphoma. *Lancet*, **337**, 805–809
- Berard, C., O'Connor, G.T., Thomas, L.B. & Torloni, H. (1969) Histopathological definition of Burkitt's tumour. *Bull. World Health Organ.*, **40**, 601–607
- Berger, F. & Delecluse, H.J. (1993) Lymphomas in immunocompromised hosts. *Rev. Prat.*, **43**, 1661–1664 (in French)
- Bergmann, M., Blasius, S., Bankfalvi, A. & Mellin, W. (1995/96) Primary non-Hodgkin lymphomas of the CNS: Proliferation, oncoproteins and Epstein-Barr virus. *Gen. diagn. Pathol.*, **141**, 235–242
- Bernard, S.M., Cartwright, R.A., Bird, C.C., Richards, I.D.G., Lauder, I. & Roberts, B.E. (1984) Aetiologic factors in lymphoid malignancies: A case-control epidemiological study. *Leukemia Res.*, **8**, 681–689
- Bernard, S.M., Cartwright, R.A., Darwin, C.M., Richards, I.D.G., Roberts, B.E., O'Brien, C.O. & Bird, C.C. (1987) Hodgkin's disease: Case control epidemiological study in Yorkshire. *Br. J. Cancer*, **55**, 85–90
- Bernheim, A. & Berger, R. (1988) Cytogenetic studies of Burkitt lymphoma-leukemia in patients with acquired immunodeficiency syndrome. *Cancer Genet. Cytogenet.*, **32**, 67–74
- Bernheim, A., Berger, R. & Lenoir, G.M. (1981) Cytogenetic studies on African Burkitt's lymphoma cell lines: t(8;14), t(2;8) and t(8;22) translocations. *Cancer Genet. Cytogenet.*, **3**, 307–315
- Betuel, H., Camoun, M., Colombani, J., Day, N.E., Ellouz, R. & de Thé, G. (1975) The relationship between nasopharyngeal carcinoma and the HL-A system among Tunisians. *Int. J. Cancer*, **16**, 249–254
- Bhagat, S.K.M., Medeiros, L.J., Weiss, L.M., Wang, J., Raffeld, M. & Stetler-Stevenson, M. (1993) *Bcl-2* expression in Hodgkin's disease: Correlation with the t(14;18) translocation and Epstein-Barr virus. *Am. J. clin. Pathol.*, **99**, 604–608

- Bhatia, K., Gutiérrez, M.I., Huppi, K., Siwarski, D. & Magrath, I.T. (1992) The pattern of *p53* mutations in Burkitt's lymphoma differs from that of solid tumors. *Cancer Res.*, **52**, 4273–4276
- Bhatia, K., Spangler, G., Gaidano, G., Hamdy, N., Dalla-Favera, R. & Magrath, I. (1994) Mutations in the coding region of *c-myc* occur frequently in acquired immunodeficiency syndrome-associated lymphomas. *Blood*, **84**, 883–888
- Bhatia, K., Spangler, G., Hamdy, N., Neri, A., Brubaker, G., Levin, A. & Magrath, I.T. (1995) Mutations in the coding region of *c-myc* occur independently of mutations in the regulatory regions and are predominantly associated with *myc/Ig* translocations. *Curr. Top. Microbiol. Immunol.*, **194**, 389–398
- Bhatia, K., Raj, A., Gutiérrez, M.I., Judde, J.G., Spangler, G., Venkatesh, H. & Magrath, I.T. (1996) Variation in the sequence of Epstein Barr virus nuclear antigen 1 in normal peripheral blood lymphocytes and in Burkitt's lymphomas. *Oncogene*, **13**, 177–181
- Biberfeld, P., Christensson, B., Andersson-Anvret, M., Ernberg, I., Lewensohn, R., Ekman, M., Johansson, B. & Tribukait, B. (1981) An EBV-associated, Swedish case of Burkitt-type malignant lymphoma. *Acta pathol. microbiol. scand. Sect. A*, **89**, 417–424
- Bienzle, U., Guggenmoos-Holzmann, I. & Luzzatto, L. (1981) Plasmodium falciparum malaria and human red cells. I. A genetic and clinical study in children. *Int. J. Epidemiol.*, **10**, 9–15
- Biggar, R.J. & Nkrumah, F.K. (1979) Burkitt's lymphoma in Ghana: Urban–rural distribution, time–space clustering and seasonality. *Int. J. Cancer*, **23**, 330–336
- Biggar, R.J., Henle, W., Fleisher, G., Böcker, J., Lennette, E.T. & Henle, G. (1978) Primary Epstein-Barr virus infection in African infants. I. Decline of maternal antibodies and time of infection. *Int. J. Cancer*, **22**, 239–243
- Biggar, R.J., Gardiner, C., Lennette, E.T., Collins, W.E., Nkrumah, F.K. & Henle, W. (1981) Malaria, sex and place of residence as factors in antibody response to Epstein-Barr virus in Ghana, West Africa. *Lancet*, **ii**, 115–118
- Bignon, Y.-J., Bernard, D., Curé, H., Fonck, Y., Pauchard, J., Travade, P., Legros, M., Dastugue, B. & Plagne, R. (1990) Detection of Epstein-Barr viral genomes in lymph-nodes of Hodgkin's disease patients. *Mol. Carcinog.*, **3**, 9–11
- Bignon, Y.-J., Clavelou, P., Ramos, F., Jouvet, A., Tommasi, M., Tournilhac, M., Dastugue, B. & Plagne, R. (1991) Detection of Epstein-Barr virus sequences in primary brain lymphoma without immunodeficiency. *Neurology*, **41**, 1152–1153
- Billaud, M., Busson, P., Huang, D., Mueller-Lantzsch, N., Rousselet, G., Pavlish, O., Wakasugi, H., Seigneurin, J.M., Tursz, T. & Lenoir, G.M. (1989) Epstein-Barr virus (EBV)-containing nasopharyngeal carcinoma cells express the B-cell activation antigen Blast 2/CD23 and low levels of the EBV receptor CR2. *J. Virol.*, **63**, 4121–4128
- Billaud, M., Rousset, F., Calender, A., Cordier, M., Aubry, J.P., Laisse, V. & Lenoir, G.M. (1990) Low expression of lymphocyte function-associated antigen (LFA)-1 and LFA-3 adhesion molecules is a common trait in Burkitt's lymphoma associated with and not associated with Epstein-Barr virus. *Blood*, **75**, 1827–1833
- Birkenbach, M., Liebowitz, D., Wang, F., Sample, J. & Kieff, E. (1989) Epstein-Barr virus latent infection membrane protein increases vimentin expression in human B-cell lines. *J. Virol.*, **63**, 4079–4084
- Birkenbach, M., Tong, X., Bradbury, L.E., Tedder, T.F. & Kieff, E. (1992) Characterization of an Epstein-Barr virus receptor on human epithelial cells. *J. exp. Med.*, **176**, 1405–1414

- Birkenbach, M., Josefsen, K., Yalamanchili, R., Lenoir, G.M. & Kieff, E. (1993) Epstein-Barr virus-induced genes: First lymphocyte-specific G protein-coupled peptide receptors. *J. Virol.*, **67**, 2209–2220
- Birx, D.L., Redfield, R.R. & Tosato, G. (1986) Defective regulation of Epstein-Barr virus infection in patients with acquired immunodeficiency syndrome (AIDS) or AIDS-related disorders. *New Engl. J. Med.*, **314**, 874–879
- Black, F.L., Woodall, J.P., Evans, A.S., Liebhaber, H. & Henle, G. (1970) Prevalence of antibody against viruses in the Tiriyo, an isolated Amazon tribe. *Am. J. Epidemiol.*, **91**, 430–438
- Blair, A., Stewart, P.A., O'Berg, M., Gaffey, W., Walrath, J., Ward, J., Bales, R., Kaplan, S. & Cubit, D. (1986) Mortality among industrial workers exposed to formaldehyde. *J. natl Cancer Inst.*, **76**, 1071–1084
- Blair, A., Stewart, P.A., Hoover, R.N., Fraumeni, J.F., Jr, Walrath, J., O'Berg, M. & Gaffey, W. (1987) Cancers of the nasopharynx and oropharynx and formaldehyde exposure (Letter to the Editor). *J. natl Cancer Inst.*, **78**, 191–192
- Blasco, J., Guido, M., Carestia, M., Power, C., Drut, M. & Drut, R. (1996) Gastric undifferentiated lymphoepithelial carcinoma with Epstein-Barr virus. *Medicina*, **56**, 287–290 (in Spanish)
- Blazar, B., Patarroyo, M., Klein, E. & Klein, G. (1980) Increased sensitivity of human lymphoid lines to natural killer cells after induction of the Epstein-Barr viral cycle by superinfection or sodium butyrate. *J. exp. Med.*, **151**, 614–627
- Bochkarev, A., Barwell, J.A., Pfuetzner, R.A., Furey, W., Jr, Edwards, A.M. & Frappier, L. (1995) Crystal structure of the DNA-binding domain of the Epstein-Barr virus origin-binding protein EBNA1. *Cell*, **83**, 39–46
- Böcker, J.F., Tiedemann, K.H., Bornkamm, G.W. & zur Hausen, H. (1980) Characterization of an EBV-like virus from African green monkey lymphoblasts. *Virology*, **101**, 291–295
- Bodescot, M. & Perricaudet, M. (1986) Epstein-Barr virus mRNAs produced by alternative splicing. *Nucleic Acids Res.*, **14**, 7103–7114
- Bodescot, M., Brison, O. & Perricaudet, M. (1986) An Epstein-Barr virus transcription unit is at least 84 kilobases long. *Nucleic Acids Res.*, **14**, 2611–2620
- Bogedain, C., Wolf, H., Modrow, S., Stuber, G. & Jilg, W. (1995) Specific cytotoxic T lymphocytes recognize the immediate-early transactivator Zta of Epstein-Barr virus. *J. Virol.*, **69**, 4872–4879
- Bogger-Goren, S., Zaizov, R., Vogel, R., Leventon-Kriss, S., Sayar, Y. & Gotlieb-Stematsky, T. (1983) Clinical and virological observations in childhood Hodgkin's disease in Israel. *Isr. J. med. Sci.*, **19**, 989–991
- Boiocchi, M., Carbone, A., De Re, V. & Dolcetti, R. (1989) Is the Epstein-Barr virus involved in Hodgkin's disease? *Tumori*, **75**, 345–350
- Boiocchi, M., De Re, V., Dolcetti, R., Volpe, R., Gloghini, A., Taviani, M., Viel, A., Maestro, R. & Carbone, A. (1990) Pathogenesis of malignant lymphomas in intravenous drug-abuser, HIV-infected patients. *Cancer Detect. Prev.*, **14**, 661–668
- Boiocchi, M., Dolcetti, R., De Re, V., Gloghini, A. & Carbone, A. (1993a) Demonstration of a unique Epstein-Barr virus-positive cellular clone in metachronous multiple localizations of Hodgkin's disease. *Am. J. Pathol.*, **142**, 33–38

- Boiocchi, M., De Re, V., Gloghini, A., Vaccher, E., Dolcetti, R., Marzotto, A., Bertola, G. & Carbone, A. (1993b) High incidence of monoclonal EBV episomes in Hodgkin's disease and anaplastic large-cell KI-1-positive lymphomas in HIV-1-positive patients. *Int. J. Cancer*, **54**, 53–59
- Bonelli, L., Vitale, V., Bistolfi, F., Landucci, M. & Bruzzi, P. (1990) Hodgkin's disease in adults: Association with social factors and age at tonsillectomy. A case-control study. *Int. J. Cancer*, **45**, 423–427
- Booth, K., Burkitt, D.P., Bassett, D.J., Cooke, R.A. & Biddulph, J. (1967) Burkitt lymphoma in Papua, New Guinea. *Br. J. Cancer*, **21**, 657–664
- Borisch, B., Kirchner, T., Marx, A. & Müller-Hermelink, H.K. (1990) Absence of the Epstein-Barr virus genome in the normal thymus, thymic epithelial tumors, thymic lymphoid hyperplasia in a European population. *Virchows Arch. B. Cell Pathol.*, **59**, 359–365
- Borisch, B., Finke, J., Hennig, I., Delacrétaz, F., Schneider, J., Heitz, P.U. & Laissue, J.A. (1992a) Distribution and localization of Epstein-Barr virus subtypes A and B in AIDS-related lymphomas and lymphatic tissue of HIV-positive patients. *J. Pathol.*, **168**, 229–236
- Borisch, B., Hennig, I., Horber, F., Bürki, K. & Laissue, J. (1992b) Enteropathy-associated T-cell lymphoma in a renal transplant patient with evidence of Epstein-Barr virus involvement. *Virchows Arch. A Pathol.*, **421**, 443–447
- Borisch-Chappuis, B., Nezelof, C., Müller, H. & Müller-Hermelink, H.K. (1990a) Different Epstein-Barr virus expression in lymphomas from immunocompromised and immunocompetent patients. *Am. J. Pathol.*, **136**, 751–758
- Borisch-Chappuis, B., Müller, H., Stutte, J., Hey, M.M., Hübner, K. & Müller-Hermelink, H.K. (1990b) Identification of EBV-DNA in lymph nodes from patients with lymphadenopathy and lymphomas associated with AIDS. *Virchows Arch. B Cell Pathol.*, **58**, 199–205
- Bornkamm, G.W., Stein, H., Lennert, K., Rüggeberg, F., Bartels, F. & zur Hausen, H. (1976) Attempts to demonstrate virus-specific sequences in human tumors. IV. EB viral DNA in European Burkitt lymphoma and immunoblastic lymphadenopathy with excessive plasmacytosis. *Int. J. Cancer*, **17**, 177–181
- Bornkamm, G.W., Delius, H., Zimmer, U., Hudewentz, J. & Epstein, M.A. (1980) Comparison of Epstein-Barr virus strains of different origin by analysis of the viral DNAs. *J. Virol.*, **35**, 603–618
- Bornkamm, G.W., Hudewentz, J., Freese, U.K. & Zimmer, U. (1982) Deletion of the non-transforming Epstein-Barr virus strain P3HR-1 causes fusion of the large internal repeat to the DS_L region. *J. Virol.*, **43**, 952–968
- Bornkamm, G.W., Polack, A. & Eick, D. (1988) c-myc deregulation by chromosomal translocation in Burkitt's lymphoma. In: Klein, G., ed., *Cellular Oncogene Activation*, New York, M. Dekker, pp. 223–273
- Borras, A.M., Strominger, J.L. & Speck, S.H. (1996) Characterization of the ZI domains in the Epstein-Barr virus BZLF1 gene promoter: Role in phorbol ester induction. *J. Virol.*, **70**, 3894–3901
- van den Bosch, C., Griffin, B.E., Kazembe, P., Dziweni, C. & Kadzamira, L. (1993) Are plant factors a missing link in the evolution of endemic Burkitt's lymphoma? *Br. J. Cancer*, **68**, 1232–1235

- Bouvier, G., Hergenbahn, M., Polack, A., Bornkamm, G.W., de Thé, G. & Bartsch, H. (1995) Characterization of macromolecular lignins as Epstein-Barr virus inducer in foodstuff associated with nasopharyngeal carcinoma risk. *Carcinogenesis*, **16**, 1879–1885
- Boyle, M.J., Sewell, W.A., Sculley, T.B., Apolloni, A., Turner, J.J., Swanson, C.E., Penny, R. & Cooper, D.A. (1991) Subtypes of Epstein-Barr virus in human immunodeficiency virus-associated non-Hodgkin's lymphoma. *Blood*, **78**, 3004–3011
- Boyle, M.J., Vasak, E., Tschuchnigg, M., Turner, J.J., Sculley, T.B., Penny, R., Cooper, D.A., Tindall, B. & Sewell, W.A. (1993) Subtypes of Epstein-Barr virus (EBV) in Hodgkin's disease: Association between B-type EBV and immunocompromise. *Blood*, **81**, 468–474
- Bricháček, B., Hirsch, I., Šíbl, O., Vilikusová, E. & Vonka, V. (1983) Association of some supraglottic laryngeal carcinomas with EB virus. *Int. J. Cancer.*, **32**, 193–197
- Bricháček, B., Hirsch, I., Šíbl, O., Vilikusová, E. & Vonka, V. (1984) Presence of Epstein-Barr virus DNA in carcinomas of the palatine tonsil. *J. natl Cancer Inst.*, **72**, 809–815
- Brielmeier, M., Mautner, J., Laux, G. & Hammerschmidt, W. (1996) The latent membrane protein 2 gene of Epstein-Barr virus is important for efficient B cell immortalization. *J. gen. Virol.*, **77**, 2807–2818
- Brocksmith, D., Angel, C.A., Pringle, J.H. & Lauder, I. (1991) Epstein-Barr viral DNA in Hodgkin's disease: Amplification and detection using the polymerase chain reaction. *J. Pathol.*, **165**, 11–15
- Brooks, L.A., Yao, Q.Y., Rickinson, A.B. & Young, L.S. (1992) Epstein-Barr virus latent gene transcription in nasopharyngeal carcinoma cells: Co-expression of EBNA1, LMP1 and LMP2 transcripts. *J. Virol.*, **66**, 2689–2697
- Brooks, L.A., Lear, A.L., Young, L.S. & Rickinson, A.B. (1993a) Transcripts from the Epstein-Barr virus *Bam*HI A fragment are detectable in all three forms of virus latency. *J. Virol.*, **67**, 3182–3190
- Brooks, J.M., Murray, R.J., Thomas, W.A., Kurilla, M.G. & Rickinson, A.B. (1993b) Different HLA-B27 subtypes present the same immunodominant Epstein-Barr virus peptide. *J. exp. Med.*, **178**, 879–887
- Brousset, P., Chittal, S., Schlaifer, D., Icart, J., Payen, C., Rigal-Huguet, F., Voigt, J.-J. & Delsol, G. (1991) Detection of Epstein-Barr virus messenger RNA in Reed-Sternberg cells of Hodgkin's disease by in situ hybridization with biotinylated probes on specially processed modified acetone methyl benzoate xylene (ModAMeX) sections. *Blood*, **77**, 1781–1786
- Brousset, P., Butet, V., Chittal, S., Selves, J. & Delsol, G. (1992) Comparison of in situ hybridization using different nonisotopic probes for detection of Epstein-Barr virus in nasopharyngeal carcinoma and immunohistochemical correlation with anti-latent membrane protein antibody. *Lab. Invest.*, **67**, 457–464
- Brousset, P., Knecht, H., Rubin, B., Drouet, E., Chittal, S., Meggetto, F., Al Saati, T., Bachmann, E., Denoyel, G., Sergeant, A. & Delsol, G. (1993) Demonstration of Epstein-Barr virus replication in Reed-Sternberg cells of Hodgkin's disease. *Blood*, **82**, 872–876
- Brousset, P., Schlaifer, D., Meggetto, F., Bachmann, E., Rothenberger, S., Pris, J., Delsol, G. & Knecht, H. (1994) Persistence of the same viral strain in early and late relapses of Epstein-Barr virus-associated Hodgkin's disease. *Blood*, **84**, 2447–2451
- Brown, T.M., Jr, Heath, C.W., Jr, Lang, R.M., Lee, S.K. & Whalley, B.W. (1976) Nasopharyngeal cancer in Bermuda. *Cancer*, **37**, 1464–1468

- Brown, N.A., Liu, C., Garcia, C.R., Wang, Y.-F., Griffith, A., Sparkes, R.S. & Calame, K.L. (1986) Clonal origins of lymphoproliferative disease induced by Epstein-Barr virus. *J. Virol.*, **58**, 975–978
- Brubaker, G., Geser, A. & Pike, M.C. (1973) Burkitt's lymphoma in the North Mara district of Tanzania 1964–70: Failure to find evidence of time–space clustering in a high risk isolated rural area. *Br. J. Cancer*, **28**, 469–472
- Brubaker, G., Levin, A.G., Steel, C.M., Creasey, G., Cameron, H.M., Linsell, C.A. & Smith, P.G. (1980) Multiple cases of Burkitt's lymphoma and other neoplasms in families in the North Mara district of Tanzania. *Int. J. Cancer*, **26**, 165–170
- Buckmaster, A.E., Scott, S.D., Sanderson, M.J., Bourns, M.E.G., Ross, N.L.J. & Binns, M.M. (1988) Gene sequence and mapping data from Marek's disease virus and herpesvirus of turkeys: Implication for herpesvirus classification. *J. gen. Virol.*, **69**, 2033–2042
- Buell, P. (1973) Race and place in the etiology of nasopharyngeal cancer: A study based on California death certificates. *Int. J. Cancer*, **11**, 268–272
- Buell, P. (1974) The effect of migration on the risk of nasopharyngeal cancer among Chinese. *Cancer Res.*, **34**, 1189–1191
- Burdin, N., Péronne, C., Banchereau, J. & Rousset, F. (1993) Epstein-Barr virus transformation induces B lymphocytes to produce human interleukin 10. *J. exp. Med.*, **177**, 295–304
- Burke, A.P., Yen, T.S.B., Shekitka, K.M. & Sobin, L.H. (1990) Lymphoepithelial carcinoma of the stomach with Epstein-Barr virus demonstrated by polymerase chain reaction. *Mod. Pathol.*, **3**, 377–380
- Burkhardt, A.L., Bolen, J.B., Kieff, E. & Longnecker, R. (1992) An Epstein-Barr virus transformation-associated membrane protein interacts with *src* family tyrosine kinases. *J. Virol.*, **66**, 5161–5167
- Burkitt, D.P. (1958) A sarcoma involving the jaws in African children. *Br. J. Surg.*, **46**, 218–223
- Burkitt, D.P. (1962a) Determining the climatic limitations of a children's cancer common in Africa. *Br. med. J.*, **ii**, 1019–1023
- Burkitt, D. (1962b) A children's cancer dependent on climatic factors. *Nature*, **194**, 232–234
- Burkitt, D. (1962c) A 'tumour safari' in East and Central Africa. *Br. J. Cancer*, **16**, 379–386
- Burkitt, D.P. (1963) A lymphoma syndrome dependent on environment. 1. Clinical aspects. In: *Symposium on Lymph Tumours in Africa*, Paris, Karger, pp. 80–93
- Burkitt, D.P. (1967) Burkitt's lymphoma outside the known endemic areas of Africa and New Guinea. *Int. J. Cancer*, **2**, 562–565
- Burkitt, D.P. (1969) Etiology of Burkitt's lymphoma — An alternative hypothesis to a vectored virus. *J. natl Cancer Inst.*, **42**, 19–28
- Burkitt, D.P. (1970a) General features and facial tumours. In: Burkitt, D.P. & Wright, D.H., eds, *Burkitt's Lymphoma*, Edinburgh, E. & S. Livingstone, pp. 6–15
- Burkitt, D.P. (1970b) Geographical distribution. In: Burkitt, D.P. & Wright, D.H., eds, *Burkitt's Lymphoma*, Edinburgh, E. & S. Livingstone, pp. 186–197
- Burkitt, D.P. (1985) The beginnings of the Burkitt's lymphoma story. In: Lenoir, G.M., O'Connor, G. & Olweny, C.L.M., eds, *Burkitt's Lymphoma: A Human Cancer Model* (IARC Scientific Publications No. 60), Lyon, IARC, pp. 11–15
- Burkitt, D.P. & Davies, J.N.P. (1961) Lymphoma syndrome in Uganda and tropical Africa. *Med. Press*, **245**, 367–369

- Burkitt, D.P. & Wright, D.H. (1963) A lymphoma syndrome in tropical Africa. *Int. Rev. exp. Pathol.*, **2**, 67–138
- Burkitt, D.P. & Wright, D.H. (1966) Geographical and tribal distribution of the African lymphoma in Uganda. *Br. med. J.*, **i**, 569–573
- Burrows, S.R., Misko, I.S., Sculley, T.B., Schmidt, C. & Moss, D.J. (1990a) An Epstein-Barr virus-specific cytotoxic T-cell epitope present on A- and B-type transformants. *J. Virol.*, **64**, 3974–3976
- Burrows, S.R., Sculley, T.B., Misko, I.S., Schmidt, C. & Moss, D.J. (1990b) An Epstein-Barr virus-specific cytotoxic T cell epitope in EBV nuclear antigen 3 (EBNA 3). *J. exp. Med.*, **171**, 345–349
- Burrows, S.R., Khanna, R., Burrows, J.M. & Moss, D.J. (1994) An alloresponse in humans is dominated by cytotoxic T lymphocytes (CTL) cross-reactive with a single Epstein-Barr virus CTL epitope: Implications for graft-versus-host disease. *J. exp. Med.*, **179**, 1155–1161
- Burrows, J.M., Khanna, R., Sculley, T.B., Alpers, M.P., Moss, D.J. & Burrows, S.R. (1996a) Identification of a naturally occurring recombinant Epstein-Barr virus isolate from New Guinea that encodes both type 1 and type 2 nuclear antigen sequences. *J. Virol.*, **70**, 4829–4833
- Burrows, J.M., Burrows, S.R., Poulsen, L.M., Sculley, T.B., Moss, D.J. & Khanna, R. (1996b) Unusually high frequency of Epstein-Barr virus genetic variants in Papua New Guinea that can escape cytotoxic T-cell recognition: Implications for virus evolution. *J. Virol.*, **70**, 2490–2496
- Burt, R.D., Vaughan, T.L. & McKnight, B. (1992) Descriptive epidemiology and survival analysis of nasopharyngeal carcinoma in the United States. *Int. J. Cancer*, **52**, 549–556
- Burt, R.D., Vaughan, T.L., Nisperos, B., Swanson, M. & Berwick, M. (1994) A protective association between the HLA-A2 antigen and nasopharyngeal carcinoma in US Caucasians. *Int. J. Cancer*, **56**, 465–467
- Busson, P., Braham, K., Ganem, G., Thomas, F., Grausz, D., Lipinski, M., Wakasugi, H. & Tursz, T. (1987) Epstein-Barr virus-containing epithelial cells from nasopharyngeal carcinoma produce interleukin 1 alpha. *Proc. natl Acad. Sci. USA*, **84**, 6262–6266
- Busson, P., Ganem, G., Flores, P., Mugneret, F., Clause, B., Caillou, B., Braham, K., Wakasugi, H., Lipinski, M. & Tursz, T. (1988) Establishment and characterization of three transplantable EBV-containing nasopharyngeal carcinomas. *Int. J. Cancer*, **42**, 599–606
- Busson, P., McCoy, R., Sadler, R., Gilligan, K., Tursz, T. & Raab-Traub, N. (1992a) Consistent transcription of the Epstein-Barr virus LMP2 gene in nasopharyngeal carcinoma. *J. Virol.*, **66**, 3257–3262
- Busson, P., Zhang, Q., Guillon, J.-M., Gregory, C.D., Young, L.S., Clause, B., Lipinski, M., Rickinson, A.B. & Tursz, T. (1992b) Elevated expression of ICAM1 (CD54) and minimal expression of LFA3 (CD58) in Epstein-Barr-virus-positive nasopharyngeal carcinoma cells. *Int. J. Cancer*, **50**, 863–867
- Butler, A.E., Colby, T.V., Weiss, L. & Lombard, C. (1989) Lymphoepithelioma-like carcinoma of the lung. *Am. J. surg. Pathol.*, **13**, 632–639
- Byars, N.E., Nakano, G., Welch, M., Lehman, D. & Allison, A.C. (1991) Improvement of hepatitis B vaccine by the use of a new adjuvant. *Vaccine*, **9**, 309–318

- Callan, M.F.C., Steven, N., Krausa, P., Wilson, J.D.K., Moss, P.A.H., Gillespie, G.M., Bell, J.I., Rickinson, A.B. & McMichael, A.J. (1996) Large clonal expansions of CD8⁺ T cells in acute infectious mononucleosis. *Nature Med.*, **2**, 906–911
- Calnek, B.W. (1986) Marek's disease — A model for herpesvirus oncology. *CRC crit. Rev. Microbiol.*, **12**, 293–320
- Calnek, B.W. & Witter, R.L. (1991) Marek's disease. In: Calnek, B.W., Barnes, H.J., Beard, C.W., Reid, W.M. & Yoder, H.W., Jr, eds, *Diseases of Poultry*, Ames, Iowa, Iowa State University Press, pp. 342–385
- Calnek, B.W., Adldinger, H.K. & Kahn, D.E. (1970) Feather follicle epithelium: A source of enveloped and infectious cell-free herpesvirus from Marek's disease. *Avian Dis*, **14**, 219–233
- Cammoun, M., Vogt Hoerner, G. & Mourali, N. (1974) Tumors of the nasopharynx in Tunisia. An anatomic and clinical study based on 143 cases. *Cancer*, **33**, 184–192
- de Campos-Lima, P.-O., Gavioli, R., Zhang, Q.-J., Wallace, L.E., Dolcetti, R., Rowe, M., Rickinson, A.B. & Masucci, M.G. (1993a) HLA-A11 epitope loss isolates of Epstein-Barr virus from a highly A11⁺ population. *Science*, **260**, 98–100
- de Campos-Lima, P.-O., Torsteinsdóttir, S., Cuomo, L., Klein, G., Sulitzeanu, D. & Masucci, M.G. (1993b) Antigen processing and presentation by EBV-carrying cell lines: Cell-phenotype dependence and influence of the EBV-encoded LMP1. *Int. J. Cancer*, **53**, 856–862
- de Campos-Lima, P.-O., Levitsky, V., Brooks, J., Lee, S.P., Hu, L.F., Rickinson, A.B. & Masucci, M.G. (1994) T Cell responses and virus evolution: Loss of HLA A11-restricted CTL epitopes in Epstein-Barr virus isolates from highly A11-positive populations by selective mutation of anchor residues. *J. exp. Med.*, **179**, 1297–1305
- de Campos-Lima, P.-O., Levitskaya, J., Frisan, T. & Masucci, M.G. (1996) Strategies of immunoescape in Epstein-Barr virus persistence and pathogenesis. *Semin. Virol.*, **7**, 75–82
- Carbone, A., Gloghini, A., Zanette, I., Canal, B. & Volpe, R. (1993a) Demonstration of Epstein-Barr viral genomes by in situ hybridization in acquired immune deficiency syndrome-related high grade and anaplastic large cell CD30⁺ lymphomas. *Am. J. clin. Pathol.*, **99**, 289–297
- Carbone, A., Tirelli, U., Gloghini, A., Volpe, R. & Boiocchi, M. (1993b) Human immunodeficiency virus-associated systemic lymphomas may be subdivided into two main groups according to Epstein-Barr viral latent gene expression. *J. clin. Oncol.*, **11**, 1674–1681
- Carbone, A., Gloghini, A., Zanette, I., Canal, B., Rizzo, A. & Volpe, R. (1993c) Co-expression of Epstein-Barr virus latent membrane protein and vimentin in 'aggressive' histological subtypes of Hodgkin's disease. *Virchows Arch. A Pathol. Anat.*, **422**, 39–45
- Carbone, A., Dolcetti, R., Gloghini, A., Maestro, R., Vaccher, E., Di Luca, D., Tirelli, U. & Boiocchi, M. (1996) Immunophenotypic and molecular analyses of acquired immune deficiency syndrome-related and Epstein-Barr virus-associated lymphomas: A comparative study. *Hum. Pathol.*, **27**, 133–146
- Carr, K.A., Bulengo, S., Weiss, L.M. & Nickoloff, B.J. (1992) Lymphoepitheliomalike carcinoma of the skin. A case report with immunophenotypic analysis and in situ hybridization for Epstein-Barr viral genome. *Am. J. surg. Pathol.*, **16**, 909–913
- Carter, C.D., Brown, T.M., Jr, Herbert, J.T. & Heath, C.W., Jr (1977) Cancer incidence following infectious mononucleosis. *Am. J. Epidemiol.*, **105**, 30–36
- Çavdar, A.O., Yavuz, G., Babacan, E., Gözdasoglu, S., Ünal, E., Ertem, U., Pamir, A., Yücesan, S., Gökcora, H., Uluoglu, Ö. & Ikcincogullari, A. (1994) Burkitt's lymphoma in Turkish children: Clinical, viral [EBV] and molecular studies. *Leukemia Lymphoma*, **14**, 323–330

- Cesarman, E., Moore, P.S., Rao, P.H., Inghirami, H., Knowles, D.M. & Chang, Y. (1995) In vitro establishment and characterization of two acquired immunodeficiency syndrome-related lymphoma cell lines (BC-1 and BC-2) containing Kaposi's sarcoma-associated herpesvirus-like (KSHV) DNA sequences. *Blood*, **86**, 2708–2714
- Chadburn, A., Suciú-Foca, N., Cesarman, E., Reed, E., Michler, R.E. & Knowles, D.M. (1995a) Post-transplantation lymphoproliferative disorders arising in solid organ transplant recipients are usually of recipient origin. *Am. J. Pathol.*, **147**, 1862–1870
- Chadburn, A., Cesarman, E., Liu, Y.F., Addonizio, L., Hsu, D., Michler, R.E. & Knowles, D.M. (1995b) Molecular genetic analysis demonstrates that multiple posttransplantation lymphoproliferative disorders occurring in one anatomic site in a single patient represent distinct primary lymphoid neoplasms. *Cancer*, **75**, 2747–2756
- Chan, S.H., Levine, P.H., de Thé, G., Mulroneý, S.E., Lavoué, M.F., Glen, S.P.P., Goh, E.H., Khor, T.H. & Connelly, R.R. (1979a) A comparison of the prognostic value of antibody-dependent lymphocyte toxicity and other EBV antibody assays in Chinese patients with nasopharyngeal carcinoma. *Int. J. Cancer*, **23**, 181–185
- Chan, S.H., Wee, G.B., Srinivasan, N., Glen, S.P.P., Cheng, P., Vengadasalam, D., Alano, F.A. & Simons, M.J. (1979b) HLA antigens in three common populations in South East Asia — Chinese, Malay and Filipino. *Tissue Antigens*, **13**, 361–368
- Chan, S.H., Day, N.E., Khor, T.H. & Kunaratnam, N. & Chia, K.B. (1981) HLA markers in the development and prognosis of NPC in Chinese. In: Grundmann, E., Krueger, G.R.F. & Ablashi, D.V., eds, *Cancer Campaign*, Vol. 5, *Nasopharyngeal Carcinoma*, Stuttgart, Gustav Fischer Verlag, pp. 205–211
- Chan, S.H., Day, N.E., Kunaratnam, N., Chia, K.B. & Simons, M.J. (1983a) HLA and nasopharyngeal carcinoma in Chinese — A further study. *Int. J. Cancer*, **32**, 171–176
- Chan, S.H., Wee, G.B., Kunaratnam, N., Chia, K.B. & Day, N.E. (1983b) HLA locus B and DR antigen associations in Chinese NPC patients and controls. In: Prasad, U., Ablashi, D.V., Levine, P.H. & Pearson, G.R., eds, *Nasopharyngeal Carcinoma: Current Concepts*, Kuala Lumpur, University of Malaya Press, pp. 307–312
- Chan, S.H., Chew, C.T., Prasad, U., Wee, G.B., Srinivasan, N. & Kunaratnam, N. (1985) HLA and nasopharyngeal carcinoma in Malays. *Br. J. Cancer*, **51**, 389–392
- Chan, S.H., Chew, C.T., Chandanayingyong, D., Vootiprux, V., Sangruchi, S., Zhu, X.N. & Chen, R. (1986) Nasopharyngeal carcinoma: Joint report. In: Aizawa, M., ed., *HLA in Asia-Oceania, 1986, Proceedings of the 3rd Asia-Oceania Histocompatibility Workshop Conference*, Sapporo, Hokkaido University Press, pp. 396–400
- Chan, C.K., Mueller, N., Evans, A., Harris, N.L., Comstock, G.W., Jellum, E., Magnus, K., Orentreich, N., Polk, F. & Vogelmann, J. (1991) Epstein-Barr virus antibody patterns preceding the diagnosis of nasopharyngeal carcinoma. *Cancer Causes Control*, **2**, 125–131
- Chan, J.K.C., Yip, T.T.C., Tsang, W.Y.W., Ng, C.S., Lau, W.-H., Poon, Y.F., Wong, C. S.C. & Ma, V.W.S. (1994a) Detection of Epstein-Barr viral RNA in malignant lymphomas of the upper aerodigestive tract. *Am. J. surg. Pathol.*, **18**, 938–946
- Chan, J.K.C., Yip, T.T.C., Tsang, W.Y.W., Poon, Y.F., Wong, C.S.C. & Ma, V.W.S. (1994b) Specific association of Epstein-Barr virus with lymphoepithelial carcinoma among tumors and tumorlike lesions of the salivary gland. *Arch. Pathol. Lab. Med.*, **118**, 994–997

- Chan, J.K.C., Tsang, W.Y.M., Ng, C.S., Wong, C.S.C. & Lo, E.S.F. (1995a) A study of the association of Epstein-Barr virus with Burkitt's lymphoma occurring in a Chinese population. *Histopathology*, **26**, 239–245
- Chan, J.K.C., Yip, T.T.C., Tsang, W.Y.M., Lau, W.-H., Wong, C.S.C. & Ma, V.W.S. (1995b) Detection of Epstein-Barr virus in Hodgkin's disease occurring in an oriental population. *Hum. Pathol.*, **26**, 314–318
- Chang, Y.-N., Dong, D.L.-Y., Hayward, G.S. & Hayward, S.D. (1990) The Epstein-Barr virus Zta transactivator: A member of the bZIP family with unique DNA-binding specificity and a dimerization domain that lacks the characteristic heptad leucine zipper motif. *J. Virol.*, **64**, 3358–3369
- Chang, K.L., Flaris, N., Hickey, W.F., Johnson, R.M., Meyer, J.S. & Weiss, L.M. (1993a) Brain lymphomas of immunocompetent and immunocompromised patients: Study of the association with Epstein-Barr virus. *Mod. Pathol.*, **6**, 427–432
- Chang, K.L., Albújar, P.F., Chen, Y.-Y., Johnson, R.M. & Weiss, L.M. (1993b) High prevalence of Epstein-Barr virus in the Reed-Sternberg cells of Hodgkin's disease occurring in Peru. *Blood*, **81**, 496–501
- Chang, Y., Cesarman, E., Pessin, M.S., Lee, F., Culpepper, J., Knowles, D.M. & Moore, P.S. (1994) Identification of herpesvirus-like DNA sequences in AIDS-associated Kaposi's sarcoma. *Science*, **266**, 1865–1869
- Chang, Y.-S., Su, I.-J., Chung, P.J., Shu, C.-H., Ng, C.-K., Wu, S.-J. & Liu, S.-T. (1995) Detection of an Epstein-Barr-virus variant in T-cell-lymphoma tissues identical to the distinct strain observed in nasopharyngeal carcinoma in the Taiwanese population. *Int. J. Cancer*, **62**, 673–677
- Chao, T.-Y., Chow, K.-C., Chang, J.-Y., Wang, C.-C., Tsao, T.-Y., Harn, H.-J. & Chi, K.-H. (1996) Expression of Epstein-Barr virus-encoded RNAs as a marker for metastatic undifferentiated nasopharyngeal carcinoma. *Cancer*, **78**, 24–29
- Chapman, C.J., Mockridge, C.I., Rowe, M., Rickinson, A.B. & Stevenson, F.K. (1995) Analysis of V_H genes used by neoplastic B cells in endemic Burkitt's lymphoma shows somatic hypermutation and intracлонаl heterogeneity. *Blood*, **85**, 2176–2181
- Chen, W. & Cooper, N.R. (1996) Epstein-Barr virus nuclear antigen 2 and latent membrane protein independently transactivate p53 through induction of NF κ B activity. *J. Virol.*, **70**, 4849–4853
- Chen, J.-Y., Chen, C.-J., Liu, M.-Y., Cho, S.-M., Hsu, M.-M., Lynn, T.-C., Shieh, T., Tu, S.-M., Lee, H.H. & Kuo, S.L. (1987) Antibodies to Epstein-Barr virus-specific DNase in patients with nasopharyngeal carcinoma and control groups. *J. med. Virol.*, **23**, 11–21
- Chen, C.-J., Chen, J.-Y. & Hsu, M.-M. (1988a) Epidemiological characteristics and early detection of nasopharyngeal carcinoma in Taiwan. In: Wolf, G.T. & Carey, T.E., eds, *Head and Neck Oncology Research*, Amsterdam, Kugler Publications, pp. 505–513
- Chen, C.-J., Wang, Y.-F., Shieh, T., Chen, J.-Y. & Liu, M.-Y. (1988b) Multifactorial etiology of nasopharyngeal carcinoma. Epstein-Barr virus, familial tendency and environmental cofactors. In: Wolf, G.T. & Carey, T.E., eds, *Head and Neck Oncology Research*, Amsterdam, Kugler Publications, pp. 469–476

- Chen, J.-Y., Chen, C.-J., Liu, M.-Y., Cho, S.-M., Hsu, M.-M., Lynn, T.-C., Shieh, T., Tu, S.-M., Beasley, R.P., Hwang, L.-Y., Lee, H.-H., Kuo, S.-L. & Yang, C.-S. (1989) Antibody to Epstein-Barr virus-specific DNase as a marker for field survey of patients with nasopharyngeal carcinoma in Taiwan. *J. med. Virol.*, **27**, 269–273
- Chen, M.-L., Tsai, C.-N., Liang, C.-L., Shu, C.-H., Huang, C.-R., Sulitzeanu, D., Liu, S.-T. & Chang, Y.-S. (1992a) Cloning and characterization of the latent membrane protein (LMP) of a specific Epstein-Barr virus variant derived from the nasopharyngeal carcinoma in the Taiwanese population. *Oncogene*, **7**, 2131–2140
- Chen, H.-F., Kevan-Jah, S., Suentzenich, K.-O., Grässer, F.A. & Mueller-Lantzsch, N. (1992b) Expression of the Epstein-Barr virus latent membrane protein (LMP) in insect cells and detection of antibodies in human sera against this protein. *Virology*, **190**, 106–115
- Chen, H.-L., Lung, M.M.L., Sham, J.S.T., Choy, D.T.K., Griffin, B.E. & Ng, M.H. (1992c) Transcription of *Bam*HI-A region of the EBV genome in NPC tissues and B cells. *Virology*, **191**, 193–201
- Chen, F., Zou, J.-Z., di Renzo, L., Winberg, G., Hu, L.-F., Klein, E., Klein, G. & Ernberg, I. (1995a) A subpopulation of normal B cells latently infected with Epstein-Barr virus resembles Burkitt lymphoma cells in expressing EBNA-1 but not EBNA-2 or LMP1. *J. Virol.*, **69**, 3752–3758
- Chen, Y., Chew, C.T. & Chan, S.H. (1995b) T-Cell receptor gene expression in tumour-infiltrating lymphocytes and peripheral blood lymphocytes of patients with nasopharyngeal carcinoma. *Br. J. Cancer*, **72**, 117–122
- Cheng, Y.-C., Chen, J.-Y., Glaser, R. & Henle, W. (1980) Frequency and levels of antibodies to Epstein-Barr virus-specific DNase are elevated in patients with nasopharyngeal carcinoma. *Proc. natl Acad. Sci. USA*, **77**, 6162–6165
- Cheng, Y.-C., Huang, E.-S., Lin, J.-C., Mar, E.-C., Pagano, J.S., Dutschman, G.E. & Grill, S.P. (1983) Unique spectrum of activity of 9-[(1,3-dihydroxy-2-propoxy)methyl]guanine against herpesviruses *in vitro* and its mode of action against herpes simplex virus type 1. *Proc. natl Acad. Sci. USA*, **80**, 2767–2770
- Cheng, H.-M., Foong, Y.-T., Mathew, A., Sam, C.-K., Dillner, J. & Prasad, U. (1993) Screening for nasopharyngeal carcinoma with an ELISA using the Epstein-Barr virus nuclear antigen, EBNA 1: A complementary test to the IgA/VCA immunofluorescence assay. *J. virol. Meth.*, **42**, 45–52
- Cheung, S.-T., Lo, K.-W., Leung, S.F., Chan, W.-Y., Choi, P.H.K., Johnson, P.J., Lee, J.C.K. & Huang, D.P. (1996) Prevalence of LMP1 deletion variant of Epstein-Barr virus in nasopharyngeal carcinoma and gastric tumors in Hong Kong (Letter to the Editor). *Int. J. Cancer*, **66**, 711–712
- Chi, T. & Carey, M. (1993) The ZEBRA activation domain: Modular organization and mechanism of action. *Mol. cell. Biol.*, **13**, 7045–7055
- Chinn, T.W., Lai, H.M. & Choy, P.P., eds (1969) *A History of the Chinese in California. A Syllabus*, San Francisco, Chinese Historical Society of America
- Cho, M.-S., Bornkamm, G.W. & zur Hausen, H. (1984) Structure of defective DNA molecules in Epstein-Barr virus preparations from P3HR-1 cells. *J. Virol.*, **51**, 199–207
- Chow, W.-H., McLaughlin, J.K., Hrubec, Z., Nam, J.-M. & Blot, W.J. (1993) Tobacco use and nasopharyngeal carcinoma in a cohort of US veterans. *Int. J. Cancer*, **55**, 538–540

- Christensen, S., Kodoyianni, V., Bosenberg, M., Friedman, L. & Kimble, J. (1996) *Lag-1*, a gene required for *lin-12* and *glp-1* signalling in *Caenorhabditis elegans*, is homologous to human CBF1 and *Drosophila* Su(H). *Development*, **122**, 1373–1383
- Churchill, A.E. & Biggs, P.M. (1967) Agent of Marek's disease in tissue culture. *Nature*, **215**, 528–530
- Churchill, A.E. & Biggs, P.M. (1968) Herpes-type virus isolated in cell culture from tumors of chickens with Marek's disease. II. Studies *in vivo*. *J. natl Cancer Inst.*, **41**, 951–956
- Churchill, A.E., Payne, L.N. & Chubb, R.C. (1969) Immunization against Marek's disease using a live attenuated virus. *Nature*, **221**, 744–747
- Cinque, P., Brytting, M., Vago, L., Castagna, A., Parravicini, C., Zanchetta, N., Monforte, A.D'A., Wahren, B., Lazzarin, A. & Linde, A. (1993) Epstein-Barr virus DNA in cerebrospinal fluid from patients with AIDS-related primary lymphoma of the central nervous system. *Lancet*, **342**, 398–401
- Cleary, M.L., Epstein, M.A., Finerty, S., Dorfman, R.F., Bornkamm, G.W., Kirkwood, J.K., Morgan, A.J. & Sklar, J. (1985) Individual tumors of multifocal EB virus-induced malignant lymphomas in tamarins arise from different B-cell clones. *Science*, **228**, 722–724
- Cleary, M.L., Smith, S.D. & Sklar, J. (1986) Cloning and structural analysis of cDNAs for *bcl-2* and a hybrid *bcl-2*/immunoglobulin transcript resulting from the t(14;18) translocation. *Cell*, **47**, 19–28
- Clifford, P. (1965) Carcinoma of the nasopharynx in Kenya. *E. Afr. med. J.*, **42**, 373–396
- Clifford, P. (1972) Carcinogens in the nose and throat: Nasopharyngeal carcinoma in Kenya. *Proc. R. Soc. Med.*, **65**, 682–686
- Coates, P.J., Slavin, G. & d'Ardenne, A.J. (1991a) Persistence of Epstein-Barr virus in Reed-Sternberg cells throughout the course of Hodgkin's disease. *J. Pathol.*, **164**, 291–297
- Coates, P.J., Mak, W.P., Slavin, G. & d'Ardenne, A.J. (1991b) Detection of single copies of Epstein-Barr virus in paraffin wax sections by non-radioactive *in situ* hybridisation. *J. clin. Pathol.*, **44**, 487–491
- Cochet, C., Martel-Renoir, D., Grunewald, V., Bosq, J., Cochet, G., Schwaab, G., Bernaudin, J.-F. & Joab, I. (1993) Expression of Epstein-Barr virus immediate early gene, BZLF1, in nasopharyngeal carcinoma tumor cells. *Virology*, **197**, 358–365
- Cohen, J.I. (1992) A region of herpes simplex virus VP16 can substitute for a transforming domain of Epstein-Barr virus nuclear protein 2. *Proc. natl Acad. Sci. USA*, **89**, 8030–8034
- Cohen, J.I. & Kieff, E. (1991) An Epstein-Barr virus nuclear protein 2 domain essential for transformation is a direct transcriptional activator. *J. Virol.*, **65**, 5880–5885
- Cohen, S. & McGregor, I.A. (1963) Gamma-globulin and acquired immunity to malaria. In: Garnam, P.C.C., Pierce, A.E. & Roitt, I., eds, *Immunity to Protozoa*, Oxford, Blackwell, pp. 123–159
- Cohen, S., McGregor, I.A. & Carrington, S. (1961) Gamma-globulin and acquired immunity to human malaria. *Nature*, **192**, 733–737
- Cohen, B.M., Smetana, H.F. & Miller, R.W. (1964) Hodgkin's disease: Long survival in a study of 388 World War II army cases. *Cancer*, **17**, 856–866
- Cohen, J.I., Wang, F., Mannick, J. & Kieff, E. (1989) Epstein-Barr virus nuclear protein 2 is a key determinant of lymphocyte transformation. *Proc. natl Acad. Sci. USA*, **86**, 9558–9562

- Cohen, J.I., Wang, F. & Kieff, E. (1991) Epstein-Barr virus nuclear protein 2 mutations define essential domains for transformation and transactivation. *J. Virol.*, **65**, 2545–2554
- Cohen, J.I., Picchio, G.R. & Mosier, D.E. (1992) Epstein-Barr virus nuclear protein 2 is a critical determinant for tumor growth in SCID mice and for transformation *in vitro*. *J. Virol.*, **66**, 7555–7559
- Colby, B.M., Shaw, J.E., Elion, G.B. & Pagano, J.S. (1980) Effect of acyclovir [9-(2-hydroxyethoxymethyl)guanine] on Epstein-Barr virus DNA replication. *J. Virol.*, **34**, 560–568
- Collins, J.J., Caporossi, J.C. & Utidjian, H.M.D. (1988) Formaldehyde exposure and nasopharyngeal cancer: Re-examination of the National Cancer Institute study and an update of one plant (Letter to the Editor). *J. natl Cancer Inst.*, **80**, 376–377
- Connelly, R.R. & Christine, B.W. (1974) A cohort study of cancer following infectious mononucleosis. *Cancer Res.*, **34**, 1172–1178
- Contreras-Brodin, B., Anvret, M., Imreh, S., Altiok, E., Klein, G. & Masucci, M.G. (1991) B Cell phenotype-dependent expression of the Epstein-Barr virus nuclear antigens EBNA-2 to EBNA-6: Studies with somatic cell hybrids. *J. gen. Virol.*, **72**, 3025–3033
- Contreras-Salazar, B., Klein, G. & Masucci, M.G. (1989) Host cell-dependent regulation of growth transformation-associated Epstein-Barr virus antigens in somatic cell hybrids. *J. Virol.*, **63**, 2768–2772
- Conway, M., Morgan, A.J. & Mackett, M. (1989) Expression of Epstein-Barr virus membrane antigen gp340/220 in mouse fibroblasts using a bovine papillomavirus vector. *J. gen. Virol.*, **70**, 729–734
- Conway, E.J., Hudnall, S.D., Lazarides, A., Bahler, A., Fraire, A.E. & Cagle, P.T. (1996) Absence of evidence for an etiologic role for Epstein-Barr virus in neoplasms of the lung and pleura. *Mod. Pathol.*, **9**, 491–495
- Correa, P. & O'Connor, G.T. (1971) Epidemiologic patterns of Hodgkin's disease. *Int. J. Cancer*, **8**, 192–201
- Cox, M.A., Leahy, J. & Hardwick, J.M. (1990) An enhancer within the divergent promoter of Epstein-Barr virus responds synergistically to the R and Z transactivators. *J. Virol.*, **64**, 313–321
- Cox, C., Chang, S., Karran, L., Griffin, B. & Wedderburn, N. (1996) Persistent Epstein-Barr virus infection in the common marmoset (*Callithrix jacchus*). *J. gen. Virol.*, **77**, 1173–1180
- Cozen, W., Katz, J. & Mack, T.M. (1992) Risk patterns of Hodgkin's disease in Los Angeles vary by cell type. *Cancer Epidemiol. Biomarkers Prev.*, **1**, 261–268
- Craig, F.E., Gulley, M.L. & Banks, P.M. (1993) Posttransplantation lymphoproliferative disorders. *Am. J. clin. Pathol.*, **99**, 265–276
- Crawford, D.H. & Ando, I. (1986) EB virus induction is associated with B-cell maturation. *Immunology*, **59**, 405–409
- Crawford, D.H., Epstein, M.A., Bornkamm, G.W., Achong, B.G., Finerty, S. & Thompson, J.L. (1979) Biological and biochemical observations on isolates of EB virus from the malignant epithelial cells of two nasopharyngeal carcinomas. *Int. J. Cancer*, **24**, 294–302
- Croce, C.M., Shander, M., Martinis, J., Cicurel, L., D'Ancona, G.G., Dolby, T.W. & Koprowski, H. (1979) Chromosomal location of the genes for human immunoglobulin heavy chains. *Proc. natl Acad. Sci. USA*, **76**, 3416–3419

- Crompton, C.H., Cheung, R.K., Donjon, C., Miyazaki, I., Feinmesser, R., Hébert, D. & Dosch, H.-M. (1994) Epstein-Barr virus surveillance after renal transplantation. *Transplantation*, **57**, 1182–1189
- Cuomo, L., Trivedi, P., Wang, F., Winberg, G., Klein, G. & Masucci, M.G. (1990) Expression of the Epstein-Barr virus (EBV)-encoded membrane antigen (LMP) increases the stimulatory capacity of EBV-negative B lymphoma lines in allogeneic mixed lymphocyte cultures. *Eur. J. Immunol.*, **20**, 2293–2299
- Cuomo, L., Ramquist, T., Trivedi, P., Wang, F., Klein, G. & Masucci, M.G. (1992) Expression of the Epstein-Barr virus (EBV)-encoded membrane protein LMP-1 impairs the in vitro growth, clonability and tumorigenicity of an EBV-negative Burkitt lymphoma line. *Int. J. Cancer*, **51**, 949–955
- Cwirla, S.E., Peters, E.A., Barrett, R.W. & Dower, W.J. (1990) Peptides on phage: A vast library of peptides for identifying ligands. *Proc. natl Acad. Sci. USA*, **87**, 6378–6382
- Daibata, M., Speck, S.H., Mulder, C. & Sairenji, T. (1994) Regulation of the BZLF1 promoter of Epstein-Barr virus by second messengers in anti-immunoglobulin-treated B cells. *Virology*, **198**, 446–454
- Dalla-Favera, R., Bregni, M., Erikson, J., Patterson, D., Gallo, R.C. & Croce, C.M. (1982) Human *c-myc onc* gene is located on the region of chromosome 8 that is translocated in Burkitt lymphoma cells. *Proc. natl Acad. Sci. USA*, **79**, 7824–7827
- Dalldorf, G. (1962) Lymphomas of African children with different forms or environmental influences. *J. Am. med. Assoc.*, **181**, 1026–1028
- Dalldorf, G., Linsell, C.A., Barnhart, F.E. & Martyn, R. (1964) An epidemiological approach to the lymphomas of African children and Burkitt's sarcoma of the jaws. *Perspect. Biol. Med.*, **7**, 435–449
- Dambaugh, T., Nkrumah, F.K., Biggar, R.J. & Kieff, E. (1979) Epstein-Barr virus RNA in Burkitt tumor tissue. *Cell*, **16**, 313–322
- Dambaugh, T., Raab-Traub, N., Heller, M., Beisel, C., Hummel, M., Cheung, A., Fennewald, S., King, W. & Kieff, E. (1980) Variations among isolates of Epstein-Barr virus. *Ann. N.Y. Acad. Sci.*, **354**, 309–325
- Dambaugh, T., Hennessy, K., Chamnankit, L. & Kieff, E. (1984) U2 region of Epstein-Barr virus DNA may encode Epstein-Barr nuclear antigen 2. *Microbiology*, **81**, 7632–7636
- Daniel, L.W., Bauer, G. & zur Hausen, H. (1984) Effect of indomethacin on Epstein-Barr virus early antigen induction. *Cancer Res.*, **44**, 981–983
- David, E.M. & Morgan, A.J. (1988) Efficient purification of Epstein-Barr virus membrane antigen gp340 by fast protein liquid chromatography. *J. immunol. Meth.*, **108**, 231–236
- Davies, J.N.P. (1948) Reticuloendothelial tumours. *E. Afr. med. J.*, **25**, 117
- Davies, J.N.P., Elmes, S., Hutt, M.S.R., Mtimavalye, L.A.R., Owor, R. & Shaper, L. (1964a) Cancer in an African community, 1897–1956. An analysis of the records of Mengo Hospital, Kampala, Uganda: Part 1. *Br. med. J.*, **i**, 259–264
- Davies, J.N.P., Elmes, S., Hutt, M.S.R., Mtimavalye, L.A.R., Owor, R. & Shaper, L. (1964b) Cancer in an African community, 1897–1956. An analysis of the records of Mengo Hospital, Kampala, Uganda: Part 2. *Br. med. J.*, **i**, 336–341
- Davis, C.L., Harrison, K.L., McVicar, J.P., Forg, P.J., Bronner, M.P. & Marsh, C.L. (1995) Antiviral prophylaxis and the Epstein Barr virus-related post-transplant lymphoproliferative disorder. *Clin. Transplant.*, **9**, 53–59

- Davison, S.P., Habermann, T.M., Strickler, J.G., DeRemee, R.A., Earle, J.D. & McDonald, T.J. (1996) Nasal and nasopharyngeal angiocentric T-cell lymphomas. *Laryngoscope*, **106**, 139-143
- Dawson, C.W., Rickinson, A.B. & Young, L.S. (1990) Epstein-Barr virus latent membrane protein inhibits human epithelial cell differentiation. *Nature*, **344**, 777-780
- Deacon, E.M., Pallesen, G., Niedobitek, G., Crocker, J., Brooks, L., Rickinson, A.B. & Young, L.S. (1993) Epstein-Barr virus and Hodgkin's disease: Transcriptional analysis of virus latency in the malignant cells. *J. exp. Med.*, **177**, 339-349
- Deamant, F.D., Albújar, P.F., Chen, Y.-Y. & Weiss, L.M. (1993) Epstein-Barr virus distribution in nonneoplastic lymph nodes. *Mod. Pathol.*, **6**, 729-732
- DeAngelis, L.M., Wong, E., Rosenblum, M. & Furneaux, H. (1992) Epstein-Barr virus in acquired immunodeficiency syndrome (AIDS) and non-AIDS primary central nervous system lymphoma. *Cancer*, **70**, 1607-1611
- Deinhardt, F. & Deinhardt, J. (1979) Oncogenic animal herpesviruses. In: Epstein, M.A. & Achong, B.G., eds, *Epstein-Barr Virus*, Berlin, Springer-Verlag, pp. 374-415
- Deinhardt, F., Falk, L., Wolfe, L.G., Paciga, L. & Johnson, D.R. (1975) Response of marmosets to experimental infection with Epstein-Barr virus. In: de Thé, G., Epstein, M.A. & zur Hausen, H., eds, *Oncogenesis and Herpesviruses II* (IARC Scientific Publications No. 11), Lyon, IARC, pp. 161-168
- Deinhardt, F., Falk, L., Wolfe, L.G., Schudel, A., Nonoyama, M., Lai, P., Lapin, B. & Yakovleva, L. (1978) Susceptibility of marmosets to Epstein-Barr virus-like baboon herpesviruses. *Primate Med.*, **10**, 163-170
- Delabie, J., Tierens, A., Gavriil, T., Wu, G., Weisenburger, D.D. & Chan, W.C. (1996) Phenotype, genotype and clonality of Reed-Sternberg cells in nodular sclerosis Hodgkin's disease: Results of a single-cell study. *Br. J. Haematol.*, **94**, 198-205
- Delecluse, H.-J., Bartnizke, S., Hammerschmidt, W., Bullerdiek, J. & Bornkamm, G.W. (1993a) Episomal and integrated copies of Epstein-Barr virus coexist in Burkitt lymphoma cell lines. *J. Virol.*, **67**, 1292-1299
- Delecluse, H.-J., Schüller, S. & Hammerschmidt, W. (1993b) Latent Marek's disease virus can be activated from its chromosomally integrated state in herpesvirus-transformed lymphoma cells. *EMBO J.*, **12**, 3277-3286
- Delecluse, H.-J., Raphael, M., Magaud, J.P., Felman, P., Alsamad, I.A., Bornkamm, G.W. & Lenoir, G.M. (1993c) Variable morphology of human immunodeficiency virus-associated lymphomas with c-myc rearrangements. The French study group of pathology for human immunodeficiency virus-associated tumors. I. *Blood*, **82**, 552-563
- Delecluse, H.-J., Kremmer, E., Rouault, J.-P., Cour, C., Bornkamm, G.W. & Berger, F. (1995a) The expression of Epstein-Barr virus latent proteins is related to the pathological features of post-transplant lymphoproliferative disorders. *Am. J. Pathol.*, **146**, 1113-1120
- Delecluse, H.-J., Rouault, J.-P., Ffrench, M., Dureau, G., Magaud, J.P. & Berger, F. (1995b) Post-transplant lymphoproliferative disorders with genetic abnormalities commonly found in malignant tumours. *Br. J. Haematol.*, **89**, 90-97
- Delsol, G., Brousset, P., Chittal, S. & Rigal-Huguet, F. (1992) Correlation of the expression of Epstein-Barr virus latent membrane protein and in situ hybridization with biotinylated *Bam*HI-W probes in Hodgkin's disease. *Am. J. Pathol.*, **140**, 247-253

- Demers, P.A., Boffetta, P., Kogevinas, M., Blair, A., Miller, B.A., Robinson, C.F., Roscoe, R.J., Winter, P.D., Colin, D., Matos, E. & Vainio, H. (1995) Pooled reanalysis of cancer mortality among five cohorts of workers in wood-related industries. *Scand. J. Work Environ. Health*, **21**, 179–190
- Desgranges, C. & de Thé, G. (1977) Epstein-Barr virus induces viral nuclear antigen in nasopharyngeal epithelial cells (Letter to the Editor). *Lancet*, **ii**, 1286–1287
- Desgranges, C. & de Thé, G. (1978) Presence of Epstein-Barr virus specific IgA in saliva of nasopharyngeal carcinoma patients: Their activity, origin and possible clinical value. In: de Thé, G. & Ito, Y., *Nasopharyngeal Carcinoma: Etiology and Control* (IARC Scientific Publications No. 20), Lyon, IARC, pp. 459–469
- Desgranges, C., Wolf, H., de Thé, G., Shanmugaratnam, K., Cammoun, N., Ellouz, R., Klein, G., Lennert, K., Muñoz, N. & zur Hausen, H. (1975) Nasopharyngeal carcinoma. X. Presence of Epstein-Barr genomes in separated epithelial cells of tumours in patients from Singapore, Tunisia and Kenya. *Int. J. Cancer*, **16**, 7–15
- Desgranges, C., Lenoir, G.M., de Thé, G., Seigneurin, J.-M., Hilgers, J. & Dubouch, P. (1976) In vitro transforming activity of EBV. 1. Establishment and properties of two EBV strain (M81 and M72) produced by immortalized *Callithrix jacchus* lymphocytes. *Biomedicine*, **25**, 349–352
- Desgranges, C., de Thé, G., Ho, J.H.C. & Ellouz, R. (1977) Neutralizing EBV-specific IgA in throat washings of nasopharyngeal carcinoma (NPC) patients. *Int. J. Cancer*, **19**, 627–633
- Desgranges, C., Bornkamm, G.W., Zeng, Y., Wang, P.C., Zhu, J.S., Shang, M. & de Thé, G. (1982) Detection of Epstein-Barr viral DNA internal repeats in the nasopharyngeal mucosa of Chinese with IgA/EBV-specific antibodies. *Int. J. Cancer*, **29**, 87–91
- De Smet, M.P. (1956) Clinical observations of malignant tumours of reticuloendothelial and haemolymphopoietic tissues in the Congo. *Ann. Soc. belge Méd. trop.*, **36**, 53–70
- Devergne, O., Hummel, M., Koeppen, H., Le Beau, M.M., Nathanson, E.C., Kieff, E. & Birkenbach, M. (1996) A novel interleukin-12 p40-related protein induced by latent Epstein-Barr virus infection in B lymphocytes. *J. Virol.*, **70**, 1143–1153
- DeVita, V.T., Hellman, S. & Rosenberg, S.A. (1993) *Cancer: Principles and Practice of Oncology*, 4th Ed., Philadelphia, J.B. Lippincott Co., pp. 1819–1852
- Dictor, M., Cervin, A., Kalm, O. & Rambech, E. (1996) Sinonasal T-cell lymphoma in the differential diagnosis of lethal midline granuloma using in situ hybridization for Epstein-Barr virus RNA. *Mod. Pathol.*, **9**, 7–14
- Diehl, V., Taylor, J.R., Parlin, J.A., Henle, G. & Henle, W. (1969) Infectious mononucleosis in East Africa. *E. Afr. med. J.*, **46**, 407–413
- Dietl, J., Horny, H.-P. & Kaiserling, E. (1994) Lymphoepithelioma-like carcinoma of the vagina: A case report with special reference to the immunophenotype of the tumor cells and tumor-infiltrating lymphoreticular cells. *Int. J. gynecol. Pathol.*, **13**, 186–189
- DiGiuseppe, J.A., Wu, T.-C. & Corio, R.L. (1994) Analysis of Epstein-Barr virus-encoded small RNA 1 expression in benign lymphoepithelial salivary gland lesions. *Mod. Pathol.*, **7**, 555–559
- Dillner, J., Kallin, B., Alexander, H., Ernberg, I., Uno, M., Ono, Y., Klein, G. & Lerner, R.A. (1986) An Epstein-Barr virus (EBV)-determined nuclear antigen (EBNA5) partly encoded by the transformation-associated *Bam* WYH region of EBV DNA: Preferential expression in lymphoblastoid cell lines. *Proc. natl Acad. Sci. USA*, **83**, 6641–6645

- Dillon, S.B., Demuth, S.G., Schneider, M.A., Weston, C.B., Jones, C.S., Young, J.F., Scott, M., Bhatnagar, P.K., LoCastro, S. & Hanna, N. (1992) Induction of protective class I MHC-restricted CTL in mice by a recombinant influenza vaccine in aluminium hydroxide adjuvant. *Vaccine*, **10**, 309–318
- Dimery, I.W., Lee, J.S., Blick, M., Pearson, G., Spitzer, G. & Hong, W.K. (1988) Association of the Epstein-Barr virus with lymphoepithelioma of the thymus. *Cancer*, **61**, 2475–2480
- Diss, T.C., Wotherspoon, A.C., Speight, P., Pan, L. & Isaacson, P.G. (1995) B-Cell monoclonality, Epstein-Barr virus, and t(14;18) in myoepithelial sialadenitis and low-grade B-cell MALT [mucosa-associated lymphoid tissue] lymphoma of the parotid gland. *Am. J. surg. Pathol.*, **19**, 531–536
- Dix, S.P. & Wingard, J.R. (1996) Management of viral infections in bone marrow transplant recipients. *Clin. Immunother.*, **6**, 352–382
- Dobner, T., Wolf, I., Emrich, T. & Lipp, M. (1992) Differentiation-specific expression of a novel G protein-coupled receptor from Burkitt's lymphoma. *Eur. J. Immunol.*, **22**, 2795–2799
- Dobson, W.H. (1924) Cervical lymphosarcoma. *Chin. med. J.*, **38**, 786–787
- Dolcetti, R., Frisan, T., Sjöberg, J., de Campos-Lima, P.O., Pisa, P., De Re, V., Gloghini, A., Rizzo, S., Masucci, M.G. & Boiocchi, M. (1995) Identification and characterization of an Epstein-Barr virus-specific T-cell response in the pathologic tissue of a patient with Hodgkin's disease. *Cancer Res.*, **55**, 3675–3681
- Dolezal, M.V., Kamel, O.W., van de Rijn, M., Cleary, M.L., Sibley, R.K. & Warnke, R.A. (1995) Virus-associated hemophagocytic syndrome characterized by clonal Epstein-Barr virus genome. *Am. J. clin. Pathol.*, **103**, 189–194
- Doll, R., Muir, C.S. & Waterhouse, J.A.H., eds (1970) *Cancer Incidence in Five Continents*, Vol. 2, Geneva, UICC
- Dorfman, R.F. (1965) Childhood lymphosarcoma in St Louis, Missouri, clinically and histologically resembling Burkitt's tumor. *Cancer*, **18**, 418–430
- Dotsika, E., Karagouni, E., Sundquist, B., Morein, B., Morgan, A. & Villacres-Eriksson, M. (1997) Influence of the Quillaja saponaria triterpenoid content on the immunomodulatory capacity of Epstein-Barr virus (EBV) iscoms. *Scand. J. Immunol.*, **45**, 261–268
- Draper, C.C., Brubaker, G., Geser, A., Kilimali, V.A.E.B. & Wernsdorfer, W.H. (1985) Serial studies on the evolution of chloroquine resistance in an area of East Africa receiving intermittent malaria chemosuppression. *Bull. World Health Organ.*, **63**, 109–118
- Drut, R.M., Day, S., Drut, R. & Meisner, L. (1994) Demonstration of Epstein-Barr viral DNA in paraffin-embedded tissues of Burkitt's lymphoma from Argentina using the polymerase chain reaction and in-situ hybridization. *Pediatr. Pathol.*, **14**, 101–109
- DuBois, R.E., Seeley, J.K., Brus, I., Sakamoto, K., Ballow, M., Harada, S., Bechtold, T.A., Pearson, G. & Purtle, D.T. (1984) Chronic mononucleosis syndrome. *South. med. J.*, **77**, 1376–1382
- Durandy, A., Le Deist, F., Emile, J.-F., Debatin, K. & Fischer, A. (1997) Sensitivity of Epstein-Barr virus-induced B cell tumor to apoptosis mediated by anti-CD95/Apo-1/fas antibody. *Eur. J. Immunol.*, **27**, 538–543
- Durodola, J.I. (1976) Burkitt's lymphoma presenting during lactation. *Int. J. Gynaecol. Obstet.*, **14**, 225–231

- Dyck, J.A., Maul, G.G., Miller, W.H., Jr, Chen, J.D., Kakizuka, A. & Evans, R.M. (1994) A novel macromolecular structure is a target of the promyelocyte-retinoic acid receptor oncoprotein. *Cell*, **76**, 333–343
- Ebbers, J., Koldovsky, P. & Vosteen, K.-H. (1985) The expression of Ia-antigen on nasopharyngeal carcinomas xenografted into nude mice. *Arch. Otorhinolaryngol.*, **242**, 209–215
- Edington, G.M. (1956) Malignant disease in the Gold Coast. *Br. J. Cancer*, **10**, 41–54
- Edington, G.M. (1978) The pattern of cancer in the northern savannah of Nigeria with special reference to primary liver cell carcinoma and the Burkitt lymphoma. *Niger. med. J.*, **8**, 281–289
- Edington, G.M. & Gilles, H.M.J. (1968) *Pathology in the Tropics*, London, Arnold
- Edington, G.M. & MacLean, C.M.U. (1964) Incidence of the Burkitt tumour in Ibadan, western Nigeria. *Br. med. J.*, **i**, 264–266
- Effert, P., McCoy, R., Abdel-Hamid, M., Flynn, K., Zhang, Q., Busson, P., Tursz, T., Liu, E. & Raab-Traub, N. (1992) Alterations of the p53 gene in nasopharyngeal carcinoma. *J. Virol.*, **66**, 3768–3775
- Egeler, R.M., de Kraker, J., Slater, R. & Purtilo, D.T. (1992) Documentation of Burkitt lymphoma with t(8;14) (q24;q32) in X-linked lymphoproliferative disease. *Cancer*, **70**, 683–687
- Emilie, D., Devergne, O., Raphael, M., Coumbaras, L.J. & Galanaud, P. (1992a) Production of interleukin-6 in high grade B lymphomas. *Curr. Top. Microbiol. Immunol.*, **182**, 349–355
- Emilie, D., Tuitou, R., Raphael, M., Peuchmaur, M., Devergne, O., Rea, D., Coumbaras, J., Crevon, M.-C., Edelman, L., Joab, I. & Galanaud, P. (1992b) In vivo production of interleukin-10 by malignant cells in AIDS lymphomas. *Eur. J. Immunol.*, **22**, 2937–2942
- Emini, E.A., Luka, J., Armstrong, M.E., Banker, F.S., Provost, P.J. & Pearson, G.R. (1986) Establishment and characterization of a chronic infectious mononucleosis-like syndrome in common marmosets. *J. med. Virol.*, **18**, 369–379
- Emini, E.A., Luka, J., Armstrong, M.E., Keller, P.M., Ellis, R.W. & Pearson, G.R. (1987) Identification of an Epstein-Barr virus glycoprotein which is antigenically homologous to the varicella-zoster virus glycoprotein II and the herpes simplex virus glycoprotein B. *Virology*, **157**, 552–555
- Emini, E.A., Schleif, W.A., Armstrong, M.E., Silberklang, M., Schultz, L.D., Lehman, D., Maigetter, R.Z., Qualtière, L.F., Pearson, G.R. & Ellis, R.W. (1988) Antigenic analysis of the Epstein-Barr virus major membrane antigen (gp350/220) expressed in yeast and mammalian cells: Implications for the development of a subunit vaccine. *Virology*, **166**, 387–393
- Emini, E.A., Schleif, W.A., Silberklang, M., Lehman, D. & Ellis, R.W. (1989) Vero cell-expressed Epstein-Barr virus (EBV) gp350/220 protects marmosets from EBV challenge. *J. med. Virol.*, **27**, 120–123
- Epstein, M.A. (1985) Historical background; Burkitt's lymphoma and Epstein-Barr virus. In: Lenoir, G.M., O'Connor, G. & Olweny, C.L.M., eds, *Burkitt's Lymphoma: A Human Cancer Model* (IARC Scientific Publications No. 60), Lyon, IARC, pp. 17–27
- Epstein, M.A. & Achong, B.G. (1968) Specific immunofluorescence test for the herpes-type EB virus of Burkitt lymphoblasts, authenticated by electron microscopy. *J. natl Cancer Inst.*, **40**, 593–607
- Epstein, M.A., Achong, B.G. & Barr, Y.M. (1964) Virus particles in cultured lymphoblasts from Burkitt's lymphoma. *Lancet*, **i**, 702–703

- Epstein, M.A., Barr, Y.M. & Achong, B.G. (1965) The behaviour and morphology of a second tissue culture strain (EB2) of lymphoblasts from Burkitt's lymphoma. *Br. J. Cancer*, **19**, 108–114
- Epstein, M.A., Hunt, R.D. & Rabin, H. (1973) Pilot experiments with EB virus in owl monkeys (*Aotus trivirgatus*). I. Reticuloproliferative disease in an inoculated animal. *Int. J. Cancer*, **12**, 309–318
- Epstein, M.A., Morgan, A.J., Finerty, S., Randle, B.J. & Kirkwood, J.K. (1985) Protection of cottontop tamarins against Epstein-Barr virus-induced malignant lymphoma by a prototype subunit vaccine. *Nature*, **318**, 287–289
- Ernberg, I. & Altiok, E. (1989) The role of Epstein-Barr virus in lymphomas of HIV-carriers. *Acta pathol. microbiol. immunol. scand.*, **8**, 58–61
- Ernberg, I., Andersson-Anvret, M., Klein, G., Lundin, L. & Killanger, D. (1977) Relationship between amount of Epstein-Barr virus-determined nuclear antigen per cell and number of EBV-DNA copies per cell. *Nature*, **266**, 269–271
- Ernberg, I., Falk, K. & Hansson, M. (1987) Progenitor and pre-B lymphocytes transformed by Epstein-Barr virus. *Int. J. Cancer*, **39**, 190–197
- Ernberg, I., Falk, K., Minarovits, J., Busson, P., Tursz, T., Masucci, M.G. & Klein, G. (1989) The role of methylation in the phenotype-dependent modulation of Epstein-Barr nuclear antigen 2 and latent membrane protein genes in cells latently infected with Epstein-Barr virus. *J. gen. Virol.*, **70**, 2989–3002
- Eshleman, J.L. (1966) A study of the relative incidence of malignant tumours seen at Shirati Hospital in Tanzania. *E. Afr. med. J.*, **43**, 274–283
- Estrov, Z., Kurzrock, R., Pocsik, E., Pathak, S., Kantarjian, H.M., Zipf, T.F., Harris, D., Talpaz, M. & Aggarwal, B.B. (1993) Lymphotoxin is an autocrine growth factor for Epstein-Barr virus-infected B cell lines. *J. exp. Med.*, **177**, 763–774
- Evan, G.I., Wyllie, A.H., Gilbert, C.S., Littlewood, T.D., Land, H., Brooks, M., Waters, C.M., Penn, L.Z. & Hancock, D.C. (1992) Induction of apoptosis in fibroblasts by c-myc protein. *Cell*, **69**, 119–128
- Evans, A.S. (1972) Clinical syndromes associated with EB virus infection. *Adv. intern. Med.*, **18**, 77–93
- Evans, A.S. (1993) Epstein-Barr vaccine: Use in infectious mononucleosis. In: Tursz, T., Pagano, J.S., Ablashi, D.V., de Thé, G., Lenoir, G. & Pearson, G.R., eds, *The Epstein-Barr Virus and Associated Diseases* (Colloque INSERM No. 225), Paris, INSERM/John Libbey Eurotext Ltd, pp. 593–598
- Evans, A.S. & Gutensohn, N. (1984) A population-based case-control study of EBV and other viral antibodies among persons with Hodgkin's disease and their siblings. *Int. J. Cancer*, **34**, 149–157
- Evans, A.S. & Kaslow, R.A. (1997) *Viral Infections in Humans*, 4th Ed., New York, Plenum (in press)
- Evans, A.S. & Niederman, J.C. (1989) Epstein-Barr virus. In: Evans, A.S., ed., *Viral Infections of Humans*, 3rd Ed., New York, Plenum, pp. 265–292
- Evans, A.S., Niederman, J.C. & McCollum, R.W. (1968) Seroepidemiological studies of infectious mononucleosis with EB virus. *New Engl. J. Med.*, **279**, 1121–1127

- Evans, D.L., Barnett, J.W., Bowen, J.M. & Dmochowski, L. (1972) Antigenic relationship between the herpesviruses of infectious bovine rhinotracheitis, Marek's disease, and Burkitt's lymphoma. *J. Virol.*, **2**, 277–287
- Evans, A.S., Carvalho, R.P.S., Frost, P., Jamra, M. & Pozzi, D.H.B. (1978) Epstein-Barr virus infections in Brazil. II. Hodgkin's disease. *J. natl Cancer Inst.*, **61**, 19–26
- Evans, A.S., Kirchhoff, L.V., Pannuti, C.S., Carvalho, R.P.S. & McClelland, K.E. (1980) A case-control study of Hodgkin's disease in Brazil. II. Seroepidemiological studies in cases and family members. *Am. J. Epidemiol.*, **112**, 609–618
- Fåhraeus, R., Fu, H.L., Ernberg, I., Finke, J., Rowe, M., Klein, G., Falk, K., Nilsson, E., Yadav, M., Busson, P., Tursz, T. & Kallin, B. (1988) Expression of Epstein-Barr virus-encoded proteins in nasopharyngeal carcinoma. *Int. J. Cancer*, **42**, 329–338
- Fåhraeus, R., Rymo, L., Rhim, J.S. & Klein, G. (1990a) Morphological transformation of human keratinocytes expressing the LMP gene of Epstein-Barr virus. *Nature*, **345**, 447–449
- Fåhraeus, R., Jansson, A., Ricksten, A., Sjöblom, A. & Rymo, L. (1990b) Epstein-Barr virus-encoded nuclear antigen 2 activates the viral latent membrane protein promoter by modulating the activity of a negative regulatory element. *Proc. natl Acad. Sci. USA*, **87**, 7390–7394
- Fåhraeus, R., Chen, W., Trivedi, P., Klein, G. & Öbrink, B. (1992) Decreased expression of E-cadherin and increased invasive capacity in EBV-LMP-transfected human epithelial and murine adenocarcinoma cells. *Int. J. Cancer*, **52**, 834–838
- Fåhraeus, R., Jansson, A., Sjöblom, A., Nilsson, T., Klein, G. & Rymo, L. (1993) Cell phenotype-dependent control of Epstein-Barr virus latent membrane protein 1 gene regulatory sequences. *Virology*, **195**, 71–80
- Falk, L.A. (1979) A review of *Herpesvirus papio*, a B-lymphotropic virus of baboons related to EBV. *Comp. Immunol. Microbiol. infect. Dis.*, **2**, 257–264
- Falk, L.A., Wolfe, L.G., Sheramek, G. & Deinhardt, F. (1970) Herpesvirus saimiri neoplasia. *Proc. central soc. clin. Res.*, **43**, 80–81
- Falk, L., Deinhardt, F., Nonoyama, M., Wolfe, L.G., Bergholz, C., Lapin, B., Yakovleva, Agrba, V., Henle, G. & Henle, W. (1976) Properties of a baboon lymphotropic herpesvirus related to Epstein-Barr virus. *Int. J. Cancer*, **18**, 798–807
- Falk, L., Lindahl, T., Bjuvsell, G. & Klein, G. (1979) Herpesvirus papio: State and properties of intracellular viral DNA in baboon lymphoblastoid cell lines. *Int. J. Cancer*, **24**, 75–79
- Falk, K., Ernberg, I., Sakthivel, R., Davis, J., Christensson, B., Luka, J., Okano, M., Grierson, H.L., Klein, G. & Purtilo, D.T. (1990) Expression of Epstein-Barr virus-encoded proteins and B-cell markers in fatal infectious mononucleosis. *Int. J. Cancer*, **46**, 976–984
- Falk, M.H., Hültner, L., Milner, A., Gregory, C.D. & Bornkamm, G.W. (1993) Irradiated fibroblasts protect Burkitt lymphoma cells from apoptosis by a mechanism independent of *bcl-2*. *Int. J. Cancer*, **55**, 485–491
- Farrell, P.J., Allan, G.J., Shanahan, F., Vousden, K.H. & Crook, T. (1991) p53 is frequently mutated in Burkitt's lymphoma cell lines. *EMBO J.*, **10**, 2879–2887
- Farrell, P.J., Hollyoake, M., Niedobitek, G., Agathangelou, A., Morgan, A. & Wedderburn, N. (1997) Direct demonstration of persistent Epstein-Barr virus gene expression in peripheral blood of infected common marmosets and analysis of virus-infected tissues *in vivo*. *J. gen. Virol.*, **78**, 1417–1424

- Feichtinger, H., Li, S.-L., Kaaya, E., Putkonen, P., Grünewald, K., Weyrer, K., Böttiger, D., Ernberg, I., Linde, A., Biberfeld, G. & Biberfeld, P. (1992) A monkey model for Epstein Barr virus-associated lymphomagenesis in human acquired immunodeficiency syndrome. *J. exp. Med.*, **176**, 281–286
- Fellbaum, C., Hansmann, M.-L., Niedermeyer, H., Kraus, I., Alavaikko, M.J., Blanco, G., Aine, R., Busch, R., Pütz, B., Fischer, R. & Höfler, H. (1992) Influence of Epstein-Barr virus genomes on patient survival in Hodgkin's disease. *Am. J. clin. Pathol.*, **98**, 319–323
- Fennewald, S., van Santen, V. & Kieff, E. (1984) Nucleotide sequence of an mRNA transcribed in latent growth-transforming virus infection indicates that it may encode a membrane protein. *J. Virol.*, **51**, 411–419
- Ferrara, G. & Nappi, O. (1995) Lymphoepithelioma-like carcinoma of the lung. Two cases diagnosed in Caucasian patients. *Tumori*, **81**, 144–147
- Filipovich, A.H., Mathur, A., Kamat, D. & Shapiro, R.S. (1992) Primary immunodeficiencies: Genetic risk factors for lymphoma. *Cancer Res.*, **52**, 5465s–5467s
- Finerty, S., Scullion, F.T. & Morgan, A.J. (1988) Demonstration *in vitro* of cell-mediated immunity to Epstein-Barr virus in cotton-top tamarins. *Clin. exp. Immunol.*, **73**, 181–185
- Finerty, S., Mackett, M., Arrand, J.R., Watkins, P.E., Tarlton, J. & Morgan, A.J. (1994) Immunisation of cotton-top tamarins and rabbits with a candidate vaccine against the Epstein-Barr virus based on the major viral envelope glycoprotein gp340 and alum. *Vaccine*, **12**, 1180–1184
- Fingeroth, J.D., Weis, J.J., Tedder, T.F., Strominger, J.L., Biro, P.A. & Fearon, D.T. (1984) Epstein-Barr virus receptor of human B lymphocytes is the C3d receptor CR2. *Proc. natl Acad. Sci. USA*, **81**, 4510–4514
- Fingeroth, J.D., Clabby, M.L. & Strominger, J.D. (1988) Characterization of a T-lymphocyte Epstein-Barr virus/C3d receptor (CD21). *J. Virol.*, **62**, 1442–1447
- Finke, J., Rowe, M., Kallin, B., Ernberg, I., Rosén, A., Dillner, J. & Klein, G. (1987) Monoclonal and polyclonal antibodies against Epstein-Barr virus nuclear antigen 5 (EBNA-5) detect multiple protein species in Burkitt's lymphoma and lymphoblastoid cell lines. *J. Virol.*, **61**, 3870–3878
- Finlay, J., Luft, B., Yousem, S., Wood, G.S., Link, M., Arvin, A., Glader, B., Lennette, E., Shatsky, M., Olds, L., Borchering, W., Hong, R. & Purtilo, D. (1986) Chronic infectious mononucleosis syndrome, pancytopenia, and polyclonal B-lymphoproliferation terminating in acute lymphoblastic leukemia. *Am. J. pediatr. Hematol. Oncol.*, **8**, 18–27
- Fischer, A., Fischer, G.O. & Cooper, E. (1984) Familial nasopharyngeal carcinoma. *Pathology*, **16**, 23–24
- Fleisher, G., Lennette, E.T., Henle, G. & Henle, W. (1979) Incidence of heterophil antibody responses in children with infectious mononucleosis. *J. Pediatr.*, **94**, 723–728
- Floetmann, J.E., Ward, K., Rickinson, A.B. & Rowe, M. (1996) Cytostatic effect of Epstein-Barr virus latent membrane protein-1 analyzed using tetracycline-regulated expression in B cell lines. *Virology*, **223**, 29–40
- Fortini, M.E. & Artavanis-Tsakonas, S. (1994) The suppressor of hairless protein participates in Notch receptor signaling. *Cell*, **79**, 273–282
- Franken, M., Annis, B., Ali, A.N. & Wang, F. (1995) 5' Coding and regulatory region sequence divergence with conserved function of the Epstein-Barr virus LMP2A homolog in Herpesvirus papio. *J. Virol.*, **69**, 8011–8019

- Frappier, L. & O'Donnell, M. (1991) Overproduction, purification, and characterization of EBNA1, the origin binding protein of Epstein-Barr virus. *J. biol. Chem.*, **266**, 7819–7826
- Frappier, L. & O'Donnell, M. (1992) EBNA1 distorts *oriP*, the Epstein-Barr virus latent replication origin. *J. Virol.*, **66**, 1786–1790
- Fraumeni, J.F., Jr & Mason, T.J. (1974) Cancer mortality among Chinese Americans, 1950–69. *J. natl Cancer Inst.*, **52**, 659–665
- Frech, B., Zimmer-Strobl, U., Yip, T.T.C., Lau, W.H. & Mueller-Lantzsch, N. (1993) Characterization of the antibody response to the latent infection terminal proteins of Epstein-Barr virus in patients with nasopharyngeal carcinoma. *J. gen. Virol.*, **74**, 811–818
- Freese, U.K., Laux, G., Hudewentz, J., Schwarz, E. & Bornkamm, G.W. (1983) Two distant clusters of partially homologous small repeats of Epstein-Barr virus are transcribed upon induction of an abortive or lytic cycle of the virus. *J. Virol.*, **48**, 731–743
- Fresen, K.O., Cho, M.S., Gissman, L. & zur Hausen, H. (1980) NC37R1 EB virus: A possible recombinant between 'intracellular' NC37 viral DNA and superinfecting P3HR1 EBV. *Intervirology*, **12**, 303–310
- Fries, K.L., Miller, W.E. & Raab-Traub, N. (1996) Epstein-Barr Virus latent membrane protein 1 blocks p53-mediated apoptosis through the induction of the A20 gene. *J. Virol.*, **70**, 8653–8659
- Fries, K.L., Sculley, T.B., Webster-Cyriaque, J., Rajadurai, P., Sadler, R.H. & Raab-Traub, N. (1997) Identification of a novel protein encoded by the *Bam*HI A region of the Epstein-Barr virus. *J. Virol.*, **71**, 2765–2771
- Frisan, T., Sjöberg, J., Dolcetti, R., Boiocchi, M., De Re, V., Carbone, A., Brautbar, C., Battat, S., Biberfeld, P., Eckman, M., Öst, Å., Christensson, B., Sundström, C., Björkholm, M., Pisa, P. & Masucci, M.G. (1995) Local suppression of Epstein-Barr virus (EBV)-specific cytotoxicity in biopsies of EBV-positive Hodgkin's disease. *Blood*, **86**, 1493–1501
- Frisan, T., Zhang, Q.-J., Levitskaya, J., Coram, M., Kurilla, M.G. & Masucci, M.G. (1996) Defective presentation of MHC class I-restricted cytotoxic T-cell epitopes in Burkitt's lymphoma cells. *Int. J. Cancer*, **68**, 251–258
- Fujimoto, K., Terato, K., Miyamoto, J., Ishiko, H., Fujisaki, M., Cho, F. & Honjo, S. (1990) Establishment of a B-lymphoblastoid cell line infected with Epstein-Barr related virus from a cynomolgus monkey (*Macaca fascicularis*). *J. med. Primatol.*, **19**, 21–30
- Fukayama, M., Hayashi, Y., Iwasaki, Y., Chong, J., Ooba, T., Takizawa, T., Koike, M., Mizutani, S., Miyaki, M. & Hirai, K. (1994) Epstein-Barr virus-associated gastric carcinoma and Epstein-Barr virus infection of the stomach. *Lab. Invest.*, **71**, 73–81
- Funakoshi, S., Beckwith, M., Fanslow, W., Longo, D.L. & Murphy, W.J. (1995) Epstein-Barr virus-induced human B-cell lymphoma arising in HuPBL-SCID chimeric mice: Characterization and the role of CD40 stimulation in their treatment and prevention. *Pathobiology*, **63**, 133–142
- Furukawa, M., Sakashita, H., Kato, C. & Umeda, R. (1990) Epstein-Barr virus infection of epithelial cells derived from primary cultures of adenoidal tissue. *Eur. Arch. Otorhinolaryngol.*, **247**, 109–113
- Furukawa, T., Maruyama, S., Kawaichi, M. & Honjo, T. (1992) The Drosophila homolog of the immunoglobulin recombination signal-binding protein regulates peripheral nervous system development. *Cell*, **69**, 1191–1197

- Gahn, T.A. & Sugden, B. (1995) An EBNA-1-dependent enhancer acts from a distance of 10 kilobase pairs to increase expression of the Epstein-Barr virus LMP gene. *J. Virol.*, **69**, 2633–2636
- Gaidano, G. & Dalla-Favera, R. (1995) Molecular pathogenesis of AIDS-related lymphomas. *Adv. Cancer Res.*, **67**, 113–153
- Gaidano, G., Ballerini, P., Gong, J.Z., Inghirami, G., Neri, A., Newcomb, E.W., Magrath, I.T., Knowles, D.M. & Dalla-Favera, R. (1991) p53 Mutations in human lymphoid malignancies: Association with Burkitt's lymphoma and chronic lymphocytic leukemia. *Proc. natl Acad. Sci. USA*, **88**, 5413–5417
- Gaidano, G., Hauptschein, R.S., Parsa, N.Z., Offit, K., Rao, P.H., Lenoir, G., Knowles, D.M., Chaganti, R.S. & Dalla-Favera, R. (1992) Deletions involving two distinct regions of 6q in B-cell non-Hodgkin lymphoma. *Blood*, **80**, 1781–1787
- Gaidano, G., Lo Coco, F., Ye, B.H., Shibata, D., Levine, A.M., Knowles, D.M. & Dalla-Favera, R. (1994) Rearrangements of the BCL-6 gene in acquired immunodeficiency syndrome-associated non-Hodgkin's lymphoma: Association with diffuse large-cell subtype. *Blood*, **84**, 397–402
- Gajwani, B.W., Devereaux, J.M. & Beg, J.A. (1980) Familial clustering of nasopharyngeal carcinoma. *Cancer*, **46**, 2325–2327
- Gal, A.A., Unger, E.R., Koss, M.N. & Yen, T.S. (1991) Detection of Epstein-Barr virus in lymphoepithelioma-like carcinoma of the lung. *Mod.-Pathol.*, **4**, 264–268
- Gallagher, R.P. & Elwood, J.M. (1979) Cancer mortality among Chinese, Japanese, and Indians in British Columbia, 1964–73. *Natl Cancer Inst. Monogr.*, **53**, 89–94
- Gallo, O., Di Lollo, S., Graziani, P., Gallina, E. & Baroni, G. (1995) Detection of Epstein-Barr virus genome in sinonasal undifferentiated carcinoma by use of in situ hybridization. *Otolaryngol. Head Neck Surg.*, **112**, 659–664
- Gan, Y.-J., Chodosh, J., Morgan, A. & Sixbey, J.W. (1997) Epithelial cell polarization is a determinant in the infectious outcome of immunoglobulin A-mediated entry by Epstein-Barr virus. *J. Virol.*, **71**, 519–526
- Garcia, C.R., Brown, N.A., Schreck, R., Stiehm, E.R. & Hudnall, S.D. (1987) B-cell lymphoma in severe combined immunodeficiency not associated with the Epstein-Barr virus. *Cancer*, **60**, 2941–2947
- Gardner, M.J., Pannett, B., Winter, P.D. & Cruddas, A.M. (1993) A cohort study of workers exposed to formaldehyde in the British chemical industry: An update. *Br. J. ind. Med.*, **50**, 827–834
- Garnier, J.-L., Cannon, M.J., Chargui, J., Touraine, J.-L. & Cooper, N.R. (1993) EBV human B-cell lymphomas in Scid mice: Description of the model and study of the role of anti-CD40 and anti-CD23 monoclonal antibodies in their development. *Transplant. Proc.*, **25**, 1387–1383
- Garnier, J.-L., Lebranchu, Y., Dantal, J., Bedrossian, J., Cahen, R., Assouline, D., Jaccard, A., Fetissoff, F., Moreau, A., Martin, X., Delsol, G., Berger, F. & Touraine, J.-L. (1996) Hodgkin's disease after transplantation. *Transplantation*, **61**, 71–76
- Gavioli, R., de Campos-Lima, P.O., Kurilla, M.G., Kieff, E., Klein, G. & Masucci, M.G. (1992) Recognition of the Epstein-Barr virus-encoded nuclear antigens EBNA-4 and EBNA-6 by HLA-A11-restricted cytotoxic T lymphocytes: Implications for down-regulation of HLA-A11 in Burkitt lymphoma. *Proc. natl Acad. Sci. USA*, **89**, 5862–5866

- Gavioli, R., Kurilla, M.G., de Campos-Lima, P.O., Wallace, L.E., Dolcetti, R., Murray, R.J., Rickinson, A.B. & Masucci, M.G. (1993) Multiple HLA A11-restricted cytotoxic T-lymphocyte epitopes of different immunogenicities in the Epstein-Barr virus-encoded nuclear antigen 4. *J. Virol.*, **67**, 1572–1578
- Geddes, J.F., Bhattacharjee, M.B., Savage, K. Scaravilli, F. & McLaughlin, J.E. (1992) Primary cerebral lymphoma: A study of 47 cases probed for Epstein-Barr virus genome. *J. clin. Pathol.*, **45**, 587–590
- van Gelder, T., Jonkman, F.A.M., Niesters, H.G.M., Vuzevski, V.D., Spillenaar Bilgen, E.J. & Weimar, W. (1996) Absence of Epstein-Barr virus involvement in an adult heart transplant recipient with an epitheloid leiomyosarcoma (Letter to the Editor). *J. Heart Lung Transpl.*, **15**, 650–651
- Gerber, P. & Birch, S. (1967) Complement-fixing antibodies in sera of human and non-human primates to viral antigens derived from Burkitt's lymphoma cells. *Proc. natl Acad. Sci. USA*, **58**, 478–484
- Gerber, P., Nkrumah, F.K., Pritchett, R. & Kieff, E. (1976a) Comparative studies of Epstein-Barr virus strains from Ghana and the United States. *Int. J. Cancer*, **17**, 71–81
- Gerber, P., Pritchett, R.F. & Kieff, E.D. (1976b) Antigens and DNA of chimpanzee agent related to Epstein-Barr virus. *J. Virol.*, **19**, 1090–1099
- Gerber, P., Kalter, S.S., Schidlovsky, G., Peterson, W.D. & Daniel, M.D. (1977) Biologic and antigenic characteristics of Epstein-Barr virus related herpesviruses of chimpanzees and baboons. *Int. J. Cancer*, **20**, 448–459
- Gergely, L., Klein, G. & Ernberg, I. (1971) Host cell macromolecular synthesis in cells containing EBV-induced early antigens, studied by combined immunofluorescence and radioautography. *Virology*, **45**, 22–29
- Gerhartz, H.H., Mittermüller, J., Raghavachar, A., Schmetzer, H., Clemm, C., Kolb, H.-J., Bartram, C.C. & Wolf, H. (1988) Epstein-Barr virus-positive recipient type B-cells survive in a 'complete chimera' after allogeneic bone-marrow transplantation. *Int. J. Cancer*, **42**, 672–676
- Gerritsen, E.J.A., Stam, E.D., Hermans, J., van den Berg, H., Haraldsson, A., van Tol, M.J.D., van den Bergh, R.L., Waaijer, J.L.M., Kroes, A.C.M., Kluin, P.M. & Vossen, J.M. (1996) Risk factors for developing EBV-related B cell lymphoproliferative disorders (BLPD) after non-HLA-identical BMT in children. *Bone Marrow Transplant.*, **18**, 377–382
- Geser, A., Charnay, N., Day, N.E., de Thé, G. & Ho, H.C. (1978) Environmental factors in the etiology of nasopharyngeal carcinoma: Report on a case-control study in Hong Kong. In: de Thé, G. & Ito, Y., eds, *Nasopharyngeal Carcinoma: Etiology and Control* (IARC Scientific Publications No. 20), Lyon, IARC, pp. 213–229
- Geser, A., de Thé, G., Lenoir, G., Day, N.E. & Williams, E.H. (1982) Final case reporting from the Ugandan prospective study of the relationship between EBV and Burkitt's lymphoma. *Int. J. Cancer*, **29**, 397–400
- Geser, A., Brubaker, G. & Draper, C.C. (1989) Effect of a malaria suppression program on the incidence of African Burkitt's lymphoma. *Am. J. Epidemiol.*, **129**, 740–752
- Geysen, H.M., Rodda, S.J. & Mason, T.J. (1986) *A priori* delineation of a peptide which mimics a discontinuous antigenic determinant. *Mol. Immunol.*, **23**, 709–715
- Ghosh, D. & Kieff, E. (1990) *cis*-Acting regulatory elements near the Epstein-Barr virus latent-infection membrane protein transcriptional start site. *J. Virol.*, **64**, 1855–1858

- Gibbons, D.L., Rowe, M., Cope, A.P., Feldmann, M. & Brennan, F.M. (1994) Lymphotoxin acts as an autocrine growth factor for Epstein-Barr virus-transformed B cells and differentiated Burkitt lymphoma cell lines. *Eur. J. Immunol.*, **24**, 1879–1885
- Gilligan, K., Rajadurai, P., Resnick, L. & Raab-Traub, N. (1990a) Epstein-Barr virus small nuclear RNAs are not expressed in permissively infected cells in AIDS-associated leukoplakia. *Proc. natl Acad. Sci. USA*, **87**, 8790–8794
- Gilligan, K., Sato, H., Rajadurai, P., Busson, P., Young, L., Rickinson, A., Tursz, T. & Raab-Traub, N. (1990b) Novel transcription from the Epstein-Barr virus terminal *EcoRI* fragment, DJJhet, in a nasopharyngeal carcinoma. *J. Virol.*, **64**, 4948–4956
- Gilligan, K.J., Rajadurai, P., Lin, J.-C., Busson, P., Abdel-Hamid, M., Prasad, U., Tursz, T. & Raab-Traub, N. (1991) Expression of the Epstein-Barr virus *BamHI* A fragment in nasopharyngeal carcinoma: Evidence for a viral protein expressed *in vivo*. *J. Virol.*, **65**, 6252–6259
- Gilles, H.M.J. (1963) *Akeefe. An Environmental Study of a Nigerian Village Community*, Ibadan, Ibadan University Press
- Glaser, S.L. (1987) Regional variation in Hodgkin's disease incidence by histologic subtype in the US. *Cancer*, **60**, 2841–2847
- Glaser, S.L. (1990) Spatial clustering of Hodgkin's disease in the San Francisco Bay area. *Am. J. Epidemiol.*, **132**, S167–S177
- Glaser, S.L., Lin, R.J., Stewart, S.L., Ambinder, R.F., Jarrett, R.F., Brousset, P., Pallesen, G., Gulley, M.L., Khan, G., O'Grady, J., Hummel, M., Preciado, M.V., Knecht, H., Chan, J.K.C. & Claviez, A. (1997) Epstein-Barr virus-associated Hodgkin's disease: Epidemiologic characteristics in international data. *Int. J. Cancer*, **70**, 375–382
- Gledhill, S., Gallagher, A., Jones, D.B., Krajewski, A.S., Alexander, F.E., Klee, E., Wright, D.H., O'Brien, C., Onions, D.E. & Jarrett, R.F. (1991) Viral involvement in Hodgkin's disease: Detection of clonal type A Epstein-Barr virus genomes in tumour samples. *Br. J. Cancer*, **64**, 227–232
- Glickman, J.N., Howe, J.G. & Steitz, J.A. (1988) Structural analyses of EBER1 and EBER2 ribonucleoprotein particles present in Epstein-Barr virus-infected cells. *J. Virol.*, **62**, 902–911
- Goldberg, J.C. & Drut, R. (1986) Undifferentiated Burkitt type lymphoma in Argentina: 16 years later. *Med. Buenos Aires*, **46**, 646 (in Spanish)
- Goldfeld, A.E., Liu, P., Liu, S., Flemington, E.K., Strominger, J.L. & Speck, S.H. (1995) Cyclosporin A and FK506 block induction of the Epstein-Barr virus lytic cycle by anti-immunoglobulin. *Virology*, **209**, 225–229
- Goldman, J.M. & Aisenberg, A.C. (1970) Incidence of antibody to EB virus, herpes simplex, and cytomegalovirus in Hodgkin's disease. *Cancer*, **26**, 327–331
- Goldschmidts, W.L., Bhatia, K., Johnson, J.F., Akar, N., Gutiérrez, M.I., Shibata, D., Carolan, M., Levine, A. & Magrath, I.T. (1992) Epstein-Barr virus genotypes in AIDS-associated lymphomas are similar to those in endemic Burkitt's lymphomas. *Leukemia*, **6**, 875–878
- Goldsmith, K., Bendell, L. & Frappier, L. (1993) Identification of EBNA1 amino acid sequences required for the interaction of the functional elements of the Epstein-Barr virus latent origin of DNA replication. *J. Virol.*, **67**, 3418–3426
- Goma, L.K.H. (1965) The environmental background to cases of Burkitt's lymphoma syndrome in Uganda. *E. Afr. med. J.*, **42**, 62–66

- Gong, M. & Kieff, E. (1990) Intracellular trafficking of two major Epstein-Barr virus glycoproteins, gp350/220 and gp110. *J. Virol.*, **64**, 1507–1516
- Gong, M., Ooka, T., Matsuo, T. & Kieff, E. (1987) Epstein-Barr virus glycoprotein homologous to herpes simplex virus gB. *J. Virol.*, **61**, 499–508
- Goplen, A.K., Dunlop, O., Liestøl, K., Lingjaerde, O.C., Bruun, J.N. & Maehlen, J. (1997) The impact of primary central nervous system lymphoma in AIDS patients: A population-based autopsy study from Oslo. *J. Acquired Immune Defic. Synd. Hum. Retrovirol.*, **14**, 351–354
- Gosselin, J., Flamand, L., D'Addario, M., Hiscott, J., Stefanescu, I., Ablashi D.V., Gallo R.C. & Menezes, J. (1992) Modulatory effects of Epstein-Barr, herpes simplex, and human herpes-6 viral infections and coinfections on cytokine synthesis. A comparative study. *J. Immunol.*, **149**, 181–187
- Gotlieb-Stematsky, T., Vonsover, A., Ramot, B., Zaizov, R., Nordan, U., Aghai, E., Kende, G. & Modan, M. (1975) Antibodies to Epstein-Barr virus in patients with Hodgkin's disease and leukemia. *Cancer*, **36**, 1640–1645
- Gotlieb-Stematsky, T., Ramot, B., Vonsover, A., Aghai, E., Kende, G., Ninio, M. & Modan, M. (1976) Antibodies to Epstein-Barr viral capsid and early antigens associated with Burkitt's lymphoma and lymphoblastic lymphosarcoma in Israel. *J. natl Cancer Inst.*, **56**, 721–723
- Graham, F.L., Smiley, J., Russell, W.C. & Nairn, R. (1977) Characteristics of a human cell line transformed by DNA from human adenovirus type 5. *J. gen. Virol.*, **36**, 59–72
- Grässer, F.A., Murray, P.G., Kremmer, E., Klein, K., Remberger, K., Feiden, W., Reynolds, G., Niedobitek, G., Young, L.S. & Mueller Lantzsch, N. (1994) Monoclonal antibodies directed against the Epstein-Barr virus-encoded nuclear antigen 1 (EBNA1): Immunohistologic detection of EBNA1 in the malignant cells of Hodgkin's disease. *Blood*, **84**, 3792–3798
- Gratama, J.W. & Ernberg, I. (1995) Molecular epidemiology of Epstein-Barr virus infection. *Adv. Cancer Res.*, **67**, 197–255
- Gratama, J.W., Oosterveer, M.A.P., Zwaan, F.E., Lepoutre, J., Klein, G. & Ernberg, I. (1988) Eradication of Epstein-Barr virus by allogeneic bone marrow transplantation: Implications for sites of viral latency. *Proc. natl Acad. Sci. USA*, **85**, 8693–8696
- Gratama, J.W., Oosterveer, M.A.P., Klein, G. & Ernberg, I. (1990) EBNA size polymorphism can be used to trace Epstein-Barr virus spread within families. *J. Virol.*, **64**, 4703–4708
- Gratama, J.W., Lennette, E.T., Lönnqvist, B., Oosterveer, M.A.P., Klein, G., Ringdén, O. & Ernberg, I. (1992) Detection of multiple Epstein-Barr viral strains in allogeneic bone marrow transplant recipients. *J. med. Virol.*, **37**, 39–47
- Gravell, M., Levine, P.H., McIntyre, R.F., Land, V.J. & Pagano, J.S. (1976) Epstein-Barr virus in an American patient with Burkitt's lymphoma: Detection of viral genome in tumor tissue and establishment of a tumor-derived cell line (NAB). *J. natl Cancer Inst.*, **56**, 701–704
- Greenspan, J.S., Greenspan, D., Lennette, E.T., Abrams, D.I., Conant, M.A., Petersen, V. & Freese, U.K. (1985) Replication of Epstein-Barr virus within the epithelial cells of oral 'hairy' leukoplakia, an AIDS-associated lesion. *New Engl. J. Med.*, **313**, 1564–1571
- Gregory, C.D., Kirchgens, C., Edwards, C.F., Young, L.S., Rowe, M., Forster, A., Rabbitts, T.H. & Rickinson, A.B. (1987a) Epstein-Barr virus-transformed human precursor B cell lines: Altered growth phenotype of lines with germ-line or rearranged but nonexpressed heavy chain genes. *Eur. J. Immunol.*, **17**, 1199–1207

- Gregory, C.D., Tursz, T., Edwards, C.F., Tetaud, C., Talbot, M., Caillou, B., Rickinson, A.B. & Lipinski, M. (1987b) Identification of a subset of normal B cells with a Burkitt's lymphoma (BL)-like phenotype. *J. Immunol.*, **139**, 313–318
- Gregory, C.D., Murray, R.J., Edwards, C.F. & Rickinson, A.B. (1988) Downregulation of cell adhesion molecules LFA-3 and ICAM-1 in Epstein-Barr virus-positive Burkitt's lymphoma underlies tumor cell escape from virus-specific T cell surveillance. *J. exp. Med.*, **167**, 1811–1824
- Gregory, C.D., Rowe, M. & Rickinson, A.B. (1990) Different Epstein-Barr virus–B cell interactions in phenotypically distinct clones of a Burkitt's lymphoma cell line. *J. gen. Virol.*, **71**, 1481–1495
- Gregory, C.D., Dive, C., Henderson, S., Smith, C.A., Williams, G.T., Gordon, J. & Rickinson, A.B. (1991) Activation of Epstein-Barr virus latent genes protects human B cells from death by apoptosis. *Nature*, **349**, 612–614
- Griffin, B.E. & Karran, L. (1984) immortalization of monkey epithelial cells by specific fragments of Epstein-Barr virus DNA. *Nature*, **309**, 78–82
- Grogan, E.A., Summers, W.P., Dowling, S., Shedd, D., Gradoville, L. & Miller, G. (1983) Two Epstein-Barr viral nuclear neoantigens distinguished by gene transfer, serology, and chromosome binding. *Proc. natl Acad. Sci. USA*, **80**, 7650–7653
- Grossman, S.R., Johannsen, E., Tong, X., Yalamanchili, R. & Kieff, E. (1994) The Epstein-Barr virus nuclear antigen 2 transactivator is directed to response elements by the Jk recombination signal binding protein. *Proc. natl Acad. Sci. USA*, **91**, 7568–7572
- Groux, H., Cottrez, F., Montpellier, C., Quatannens, B., Coll, J., Stehelin, D. & Auriault, C. (1997) Isolation and characterization of transformed human T-cell lines infected by Epstein-Barr virus. *Blood*, **89**, 4521–4530
- Gruffat, H. & Sergeant, A. (1994) Characterization of the DNA-binding site repertoire for the Epstein-Barr virus transcription factor R. *Nucleic Acids Res.*, **22**, 1172–1178
- van Grunsven, W.M.J., Spaan, J.M. & Middeldorp, J.M. (1994) Localization and diagnostic application of immunodominant domains of the BFRF3-encoded Epstein-Barr virus capsid protein. *J. infect. Dis.*, **170**, 13–19
- Gu, S.-Y. & Zeng, Y. (1978) Complement fixing antibody levels in sera from population groups in Kwangchow and in Peking. *Chin. J. ENT*, **1**, 23–25
- Gu, S.-Y., Tang, W.P., Zeng, Y., Zhao, M.L., Zhao, E.W.P., Deng, W.H. & Li, K. (1983) An epithelial cell line established from poorly differentiated nasopharyngeal carcinoma. *Chin. J. Cancer*, **2**, 70–72
- Gu, S.-Y., Huang, T.-M., Ruan, L., Miao, Y.-H., Lu, H., Chu, C.-M., Motz, M. & Wolf, H. (1995) First EBV vaccine trial in humans using recombinant vaccinia virus expressing the major membrane antigen. *Dev. Biol. Stand.*, **84**, 171–177
- Guarner, J., del Rio, C., Carr, D., Hendrix, L.E., Eley, J.W. & Unger, E.R. (1991) Non-Hodgkin's lymphomas in patients with human immunodeficiency virus infection. Presence of Epstein-Barr virus by in situ hybridization, clinical presentation, and follow-up. *Cancer*, **68**, 2460–2465
- Guettier, C., Hamilton-Dutoit, S., Guillemain, R., Farge, D., Amrein, C., Vulser, C., Hofman, P., Carpentier, A. & Diebold, J. (1992) Primary gastrointestinal malignant lymphomas associated with Epstein-Barr virus after heart transplantation. *Histopathology*, **20**, 21–28

- Guinee, D., Jr, Jaffe, E., Kingma, D., Fishback, N., Wallberg, K., Krishnan, J., Frizzera, G., Travis, W. & Koss, M. (1994) Pulmonary lymphomatoid granulomatosis. Evidence for a proliferation of Epstein-Barr virus infected B-lymphocytes with a prominent T-cell component and vasculitis. *Am J. surg. Pathol.*, **18**, 753-764
- Gulley, M.L., Eagan, P.A., Quintanilla-Martinez, L., Picado, A.L., Smir, B.N., Childs, C., Dunn, C.D., Craig, F.E., Williams, J.W., Jr & Banks, P.M. (1994) Epstein-Barr virus DNA is abundant and monoclonal in the Reed-Sternberg cells of Hodgkin's disease: Association with mixed cellularity subtype and Hispanic American ethnicity. *Blood*, **83**, 1595-1602
- Gulley, M.L., Amin, M.B., Nicholls, J.M., Banks, P.M., Ayala, A.G., Srigley, J.R., Eagan, P.A. & Ro, J.Y. (1995) Epstein-Barr virus is detected in undifferentiated nasopharyngeal carcinoma but not in lymphoepithelioma-like carcinoma of the urinary bladder. *Hum. Pathol.*, **26**, 1207-1214
- Gulley, M.L., Pulitzer, D.R., Eagan, P.A. & Schneider, B.G. (1996) Epstein-Barr virus infection is an early event in gastric carcinogenesis and is independent of *bcl-2* expression and p53 accumulation. *Hum. Pathol.*, **27**, 20-27
- Gunapala, D.E., Facer, C.A., Davidson, R. & Weir, W.R.C. (1990) In vitro analysis of Epstein-Barr virus: Host balance in patients with acute *Plasmodium falciparum* malaria. I. Defective T-cell control. *Parasitol. Res.*, **76**, 531-535
- Guvén, P., Klein, G., Klein, E., Norin, T. & Singh, S. (1980) Surface immunoglobulins on Burkitt's lymphoma biopsy cells from 91 patients. *Int. J. Cancer*, **25**, 711-719
- Gupta, R.K. & Siber, G.R. (1995) Adjuvants for human vaccines — Current status, problems and future prospects. *Vaccine*, **13**, 1263-1276
- Gussander, E. & Adams, A. (1984) Electron microscopic evidence for replication of circular Epstein-Barr virus genomes in latently infected Raji cells. *J. Virol.*, **52**, 549-556
- Gutensohn, N.M. (1982) Social class and age at diagnosis of Hodgkin's disease: New epidemiologic evidence for the 'two-disease' hypothesis. *Cancer Treat. Rep.*, **66**, 689-695
- Gutensohn, N. & Cole, P. (1977) Epidemiology of Hodgkin's disease in the young. *Int. J. Cancer*, **19**, 595-604
- Gutensohn, N. & Cole, P. (1981) Childhood social environment and Hodgkin's disease. *New Engl. J. Med.*, **304**, 135-140
- Gutensohn, N.M. & Shapiro, D.S. (1982) Social class risk factors among children with Hodgkin's disease. *Int. J. Cancer*, **30**, 433-435
- Gutiérrez, M.I., Bhatia, K., Barriga, F., Diez, B., Muriel, F.S., de Andreas, M.L., Epelman, S., Risueño, C. & Magrath, I.T. (1992) Molecular epidemiology of Burkitt's lymphoma from South America: Differences in breakpoint location and Epstein-Barr virus association from tumors in other world regions. *Blood*, **79**, 3261-3266
- Gutiérrez, M.I., Bhatia, K. & Magrath, I. (1993) Replicative viral DNA in Epstein-Barr virus associated Burkitt's lymphoma biopsies. *Leukemia Res.*, **17**, 285-289
- Gutiérrez, M.I., Raj, A., Spangler, G., Sharma, A., Hussain, A., Judde, J.-G., Tsao, S.W., Yuen, P.W., Joab, I., Magrath, I.T. & Bhatia, K. (1997) Sequence variations in EBNA-1 may dictate restriction of tissue distribution of Epstein-Barr virus in normal and tumour cells. *J. gen. Virol.*, **78**, 1663-1670
- Gutsch, D.E., Holley-Guthrie, E.A., Zhang, Q., Stein, B., Blonar, M.A., Baldwin, A.S. & Kenney, S.C. (1994) The bZIP transactivator of Epstein-Barr virus, BZLF1, functionally and physically interacts with the p65 subunit of NF-kappa B. *Mol. Cell Biol.*, **14**, 1939-1948

- Haas, H., Mohr, U. & Krüger, F.W. (1973) Comparative studies with different doses of N-nitrosomorpholine, N-nitrosopiperidine, N-nitrosomethylurea, and dimethylnitrosamine in Syrian golden hamsters. *J. natl Cancer Inst.*, **51**, 1295–1301
- Haddow, A.J. (1963) An improved map for the study of Burkitt's lymphoma syndrome in Africa. *E. Afr. med. J.*, **40**, 429–432
- Haddy, T.B., Adde, M.A. & Magrath, I.T. (1991) CNS involvement in small non-cleaved cell lymphoma: Is CNS disease per se a poor prognostic sign? *J. clin. Oncol.*, **9**, 1973–1982
- Halbert, S.P., Anken, M., Henle, W. & Golubjatnikov, R. (1982) Detection of infectious mononucleosis heterophil antibody by a rapid, standardized enzyme-linked immunosorbent assay procedure. *J. clin. Microbiol.*, **15**, 610–616
- Hall, P.J., Levin, A.G., Entwistle, C.C., Knight, S.C., Wasunna, A., Kung'u, A. & Brubaker, G. (1982) HLA antigens in East African black patients with Burkitt's lymphoma or nasopharyngeal carcinoma and in controls: A pilot study. *Hum. Immunol.*, **5**, 91–105
- Hallee, T.J., Evans, A.S., Niederman, J.C., Brooks, C.M. & Voegtly, J.H. (1974) Infectious mononucleosis at the United States military academy. A prospective study of a single class over four years. *Yale J. Biol. Med.*, **3**, 182–195
- Halprin, J., Scott, A.L., Jacobson, L., Levine, P.H., Ho, J.H.C., Niederman, J.C., Hayward, D. & Milman, G. (1986) Enzyme-linked immunosorbent assay of antibodies to Epstein-Barr virus nuclear and early antigens in patients with infectious mononucleosis and nasopharyngeal carcinoma. *Am. Coll. Phys.*, **104**, 331–337
- Haluska, F.G., Brufsky, A.M. & Canellos, G.P. (1994) The cellular biology of the Reed-Sternberg cell. *Blood*, **84**, 1005–1019
- Hamilton-Dutoit, S.J. & Pallesen, G. (1992) A survey of Epstein-Barr virus gene expression in sporadic non-Hodgkin's lymphomas. Detection of Epstein-Barr virus in a subset of peripheral T-cell lymphomas. *Am. J. Pathol.*, **140**, 1315–1325
- Hamilton-Dutoit, S.J. & Pallesen, G. (1994) Detection of Epstein-Barr virus small RNAs in routine paraffin sections using non-isotopic RNA/RNA in situ hybridization. *Histopathology*, **25**, 101–111
- Hamilton-Dutoit, S.J., Therkildsen, M.H., Nielsen, N.H., Jensen, H., Hansen, J.P.H. & Pallesen, G. (1991a) Undifferentiated carcinoma of the salivary gland in Greenlandic Eskimos: Demonstration of Epstein-Barr virus DNA by in situ nucleic acid hybridization. *Hum. Pathol.*, **22**, 811–815
- Hamilton-Dutoit, S.J., Pallesen, G., Franzmann, M.B., Karkov, J., Black, F., Skinhøj, P. & Pedersen, C. (1991b) AIDS-related lymphoma. Histopathology, immunophenotype, and association with Epstein-Barr virus as demonstrated by in situ nucleic acid hybridization. *Am. J. Pathol.*, **138**, 149–163
- Hamilton-Dutoit, S.J., Rea, D., Raphael, M., Sandvej, K., Delecluse, H.J., Gisselbrecht, C., Marelle, L., van Krieken, J.H.J.M. & Pallesen, G. (1993a) Epstein-Barr virus-latent gene expression and tumor cell phenotype in acquired immunodeficiency syndrome-related non-Hodgkin's lymphoma. Correlation of lymphoma phenotype with three distinct patterns of viral latency. *Am. J. Pathol.*, **143**, 1072–1085
- Hamilton-Dutoit, S.J., Raphael, M., Audouin, J., Diebold, J., Lisse, I., Pedersen, C., Oksenhendler, E., Marelle, L. & Pallesen, G. (1993b) In situ demonstration of Epstein-Barr virus small RNAs (EBER 1) in acquired immunodeficiency syndrome-related lymphomas: Correlation with tumor morphology and primary site. *Blood*, **82**, 619–624

- Hammarskjöld, M.-L. & Simurda, M.C. (1992) Epstein-Barr virus latent membrane protein transactivates the human immunodeficiency virus type 1 long terminal repeat through induction of NF- κ B activity. *J. Virol.*, **66**, 6496–6501
- Hammerschmidt, W. & Sugden, B. (1988) Identification and characterization of *oriLyt*, a lytic origin of DNA replication of Epstein-Barr virus. *Cell*, **55**, 427–433
- Hammerschmidt, W. & Sugden, B. (1989) Genetic analysis of immortalizing functions of Epstein-Barr virus in human B lymphocytes. *Nature*, **340**, 393–397
- Hammerschmidt, W., Sugden, B. & Baichwal, V.R. (1989) The transforming domain alone of the latent membrane protein of Epstein-Barr virus is toxic to cells when expressed at high levels. *J. Virol.*, **63**, 2469–2475
- Hampar, B., Tanaka, A., Nonoyama, M. & Derge, J.G. (1974) Replication of the resident repressed Epstein-Barr virus genome during the early S phase (S-1 period) of nonproducer Raji cells. *Proc. natl Acad. Sci. USA*, **71**, 631–633
- Hansson, M., Falk, K. & Ernberg, I. (1983) Epstein-Barr virus transformation of human pre-B cells. *J. exp. Med.*, **158**, 616–622
- Harabuchi, Y., Yamanaka, N., Kataura, A., Imai, S., Kinoshita, T., Mizuno, F. & Osato, T. (1990) Epstein-Barr virus in nasal T-cell lymphomas in patients with lethal midline granuloma. *Lancet*, **335**, 128–130
- Harabuchi, Y., Imai, S., Wakashima, J., Hirao, M., Kataura, A., Osato, T. & Kon, S. (1996) Nasal T-cell lymphoma causally associated with Epstein-Barr virus. Clinicopathologic, phenotypic, and genotypic studies. *Cancer*, **77**, 2137–2149
- Harada, S. & Kieff, E. (1997) Epstein-Barr virus nuclear protein LP stimulates EBNA-2 acidic domain-mediated transcriptional activation. *J. Virol.*, **71**, 6611–6618
- Harn, H.-J., Chang, J.-Y., Wang, M.-W., Ho, L.-I., Lee, H.-S., Chiang, J.-H. & Lee, W.-H. (1995) Epstein-Barr virus-associated gastric adenocarcinoma in Taiwan. *Hum. Pathol.*, **26**, 267–271
- Harrington, D.S., Weisenburger, D.D. & Purtilo, D.T. (1987) Malignant lymphoma in the X-linked lymphoproliferative syndrome. *Cancer*, **59**, 1419–1429
- Harris, A., Young, B.D. & Griffin, B.E. (1985) Random association of Epstein-Barr virus genomes with host cell metaphase chromosomes in Burkitt's lymphoma-derived cell lines. *J. Virol.*, **56**, 328–332
- Harris, N. L., Jaffe, E.S., Stein, H., Banks, P.M., Chan, J.K.C., Cleary, M. L., Delsol, G., De Wolf-Peters, C., Falini, B., Gatter, K.C., Grogan, T.M., Isaacson, P.G., Knowles, D.M., Mason, D.Y., Muller-Hermelink, H.-K., Pileri, S.A., Piris, M.A., Ralfkiaer, E., & Warnke, R.A. (1994) A revised European–American classification of lymphoid neoplasms: A proposal from the International Lymphoma Study Group. *Blood*, **84**, 1361–1392
- Hartge, P., Devesa, S.S. & Fraumeni, J.F., Jr (1994) Hodgkin's and non-Hodgkin's lymphomas. In: *Cancer Surveys*, Vol. 19/20, *Trends in Cancer Incidence and Mortality*, London, Imperial Cancer Research Fund, pp. 423–453
- zur Hausen, H. (1976) Biochemical approaches to detection of Epstein-Barr virus in human tumors. *Cancer Res.*, **36**, 678–680
- zur Hausen, H. & Schulte-Holthausen, H. (1970) Presence of EB virus nucleic acid homology in a 'virus-free' line of Burkitt tumour cells. *Nature*, **227**, 245–248

- zur Hausen, H., Schulte-Holthausen, H., Klein, G., Henle, W., Henle, G., Clifford, P. & Santesson, L. (1970) EBV DNA in biopsies of Burkitt tumours and anaplastic carcinomas of the nasopharynx. *Nature*, **228**, 1056–1058
- Hawkins, E.P., Krischer, J.P., Smith, B.E., Hawkins, H.K. & Finegold, M.J. (1990) Nasopharyngeal carcinoma in children — A retrospective review and demonstration of Epstein-Barr viral genomes in tumor cell cytoplasm: A report of the Pediatric Oncology Group. *Hum. Pathol.*, **21**, 805–810
- Hayes, R.B., Blair, A., Stewart, P.A., Herrick, R.F. & Mahar, H. (1990) Mortality of US embalmers and funeral directors. *Am. J. ind. Med.*, **18**, 641–652
- Hearing, J.C. & Levine, A.J. (1985) The Epstein-Barr virus nuclear antigen (BamHI K antigen) is a single-stranded DNA binding phosphoprotein. *Virology*, **145**, 105–116
- Hedrick, J.A., Watry, D., Speiser, C., O'Donnell, P., Lambris, J.D. & Tsoukas, C.D. (1992) Interaction between Epstein-Barr virus and a T cell line (HSB-2) via a receptor phenotypically distinct from complement receptor type 2. *Eur. J. Immunol.*, **22**, 1123–1131
- Heineman, T., Gong, M., Sample, J. & Kieff, E. (1988) Identification of the Epstein-Barr virus gp85 gene. *J. Virol.*, **62**, 1101–1107
- Henderson, B.E. & Louie, E. (1978) Discussion of risk factors for nasopharyngeal carcinoma. In: de Thé, G. & Ito, Y., eds, *Nasopharyngeal Carcinoma: Etiology and Control* (IARC Scientific Publications No. 20), Lyon, IARC, pp. 251–260
- Henderson, B.E., Dworsky, R., Menck, H., Alena, B., Henle, W., Henle, G., Teraski, P., Newell, G.R., Rawlings, W. & Kinnear, B.K. (1973) Case-control study of Hodgkin's disease. II. Herpesvirus group antibody titers and HL-A type. *J. natl Cancer Inst.*, **51**, 1443–1447
- Henderson, B.E., Louie, E., Jing, J.S., Buell, P. & Gardner, M.B. (1976) Risk factors associated with nasopharyngeal carcinoma. *New Engl. J. Med.*, **295**, 1101–1106
- Henderson, B.E., Dworsky, R., Pike, M.C., Baptista, J., Menck, H., Preston-Martin, S. & Mack, T. (1979) Risk factors for nodular sclerosis and other types of Hodgkin's disease. *Cancer Res.*, **39**, 4507–4511
- Henderson, A., Ripley, S., Heller, M. & Kieff, E. (1983) Chromosome site for Epstein-Barr virus DNA in a Burkitt tumor cell line and in lymphocytes growth-transformed *in vitro*. *Proc. natl Acad. Sci. USA*, **80**, 1987–1991
- Henderson, S., Rowe, M., Gregory, C., Croom-Carter, D., Wang, F., Longnecker, R., Kieff, E. & Rickinson, A. (1991) Induction of *bcl-2* expression by Epstein-Barr virus latent membrane protein 1 protects infected B cells from programmed cell death. *Cell*, **65**, 1107–1115
- Henderson, S., Huen, D., Rowe, M., Dawson, C., Johnson, G. & Rickinson, A. (1993) Epstein-Barr virus-coded BHRF1 protein, a viral homologue of Bcl-2, protects human B cells from programmed cell death. *Proc. natl Acad. Sci. USA*, **90**, 8479–8483
- Henkel, T., Ling, P.D., Hayward, S.D. & Peterson, M.G. (1994) Mediation of Epstein-Barr virus EBNA2 transactivation by recombination signal-binding protein J κ . *Science*, **265**, 92–95
- Henle, G. & Henle, W. (1966) Immunofluorescence in cells derived from Burkitt's lymphoma. *J. Bacteriol.*, **91**, 1248–1256
- Henle, G. & Henle, W. (1967) Immunofluorescence, interference, and complement fixation technics in the detection of herpes-type virus in Burkitt tumor cell lines. *Cancer Res.*, **27**, 2242–2246
- Henle, G. & Henle, W. (1970) Observations on childhood infections with the Epstein-Barr virus. *J. infect. Dis.*, **121**, 303–310

- Henle, W. & Henle, G. (1973a) Epstein-Barr virus and infectious mononucleosis. *New Engl. J. Med.*, **288**, 263–264
- Henle, W. & Henle, G. (1973b) Epstein-Barr virus-related serology in Hodgkin's disease. *Natl Cancer Inst. Monogr.*, **36**, 79–84
- Henle, W. & Henle, G. (1976a) The sero-epidemiology of Epstein-Barr virus. *Adv. Pathobiol.*, 5–17
- Henle, G. & Henle, W. (1976b) Epstein-Barr virus-specific IgA serum antibodies as an outstanding feature of nasopharyngeal carcinoma. *Int. J. Cancer*, **17**, 1–7
- Henle, W. & Henle, G. (1979) Seroepidemiology of the virus. In: Epstein, M.A. & Achong, B.G., eds, *The Epstein-Barr Virus*, Berlin, Springer-Verlag, pp. 61–78
- Henle, W. & Henle, G. (1985) Epstein-Barr virus and human malignancies. *Adv. viral Oncol.*, **5**, 201–238
- Henle, W., Diehl, V., Kohn, G., zur Hausen, H. & Henle, G. (1967) Herpes-type virus and chromosome marker in normal leukocytes after growth with irradiated Burkitt cells. *Science*, **157**, 1064–1065
- Henle, G., Henle, W., Clifford, P., Diehl, V., Kafuko, G.W., Kirya, B.G., Klein, G., Morrow, R.H., Munube, G.M.R., Pike, P., Tukei, P.M. & Ziegler, J.L. (1969) Antibodies to Epstein-Barr virus in Burkitt's lymphoma and control groups. *J. natl Cancer Inst.*, **43**, 1147–1157
- Henle, W., Henle, G., Ho, H.-C., Burtin, P., Cachin, Y., Clifford, P., de Schryver, A., de Thé, G., Diehl, V. & Klein, G. (1970) Antibodies to Epstein-Barr virus in nasopharyngeal carcinoma, other head and neck neoplasms and control groups. *J. natl Cancer Inst.*, **44**, 225–231
- Henle, G., Henle, W. & Klein, G. (1971a) Demonstration of two distinct components in the early antigen complex of Epstein-Barr virus-infected cells. *Int. J. Cancer*, **8**, 272–282
- Henle, G., Henle, W., Klein, G., Gunven, P., Clifford, P., Morrow, R.H. & Ziegler, J.L. (1971b) Antibodies to early Epstein-Barr virus-induced antigens in Burkitt's lymphoma. *J. natl. Cancer Inst.*, **46**, 861–871
- Henle, W., Henle, G., Andersson, J., Ernberg, I., Klein, G., Horwitz, C.A., Marklund, G., Rymo, L., Wellinder, C. & Straus, S.E. (1987) Antibody responses to Epstein-Barr virus-determined nuclear antigen (EBNA)-1 and EBNA-2 in acute and chronic Epstein-Barr virus infection. *Proc. natl Acad. Sci. USA*, **84**, 570–574
- Hennessy, K., Fennewald, S., Hummel, M., Cole, T. & Kieff, E. (1984) A membrane protein encoded by Epstein-Barr virus in latent growth-transforming infection. *Proc. natl Acad. Sci. USA*, **81**, 7207–7211
- Hennessy, K., Fennewald, S. & Kieff, E. (1985) A third viral nuclear protein in lymphoblasts immortalized by Epstein-Barr virus. *Proc. natl Acad. Sci. USA*, **82**, 5944–5948
- Hennessy, K., Wang, F., Bushman, E.W. & Kieff, E. (1986) Definitive identification of a member of the Epstein-Barr virus nuclear protein 3 family. *Proc. natl Acad. Sci. USA*, **83**, 5693–5697
- Herbst, H. & Niedobitek, G. (1993) Epstein-Barr virus and Hodgkin's disease. *Int. J. clin. lab. Res.*, **23**, 13–16
- Herbst, H., Tippelmann, G., Anagnostopoulos, I., Gerdes, J., Schwarting, R., Boehm, T., Pileri, S., Jones, D.B. & Stein, H. (1989) Immunoglobulin and T-cell receptor gene rearrangements in Hodgkin's disease and Ki-1-positive anaplastic large cell lymphoma: Dissociation between phenotype and genotype. *Leukemia Res.*, **13**, 103–116

- Herbst, H., Niedobitek, G., Kneba, M., Hummel, M., Finn, T., Anagnostopoulos, I., Bergholz, M., Krieger, G. & Stein, H. (1990) High incidence of Epstein-Barr virus genomes in Hodgkin's disease. *Am. J. Pathol.*, **137**, 13–18
- Herbst, H., Dallenbach, F., Hummel, M., Niedobitek, G., Pileri, S., Müller-Lantzsch, N. & Stein, H. (1991a) Epstein-Barr virus latent membrane protein expression in Hodgkin and Reed-Sternberg cells. *Proc. natl Acad. Sci. USA*, **88**, 4766–4770
- Herbst, H., Dallenbach, F., Hummel, M., Niedobitek, G., Finn, T., Young, L.S., Rowe, M., Müller-Lantzsch, N. & Stein, H. (1991b) Epstein-Barr virus DNA and latent gene products in Ki-1 (CD30)-positive anaplastic large cell lymphomas. *Blood*, **78**, 2666–2673
- Herbst, H., Steinbrecher, E., Niedobitek, G., Young, L.S., Brooks, L., Müller-Lantzsch, N. & Stein, H. (1992) Distribution and phenotype of Epstein-Barr virus-harboring cells in Hodgkin's disease. *Blood*, **80**, 484–491
- Herbst, H., Stein, H. & Niedobitek, G. (1993) Epstein-Barr virus and CD30⁺ malignant lymphomas. *Crit. Rev. Oncog. Hematol.*, **4**, 191–239
- Herbst, H., Raff, T. & Stein, H. (1996a) Phenotypic modulation of Hodgkin and Reed-Sternberg cells by Epstein-Barr virus. *J. Pathol.*, **179**, 54–59
- Herbst, H., Foss, H.-D., Samol, J., Araujo, I., Klotzbach, H., Krause, H., Agathangelou, A., Niedobitek, G. & Stein, H. (1996b) Frequent expression of interleukin-10 by Epstein-Barr virus-harboring tumor cells of Hodgkin's disease. *Blood*, **87**, 2918–2929
- Herndier, B.G., Sanchez, H.C., Chang, K.L., Chen, Y.-Y. & Weiss, L.M. (1993) High prevalence of Epstein-Barr virus in the Reed-Sternberg cells of HIV-associated Hodgkin's disease. *Am. J. Pathol.*, **142**, 1073–1079
- Heslop, H.E., Brenner, M.K. & Rooney, C.M. (1994) Donor T cells to treat EBV-associated lymphoma (Letter to the Editor). *New Engl. J. Med.*, **331**, 679–680
- Heslop, H.E., Ng, C.Y.C., Li, C., Smith, C.A., Loftin, S.K., Krance, R.A., Brenner, M.K. & Rooney, C.M. (1996) Long-term restoration of immunity against Epstein-Barr virus infection by adoptive transfer of gene-modified virus-specific T lymphocytes. *Nature Med.*, **2**, 551–555
- Hesse, J., Levine, P.H., Ebbesen, P., Connelly, R.R. & Mordhorst, C.H. (1977) A case control study on immunity to two Epstein-Barr virus-associated antigens, and to herpes simplex virus and adenovirus in a population-based group of patients with Hodgkin's disease in Denmark, 1971–73. *Int. J. Cancer*, **19**, 49–58
- Hessing, M., van Schijndel, H.B. & van Grunsven, W.M.J. (1992) Purification and quantification of recombinant Epstein-Barr viral glycoproteins gp350/220 from Chinese hamster ovary cells. *J. Chromatogr.*, **599**, 267–272
- Hidayatalla, A., Malik, M.O.A., El Hadi, A.E., Osman, A.A. & Hutt, M.S.R. (1983) Studies on nasopharyngeal carcinoma in the Sudan. I. Epidemiology and aetiology. *Eur. J. Cancer clin. Oncol.*, **19**, 705–710
- Hildesheim, A., West, S., De Veyra, E., De Guzman, M.F., Jurado, A., Jones, C., Imai, J. & Hinuma, Y. (1992) Herbal medicine use, Epstein-Barr virus, and risk of nasopharyngeal carcinoma. *Cancer Res.*, **52**, 3048–3051
- Hilgers, F. & Hilgers, J. (1976) An immunofluorescence technique with counterstain on fixed cells for the detection of antibodies to human herpesviruses; antibody patterns in patients with Hodgkin's disease and nasopharyngeal carcinoma. *Intervirology*, **7**, 309–327

- Hill, A.B., Lee, S.P., Haurum, J.S., Murray, N., Yao, Q.-Y., Rowe, M., Signoret, N., Rickinson, A.B. & McMichael, A.J. (1995) Class I major histocompatibility complex-restricted cytotoxic T lymphocytes specific for Epstein-Barr virus (EBV) nuclear antigen fail to lyse the EBV-transformed B lymphoblastoid cell lines against which they were raised. *J. exp. Med.*, **181**, 2221–2228
- Hilton, D.A., Brown, L.J.R., Pringle, J.H. & Nandha, H. (1993) Absence of Epstein-Barr virus in carcinoma of the cervix. *Cancer*, **72**, 1946–1948
- Hinuma, Y., Konn, M., Yamaguchi, J., Wudarski, D., Blakeslee, J. & Grace, J. (1967) Immunofluorescence and herpes type virus particles in the P3HR-1 Burkitt lymphoma gene. *J. Virol.*, **1**, 1045–1051
- Hinuma, Y., Ohta-Hatano, R., Suto, T. & Numazaki, Y. (1969) High incidence of Japanese infants with antibody to a herpes-type virus associated with cultured Burkitt lymphoma cells. *Jpn. J. Microbiol.*, **13**, 309–311
- Hirayama, T. & Ito, Y. (1981) A new view of the etiology of nasopharyngeal carcinoma. *Prev. Med.*, **10**, 614–622
- Hirose, Y., Masaki, Y., Shimizu, S., Ogawa, Y., Takeshita, S., Fukutoku, M., Sugai, S. & Takiguchi, T. (1996) Association of Epstein-Barr virus with human immunodeficiency virus-negative T-cell lymphomas in Japan, *in situ* hybridization, polymerase chain reaction and immunohistochemical studies. *Leukemia*, **10**, 1673–1676
- Hirshaut, Y., Cohen, M.H. & Stevens, D.A. (1973) Epstein-Barr-virus antibodies in American and African Burkitt's lymphoma. *Lancet*, **ii**, 114–116
- Hirshaut, Y., Reagen, R.L., Perry, S., De Vita, V., Jr & Barile, M.F. (1974) The search for a viral agent in Hodgkin's disease. *Cancer*, **34**, 1080–1089
- Hitt, M.M., Allday, M.J., Hara, T., Karran, L., Jones, M.D., Busson, P., Tursz, T., Ernberg, I. & Griffin, B.E. (1989) EBV gene expression in an NPC-related tumour. *EMBO J.*, **8**, 2639–2651
- Ho, P.-T. (1959) *Studies on the Population of China, 1368–1953*, Cambridge, MA, Harvard University Press, pp. 166–168
- Ho, H.C. (1967) Nasopharyngeal carcinoma in Hong Kong. In: Muir, C.S. & Shanmugaratnam, K., eds, *Cancer of the Nasopharynx* (UICC Monograph Series, Vol. 1), Copenhagen, Munksgaard, pp. 58–63
- Ho, J.H.C. (1971) Genetic and environmental factors in nasopharyngeal carcinoma. In: Nakahara, W., Nishioka, K., Hirayama, T. & Ito, Y., eds, *Recent Advances in Human Tumor Virology and Immunology*, Tokyo, University of Tokyo Press, pp. 275–295
- Ho, H.C. (1972) Current knowledge of the epidemiology of nasopharyngeal carcinoma — A review. In: Biggs, P.M., de Thé, G. & Payne, L.N., eds, *Oncogenesis and Herpesviruses* (IARC Scientific Publications No. 2), Lyon, IARC, pp. 357–366
- Ho, H.C. (1976) Epidemiology of nasopharyngeal carcinoma. *Gann Monogr. Cancer Res.*, **18**, 49–61
- Ho, J.H.C. (1978) An epidemiologic and clinical study of nasopharyngeal carcinoma. *Int. J. Radiat. Oncol. biol. Phys.*, **4**, 183–198
- Ho, H.C., Ng, M.H., Kwan, H.C. & Chau, J.C.W. (1976) Epstein-Barr-virus-specific IgA and IgG serum antibodies in nasopharyngeal carcinoma. *Br. J. Cancer*, **34**, 655–660

- Ho, M., Miller, G., Atchison, R.W., Breinig, M.K., Dummer, J.S., Andiman, W., Starzl, T.E., Eastman, R., Griffith, B.P., Hardesty, R.L., Bahnson, H.T., Hakala, T.R. & Rosenthal, J.T. (1985) Epstein-Barr virus infections and DNA hybridization studies in posttransplantation lymphoma and lymphoproliferative lesions: The role of primary infection. *J. infect. Dis.*, **152**, 876–886
- Ho, Y.-S., Subhendu, C. & Hsu, S.-M. (1987) Induction of differentiation of African Burkitt's lymphoma cells by phorbol ester: Possible relation with early B cells. *Cancer Invest.*, **5**, 101–107
- Ho, F.C.S., Srivastava, G., Loke, S.L., Fu, K.H., Leung, B.P.Y., Liang, R. & Choy, D. (1990) Presence of Epstein-Barr virus DNA in nasal lymphomas of B and 'T' cell type. *Hematol. Oncol.*, **8**, 271–281
- Hochberg, F.H., Miller, G., Schooley, R.T., Hirsch, M.S., Feorino, P. & Henle, W. (1983) Central-nervous-system lymphoma related to Epstein-Barr virus. *New Engl. J. Med.*, **309**, 745–748
- van Hoeven, K.H., Factor, S.M., Kress, Y. & Woodruff, J.M. (1993) Visceral myogenic tumors. A manifestation of HIV infection in children. *Am. J. surg. Pathol.*, **17**, 1176–1181
- Holley-Guthrie, E.A., Quinlivan, E.B., Mar, E.-C. & Kenney, S. (1990) The Epstein-Barr virus (EBV) BMRF1 promoter for early antigen (EA-D) is regulated by the EBV transactivators, BRLF1 and BZLF1, in a cell-specific manner. *J. Virol.*, **64**, 3753–3759
- Honess, R.W., Gompels, U.A., Barrell, B.G., Craxton, M., Cameron, K.R., Staden, R., Chang, Y.-N. & Hayward, G.S. (1989) Deviations from expected frequencies of CpG dinucleotides in herpesvirus DNAs may be diagnostic of differences in the states of their latent genomes. *J. gen. Virol.*, **70**, 837–855
- Hoover, R., Mason, T.J., McKay, F.W. & Fraumeni, J.F., Jr (1975) Geographic patterns of cancer mortality in the United States. In: Fraumeni, J.F., ed., Jr, *Persons at High Risk of Cancer. An Approach to Cancer Etiology and Control*, New York, Academic Press, pp. 343–360
- van der Horst, C.M., Lin, J.-C., Raab-Traub, N., Smith, M.C. & Pagano, J.S. (1987) Differential effects of acyclovir and 9-(1,3-dihydroxy-2-propoxymethyl)guanine on herpes simplex virus and Epstein-Barr virus in a dually infected human lymphoblastoid cell line. *J. Virol.*, **61**, 607–610
- van der Horst, C., Joncas, J., Ahronheim, G., Gustafson, N., Stein, G., Gurwith, M., Fleisher, G., Sullivan, J., Sixbey, J., Roland, S., Fryer, J., Champney, K., Schooley, R., Sumaya, C. & Pagano, J.S. (1991) Lack of effect of peroral acyclovir for the treatment of acute infectious mononucleosis. *J. infect. Dis.*, **164**, 788–792
- Hörtnagel, K., Mautner, J., Strobl, L.J., Wolf, D.A., Christoph, B., Geltinger, C. & Polack, A. (1995) The role of immunoglobulin κ elements in *c-myc* activation. *Oncogene*, **10**, 1393–1401
- Horwitz, C.A., Henle, W., Henle, G. & Schmitz, H. (1975) Clinical evaluation of patients with infectious mononucleosis and development of antibodies to the R component of the Epstein-Barr virus-induced early antigen complex. *Am. J. Med.*, **58**, 330–338
- Horwitz, C.A., Henle, W., Henle, G., Rudnick, H. & Latts, E. (1985) Long-term serological follow-up of patients for Epstein-Barr virus after recovery from infectious mononucleosis. *J. infect. Dis.*, **151**, 1150–1153

- Howe, J.G. & Shu, M.-D. (1988) Isolation and characterization of the genes of two small RNAs of Herpesvirus papio and their comparison with Epstein-Barr virus-encoded EBER RNAs. *J. Virol.*, **62**, 2790–2798
- Howe, J.G. & Shu, M.-D. (1989) Epstein-Barr virus small RNA (EBER) genes: Unique transcription units that combine RNA polymerase II and III promoter elements. *Cell*, **57**, 825–834
- Howe, J.G. & Steitz, J.A. (1986) Localization of Epstein-Barr virus-encoded small RNAs by in situ hybridization. *Proc. natl Acad. Sci. USA*, **83**, 9006–9010
- Hsieh, J.J.-D. & Hayward, S.D. (1995) Masking of the CBF1/RBPJ_κ transcriptional repression domain by Epstein-Barr virus EBNA2. *Science*, **268**, 560–563
- Hsieh, J.J.-D., Henkel, T., Salmon, P., Robey, E., Peterson, M.G. & Hayward, S.D. (1996) Truncated mammalian Notch1 activates CBF1/RBPJ_κ-repressed genes by a mechanism resembling that of Epstein-Barr virus EBNA2. *Mol. cell. Biol.*, **16**, 952–959
- Hsu, H.C., Chen, C.C., Huang, G.T. & Lee, P.H. (1996) Clonal Epstein-Barr virus associated cholangiocarcinoma with lymphoepithelioma-like component. *Hum. Pathol.*, **27**, 848–850
- Hu, E., Hufford, S., Lukes, R., Bernstein-Singer, M., Sobel, G., Gill, P., Pinter-Brown, L., Rarick, M., Rosen, P., Brynes, R., Nathwani, B., Feinstein, D. & Levine, A. (1988) Third-world Hodgkin's disease at Los Angeles County–University of Southern California Medical Center. *J. clin. Oncol.*, **6**, 1285–1292
- Hu, L.-F., Zabarovsky, E.R., Chen, F., Cao, S.-L., Ernberg, I., Klein, G. & Winberg, G. (1991a) Isolation and sequencing of the Epstein-Barr virus BNLF-1 gene (LMP1) from a Chinese nasopharyngeal carcinoma. *J. gen. Virol.*, **72**, 2399–2409
- Hu, L.-F., Minarovits, J., Cao, S.-L., Contreras-Salazar, B., Rymo, L., Falk, K., Klein, G. & Ernberg, I. (1991b) Variable expression of latent membrane protein in nasopharyngeal carcinoma can be related to methylation status of the Epstein-Barr virus BNLF-1 5'-flanking region. *J. Virol.*, **65**, 1558–1567
- Hu, L.-F., Chen, F., Zheng, X., Ernberg, I., Cao, S.-L., Christensson, B., Klein, G. & Winberg, G. (1993) Clonability and tumorigenicity of human epithelial cells expressing the EBV encoded membrane protein LMP1. *Oncogene*, **8**, 1575–1583
- Hu, L.-F., Chen, F., Zhen, Q.-F., Zhang, Y.-W., Luo, Y., Zheng, X., Winberg, G., Ernberg, I. & Klein, G. (1995) Differences in growth pattern and clinical course of EBV-LMP1 expressing and non-expressing nasopharyngeal carcinomas. *Eur. J. Cancer*, **31A**, 658–660
- Huang, D.P., Ho, J.H.C., Henle, W. & Henle, G. (1974) Demonstration of Epstein-Barr virus-associated nuclear antigen in nasopharyngeal carcinoma cells from fresh biopsies. *Int. J. Cancer*, **14**, 580–588
- Huang, D.P., Ho, J.H.C. & Ng, M.H. (1978a) Morphological transformation of nasopharyngeal epithelial cells *in vitro* by Epstein-Barr virus from B95-8 cells. In: de Thé, G. & Ito, Y., eds, *Nasopharyngeal Carcinoma: Etiology and Control* (IARC Scientific Publications No. 20), Lyon, IARC, pp. 359–368
- Huang, D.P., Ho, H.C., Henle, W., Henle, G., Saw, D. & Lui, M. (1978b) Presence of EBNA in nasopharyngeal carcinoma and control patient tissues related to EBV serology. *Int. J. Cancer*, **22**, 266–274
- Huang, D.P., Ho, J.H.C., Saw, D. & Teoh, T.B. (1978c) Carcinoma of the nasal and paranasal regions in rats fed Cantonese salted marine fish. In: de Thé, G. & Ito, Y., eds, *Nasopharyngeal Carcinoma: Etiology and Control* (IARC Scientific Publications No. 20), Lyon, IARC, pp. 315–328

- Huang, D.P., Ho, J.H.C., Webb, K.S., Wood, B.J. & Gough, T.A. (1981) Volatile nitrosamines in salt-preserved fish before and after cooking. *Food Cosmet. Toxicol.*, **19**, 167–171
- Huang, D.P., Ng, H.K., Ho, Y.H. & Chan, K.M. (1988) Epstein-Barr virus (EBV)-associated undifferentiated carcinoma of the parotid gland. *Histopathology*, **13**, 509–517
- Huang, D.P., Lo, K.-W., Choi, P.H.K., Ng, A.Y.T., Tsao, S.-Y., Yiu, G.K.C. & Lee, J.C.K. (1991) Loss of heterozygosity on the short arm of chromosome 3 in nasopharyngeal carcinoma. *Cancer Genet. Cytogenet.*, **54**, 91–99
- Huang, D.P., Lo, K.W., van Hasselt, C.A., Woo, J.K.S., Choi, P.H.K., Leung, S.-F., Cheung, S.-T., Cairns, P., Sidransky, D. & Lee, J.C.K. (1994) A region of homozygous deletion on chromosome 9p21–22 in primary nasopharyngeal carcinoma. *Cancer Res.*, **54**, 4003–4006
- Hubscher, S.G., Williams, A., Davison, S.M., Young, L.S. & Niedobitek, G. (1994) Epstein-Barr virus in inflammatory diseases of the liver and liver allografts: An *in situ* hybridization study. *Hepatology*, **20**, 899–907
- Hudewentz, J., Delius, H., Freese, U.K., Zimmer, U. & Bornkamm, G.W. (1982) Two distant regions of the Epstein-Barr virus genome with sequence homologies have the same orientation and involve small tandem repeats. *EMBO J.*, **1**, 21–26
- Hudson, G.S., Farrell, P.J. & Barrell, B.G. (1985) Two related but differentially expressed potential membrane proteins encoded by the *EcoRI* Dhet region of Epstein-Barr virus B95-8. *J. Virol.*, **53**, 528–535
- Huen, D.S., Fox, A., Kumar, P. & Searle, P.F. (1993) Dilated heart failure in transgenic mice expressing the Epstein-Barr virus nuclear antigen-leader protein. *J. gen. Virol.*, **74**, 1381–1391
- Huen, D.S., Henderson, S.A., Croom Carter, D. & Rowe, M. (1995) The Epstein-Barr virus latent membrane protein-1 (LMP1) mediates activation of NF- κ B and cell surface phenotype via two effector regions in its carboxy-terminal cytoplasmic domain. *Oncogene*, **10**, 549–560
- Huh, J., Park, C., Juhng, S., Kim, C.E., Poppema, S. & Kim, C. (1996) A pathologic study of Hodgkin's disease in Korea and its association with the Epstein-Barr virus infection. *Cancer*, **77**, 949–955
- Hummel, M. & Kieff, E. (1982a) Mapping of polypeptides encoded by the Epstein-Barr virus genome in productive infection. *Proc. natl Acad. Sci. USA*, **79**, 5698–5702
- Hummel, M. & Kieff, E. (1982b) Epstein-Barr virus RNA. VIII. Viral RNA in permissively infected B95-8 cells. *J. Virol.*, **43**, 262–272
- Hummel, M., Thorley-Lawson, D. & Kieff, E. (1984) An Epstein-Barr virus DNA fragment encodes messages for the two major envelope glycoproteins (gp350/300 and gp220/200). *J. Virol.*, **49**, 413–417
- Hummel, M., Ziemann, K., Lammert, H., Pileri, S., Sabattini, E. & Stein, H. (1995a) Hodgkin's disease with monoclonal and polyclonal populations of Reed-Sternberg cells. *New Engl. J. Med.*, **333**, 901–906
- Hummel, M., Anagnostopoulos, I., Korbjuhn, P. & Stein, H. (1995b) Epstein-Barr virus in B-cell non-Hodgkin's lymphomas: Unexpected infection patterns and different infection incidence in low- and high-grade types. *J. Pathol.*, **175**, 263–271
- Hunter, T. (1991) Cooperation between oncogenes. *Cell*, **64**, 249–270
- Hurley, E.A. & Thorley-Lawson, D.A. (1988) B Cell activation and the establishment of Epstein-Barr virus latency. *J. exp. Med.*, **168**, 2059–2075

- Hurley, E.A., Agger, S., McNeil, J.A., Lawrence, J.B., Calendar, A., Lenoir, G. & Thorley-Lawson, D.A. (1991a) When Epstein-Barr virus persistently infects B-cell lines, it frequently integrates. *J. Virol.*, **65**, 1245–1254
- Hurley, E.A., Klamman, L.D., Agger, S., Lawrence, J.B. & Thorley-Lawson, D.A. (1991b) The prototypical Epstein-Barr virus-transformed lymphoblastoid cell line IB4 is an unusual variant containing integrated but no episomal viral DNA. *J. Virol.*, **65**, 3958–3963
- Hutt-Fletcher, L.M. (1987) Synergistic activation of cells by Epstein-Barr virus and B-cell growth factor. *J. Virol.*, **61**, 774–781
- IARC (1986) *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, Vol. 38, *Tobacco Smoking*, Lyon, pp. 270–275
- IARC (1990) *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, Vol. 50, *Some Pharmaceutical Drugs*, Lyon, pp. 77–114
- IARC (1993) *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, Vol. 56, *Some Naturally Occurring Substances: Food Items and Constituents, Heterocyclic Aromatic Amines and Mycotoxins*, Lyon, pp. 41–82
- IARC (1995a) *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, Vol. 62, *Wood Dusts and Formaldehyde*, Lyon, pp. 35–215
- IARC (1995b) *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, Vol. 62, *Wood Dusts and Formaldehyde*, Lyon, pp. 217–362
- IARC (1996) *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, Vol. 67, *Human Immunodeficiency Viruses and Human T-cell Lymphotropic Viruses*, Lyon, pp. 31–259
- Ifekwunigwe, A.E., Pulvertaft, R.J. & Williams, A.O. (1966) The cerebrospinal fluid in retinoblastoma. *Br. J. Cancer*, **20**, 250–255
- Ilyas, M., Niedobitek, G., Agathangelou, A., Barry, R.E., Read, A.E., Tierney, R., Young, L.S. & Rooney, N. (1995) Non-Hodgkin's lymphoma, coeliac disease, and Epstein-Barr virus: A study of 13 cases of enteropathy-associated T-and B-cell lymphoma. *J. Pathol.*, **177**, 115–122
- Imai, S., Koizumi, S., Sugiura, M., Tokunaga, M., Uemura, Y., Yamamoto, N., Tanaka, S., Sato, E. & Osato, T. (1994a) Gastric carcinoma: Monoclonal epithelial malignant cells expressing Epstein-Barr virus latent infection protein. *Proc. natl Acad. Sci. USA*, **91**, 9131–9135
- Imai, S., Sugiura, M., Mizuno, F., Ohigashi, H., Koshimizu, K., Chiba, S. & Osato, T. (1994b) African Burkitt's lymphoma: A plant, *Euphorbia tirucalli*, reduces Epstein-Barr virus-specific cellular immunity. *Anticancer Res.*, **14**, 933–936
- Imai, S., Sugiura, M., Oikawa, O., Koizumi, S., Hirao, M., Kimura, H., Hayashibara, H., Terai, N., Tsutsumi, H., Oda, T., Chiba, S. & Osato, T. (1996) Epstein-Barr virus (EBV)-carrying and -expressing T-cell lines established from severe chronic active EBV infection. *Blood*, **87**, 1446–1457
- Imoto, S., Kameya, T., Sato, Y., Sato, B., Inoue, K. & Oya, M. (1995) Localization of virus in liver biopsy specimens of acute EBV hepatitis using non-isotopic in situ hybridization procedure: Presence of EBV in hepatocytes and lymphocytes. *Int. Hepatol. Commun.*, **3**, 53–56
- Imreh, M.P., Zhang, Q.-J., de Campos-Lima, P.O., Imreh, S., Krausa, P., Browning, M., Klein, G. & Masucci, M.G. (1995) Mechanisms of allele-selective down regulation of HLA class I in Burkitt's lymphoma. *Int. J. Cancer*, **62**, 90–96

- Inman, G.J. & Farrell, P.J. (1995) Epstein-Barr virus EBNA-LP and transcription regulation properties of pRB, p107 and p53 in transfection assays. *J. gen. Virol.*, **76**, 2141–2149
- Isaacson, P.G., Schmid, C., Pan, L., Wotherspoon, A.C. & Wright, D.H. (1992) Epstein-Barr virus latent membrane protein expression by Hodgkin and Reed-Sternberg-like cells in acute infectious mononucleosis. *J. Pathol.*, **167**, 267–271
- Ito, Y., Kawanishi, M., Harayama, T. & Takabayashi, S. (1981) Combined effect of the extracts from *Croton tiglium*, *Euphorbia lathyris* or *Euphorbia tirucalli* and *n*-butyrate on Epstein-Barr virus expression in human lymphoblastoid P3HR-1 and Raji cells. *Cancer Lett.*, **12**, 175–180
- Ito, Y., Ohigashi, H., Koshimizu, K. & Yi, Z. (1983) Epstein-Barr virus-activating principle in the ether extracts of soils collected from under plants which contain active diterpene esters. *Cancer Lett.*, **19**, 113–117
- Izumi, K.M., Kaye, K.M. & Kieff, E.D. (1997) The Epstein-Barr virus LMP1 amino acid sequence that engages tumor necrosis factor receptor associated factors is critical for primary B lymphocyte growth transformation. *Proc. natl Acad. Sci. USA*, **94**, 1447–1452
- Jarrett, R.F., Gallagher, A., Jones, D.B., Alexander, F.E., Krajewski, A.S., Kelsey, A., Adams, J., Angus, B., Gledhill, S., Wright, D.H., Cartwright, R.A. & Onions, D.E. (1991) Detection of Epstein-Barr virus genomes in Hodgkin's disease: Relation to age. *J. clin. Pathol.*, **44**, 844–848
- Jarrett, A.F., Armstrong A.A. & Alexander, E. (1996) Epidemiology of EBV and Hodgkin's lymphoma. *Ann. Oncol.*, **7** (Suppl. 4), S5–S10
- Jarriault, S., Brou, C., Logeat, F., Schroeter, E.H., Kopan, R. & Israel, A. (1995) Signalling downstream of activated mammalian Notch. *Nature*, **377**, 355–358
- Jeang, K.-T. & Hayward, S.D. (1983) Organization of the Epstein-Barr virus DNA molecule. III. Location of the P3HR-1 deletion junction and characterization of the *NotI* repeat units that form part of the template for an abundant 12-*O*-tetradecanoylphorbol-13-acetate-induced mRNA transcript. *J. Virol.*, **48**, 135–148
- Jeannel, D., Hubert, A., de Vathaire, F., Ellouz, R., Camoun, M., Ben Salem, M., Sancho-Garnier, H. & de Thé, G. (1990) Diet, living conditions and nasopharyngeal carcinoma in Tunisia — A case-control study. *Int. J. Cancer*, **46**, 421–425
- Jeannel, D., Ghnassia, M., Hubert, A., Sancho-Garnier, H., Eschwège, F., Crognier, E. & de Thé, G. (1993) Increased risk of nasopharyngeal carcinoma among males of French origin born in Maghreb (North Africa). *Int. J. Cancer*, **54**, 536–539
- Jerusalem, C. (1968) Relationship between malaria infection (*Plasmodium berghei*) and malignant lymphoma in mice. *Z. Tropenmed. Parasitol.*, **19**, 94–108
- Jiang, W.-Q., Szekely, L., Wendel-Hansen, V., Ringertz, N., Klein, G. & Rosén, A. (1991) Co-localization of the retinoblastoma protein and the Epstein-Barr virus-encoded nuclear antigen EBNA-5. *Exp. Cell Res.*, **197**, 314–318
- Jin, X.W. & Speck, S.H. (1992) Identification of critical *cis* elements involved in mediating Epstein-Barr virus nuclear antigen 2-dependent activity of an enhancer located upstream of the viral *BamHI* C promoter. *J. Virol.*, **66**, 2846–2852
- Jiwa, N.M., Kanavros, P., De Bruin, P.C., van der Valk, P., Horstman, A., Vos, W., Mullink, H., Walboomers, J.M.M. & Meijer, C.J.L.M. (1993a) Presence of Epstein-Barr virus harbouring small and intermediate-sized cells in Hodgkin's disease. Is there a relationship with Reed-Sternberg cells? *J. Pathol.*, **170**, 129–136

- Jiwa, N.M., Kanavaros, P., van der Valk, P., Walboomers, J.M.M., Horstman, A., Vos, W., Mullink, H. & Meijer, C.J.L.M. (1993b) Expression of *c-myc* and *bcl-2* oncogene products in Reed-Sternberg cells independent of presence of Epstein-Barr virus. *J. clin. Pathol.*, **46**, 211–217
- Joab, I., Rowe, D.T., Bodescot, M., Nicolas, J.-C., Farrell, P.J. & Perricaudet, M. (1987) Mapping of the gene coding for Epstein-Barr virus-determined nuclear antigen EBNA3 and its transient overexpression in a human cell line by using an adenovirus expression vector. *J. Virol.*, **61**, 3340–3344
- Jochner, N., Eick, D., Zimmer-Strobl, U., Pawlita, M., Bornkamm, G.W. & Kempkes, B. (1996) Epstein-Barr virus nuclear antigen 2 is a transcriptional suppressor of the immunoglobulin μ gene: Implications for the expression of the translocated *c-myc* gene in Burkitt's lymphoma cells. *EMBO J.*, **15**, 375–382
- Johannsen, E., Koh, E., Mosialos, G., Tong, X., Kieff, E. & Grossman, S.R. (1995) Epstein-Barr virus nuclear protein 2 transactivation of the latent membrane protein 1 promoter is mediated by J κ and PU.1. *J. Virol.*, **69**, 253–262
- Johansson, B., Klein, G., Henle, W. & Henle, G. (1970) Epstein-Bar virus (EBV)-associated antibody patterns in malignant lymphoma and leukemia. I. Hodgkin's disease. *Int. J. Cancer*, **6**, 450–462
- Johansson, B., Klein, G., Henle, W. & Henle, G. (1971) Epstein-Barr virus (EBV)-associated antibody patterns in malignant lymphoma and leukemia. II. Chronic lymphocytic leukemia and lymphocytic lymphoma. *Int. J. Cancer*, **8**, 475–486
- Johnson, D.R., Wolfe, L.G., Levan, G., Klein, G., Ernberg, I. & Åman, P. (1983) Epstein-Barr virus (EBV) induced lymphoproliferative disease in cotton-topped marmoset. *Int. J. Cancer*, **31**, 91–97
- Jonas, J.H., Rioux, E. & Robitaille, R. (1976) Multiple cases of lymphoepithelioma and Burkitt's lymphoma in a Canadian family. In: Clemmesen, J. & Yohn, D.S., eds, *Comparative Leukemia Research 1975*, Basel, Karger, pp. 224–226
- Joncas, J.H., Rioux, E., Wastiaux, J.P., Leyritz, M., Robillard, L. & Menezes, J. (1976) Nasopharyngeal carcinoma and Burkitt's lymphoma in a Canadian family. I. HLA typing, EBV antibodies and serum immunoglobulins. *Can. med. Assoc. J.*, **115**, 858–860
- Jones, J.F., Shurin, S., Abramowsky, C., Tubbs, R.R., Sciotto, C.G., Wahl, R., Sands, J., Gottman, D., Katz, B.Z. & Sklar, J. (1988) T-Cell lymphomas containing Epstein-Barr viral DNA in patients with chronic Epstein-Barr virus infections. *New Engl. J. Med.*, **318**, 733–741
- Jones, K., Rivera, C., Sgadari, C., Franklin, J., Max, E.E., Bhatia, K. & Tosato, G. (1995) Infection of human endothelial cells with Epstein-Barr virus. *J. exp. Med.*, **182**, 1213–1221
- Judson, S.C., Henle, W. & Henle, G. (1977) A cluster of Epstein-Barr-virus-associated American Burkitt's lymphoma. *New Engl. J. Med.*, **297**, 464–468
- Kaaden, O.R. & Dietzschold, B. (1974) Alterations of the immunological specificity of plasma membranes from cells infected with Marek's disease and turkey herpes viruses. *J. gen. Virol.*, **25**, 1–10
- Kachel, G., Bornkamm, G.-W., Hermanek, P., Kaduk, B. & Schrickler, K.T. (1980) Burkitt's lymphoma of African type in Europe. *Dtsch. med. Wochenschr.*, **105**, 413–417 (in German)

- Kadin, M.E., Muramoto, L. & Said, J. (1988) Expression of T-cell antigens on Reed-Sternberg cells in a subset of patients with nodular sclerosing and mixed cellularity Hodgkin's disease. *Am. J. Pathol.*, **130**, 345–353
- Kafuko, G.W. & Burkitt, D.P. (1970) Burkitt's lymphoma and malaria. *Int. J. Cancer*, **6**, 1–9
- Kafuko, G.W., Henderson, B.E., Kirya, B.G., Munube, G.M.R., Tukei, P.M., Day, N.E., Henle, G., Henle, W., Morrow, R.H., Pike, M.C., Smith, P.G. & Williams, E.H. (1972) Epstein-Barr virus antibody levels in children from the West Nile District of Uganda. *Lancet*, **i**, 706–709
- Kallin, B., Dillner, J., Ernberg, I., Ehlin-Henriksson, B., Rosén, A., Henle, W., Henle, G. & Klein, G. (1986) Four virally determined nuclear antigens are expressed in Epstein-Barr virus-transformed cells. *Proc. natl Acad. Sci. USA*, **83**, 1499–1503
- Kalter, S.S. (1994) Herpesviruses — Baboon and chimpanzees. In: Webster, R.G. & Granoff, A., eds, *Encyclopedia of Virology*, Vol. 2, London, Academic Press, pp. 609–614
- Kalter, S.P., Riggs, S.A., Cabanillas, F., Butler, J.J., Hagemester, F.B., Mansell, P.W., Newell, G.R., Velasquez, W.S., Salvador, P., Barlogie, B., Rios, A. & Hersh, E.M. (1985) Aggressive non-Hodgkin's lymphomas in immunocompromised homosexual males. *Blood*, **66**, 655–659
- Kamel, O.W., van de Rijn, M., Weiss, L.M., Del Zoppo, G.J., Hench, P.K., Robbins, B.A., Montgomery, P.G., Warnke, R.A. & Dorfman, R.F. (1993) Reversible lymphomas associated with Epstein-Barr virus occurring during methotrexate therapy for rheumatoid arthritis and dermatomyositis. *New Engl. J. Med.*, **328**, 1317–1321
- Kamel, O.W., van de Rijn, M., LeBrun, D.P., Weiss, L.M., Warnke, R.A. & Dorfman, R.F. (1994) Lymphoid neoplasms in patients with rheumatoid arthritis and dermatomyositis: Frequency of Epstein-Barr virus and other features associated with immunosuppression. *Hum. Pathol.*, **25**, 638–643
- Kanavaros, P., Jiwa, N.M., De Bruin, P.C., Van Der Valk, P., Noorduyt, L.A., Van Heerde, P., Gordijn, R., Horstman, A., Mullink, R., Willemze, R., Walboomers, J.M.M. & Meijer, C.J.L.M. (1992) High incidence of EBV genome in CD30-positive non-Hodgkin's lymphomas. *J. Pathol.*, **168**, 307–315
- Kanavaros, P., Sakalidou, A., Tzardi, M., Darivianaki, K., Delides, G., Kazlaris, E. & Kalmanti, M. (1994) Frequent detection of Epstein-Barr virus (EBV), EBER transcripts and latent membrane protein-1 (LMP-1) in tumor cells in Hodgkin's disease arising in childhood. *Pathol. Res. Pract.*, **190**, 1026–1030
- Kanavaros, P., Briere, J., Lescs, M.-C. & Gaulard, P. (1996) Epstein-Barr virus in non-Hodgkin's lymphomas of the upper respiratory tract: Association with sinonasal localization and expression of NK and/or T-cell antigens by tumour cells. *J. Pathol.*, **178**, 297–302
- Kanzler, H., Kuppers, R., Hansmann, M.L. & Rajewsky, K. (1996) Hodgkin and Reed-Sternberg cells in Hodgkin's disease represent the outgrowth of a dominant tumor clone derived from (crippled) germinal center B cells. *J. exp. Med.*, **184**, 1495–1505
- Kapadia, S.B., Roman, L.N., Kingma, D.W., Jaffe, E.S. & Frizzera, G. (1995) Hodgkin's disease of Waldeyer's ring. Clinical and histoimmunophenotypic findings and association with Epstein-Barr virus in 16 cases. *Am. J. surg. Pathol.*, **19**, 1431–1439
- Kaplan, H.S. (1980) Hodgkin's disease: Unfolding concepts concerning its nature, management and prognosis. *Cancer*, **45**, 2439–2474

- Karajannis, M.A., Hummel, M., Anagnostopoulos, I. & Stein, H. (1997) Strict lymphotropism of Epstein-Barr virus during acute infectious mononucleosis in nonimmunocompromised individuals. *Blood*, **89**, 2856–2862
- Karran, L., Gao, Y., Smith, P.R. & Griffin, B.E. (1992) Expression of a family of complementary-strand transcripts in Epstein-Barr virus-infected cells. *Proc. natl Acad. Sci. USA*, **89**, 8058–8062
- Karran, L., Jones, M., Morley, G., van Noorden, S., Smith, P., Lampert, I. & Griffin, B.E. (1995) Expression of a B-cell marker, CD24, on nasopharyngeal carcinoma cells. *Int. J. Cancer*, **60**, 562–566
- Kaschka-Dierich, C., Adams, A., Lindahl, T., Bornkamm, G.W., Bjursell, G., Klein, G., Giovanella, B.C. & Singh, S. (1976) Intracellular forms of Epstein-Barr virus DNA in human tumor cells *in vivo*. *Nature*, **260**, 302–306
- Kasl, S.V., Evans, A.S. & Niederman, J.C. (1979) Psychosocial risk factors in the development of infectious mononucleosis. *Psychosom. Med.*, **41**, 445–466
- Katano, H., Morishita, Y., Cui, L.X., Watanabe, T., Hirai, K. & Mori, S. (1996) Expression of latent membrane protein 1 in clinically isolated cases and animal models of AIDS-associated non-Hodgkin's lymphomas. *Pathol. int.*, **46**, 568–574
- Katzenstein, A.-L.A. & Peiper, S.C. (1990) Detection of Epstein-Barr virus genomes in lymphomatoid granulomatosis: Analysis of 29 cases by the polymerase chain reaction technique. *Mod. Pathol.*, **3**, 435–441
- Katzin, W.E., Fishleder, A.J., Linden, M.D. & Tubbs, R.R. (1988) Immunoglobulin and T-cell receptor genes in thymomas: Genotypic evidence supporting the nonneoplastic nature of the lymphocytic component. *Hum. Pathol.*, **19**, 323–328
- Kaufman Paterson, R.L., Kelleher, C., Amankonah, T.D., Streib, J.E., Xu, J.W., Jones, J.F. & Gelfand, E.W. (1995) Model of Epstein-Barr virus infection of human thymocytes: Expression of viral genome and impact on cellular receptor expression in the T-lymphoblastic cell line, HPB-ALL. *Blood*, **85**, 456–464
- Kawachi, I., Pearce, N. & Fraser, J. (1989) A New Zealand cancer registry-based study of cancer in wood workers. *Cancer*, **64**, 2609–2613
- Kawaguchi, H., Miyashita, T., Herbst, H., Niedobitek, G., Asada, M., Tsuchida, M., Hanada, R., Kinoshita, A., Sakurai, M., Kobayashi, N. & Mizutani, S. (1993) Epstein-Barr virus-infected T lymphocytes in Epstein-Barr virus-associated hemophagocytic syndrome. *J. clin. Invest.*, **92**, 1444–1450
- Kawamura, H., King, D.J., Jr & Anderson, D.P. (1969) A herpesvirus isolated from kidney cell culture of normal turkeys. *Avian Dis.*, **13**, 853–863
- Kaye, K.M., Izumi, K.M. & Kieff, E. (1993) Epstein-Barr virus latent membrane protein 1 is essential for B-lymphocyte growth transformation. *Proc. natl Acad. Sci. USA*, **90**, 9150–9154
- Kaye, K.M., Izumi, K.M., Mosialos, G. & Kieff, E. (1995) The Epstein-Barr virus LMP1 cytoplasmic carboxy terminus is essential for B-lymphocyte transformation; fibroblast cocultivation complements a critical function within the terminal 155 residues. *J. Virol.*, **69**, 675–683

- Kelleher, C.A., Kaufman Paterson, R., Dreyfus, D.H., Streib, J.E., Xu, J.W., Takase, K., Jones, J.F. & Gelfand, E.W. (1995) Epstein-Barr virus replicative gene transcription during *de novo* infection of human thymocytes: Simultaneous early expression of BZLF-1 and its repressor RAZ. *Virology*, **208**, 685–695
- Kempkes, B., Pich, D., Zeidler, R., Sugden, B. & Hammerschmidt, W. (1995a) Immortalization of human B lymphocytes by a plasmid containing 71 kilobase pairs of Epstein-Barr virus DNA. *J. Virol.*, **69**, 231–238
- Kempkes, B., Spitkovsky, D., Jansen-Dürr, P., Ellwart, J.W., Kremmer, E., Delecluse, H.-J., Rottenberger, C., Bornkamm, G.W. & Hammerschmidt, W. (1995b) B-Cell proliferation and induction of early G₁-regulating proteins by Epstein-Barr virus mutants conditional for EBNA2. *EMBO J.*, **14**, 88–96
- Kempkes, B., Zimmer-Strobl, U., Eissner, G., Pawlita, M., Falk, M., Hammerschmidt, W. & Bornkamm, G.W. (1996) Epstein-Barr virus nuclear antigen 2 (EBNA2)–oestrogen receptor fusion proteins complement the EBNA2-deficient Epstein-Barr virus strain P3HR1 in transformation of primary B cells but suppress growth of human B cell lymphoma lines. *J. gen. Virol.*, **77**, 227–237
- Kenagy, D.N., Schlesinger, Y., Weck, K., Ritter, J.H., Gaudreault-Keener, M.M. & Storch, G.A. (1995) Epstein-Barr virus DNA in peripheral blood leukocytes of patients with post-transplant lymphoproliferative disease. *Transplantation*, **60**, 547–554
- Kenzy, S.G. & Cho, B.R. (1969) Transmission of classical Marek's disease by affected and carrier birds. *Avian Dis.*, **13**, 211–214
- Kerr, B.M., Lear, A.L., Rowe, M., Croom-Carter, D., Young, L.S., Rookes, S.M., Gallimore, P.H. & Rickinson, A.B. (1992) Three transcriptionally distinct forms of Epstein-Barr virus latency in somatic cell hybrids: Cell phenotype dependence of virus promoter usage. *Virology*, **187**, 189–201
- Khan, G., Coates, P.J., Gupta, R.K., Kangro, H.O. & Slavin, G. (1992) Presence of Epstein-Barr virus in Hodgkin's disease is not exclusive to Reed–Sternberg cells. *Am. J. Pathol.*, **140**, 757–762
- Khan, G., Norton, A.J. & Slavin, G. (1993) Epstein-Barr virus in Hodgkin disease. Relation to age and subtype. *Cancer*, **71**, 3124–3129
- Khanim, F., Yao, Q.-Y., Niedobitek, G., Sihota, S., Rickinson, A.B. & Young, L.S. (1996) Analysis of Epstein-Barr virus gene polymorphisms in normal donors and in virus-associated tumors from different geographic locations. *Blood*, **88**, 3491–3501
- Khanna, R., Burrows, S.R., Kurilla, M.G., Jacob, C.A., Misko, I.S., Sculley, T.B., Kieff, E. & Moss, D.J. (1992) Localization of Epstein-Barr virus cytotoxic T cell epitopes using recombinant vaccinia: Implications for vaccine development. *J. exp. Med.*, **176**, 169–176
- Khanna, R., Burrows, S.R., Steigerwald-Mullen, P.M., Thomson, S.A., Kurilla, M.G. & Moss, D.J. (1995) Isolation of cytotoxic T lymphocytes from healthy seropositive individuals specific for peptide epitopes from Epstein-Barr virus nuclear antigen 1: Implications for viral persistence and tumor surveillance. *Virology*, **214**, 633–637
- Khanna, R., Burrows, S.R., Silins, S.L., Moss, D.J., Poulsen, L.M. & Burrows, J.M. (1996) Cytotoxic T-lymphocyte clones specific for an immunodominant epitope display discerning antagonistic response to naturally occurring Epstein-Barr virus variants. *J. Virol.*, **70**, 7306–7311

- Khyatti, M., Patel, P.C., Stefanescu, I. & Menezes, J. (1991) Epstein-Barr virus (EBV) glycoprotein gp350 expressed on transfected cells resistant to natural killer cell activity serves as a target antigen for EBV-specific antibody-dependent cellular cytotoxicity. *J. Virol.*, **65**, 996–1001
- Kieff, E. (1996) Epstein-Barr virus and its replication. In: Fields, B.N., Knipe, D.M., Howley, P., Chanock, R.M., Melnick, J.L., Monath, T.P., Roizman, B. & Straus, S.E., eds, *Fields Virology*, Philadelphia, Lippincott-Raven, pp. 2343–2396
- Kieff, E., Given, D., Powell, A.L., King, W., Dambaugh, T. & Raab-Traub, N. (1979) Epstein-Barr virus: Structure of the viral DNA and analysis of viral RNA in infected cells. *Biochim. biophys. Acta*, **560**, 355–373
- Kikuta, H., Taguchi, Y., Tomizawa, K., Kojima, K., Kawamura, N., Ishizaka, A., Sakiyama, Y., Matsumoto, S., Imai, S., Kinoshita, T., Koizumi, S., Osato, T., Kobayashi, I., Hamada, I. & Hirai, K. (1988) Epstein-Barr virus genome-positive T lymphocytes in a boy with chronic active EBV infection associated with Kawasaki-like disease. *Nature*, **333**, 455–457
- Kikuta, H., Sakiyama, Y., Matsumoto, S., Oh-Ishi, T., Nakano, T., Nagashima, T., Oka, T., Hironaka, T. & Hirai, K. (1993) Fatal Epstein-Barr virus-associated hemophagocytic syndrome. *Blood*, **82**, 3259–3264
- Kim, O.-J. & Yates, J.L. (1993) Mutants of Epstein-Barr virus with a selective marker disrupting the TP gene transform B cells and replicate normally in culture. *J. Virol.*, **67**, 7634–7640
- King, D.H. (1988) History, pharmacokinetics, and pharmacology of acyclovir. *J. Am. Acad. Dermatol.*, **18**, 176–179
- King, H. & Haenszel, W. (1973) Cancer mortality among foreign- and native-born Chinese in the United States. *J. chron. Dis.*, **26**, 623–646
- Kingma, D.W., Shad, A., Tsokos, M., Fest, T., Otsuki, T., Frekko, K., Werner, E., Werner, A., Magrath, I., Raffeld, M. & Jaffe, E.S. (1996) Epstein-Barr virus (EBV)-associated smooth-muscle tumor arising in a post-transplant patient treated successfully for two PT-EBV-associated large-cell lymphomas. Case report. *Am. J. surg. Pathol.*, **20**, 1511–1519
- Kintner, C. & Sugden, B. (1981) Conservation and progressive methylation of Epstein-Barr viral DNA sequences in transformed cells. *J. Virol.*, **38**, 305–316
- Kirchner, H., Tosato, G., Blaese, R.M., Broder, S. & Magrath, I.T. (1979) Polyclonal immunoglobulin secretion by human B lymphocytes exposed to Epstein-Barr virus *in vitro*. *J. Immunol.*, **122**, 1310–1313
- Kitay, M.K. & Rowe, D.T. (1996a) Cell cycle stage-specific phosphorylation of the Epstein-Barr virus immortalization protein EBNA-LP. *J. Virol.*, **70**, 7885–7893
- Kitay, M.K. & Rowe, D.T. (1996b) Protein-protein interactions between Epstein-Barr virus nuclear antigen-LP and cellular gene products binding of 70-kilodalton heat shock proteins. *Virology*, **220**, 91–99
- Kitinya, J.N. & Lauren, P.A. (1982) Burkitt's lymphoma on Mount Kilimanjaro and in the inland regions of northern Tanzania. *E. Afr. med. J.*, **59**, 256–260
- Klein, G. (1979) The relationship of the virus to nasopharyngeal carcinoma. In: Epstein, M.A. & Achong, B.G., eds, *The Epstein-Barr Virus*, New York, Springer-Verlag, pp. 339–350
- Klein, E., Klein, G., Nadkarni, J.S., Nadkarni, J.J., Wigzell, H.R. & Clifford, P. (1967) Surface IgM specificity on cells derived from a Burkitt's lymphoma. *Lancet*, **ii**, 1068–1070

- Klein, G., Pearson, G., Henle, G., Henle, W., Goldstein, G. & Clifford, P. (1969) Relation between Epstein-Barr viral and cell membrane immunofluorescence in Burkitt tumor cells. III. Comparison of blocking of direct membrane immunofluorescence and anti-EBV reactivities of different sera. *J. exp. Med.*, **129**, 697-705
- Klein, G., Geering, G., Old, L.J., Henle, G., Henle, W. & Clifford, P. (1970) Comparison of the anti-EBV titer and the EBV-associated membrane reactive and precipitating antibody levels in the sera of Burkitt lymphoma and nasopharyngeal carcinoma patients and controls. *Int. J. Cancer*, **5**, 185-194
- Klein, G., Giovanella, B.C., Lindahl, T., Fialkow, P.J., Singh, S. & Stehlin, J.S. (1974) Direct evidence for the presence of Epstein-Barr virus DNA and nuclear antigen in malignant epithelial cells from patients with poorly differentiated carcinoma of the nasopharynx. *Proc. natl Acad. Sci. USA*, **71**, 4737-4741
- Klein, E., Ernberg, I., Masucci, M.G., Szigeti, R., Wu, Y.T., Masucci, G. & Svedmyr, E. (1981) T-Cell response to B-cells and Epstein-Barr virus antigens in infectious mononucleosis. *Cancer Res.*, **41**, 4210-4215
- Klein, U., Klein, G., Ehlin-Henriksson, B., Rajewsky, K. & Kuppers, R. (1995) Burkitt's lymphoma is a malignancy of mature B cells expressing somatically mutated V region genes. *Mol. Med.*, **1**, 495-505
- Klein, S.C., Kube, D., Abts, H., Diehl, V. & Tesch, H. (1996) Promotion of IL8, IL10, TNF alpha and TNF beta production by EBV infection. *Leuk. Res.*, **20**, 633-636
- von Knebel Doeberitz, M., Bornkamm, G.W. & zur Hausen, H. (1983) Establishment of spontaneously outgrowing lymphoblastoid cell lines with cyclosporin A. *Med. Microbiol. Immunol.*, **172**, 87-99
- Knecht, H., Odermatt, B.F., Bachmann, E., Teixeira, S., Sahli, R., Hayoz, D., Heitz, P. & Bachmann, F. (1991) Frequent detection of Epstein-Barr virus DNA by the polymerase chain reaction in lymph node biopsies from patients with Hodgkin's disease without genomic evidence of B- or T-cell clonality. *Blood*, **78**, 760-767
- Knecht, H., Bachmann, E., Brousset, P., Sandvej, K., Nadal, D., Bachmann, F., Odermatt, B.F., Delsol, G. & Pallesen, G. (1993) Deletions within the LMP1 oncogene of Epstein-Barr virus are clustered in Hodgkin's disease and identical to those observed in nasopharyngeal carcinoma. *Blood*, **82**, 2937-2942
- Knecht, H., McQuain, C., Martin, J., Rothenberger, S., Drexler, H.G., Berger, C., Bachmann, E., Kittler, E.L., Odermatt, B.F. & Quesenberry, P.J. (1996) Expression of the LMP1 oncoprotein in the EBV negative Hodgkin's disease cell line L-428 is associated with Reed-Sternberg cell morphology. *Oncogene*, **13**, 947-953
- Knowles, D.M. (1993) Biologic aspects of AIDS-associated non-Hodgkin's lymphoma. *Curr. Opin. Oncol.*, **5**, 845-851
- Knowles, D.M. (1996) Etiology and pathogenesis of AIDS-related non-Hodgkin's lymphoma. *Hematol. Oncol. Clin. North Am.*, **10**, 1081-1109
- Knowles, D.M., Cesarman, E., Chadburn, A., Frizzera, G., Chen, J., Rose, E.A. & Michler, R.E. (1995) Correlative morphologic and molecular genetic analysis demonstrates three distinct categories of posttransplantation lymphoproliferative disorders. *Blood*, **85**, 552-565
- Knox, P.G., Li, Q.-X., Rickinson, A.B. & Young, L.S. (1996) In vitro production of stable Epstein-Barr virus-positive epithelial cell clones which resemble the virus:cell interaction observed in nasopharyngeal carcinoma. *Virology*, **215**, 40-50

- Knutson, J.C. (1990) The level of *c-fgr* RNA is increased by EBNA-2, an Epstein-Barr virus gene required for B-cell immortalization. *J. Virol.*, **64**, 2530–2536
- Ko, Y.H. & Lee, J.D. (1994) EBV *in situ*-hybridization study for non-Hodgkin's lymphomas. *J. Korean med. Sci.*, **9**, 224–229
- Kobashi, Y., Nakamura, S., Sasajima, Y., Koshikawa, T., Yatabe, Y., Kitoh, K., Mori, S., Ueda, R., Yamabe, H. & Suchi, T. (1996) Inconsistent association of Epstein-Barr virus with CD56 (NCAM)-positive angiocentric lymphoma occurring in sites other than the upper and lower respiratory tract. *Histopathology*, **28**, 111–120
- Konoshima, T., Kozuka, M., Koyama, J., Okatani, T., Tagahara, K. & Tokuda, H. (1989) Studies on inhibitors of skin tumor promotion. VI. Inhibitory effects of quinones on Epstein-Barr virus activation. *J. nat. Prod.*, **52**, 987–995
- Konoshima, T., Takasaki, M., Tatsumoto, T., Kozuka, M., Kasai, R., Tanaka, O., Nie, R.-L., Tokuda, H., Nishino, H. & Iwashima, A. (1994) Inhibitory effects of cucurbitane triterpenoids on Epstein-Barr virus activation and two-stage carcinogenesis of skin tumors. *Biol. pharm. Bull.*, **17**, 668–671
- Konoshima, T., Takasaki, M., Kozuka, M., Nagao, T., Okabe, H., Irino, N., Nakasumi, T., Tokuda, H. & Nishino, H. (1995) Inhibitory effects of cucurbitane triterpenoids on Epstein-Barr virus activation and two-stage carcinogenesis of skin tumor. II. *Biol. pharm. Bull.*, **18**, 284–287
- Konoshima, T., Takasaki, M., Tokuda, H., Masuda, K., Arai, Y., Shiojima, K. & Ageta, H. (1996) Anti-tumor-promoting activities of triterpenoids from ferns. I. *Biol. pharm. Bull.*, **19**, 962–965
- Korbjuhn, P., Anagnostopoulos, I., Hummel, M., Tiemann, M., Dallenbach, F., Parwaresch, M.R. & Stein, H. (1993) Frequent latent Epstein-Barr virus infection of neoplastic T cells and bystander B cells in human immunodeficiency virus-negative European peripheral pleomorphic T-cell lymphomas. *Blood*, **82**, 217–223
- Kotsianti, A., Costopoulos, J., Morgello, S. & Papadimitriou, C. (1996) Undifferentiated carcinoma of the parotid gland in a white patient: Detection of Epstein-Barr virus by *in situ* hybridization. *Hum. Pathol.*, **27**, 87–90
- Kouzarides, T., Packham, G., Cook, A. & Farrell, P.J. (1991) The BZLF1 protein of EBV has a coiled coil dimerisation domain without a heptad leucine repeat but with homology to the C/EBP leucine zipper. *Oncogene*, **6**, 195–204
- Krauer, K.G., Kienzle, N., Young, D.B. & Sculley, T.B. (1996) Epstein-Barr nuclear antigen-3 and -4 interact with RBP-2N, a major isoform of RBP-J κ in B lymphocytes. *Virology*, **226**, 346–353
- Kripalani-Joshi, S. & Law, H.Y. (1994) Identification of integrated Epstein-Barr virus in nasopharyngeal carcinoma using pulse field gel electrophoresis. *Int. J. Cancer*, **56**, 187–192
- Krogh-Jensen, M., d'Amore, F., Jensen, M.K., Christensen, B.E., Thorling, K., Pedersen, M., Johansen, P., Boesen, A.M. & Andersen, E. (1994) Incidence, clinicopathological features and outcome of primary central nervous system lymphomas. Population-based data from a Danish lymphoma registry. Danish Lymphoma Study Group, LYFO. *Ann. Oncol.*, **5**, 349–354
- Krueger, J., Ieromnimon, V. & Dahr, W. (1981) Frequencies of HLA antigens in patients with NPC. In: Grundmann, E., Krueger, G.R.F. & Ablashi, D.V., eds, *Cancer Campaign*, Vol. 5, *Nasopharyngeal Carcinoma*, Stuttgart, Gustav Fischer Verlag, pp. 201–203

- Kuhn-Hallek, I., Sage, D.R., Stein, L., Groelle, H. & Fingerroth, J.D. (1995) Expression of recombination activating genes (RAG-1 and RAG-2) in Epstein-Barr virus-bearing B cells. *Blood*, **85**, 1289–1299
- Kumar, S. & Kumar, D. (1994) Lymphoepithelioma-like carcinoma of the breast. *Mod. Pathol.*, **7**, 129–131
- Kumar, S., Kumar, D., Kingma, D.W. & Jaffe, E.S. (1993) Epstein-Barr virus-associated T-cell lymphoma in a renal transplant patient. *Am. J. surg. Pathol.*, **17**, 1046–1053
- Kumari, P., Augustus, M., Naik, U., Ravi, V., Shenoy, A.M., Rao, C.R. & Kumar, R.V. (1995) Cytogenetic and viral studies in nasopharyngeal carcinomas in patients of Indian origin. *Indian J. Cancer*, **32**, 10–14
- Küppers, R., Rajewsky, K., Zhao, M., Simons, G., Laumann, R., Fischer, R. & Hansmann, M.-L. (1994) Hodgkin disease: Hodgkin and Reed-Sternberg cells picked from histological sections show clonal immunoglobulin gene rearrangements and appear to be derived from B cells at various stages of development. *Proc. natl Acad. Sci. USA*, **91**, 10962–10966
- Kvåle, G., Høyby, E.A. & Pedersen, E. (1979) Hodgkin's disease in patients with previous infectious mononucleosis. *Int. J. Cancer*, **23**, 593–597
- Labrecque, L.G., Lampert, I., Kazembe, P., Philips, J. & Griffin, B.E. (1994) Correlation between cytopathological results and in situ hybridisation on needle aspiration biopsies of suspected African Burkitt's lymphomas. *Int. J. Cancer*, **59**, 591–596
- Labrecque, L.G., Barnes, D.M., Fentiman, I.S. & Griffin, B.E. (1995) Epstein-Barr virus in epithelial cell tumors: A breast cancer study. *Cancer Res.*, **55**, 39–45
- Laherty, C.D., Hu, H.M., Opipari, A.W., Wang, F. & Dixit, V.M. (1992) The Epstein-Barr virus LMP1 gene product induces A20 zinc finger protein expression by activating nuclear factor κ B. *J. biol. Chem.*, **267**, 24157–24160
- Lai, H.M. (1988) On Chinese Americans: State of the art or challenge to the future? *Amerasia J.*, **14**, xi–xiii
- Lam, K.M., Syed, N., Whittle, H. & Crawford, D.H. (1991) Circulating Epstein-Barr virus carrying B cells in acute malaria. *Lancet*, **337**, 876–878
- Lamartine, J., Nichols, K.E., Yin, L., Krainer, M., Heitzmann, F., Bernard, A., Gaudi, S., Lenoir, G.M., Sullivan, J.L., Ikeda, J.E., Porta, G., Schlessinger, D., Romeo, G., Haber, D.A., Sylla, B.S. & Harkin, D.P. (1996) Physical map and cosmid contig encompassing a new interstitial deletion of the X-linked lymphoproliferative syndrome region. *Eur. J. hum. Genet.*, **4**, 342–351
- Landers, R.J., O'Leary, J.J., Crowley, M., Healy, I., Annis, P., Burke, L., O'Brien, D., Hogan, J., Kealy, W.F., Lewis, F.A. & Doyle, C.T. (1993) Epstein-Barr virus in normal, pre-malignant, and malignant lesions of the uterine cervix. *J. clin. Pathol.*, **46**, 931–935
- Landon, J.C., Ellis, L.B., Zeve, V.H. & Fabrizo, D.P. (1968) Herpes-type virus in cultured leukocytes from chimpanzees. *J. natl Cancer Inst.*, **40**, 181–192
- Lange, B., Arbeter, A., Hewetson, J. & Henle, W. (1978) Longitudinal study of Epstein-Barr virus antibody titers and excretion in pediatric patients with Hodgkin's disease. *Int. J. Cancer*, **22**, 521–527
- Langenhuisen, M.M.A.C., Cazemier, T., Houwen, B., Brouwers, T.M., Halie, M.R., The, T.H. & Nieweg, H.O. (1974) Antibodies to Epstein-Barr virus, cytomegalovirus, and Australia antigen in Hodgkin's disease. *Cancer*, **34**, 262–267

- Lanier, A.P., Bender, T.R., Tschopp, C.F. & Dohan, P. (1979) Nasopharyngeal carcinoma in an Alaskan Eskimo family: Report of three cases. *J. natl Cancer Inst.*, **62**, 1121–1124
- Lanier, A.P., Henle, W., Bender, T.R., Henle, G. & Talbot, M.L. (1980a) Epstein-Barr-virus-specific antibody titers in seven Alaskan natives before and after diagnosis of nasopharyngeal carcinoma. *Int. J. Cancer*, **26**, 133–137
- Lanier, A.P., Bender, T.R., Talbot, M.L., Wilmeth, S., Tschopp, C.F., Henle, W., Henle, G., Ritter, D. & Terasaki, P. (1980b) Nasopharyngeal carcinoma in Alaskan Eskimos, Indians, and Aleuts: a review of cases and study of Epstein-Barr virus, HLA, and environmental risk factors. *Cancer*, **46**, 2100–2106
- Lanyi, A., Li, B.-F., Li, S.-B., Talmadge, C.B., Brichacek, B., Davis, J.R., Kozel, B.A., Trask, B., van den Engh, G., Uzvolgyi, E., Stanbridge, E.J., Nelson, D.L., Chinault, C., Heslop, H., Gross, T.G., Seemayer, T.A., Klein, G., Purtilo, D.T. & Sumegi, J. (1997) A yeast artificial chromosome (YAC) contig encompassing the critical region of the X-linked lymphoproliferative disease (XLP) locus. *Genomics*, **39**, 55–65
- Lapin, B.A., Timanovskaya, V.V. & Yakovleva, L.A. (1985) Herpesvirus papio: A new representative in the group of the EBV-like B-lymphotropic herpesviruses of primates. *Hematol. Blood Transfus.*, **29**, 312–320
- Larocca, D. & Clough, W. (1982) Hypomethylation of Epstein-Barr virus DNA in the non-producer B-cell line EBR. *J. Virol.*, **43**, 1129–1131
- Larson, R.S., Scott, M.A., McCurley, T.L. & Vnencak-Jones, C.L. (1996) Microsatellite analysis of posttransplant lymphoproliferative disorders: determination of donor/recipient origin and identification of putative lymphomagenic mechanism. *Cancer Res.*, **56**, 4378–4381
- Lau, W.H., Kwan, H.C. & Ho, J.H.C. (1983) Serum IgA antibodies to the viral capsid antigen (VC) of Epstein-Barr virus as diagnostic markers in nasopharyngeal carcinoma. In: Prasad, U., Ablashi, D., Levine, P. & Pearson, G., eds, *Nasopharyngeal Carcinoma: Current Concepts*, Kuala Lumpur, University of Malaya Press
- Lau, R., Middeldorp, J. & Farrell, P.J. (1993) Epstein-Barr virus gene expression in oral hairy leukoplakia. *Virology*, **195**, 463–474
- Laufs, R. & Steinke, H. (1975) Vaccination of non-human primates against malignant lymphoma. *Nature*, **253**, 71–72
- Laux, G., Perricaudet, M. & Farrell, P.J. (1988a) A spliced Epstein-Barr virus gene expressed in immortalized lymphocytes is created by circularization of the linear viral genome. *EMBO J.*, **7**, 769–774
- Laux, G., Freese, U.K., Fischer, R., Polack, A., Kofler, E. & Bornkamm, G.W. (1988b) TPA-inducible Epstein-Barr virus genes in Raji cells and their regulation. *Virology*, **162**, 503–507
- Laux, G., Dugrillon, F., Eckert, C., Adam, B., Zimmer-Strobl, U. & Bornkamm, G.W. (1994a) Identification and characterization of an Epstein-Barr virus nuclear antigen 2-responsive cis element in the bidirectional promoter region of latent membrane protein and terminal protein 2 genes. *J. Virol.*, **68**, 6947–6958
- Laux, G., Adam, B., Strobl, L.J., & Moreau Gachelin, F. (1994b) The Spi-1/PU.1 and Spi-B ets family transcription factors and the recombination signal binding protein RBP-J kappa interact with an Epstein-Barr virus nuclear antigen 2 responsive cis-element. *EMBO J.*, **13**, 5624–5632

- Lawrence, J.B., Villave, C.A. & Singer, R.H. (1988) Sensitive, high-resolution chromatin and chromosome mapping *in situ*: Presence and orientation of two closely integrated copies of EBV in a lymphoma line. *Cell*, **52**, 51–61
- Lear, A.L., Rowe, M., Kurilla, M.G., Lee, S., Henderson, S., Kieff, E. & Rickinson, A.B. (1992) The Epstein-Barr virus (EBV) nuclear antigen 1 *Bam*HI F promoter is activated on entry of EBV-transformed B cells into the lytic cycle. *J. Virol.*, **66**, 7461–7468
- Lee, M.-A. & Yates, J.L. (1992) BHRF1 of Epstein-Barr virus, which is homologous to human proto-oncogene *bcl2*, is not essential for transformation of B cells or for virus replication *in vitro*. *J. Virol.*, **66**, 1899–1906
- Lee, Y.S., Tanaka, A., Lau, R.Y., Nonoyama, M. & Rabin, H. (1980) Comparative studies of Herpesvirus papio (baboon herpesvirus) DNA, and Epstein-Barr virus DNA. *J. gen. Virol.*, **51**, 245–253
- Lee, Y.S., Nonoyama, M. & Rabin, H. (1981) Collinear relationships of Herpesvirus papio DNA to Epstein-Barr virus DNA. *Virology*, **110**, 248–252
- Lee, H.P., Duffy, S.W., Day, N.E. & Shanmugaratnam, K. (1988) Recent trends in cancer incidence among Singapore Chinese. *Int. J. Cancer*, **42**, 159–166
- Lee, S.-H., Su, I.-J., Chen, R.-L., Lin, K.-S., Lin, D.-T., Chuu, W.-M. & Lin, K.-S. (1991) A pathologic study of childhood lymphoma in Taiwan with special reference to peripheral T-cell lymphoma and the association with Epstein-Barr viral infection. *Cancer*, **68**, 1954–1962
- Lee, H.P., Chia, K.S. & Shanmugaratnam, K. (1992) *Cancer Incidence in Singapore 1983–1987* (Singapore Cancer Registry Report No. 3), Singapore, Singapore Cancer Registry, p. 83
- Lee, S.P., Thomas, W.A., Murray, R.J., Khanim, F., Kaur, S., Young, L.S., Rowe, M., Kurilla, M. & Rickinson, A.B. (1993a) HLA A2.1-restricted cytotoxic T cells recognizing a range of Epstein-Barr virus isolates through a defined epitope in latent membrane protein LMP2. *J. Virol.*, **67**, 7428–7435
- Lee, S.P., Wallace, L.E., Mackett, M., Arrand, J.R., Searle, P.F., Rowe, M. & Rickinson, A.B. (1993b) MHC class II-restricted presentation of endogenously synthesized antigen: Epstein-Barr virus transformed B cell lines can present the viral glycoprotein gp340 by two distinct pathways. *Int. Immunol.*, **5**, 451–460
- Lee, J.-H., Lee, S.-S., Park, J.-H., Kim, Y.-W. & Yang, M.-H. (1994a) Prevalence of EBV RNA in sinonasal and Waldeyer's ring lymphomas. *J. Korean med. Sci.*, **9**, 281–288
- Lee, H.P., Gourley, L., Duffy, S.W., Esteve, J., Lee, J. & Day, N.E. (1994b) Preserved foods and nasopharyngeal carcinoma: A case-control study among Singapore Chinese. *Int. J. Cancer*, **59**, 585–590
- Lee, S.P., Morgan, S., Skinner, J., Thomas, W.A., Jones, S.R., Sutton, J., Khanna, R., Whittle, H.C. & Rickinson, A.B. (1995a) Epstein-Barr virus isolates with the major HLA B35.01-restricted cytotoxic T lymphocyte epitope are prevalent in a highly B35.01-positive African population. *Eur. J. Immunol.*, **25**, 102–110
- Lee, E.S., Locker, J., Nalesnik, M., Reyes, J., Jaffe, R., Alashari, M., Nour, B., Tzakis, A. & Dickman, P.S. (1995b) The association of Epstein-Barr virus with smooth-muscle tumors occurring after organ transplantation. *New Engl. J. Med.*, **332**, 19–25
- Lee, S.S., Jang, J.J., Cho, K.J., Khang, S.K. & Kim, C.W. (1997) Epstein-Barr virus-associated primary gastrointestinal lymphoma in non-immunocompromised patients in Korea. *Histopathology*, **30**, 234–242

- Lees, J.F., Arrand, J.E., Pepper, S.deV., Stewart, J.P., Mackett, M. & Arrand, J.R. (1993) The Epstein-Barr virus candidate vaccine antigen gp340/220 is highly conserved between virus types A and B. *Virology*, **195**, 578–586
- Lehtinen, T., Lumio, J., Dillner, J., Hakama, M., Knekt, P., Lehtinen, M., Teppo, L. & Leinikki, P. (1993) Increased risk of malignant lymphoma indicated by elevated Epstein-Barr virus antibodies — A prospective study. *Cancer Causes Control*, **4**, 187–193
- Leibold, W., Huldt, G., Flanagan, T.G., Andersson, M., Dalens, M., Wright, D.H., Voller, A. & Klein, G. (1976) Tumorigenicity of Epstein-Barr virus (EBV) transformed lymphoid line cells in autologous squirrel monkeys. *Int. J. Cancer*, **17**, 533–541
- Lemon, S.M., Hutt, L.M., Shaw, J.E., Li, J.-L.H. & Pagano, J.S. (1977) Replication of EBV in epithelial cells during infectious mononucleosis. *Nature*, **268**, 268–270
- Lemon, S.M., Hutt, L.M., Shaw, J.E., Li, J.-L.H. & Pagano, J.S. (1978) Replication of Epstein-Barr virus DNA in epithelial cells *in vivo*. In: de Thé, G. & Ito, Y., eds, *Nasopharyngeal Carcinoma: Etiology and Control* (IARC Scientific Publications No. 20), Lyon, IARC, pp. 739–744
- Lennette, E.T., Ward, E., Henle, G. & Henle, W. (1982) Detection of antibodies to Epstein-Barr virus capsid antigen by immune adherence hemagglutination. *J. clin. Microbiol.*, **15**, 69–73
- Lennette, E.T., Rymo, L., Yadav, M., Masucci, G., Merk, K., Timar, L. & Klein, G. (1993) Disease-related differences in antibody patterns against EBV-encoded nuclear antigens EBNA 1, EBNA 2 and EBNA 6. *Eur. J. Cancer*, **29A**, 1584–1589
- Lennette, E.T., Winberg, G., Yadav, M., Enblad, G. & Klein, G. (1995) Antibodies to LMP2A/2B in EBV-carrying malignancies. *Eur. J. Cancer*, **31A**, 1875–1878
- Lenoir, G.M. & Bornkamm, G.W. (1987) Burkitt's lymphoma, a human cancer model for the study of the multistep development of cancer: Proposal for a new scenario. *Adv. viral Oncol.*, **7**, 173–206
- Lenoir, G. & de Thé, G. (1978) Epstein-Barr virus–epithelial cell interaction and its implication in the etiology of nasopharyngeal carcinoma. In: de Thé, G. & Ito, Y., eds, *Nasopharyngeal Carcinoma: Etiology and Control* (IARC Scientific Publications No. 20), Lyon, IARC, pp. 377–384
- Lenoir, G.M., Preud'homme, J.L., Bernheim, A. & Berger, R. (1982) Correlation between immunoglobulin light chain expression and variant translocation in Burkitt's lymphoma. *Nature*, **298**, 474–476
- Leoncini, L., Spina, D., Nyong'O, A., Abinya, O., Minacci, C., Disanto, A., De Luca, F., De Vivo, A., Sabattini, E., Poggi, S., Pileri, S. & Tosi, P. (1996) Neoplastic cells of Hodgkin's disease show differences in EBV expression between Kenya and Italy. *Int. J. Cancer*, **65**, 781–784
- Le Riverend, E., Rengifo, E., Longchong, M., Ruíz, R., Tormo, B., García, J., Portero, R., Quintero, S., Valdés, M., Rodríguez, T., Rusánchez, N. & Gurtsevich, V. (1984) Burkitt's lymphoma in Cuba. I. Clinical and morphological features and EBV association. *Oncology*, **41**, 13–18
- Lerner, M.R., Andrews, N.C., Miller, G. & Steitz, J.A. (1981) Two small RNAs encoded by Epstein-Barr virus and complexed with protein are precipitated by antibodies from patients with systemic lupus erythematosus. *Proc. natl Acad. Sci. USA*, **78**, 805–809

- Le Roux, A., Kerdiles, B., Walls, D., Dedieu, J.F. & Perricaudet, M. (1994) The Epstein-Barr virus determined nuclear antigens EBNA-3A, -3B, and -3C repress EBNA-2-mediated trans-activation of the viral terminal protein 1 gene promoter. *Virology*, **205**, 596–602
- Lespagnard, L., Cochaux, P., Larsimont, D., Degeyter, M., Velu, T. & Heimann, R. (1995) Absence of Epstein-Barr virus in medullary carcinoma of the breast as demonstrated by immunophenotyping, in situ hybridization and polymerase chain reaction. *Am. J. clin. Pathol.*, **103**, 449–452
- Leung, S.Y., Chung, L.P., Yuen, S.T., Ho, C.M., Wong, M.P. & Chan, S.Y. (1995a) Lympho-epithelial carcinoma of the salivary gland: in situ detection of Epstein-Barr virus. *J. clin. Pathol.*, **48**, 1022–1027
- Leung, S.Y., Yuen, S.T., Chung, L.P., Kwong, W.K., Wong, M.P. & Chan, S.Y. (1995b) Epstein-Barr virus is present in a wide histological spectrum of sinonasal carcinomas. *Am. J. surg. Pathol.*, **19**, 994–1001
- Leung, S.Y., Chung, L.P., Ho, C.M., Yuen, S.T., Wong, M.P. & Kwong, W.K. (1996) An Epstein-Barr virus positive undifferentiated carcinoma in the lacrimal sac. *Histopathology*, **28**, 71–75
- Levine, P.H. & Connelly, R.R. (1985) Epidemiology of nasopharyngeal cancer. In: Wittes, R.E., ed., *Head and Neck Cancer*, New York, John Wiley & Sons, pp. 13–34
- Levine, P.H., Ablashi, D.V., Berard, C.W., Carbone, P.P., Waggoner, D.E. & Malan, L. (1971) Elevated antibody titers to Epstein-Barr virus in Hodgkin's disease. *Cancer*, **27**, 416–421
- Levine, P.H., O'Connor, G.T. & Berard, C.W. (1972) Antibodies to Epstein-Barr virus (EBV) in American patients with Burkitt's lymphoma. *Cancer*, **30**, 610–615
- Levine, P.H., Leiseca, S.A., Hewetson, J.F., Traul, K.A., Andrese, A.P., Granlund, D.J., Fabrizio, P. & Stevens, D.A. (1980a) Infection of rhesus monkeys and chimpanzees with Epstein-Barr virus. *Arch. Virol.*, **66**, 341–351
- Levine, P.H., Connelly, R.R. & Easton, J.M. (1980b) Demographic patterns for nasopharyngeal carcinoma in the United States. *Int. J. Cancer*, **26**, 741–748
- Levine, P.H., McKay, F.W. & Connelly, R.R. (1987) Patterns of nasopharyngeal cancer mortality in the United States. *Int. J. Cancer*, **39**, 133–137
- Levine, P.H., Pallesen, G., Ebbesen, P., Harris, N., Evans, A.S. & Mueller, N. (1994) Evaluation of Epstein-Barr virus antibody patterns and detection of viral markers in the biopsies of patients with Hodgkin's disease. *Int. J. Cancer*, **59**, 48–50
- Levitskaya, J., Coram, M., Levitsky, V., Imreh, S., Steigerwald-Mullen, P.M., Klein, G., Kurilla, M.G. & Masucci, M.G. (1995) Inhibition of antigen processing by the internal repeat region of the Epstein-Barr virus nuclear antigen-1. *Nature*, **375**, 685–688
- Lewin, N., Åman, P., Masucci, M.G., Klein, E., Klein, G., Öberg, B., Strander, H., Henle, W. & Henle, G. (1987) Characterization of EBV-carrying B-cell populations in healthy seropositive individuals with regard to density, release of transforming virus and spontaneous outgrowth. *Int. J. Cancer*, **39**, 472–476
- Lewin, N., Åman, P., Mellstedt, H., Zech, L. & Klein, G. (1988) Direct outgrowth of in vivo Epstein-Barr virus (EBV)-infected chronic lymphocytic leukemia (CLL) cells into permanent lines. *Int. J. Cancer*, **41**, 892–895
- Leyvraz, S., Henle, W., Chahinian, A.P., Perlmann, C., Klein, G., Gordon, R.E., Rosenblum, M. & Holland, J.F. (1985) Association of Epstein-Barr virus with thymic carcinoma. *New Engl. J. Med.*, **312**, 1296–1299

- Li, C.-C., Yu, M.C. & Henderson, B.E. (1985) Some epidemiologic observations of nasopharyngeal carcinoma in Guangdong, Peoples's Republic of China. *Natl Cancer Inst. Monogr.*, **69**, 49–52
- Li, Q.-X., Young, L.S., Niedobitek, G., Dawson, C.W., Birkenbach, M., Wang, F. & Rickinson, A.B. (1992) Epstein-Barr virus infection and replication in a human epithelial cell system. *Nature*, **356**, 347–350
- Li, S.L., Feichtinger, H., Kaaya, E., Migliorini, P., Putkonen, P., Biberfeld, G., Middeldorp, M., Biberfeld, P. & Ernberg, I. (1993) Expression of Epstein-Barr virus-related nuclear antigens and B-cell marker in lymphomas of SIV-immunosuppressed monkeys. *Int. J. Cancer*, **55**, 609–615
- Li, S.L., Biberfeld, P. & Ernberg, I. (1994) DNA of lymphoma-associated herpesvirus (HVMF1) in SIV-infected monkeys (*Macaca fascicularis*) shows homologies to EBNA-1, 2 and 5 genes. *Int. J. Cancer.*, **59**, 287–295
- Li, Q.-X., Turk, S.M. & Hutt-Fletcher, L.M. (1995a) The Epstein-Barr virus (EBV) BZLF2 gene product associates with the gH and gL homologs of EBV and carries an epitope critical to infection of B cells but not of epithelial cells. *J. Virol.*, **69**, 3987–3994
- Li, D., Oda, K., Mikata, A. & Yumoto, N. (1995b) Epstein-Barr virus genomes in Hodgkin's disease and non-Hodgkin's lymphomas. *Pathol. int.*, **45**, 735–741
- Li, S.N., Chang, Y.S. & Liu, S.T. (1996) Effect of a 10-amino acid deletion on the oncogenic activity of latent membrane protein 1 of Epstein-Barr virus. *Oncogene*, **12**, 2129–2135
- Li, Q.-X., Spriggs, M.K., Kovats, S., Turk, S.M., Comeau, M.R., Nepom, B. & Hutt-Fletcher, L.M. (1997) Epstein-Barr virus uses HLA class II as a cofactor for infection of B lymphocytes. *J. Virol.*, **71**, 4657–4662
- Libetta, C.M., Pringle, J.H., Angel, C.A., Craft, A.W., Malcolm, A.J. & Lauder, I. (1990) Demonstration of Epstein-Barr viral DNA in formalin-fixed, paraffin-embedded samples of Hodgkin's disease. *J. Pathol.*, **161**, 255–260
- Lieberman, P.M. & Berk, A.J. (1990) In vitro transcriptional activation, dimerization, and DNA-binding specificity of the Epstein-Barr virus Zta protein. *J. Virol.*, **64**, 2560–2568
- Liebowitz, D., Wang, D. & Kieff, E. (1986) Orientation and patching of the latent infection membrane protein encoded by Epstein-Barr virus. *J. Virol.*, **58**, 233–237
- Liebowitz, D., Mannick, J., Takada, K. & Kieff, E. (1992) Phenotypes of Epstein-Barr virus LMP1 deletion mutants indicate transmembrane and amino-terminal cytoplasmic domains necessary for effects in B-lymphoma cells. *J. Virol.*, **66**, 4612–4616
- Lijinsky, W. & Taylor, H.W. (1978) Relative carcinogenic effectiveness of derivatives of nitrosodiethylamine in rats. *Cancer Res.*, **38**, 2391–2394
- Lin, J.-C. & Machida, H. (1988) Comparison of two bromovinyl nucleoside analogs, 1- β -D-arabinofuranosyl-*E*-5-(2-bromovinyl)uracil and *E*-5-(2-bromovinyl)-2'-deoxyuridine, with acyclovir in inhibition of Epstein-Barr virus replication. *Antimicrob. Agents Chemother.*, **32**, 1068–1072
- Lin, J.-C. & Smith, M.C. (1984) Antagonistic action of retinoic acid against teleocidin and 12-*O*-tetradecanoyl-phorbol-13-acetate on activation of Epstein-Barr virus genomes. *Carcinogenesis*, **5**, 483–487
- Lin, T.M., Chen, K.P., Lin, C.C., Hsu, M.M., Tu, S.M., Chiang, T.C., Jung, P.F. & Hirayama, T. (1973) Retrospective study on nasopharyngeal carcinoma. *J. natl Cancer Inst.*, **51**, 1403–1408

- Lin, J.-C., Smith, M.C. & Pagano, J.S. (1982) Effects of 12-*O*-tetradecanoyl-phorbol-13-acetate on cell proliferation and Epstein-Barr virus DNA replication. *Virology*, **117**, 186–194
- Lin, J.-C., De Clercq, E. & Pagano, J.S. (1991) Inhibitory effects of acyclic nucleoside phosphonate analogs, including (*S*)-1-(3-hydroxy-2-phosphonylmethoxypropyl)cytosine, on Epstein-Barr virus replication. *Antimicrob. Agents Chemother.*, **35**, 2440–2443
- Lin, J.-C., Reefschläger, J., Herrmann, G. & Pagano, J.S. (1992) Structure–activity relationship between (*E*)-5-(2-bromovinyl)- and 5-vinyl-1- β -D-arabinofuranosyluracil (BV-araU, V-araU) in inhibition of Epstein-Barr virus replication. *Antiviral Res.*, **17**, 43–52
- Lin, J.-C., Lin, S.-C., De, B.K., Chan, W.P.-C. & Evatt, B.L. (1993a) Precision of genotyping of Epstein-Barr virus by polymerase chain reaction using three gene loci (EBNA-2, EBNA-3C, and EBER): Predominance of type A virus associated with Hodgkin's disease. *Blood*, **81**, 3372–3381
- Lin, C.-T., Chan, W.-Y., Chen, W., Huang, H.-M., Wu, H.-C., Hsu, M.-M., Chuang, S.-M. & Wang, C.-C. (1993b) Characterization of seven newly established nasopharyngeal carcinoma cell lines. *Lab. Invest.*, **68**, 716–727
- Lin, C.-T., Dee, A.N., Chen, W. & Chan, W.-Y. (1994) Association of Epstein-Barr virus, human papilloma virus, and cytomegalovirus with nine nasopharyngeal carcinoma cell lines. *Lab. Invest.*, **71**, 731–736
- Lindahl, T., Klein, G., Reedman, B.M., Johansson, B. & Singh, S. (1974) Relationship between Epstein-Barr virus (EBV) DNA and the EBV-determined nuclear antigen (EBNA) in Burkitt lymphoma biopsies and other lymphoproliferative malignancies. *Int. J. Cancer*, **13**, 764–772
- Lindahl, T., Adams, A., Bjursell, G., Bornkamm, G.W., Kaschka Dierich, C. & Jehn, U. (1976) Covalently closed circular duplex DNA of Epstein-Barr virus in a human lymphoid cell line. *J. mol. Biol.*, **102**, 511–530
- Lindhout, E., Lakeman, A., Mevissen, M.L. & de Groot, C. (1994) Functionally active Epstein-Barr virus-transformed follicular dendritic cell-like cell lines. *J. exp. Med.*, **179**, 1173–1184
- Ling, P.D. & Hayward, S.D. (1995) Contribution of conserved amino acids in mediating the interaction between EBNA2 and CBF1/RBPJk. *J. Virol.*, **69**, 1944–1950
- Ling, N.R., Hardie, D., Lowe, J., Johnson, G.D., Khan, M. & MacLennan, I.C. (1989) A phenotypic study of cells from Burkitt lymphoma and EBV-B-lymphoblastoid lines and their relationship to cells in normal lymphoid tissues. *Int. J. Cancer*, **43**, 112–118
- Ling, P.D., Rawlins, D.R. & Hayward, S.D. (1993a) The Epstein-Barr virus immortalizing protein EBNA-2 is targeted to DNA by a cellular enhancer-binding protein. *Proc. natl Acad. Sci. USA*, **90**, 9237–9241
- Ling, P.D., Ryon, J.J. & Hayward, S.D. (1993b) EBNA-2 of Herpesvirus papio diverges significantly from the type A and type B EBNA-2 proteins of Epstein-Barr virus but retains an efficient transactivation domain with a conserved hydrophobic motif. *J. Virol.*, **67**, 2990–3003
- Lisi, A., Pozzi, D., Carloni, G., Da Villa, G., Iacovacci, S., Valli, M.B. & Grimaldi, S. (1995) Fusion of EBV with the surface of receptor-negative human hepatoma cell line Li7A permits virus penetration and infection. *Res. Virol.*, **146**, 295–300
- Liu, Q., Ohshima, K., Masuda, Y. & Kikuchi, M. (1995) Detection of the Epstein-Barr virus in primary gastric lymphoma by in situ hybridization. *Pathol. int.*, **45**, 131–136
- Liu, S., Liu, P., Borrás, A., Chatila, T. & Speck, S.H. (1997) Cyclosporin A-sensitive induction of the Epstein-Barr virus lytic switch is mediated via a novel pathway involving a MEF2 family member. *EMBO J.*, **16**, 143–153

- Lloyd-Still, J.D., Scott, J.P. & Crussi, F. (1986) The spectrum of Epstein-Barr virus hepatitis in children. *Pediatr. Pathol.*, **5**, 337–351
- Lo, K.-W., Huang, D.P. & Lau, K.-M. (1995) p16 Gene alterations in nasopharyngeal carcinoma. *Cancer Res.*, **55**, 2039–2043
- Locker, J. & Nalesnik, M. (1989) Molecular genetic analysis of lymphoid tumors arising after organ transplantation. *Am. J. Pathol.*, **135**, 977–987
- Longnecker, R. & Kieff, E. (1990) A second Epstein-Barr virus membrane protein (LMP2) is expressed in latent infection and colocalizes with LMP1. *J. Virol.*, **64**, 2319–2326
- Longnecker, R. & Miller, C.L. (1996) Regulation of Epstein-Barr virus latency by latent membrane protein 2. *Trends Microbiol.*, **4**, 38–42
- Longnecker, R., Druker, B., Roberts, T.M. & Kieff, E. (1991) An Epstein-Barr virus protein associated with cell growth transformation interacts with a tyrosine kinase. *J. Virol.*, **65**, 3681–3692
- Longnecker, R., Miller, C.L., Miao, X.-Q., Marchini, A. & Kieff, E. (1992) The only domain which distinguishes Epstein-Barr virus latent membrane protein 2A (LMP2A) from LMP2B is dispensable for lymphocyte infection and growth transformation *in vitro*; LMP2A is therefore nonessential. *J. Virol.*, **66**, 6461–6469
- Longnecker, R., Miller, C.L., Tomkinson, B., Miao, X.-Q. & Kieff, E. (1993a) Deletion of DNA encoding the first five transmembrane domains of Epstein-Barr virus latent membrane proteins 2A and 2B. *J. Virol.*, **67**, 5068–5074
- Longnecker, R., Miller, C.L., Miao, X.-Q., Tomkinson, B. & Kieff, E. (1993b) The last seven transmembrane and carboxy-terminal cytoplasmic domains of Epstein-Barr virus latent membrane protein 2 (LMP2) are dispensable for lymphocyte infection and growth transformation *in vitro*. *J. Virol.*, **67**, 2006–2013
- Lopategui, J.R., Gaffey, M.J., Frierson, H.F., Jr, Chan, J.K.C., Mills, S.E., Chang, K.L., Chen, Y.-Y. & Weiss, L.M. (1994) Detection of Epstein-Barr viral RNA in sinonasal undifferentiated carcinoma from western and Asian patients. *Am. J. surg. Pathol.*, **18**, 391–398
- Lopategui, J.R., Gaffey, M.J., Chan, J.K.C., Frierson, H.F., Jr, Sun, L.-H., Bellafiore, F.J., Chang, K.L. & Weiss, L.W. (1995) Infrequent association of Epstein-Barr virus with CD30-positive anaplastic large cell lymphomas from American and Asian patients. *Am. J. surg. Pathol.*, **19**, 42–49
- López-Navidad, A., Domingo, P., López-Talavera, J.C., Rabella, N. & Verger, G. (1996) Epstein-Barr virus infection associated with interstitial nephritis and chronic fatigue. *Scand. J. infect. Dis.*, **28**, 185–187
- Lowe, R.S., Keller, P.M., Keech, B.J., Davison, A.J., Whang, Y., Morgan, A.J., Kieff, E. & Ellis, R.W. (1987) Varicella-zoster virus as a live vector for the expression of foreign genes. *Proc. natl Acad. Sci. USA*, **84**, 3896–3900
- Lu, S.-J., Day, N.E., Degos, L., Lepage, V., Wang, P.-C., Chan, S.-H., Simons, M., McKnight, B., Easton, D., Zeng, Y. & de Thé, G. (1990) Linkage of a nasopharyngeal carcinoma susceptibility locus to the HLA region. *Nature*, **346**, 470–471
- Lu, Q.-L., Elia, G., Lucas, S. & Thomas, J.A. (1993) *Bcl-2* proto-oncogene expression in Epstein-Barr-virus-associated nasopharyngeal carcinoma. *Int. J. Cancer*, **53**, 29–35
- Lucas, K.G., Small, T.N., Heller, G., Dupont, B. & O'Reilly, R.J. (1996) The development of cellular immunity to Epstein-Barr virus after allogeneic bone marrow transplantation. *Blood*, **87**, 2594–2603

- Luka, J., Klein, G., Henle, W. & Henle, G. (1978) Detection of the EBV-determined nuclear antigen (EBNA) in Burkitt's lymphoma and nasopharyngeal carcinoma biopsies by the acid fixed nuclear binding (AFNB) technique. *Cancer Lett.*, **4**, 199–205
- Luka, J., Kallin, B. & Klein, G. (1979) Induction of the Epstein-Barr virus (EBV) cycle in latently infected cells by *n*-butyrate. *Virology*, **94**, 228–231
- Luka, J., Chase, R.C. & Pearson, G.R. (1984) A sensitive enzyme-linked immunosorbent assay (ELISA) against the major EBV-associated antigens. 1. Correlation between ELISA and immunofluorescence titres using purified antigens. *J. immunol. Meth.*, **67**, 145–156
- Luka, J., Deeb, Z.E., Hartmann, D.P., Jenson, B. & Pearson, G.R. (1988) Detection of antigens associated with Epstein-Barr virus replication in extracts from biopsy specimens of nasopharyngeal carcinomas. *J. natl Cancer Inst.*, **80**, 1164–1167
- Lukes, R.J. & Butler, J.J. (1966) The pathology and nomenclature of Hodgkin's disease. *Cancer Res.*, **26**, 1063–1081
- Lung, M.L. & Chang, G.C. (1992) Detection of distinct Epstein-Barr virus genotypes in NPC biopsies from southern Chinese and Caucasians. *Int. J. Cancer*, **52**, 34–37
- Lung, M.L., Chan, K.H., Lam, W.P., Kou, S.K., Choy, D., Chan, C.W. & Ng, M.H. (1989) In situ detection of Epstein-Barr virus markers in nasopharyngeal carcinoma patients. *Oncology*, **46**, 310–317
- Lung, M.L., Chang, R.S., Huang, M.L., Guo, H.Y., Choy, D., Sham, J., Tsao, S.Y., Cheng, P. & Ng, M.H. (1990) Epstein-Barr virus genotypes associated with nasopharyngeal carcinoma in southern China. *Virology*, **177**, 44–53
- Lung, M.L., Lam, W.P., Chan, K.H., Li, S., Sham, J. & Choy, D. (1992) Direct detection of Epstein-Barr virus in peripheral blood and comparison of Epstein-Barr virus genotypes present in direct specimens and lymphoblastoid cell lines established from nasopharyngeal carcinoma patients and healthy carriers in Hong Kong. *Int. J. Cancer*, **52**, 174–177
- Lüscher, B. & Eisenman, R.N. (1990) New light on myc and myb. Part I. *Myb. Genes Dev.*, **4**, 2025–2035
- Mabuchi, K., Bross, D.S. & Kessler, I.I. (1985) Cigarette smoking and nasopharyngeal carcinoma. *Cancer*, **55**, 2874–2876
- Mackett, M. & Arrand, J.R. (1985) Recombinant vaccinia virus induces neutralising antibodies in rabbits against Epstein-Barr virus membrane antigen gp340. *EMBO J.*, **4**, 3229–3234
- Mackett, M., Conway, M.J., Arrand, J.R., Haddad, R.S. & Hutt-Fletcher, L.M. (1990) Characterization and expression of a glycoprotein encoded by the Epstein-Barr virus *Bam*HI I fragment. *J. Virol.*, **64**, 2545–2552
- Mackett, M., Pepper, C.deV.S., Lees, J.F., Naylor, B.A., Wedderburn, N. & Arrand, J.R. (1996) Immunisation of common marmosets with vaccinia virus expressing Epstein-Barr virus (EBV) gp340 and challenge with EBV. *J. med. Virol.*, **50**, 263–271
- MacMahon, B. (1957) Epidemiological evidence on the nature of Hodgkin's disease. *Cancer*, **10**, 1045–1054
- MacMahon, B. (1960) The ethnic distribution of cancer mortality in New York City, 1955. *Acta Unio int. contra cancerum*, **16**, 1716–1724
- MacMahon, B. (1966) Epidemiology of Hodgkin's disease. *Cancer Res.*, **26**, 1189–1200

- MacMahon, E.M.E., Glass, J.D., Hayward, S.D., Mann, R.B., Becker, P.S., Charache, P., McArthur, J.C. & Ambinder, R.F. (1991) Epstein-Barr virus in AIDS-related primary central nervous system lymphoma. *Lancet*, **338**, 969-973
- MacMillan, C., Kapadia, S.B., Finkelstein, S.D., Nalesnik, M.A. & Barnes, L. (1996) Lympho-epithelial carcinoma of the larynx and hypopharynx: Study of eight cases with relationship to Epstein-Barr virus and *p53* gene alterations, and review of the literature. *Hum. Pathol.*, **27**, 1172-1179
- Madej, M., Conway, M.J., Morgan, A.J., Sweet, J., Wallace, L., Qualtière, L.F., Arrand, J.R. & Mackett, M. (1992) Purification and characterisation of Epstein-Barr virus gp340/220 produced by a bovine papillomavirus expression vector system. *Vaccine*, **10**, 777-782
- Madisen, L. & Groudine, M. (1994) Identification of a locus control region in the immunoglobulin heavy-chain locus that deregulates *c-myc* expression in plasmacytoma and Burkitt's lymphoma cells. *Genes Dev.*, **8**, 2212-2226
- Magrath, I.T. (1990) The pathogenesis of Burkitt's lymphoma. *Recent Adv. Cancer Res.*, **55**, 133-270
- Magrath, I.T. (1991) African Burkitt's lymphoma. History, biology, clinical features, and treatment. *Am. J. pediatr. hematol. Oncol.*, **13**, 222-246
- Magrath, I. (1997) Small noncleaved cell lymphomas. In: Magrath, I., ed., *The Non-Hodgkin's Lymphomas*, 2nd Ed., London, Edward Arnold (in press)
- Magrath, I.T. & Ziegler, J.L. (1980) Bone marrow involvement in Burkitt's lymphoma and its relationship to acute B-cell leukemia. *Leukemia Res.*, **4**, 33-59
- Magrath, I.T., Mugerwa, J., Bailey, I., Olweny, C. & Kiryabwire, Y. (1974) Intracerebral Burkitt's lymphoma: Pathology, clinical features and treatment. *Q. J. Med.*, **43**, 489-508
- Magrath, I., Henle, W., Owor, R. & Olweny, C. (1975) Antibodies to Epstein-Barr virus antigens before and after the development of Burkitt's lymphoma in a patient treated for Hodgkin's disease. *New Engl. J. Med.*, **292**, 621-623
- Magrath, I., Jain, V. & Bhatia, K. (1992) Epstein-Barr virus and Burkitt's lymphoma. *Semin. Cancer Biol.*, **3**, 285-295
- Malcolm, S., Barton, P., Murphy, C., Fergusson-Smith, M.A., Bentley, D.L. & Rabbitts, T.H. (1982) Localization of human immunoglobulin kappa light chain variable region genes to the short arm of chromosome 2 by in situ hybridization. *Proc. natl Acad. Sci. USA*, **79**, 4957-4961
- Mann, K.P., Staunton, D. & Thorley-Lawson, D.A. (1985) Epstein-Barr virus-encoded protein found in plasma membranes of transformed cells. *J. Virol.*, **55**, 710-720
- Mann, R.B., Wu, T.-C., MacMahon, E.M.E., Ling, Y., Charache, P. & Ambinder, R.F. (1992) In situ localization of Epstein-Barr virus in thymic carcinoma. *Mod. Pathol.*, **5**, 363-366
- Mannick, J.B., Cohen, J.I., Birkenbach, M., Marchini, A. & Kieff, E. (1991) The Epstein-Barr virus nuclear protein encoded by the leader of the EBNA RNAs is important in B-lymphocyte transformation. *J. Virol.*, **65**, 6826-6837
- Manolov, G. & Manolova, Y. (1972) Marker band in one chromosome 14 from Burkitt lymphomas. *Nature*, **237**, 33-34
- Mar, E.-C., Chu, C.K. & Lin, J.-C. (1995) Some nucleoside analogs with anti-human immunodeficiency virus activity inhibit replication of Epstein-Barr virus. *Antiviral Res.*, **28**, 1-11

- Marchini, A., Tomkinson, B., Cohen, J.I. & Kieff, E. (1991) BHRF1, the Epstein-Barr virus gene with homology to *bcl2*, is dispensable for B-lymphocyte transformation and virus replication. *J. Virol.*, **65**, 5991–6000
- Mark, W. & Sugden, B. (1982) Transformation of lymphocytes by Epstein-Barr virus requires only one-fourth of the viral genome. *Virology*, **122**, 431–443
- Markin, R.S., Wood, R.P., Shaw, B.W., Jr, Brichacek, B. & Purtilo, D.T. (1990) Immunohistologic identification of Epstein-Barr virus-induced hepatitis reactivation after OKT-3 therapy following orthotopic liver transplant. *Am. J. Gastroenterol.*, **85**, 1014–1018
- Marklund, G., Ernberg, I., Lundberg, C., Henle, W. & Henle, G. (1986) Differences in EBV-specific antibody patterns at onset of infectious mononucleosis. *Scand. J. infect. Dis.*, **18**, 25–32
- Marschall, M., Schwarzmann, F., Leser, U., Oker, B., Alliger, P., Mairhofer, H. & Wolf, H. (1991) The BILF4 *trans*-activator of Epstein-Barr virus is modulated by type and differentiation of the host cell. *Virology*, **181**, 172–179
- Martel-Renoir, D., Grunewald, V., Touitou, R., Schwaab, G. & Joab, I. (1995) Qualitative analysis of the expression of Epstein-Barr virus lytic genes in nasopharyngeal carcinoma biopsies. *J. gen. Virol.*, **76**, 1401–1408
- Martin, J. & Sugden, B. (1991) Transformation by the oncogenic latent membrane protein correlates with its rapid turnover, membrane localization, and cytoskeletal association. *J. Virol.*, **65**, 3246–3258
- Martin, J.M., Veis, D., Korsmeyer, S.J. & Sugden, B. (1993) Latent membrane protein of Epstein-Barr virus induces cellular phenotypes independently of expression of Bcl-2. *J. Virol.*, **67**, 5269–5278
- Martínez-Leandro, E.P., Martorell, M., Alemany, P., Salvador, I. & Garcia-Guardiet, E. (1994) Lymphoepithelial-like carcinoma of the uterine cervix. Study of a case with in situ hybridization of the Epstein-Barr virus genome and the human papillomavirus genome. *Acta obstet. gynecol. scand.*, **73**, 589–592
- Masih, A., Weisenburger, D., Duggan, M., Armitage, J., Bashir, R., Mitchell, D., Wickert, R. & Purtilo, D.T. (1991) Epstein-Barr viral genome in lymph nodes from patients with Hodgkin's disease may not be specific to Reed-Sternberg cells. *Am. J. Pathol.*, **139**, 37–43
- Masood, R., Zhang, Y., Bond, M.W., Scadden, D.T., Moudgil, T., Law, R.E., Kaplan, M.H., Jung, B., Espina, B.M., Lunardi-Iskandar, Y., Levine, A.M. & Gill, P.S. (1995) Interleukin-10 is an autocrine growth factor for acquired immunodeficiency syndrome-related B-cell lymphoma. *Blood*, **85**, 3423–3430
- Masucci, M.G. & Ernberg, I. (1994) Epstein-Barr virus: Adaptation to a life within the immune system. *Trends Microbiol.*, **2**, 125–130
- Masucci, M.G., Bejarano, M.T., Masucci, G. & Klein, E. (1983) Large granular lymphocytes inhibit the in vitro growth of autologous Epstein-Barr virus-infected B cells. *Cell. Immunol.*, **76**, 311–321
- Masucci, M.G., Torsteinsdottir, S., Colombani, J., Brautbar, C., Klein, E. & Klein, G. (1987) Down-regulation of class I HLA antigens and of the Epstein-Barr virus-encoded latent membrane protein in Burkitt lymphoma lines. *Proc. natl Acad. Sci. USA*, **84**, 4567–4571

- Masucci, M.G., Contreras-Salazar, B., Ragnar, E., Falk, K., Minarovits, J., Ernberg, I. & Klein, G. (1989) 5-Azacytidine up regulates the expression of Epstein-Barr virus nuclear antigen 2 (EBNA-2) through EBNA-6 and latent membrane protein in the Burkitt's lymphoma line rael. *J. Virol.*, **63**, 3135–3141
- Mathew, G.D., Qualtière, L.F., Neel, H.B., III & Pearson, G.R. (1981) IgA antibody, antibody-dependent cellular cytotoxicity and prognosis in patients with nasopharyngeal carcinoma. *Int. J. Cancer*, **27**, 175–180
- Matsunou, H., Konishi, F., Hori, H., Ikeda, T., Sasaki, K., Hirose, Y. & Yamamichi, N. (1996) Characteristics of Epstein-Barr virus-associated gastric carcinoma with lymphoid stroma in Japan. *Cancer*, **77**, 1998–2004
- Matsuo, T., Heller, M., Petti, L., O'Shiro, E. & Kieff, E. (1984) Persistence of the entire Epstein-Barr virus genome integrated into human lymphocyte DNA. *Science*, **226**, 1322–1325
- Mauch, P.M., Kalish, L.A., Kadin, M., Coleman, C.N., Osteen, R. & Hellman, S. (1993) Patterns of presentation of Hodgkin's disease. Implications for etiology and pathogenesis. *Cancer*, **71**, 2062–2071
- Mayer, H.B., Wanke, C.A., Williams, M., Crosson, A.W., Federman, M. & Hammer, S.M. (1996) Epstein-Barr virus-induced infectious mononucleosis complicated by acute renal failure: Case report and review. *Clin. infect. Dis.*, **22**, 1009–1018
- McBride, O.W., Hieter, P.A., Hollis, G.F., Swan, D., Otey, M.C. & Leder, P. (1982) Chromosomal location of human kappa and lambda immunoglobulin light chain constant region genes. *J. exp. Med.*, **155**, 1480–1490
- McCarthy, N.J., Hazlewood, S.A., Huen, D.S., Rickinson, A.B. & Williams, G.T. (1996) The Epstein-Barr virus gene BHRF1, a homologue of the cellular oncogene bcl-2, inhibits apoptosis induced by gamma radiation and chemotherapeutic drugs. *Adv. exp. Med. Biol.*, **406**, 83–97
- McClain, K.L., Leach, C.T., Jenson, H.B., Joshi, V.V., Pollock, B.H., Parmley, R.T., DiCarlo, F.J., Chadwick, E.G. & Murphy, S.B. (1995) Association of Epstein-Barr virus with leiomyosarcomas in young people with AIDS. *New Engl. J. Med.*, **332**, 12–18
- McGregor, I.A. (1970) Plasma immunoglobulin concentrations in an African (Gambian) community in relation to season, malaria and other infections and pregnancy. *Clin. exp. Immunol.*, **7**, 51–74
- McGuire, L.J., Huang, D.P., Teoh, R., Arnold, M., Wong, K. & Lee, J.C.K. (1988) Epstein-Barr virus genome in thymoma and thymic lymphoid hyperplasia. *Am. J. Pathol.*, **131**, 385–390
- Medeiros, L.J. & Greiner, T.C. (1995) Hodgkin's disease. *Cancer*, **75** (Suppl.), 357–369
- Medeiros, L.J., Peiper, S.C., Elwood, L., Yano, T., Raffeld, M., & Jaffe, E.S. (1991) Angiocentric immunoproliferative lesions: A molecular analysis of eight cases. *Hum. Pathol.*, **22**, 1150–1157
- Melbye, M., Coté, T.R., West, D., Kessler, L., Biggar, R.J. & the AIDS/Cancer Working Group (1996) Nasopharyngeal carcinoma: An EBV-associated tumour not significantly influenced by HIV-induced immunosuppression. *Br. J. Cancer*, **73**, 995–997
- Mentzer, S.J., Longtine, J., Fingerroth, J., Reilly, J.J., DeCamp, M.M., O'Donnell, W., Swanson, S.J., Faller, D.V. & Sugarbaker, D.J. (1996) Immunoblastic lymphoma of donor origin in the allograft after lung transplantation. *Transplantation*, **61**, 1720–1725

- Merk, K., Lennette, E., Holm, G., Johansson, B., Masucci, G., Grimfors, G., Klein, G. & Björkholm, M. (1995) Antibodies to Epstein-Barr virus in relation to clinical characteristics of untreated patients with Hodgkin's disease. *Cancer Res. Ther. Control*, **4**, 223–229
- Mikaélian, I., Drouet, E., Marechal, V., Denoyel, G., Nicolas, J.-C. & Sergeant, A. (1993) The DNA-binding domain of two bZIP transcription factors, the Epstein-Barr virus switch gene product EB1 and Jun, is a bipartite nuclear targeting sequence. *J. Virol.*, **67**, 734–742
- Miller, R.W. & Beebe, G.W. (1973) Infectious mononucleosis and the empirical risk of cancer. *J. natl Cancer Inst.*, **50**, 315–321
- Miller, G. & Coope, D. (1974) Epstein-Barr viral nuclear antigen (EBNA) in tumor cell imprints of experimental lymphoma of marmosets. *Trans. Assoc. Am. Phys.*, **87**, 205–218
- Miller, N. & Hutt-Fletcher, L.M. (1988) A monoclonal antibody to glycoprotein gp85 inhibits fusion but not attachment of Epstein-Barr virus. *J. Virol.*, **62**, 2366–2372
- Miller, G., Shope, T., Lisco, H., Stitt, D. & Lipman, M. (1972) Epstein-Barr virus: Transformation, cytopathic changes, and viral antigens in squirrel monkey and marmoset leukocytes. *Proc. natl Acad. Sci. USA*, **69**, 383–387
- Miller, G., Robinson, J., Heston, L. & Lipman, M. (1974) Differences between laboratory strains of Epstein-Barr virus based on immortalization, abortive infection, and interference. *Proc. natl Acad. Sci. USA*, **71**, 4006–4010
- Miller, G., Shope, T., Coope, D., Waters, L., Pagano, J., Bornkamm, G.W. & Henlé, W. (1977) Lymphoma in cotton-top marmosets after inoculation with Epstein-Barr virus: Tumor incidence, histologic spectrum, antibody responses, demonstration of viral DNA, and characterization of viruses. *J. exp. Med.*, **145**, 948–967
- Miller, G., Rabson, M. & Heston, L. (1984) Epstein-Barr virus with heterogeneous DNA disrupts latency. *J. Virol.*, **50**, 174–182
- Miller, G., Grogan, E., Rowe, D., Rooney, C., Heston, L., Eastman, R., Andiman, W., Niederman, J., Lenoir, G., Henle, W., Henle, W., Sullivan, J., Schooley, R., Vossen, J., Strauss, S. & Issekutz, T. (1987) Selective lack of antibody to a component of EB nuclear antigen in patients with chronic active Epstein-Barr virus infection. *J. infect. Dis.*, **156**, 26–35
- Miller, W.E., Edwards, R.H., Walling, D.M. & Raab-Traub, N. (1994a) Sequence variation in the Epstein-Barr latent virus membrane protein 1. *J. gen. Virol.*, **75**, 2729–2740
- Miller, C.L., Lee, J.H., Kieff, E. & Longnecker, R. (1994b) An integral membrane protein (LMP2) blocks reactivation of Epstein-Barr virus from latency following surface immunoglobulin crosslinking. *Proc. natl Acad. Sci. USA*, **91**, 772–776
- Miller, W.E., Earp, H.S. & Raab-Traub, N. (1995a) The Epstein-Barr virus latent membrane protein 1 induces expression of the epidermal growth factor receptor. *J. Virol.*, **69**, 4390–4398
- Miller, C.L., Burkhardt, A.L., Lee, J.H., Stealey, B., Longnecker, R., Bolen, J.B. & Kieff, E. (1995b) Integral membrane protein 2 of Epstein-Barr virus regulates reactivation from latency through dominant negative effects on protein-tyrosine kinases. *Immunity*, **2**, 155–166
- Miller, W.E., Mosialos, G., Kieff, E. & Raab-Traub, N. (1997) Epstein-Barr virus LMP1 induction of the epidermal growth factor receptor is mediated through a TRAF signaling pathway distinct from NF- κ B activation. *J. Virol.*, **71**, 586–594

- Min, K.-W., Holmquist, S., Peiper, S.C. & O'Leary, T.J. (1991) Poorly differentiated adenocarcinoma with lymphoid stroma (lymphoepithelioma-like carcinomas) of the stomach. Report of three cases with Epstein-Barr virus genome demonstrated by the polymerase chain reaction. *Am. J. clin. Pathol.*, **96**, 219–227
- Minarovits, J., Minarovits-Kormuta, S., Ehlin-Henriksson, B., Falk, K., Klein, G. & Ernberg, I. (1991) Host cell phenotype-dependent methylation patterns of Epstein-Barr virus DNA. *J. gen. Virol.*, **72**, 1591–1599
- Minarovits, J., Hu, L.-F., Marcsek, Z., Minarovits-Kormuta, S., Klein, G. & Ernberg, I. (1992) RNA polymerase III-transcribed EBER 1 and 2 transcription units are expressed and hypomethylated in the major Epstein-Barr virus-carrying cell types. *J. gen. Virol.*, **73**, 1687–1692
- Minarovits, J., Hu, L.-F., Imai, S., Harabuchi, Y., Kataura, A., Minarovits-Kormuta, S., Osato, T. & Klein, G. (1994a) Clonality, expression and methylation patterns of the Epstein-Barr virus genomes in lethal midline granulomas classified as peripheral angiocentric T cell lymphomas. *J. gen. Virol.*, **75**, 77–84
- Minarovits, J., Hu, L.F., Minarovits-Kormuta, S., Klein, G. & Ernberg, I. (1994b) Sequence-specific methylation inhibits the activity of the Epstein-Barr virus LMP-1 and BCR2 enhancer–promoter regions. *Virology*, **200**, 661–667
- Misko, I.S., Pope, J.H., Hütter, R., Soszynski, T.D. & Kane, R.G. (1984) HLA-DR-antigen-associated restriction of EBV-specific cytotoxic T-cell colonies. *Int. J. Cancer*, **33**, 239–243
- Misko, I.S., Sculley, T.B., Schmidt, C., Moss, D.J., Soszynski, T. & Burman, K. (1991) Composite response of naive T cells to stimulation with the autologous lymphoblastoid cell line is mediated by CD4 cytotoxic T cell clones and includes an Epstein-Barr virus-specific component. *Cell. Immunol.*, **132**, 295–307
- Miyashita, E.M., Yang, B., Lam, K.M.C., Crawford, D.H. & Thorley-Lawson, D.A. (1995) A novel form of Epstein-Barr virus latency in normal B cells *in vivo*. *Cell*, **80**, 593–601
- Miyoshi, I. (1983) Japanese Burkitt's lymphoma: Clinicopathological review of 14 cases. *Jpn. J. clin. Oncol.*, **13**, 489–496
- Miyoshi, I., Hiraki, S., Kubonishi, I., Matsuda, Y., Kishimoto, H., Nakayama, T., Tanaka, T., Masuji, H. & Kimura, I. (1977) Establishment of an Epstein-Barr virus-negative B-cell lymphoma line from a Japanese Burkitt's lymphoma and its serial passage in hamsters. *Cancer*, **40**, 2999–3003
- Miyoshi, I., Hiraki, S., Tsubota, T., Uno, J., Nakamura, K., Ota, T., Hikita, T., Hayashi, K., Kataoka, M., Tanaka, T., Kimura, I., Sairenji, T. & Hinuma, Y. (1978) Epstein-Barr virus-positive Japanese Burkitt lymphoma. *Gann*, **69**, 449–450
- Mochanko, K., Fejes, M., Breazavscek, D.M., Suarez, A. & Bachmann, A.E. (1979) The relation between Epstein-Barr virus antibodies and clinical symptomatology and immunodeficiency in patients with Hodgkin's disease. *Cancer*, **44**, 2065–2070
- Molineaux, L. & Gramiccia, G. (1980) *The Garki Project*, Geneva, World Health Organization
- Montel, A.H., Morse, P.A. & Brahmi, Z. (1995) Upregulation of B7 molecules by the Epstein-Barr virus enhances susceptibility to lysis by a human NK-like cell line. *Cell Immunol.*, **160**, 104–114
- Montone, K.T., Litzky, L.A., Wurster, A., Kaiser, L., Bavaria, J., Kotloff, R., Palevsky, H., Pietra, G.G. & Tomaszewski, J.E. (1996a) Analysis of Epstein-Barr virus-associated post-transplantation lymphoproliferative disorder after lung transplantation. *Surgery*, **119**, 544–551

- Montone, K.T., Hodinka, R.L., Salhany, K.E., Lavi, E., Rostami, A. & Tomaszewski, J.E. (1996b) Identification of Epstein-Barr virus lytic activity in post-transplantation lymphoproliferative disease. *Mod. Pathol.*, **9**, 621–630
- Moore, S.B., Pearson, G.R., Neel, H.B., III & Weiland, L.H. (1983) HLA and nasopharyngeal carcinoma in North American Caucasoids. *Tissue Antigens*, **22**, 72–75
- Moore, M.D., DiScipio, R.G., Cooper, N.R. & Nemerow, G.R. (1989) Hydrodynamic, electron microscopic, and ligand-binding analysis of the Epstein-Barr virus/C3dg receptor (CR2). *J. Biol. Chem.*, **264**, 20576–20582
- Moore, K.W., Vieira, P., Fiorentino, D.F., Trounstein, M.L., Khan, T.A. & Mosmann, T.R. (1990) Homology of cytokine synthesis inhibitory factor (IL-10) to the Epstein-Barr virus gene BCRF1. *Science*, **248**, 1230–1234
- Moorthy, R. & Thorley-Lawson, D.A. (1990) Processing of the Epstein-Barr virus-encoded latent membrane protein p63/LMP. *J. Virol.*, **64**, 829–837
- Moorthy, R.K. & Thorley-Lawson, D.A. (1993a) All three domains of the Epstein-Barr virus-encoded latent membrane protein LMP-1 are required for transformation of rat-1 fibroblasts. *J. Virol.*, **67**, 1638–1646
- Moorthy, R.K. & Thorley-Lawson, D.A. (1993b) Biochemical, genetic, and functional analyses of the phosphorylation sites on the Epstein-Barr virus-encoded oncogenic latent membrane protein LMP-1. *J. Virol.*, **67**, 2637–2645
- Moran, C.A., Tuur, S., Angritt, P., Reid, A.H. & O'Leary, T.J. (1992) Epstein-Barr virus in Hodgkin's disease from patients with human immunodeficiency virus infection. *Mod. Pathol.*, **5**, 85–88
- Morein, B., Sundquist, B., Höglund, S., Dalsgaard, K. & Osterhaus, A. (1984) Iscom, a novel structure for antigenic presentation of membrane proteins from enveloped viruses. *Nature*, **308**, 457–460
- Morein, B., Lövgren, K., Rönnerberg, B., Sjölander, A. & Villacrés-Eriksson, M. (1995) Immunostimulating complexes. Clinical potential in vaccine development. *Clin. Immunother.*, **3**, 461–475
- Morel, D., Merville, P., Le Bail, B., Berger, F., Saric, J. & Potaux, L. (1996) Epstein-Barr virus (EBV)-associated hepatic and splenic smooth muscle tumours after kidney transplantation. *Nephrol. Dial. Transplant.*, **11**, 1864–1866
- Morgan, A.J., North, J.R. & Epstein, M.A. (1983) Purification and properties of the gp340 component of Epstein-Barr virus membrane antigen in an immunogenic form. *J. gen. Virol.*, **64**, 455–460
- Morgan, A.J., Smith, A.R., Barker, R.N. & Epstein, M.A. (1984) A structural investigation of the Epstein-Barr (EB) virus membrane antigen glycoprotein, gp340. *J. gen. Virol.*, **65**, 397–404
- Morgan, A.J., Finerty, S., Lovgren, K., Scullion, F.T. & Morein, B. (1988a) Prevention of Epstein-Barr (EB) virus-induced lymphoma in cottontop tamarins by vaccination with the EB virus envelope glycoprotein gp340 incorporated into immune-stimulating complexes. *J. gen. Virol.*, **69**, 2093–2096
- Morgan, A.J., Mackett, M., Finerty, S., Arrand, J.R., Scullion, F.T. & Epstein, M.A. (1988b) Recombinant vaccinia virus expressing Epstein-Barr virus glycoprotein gp340 protects cottontop tamarins against EBV-induced malignant lymphomas. *J. med. Virol.*, **25**, 189–195

- Morgan, A.J., Allison, A.C., Finerty, S., Scullion, F.T., Byars, N.E. & Epstein, M.A. (1989) Validation of a first-generation Epstein-Barr virus vaccine preparation suitable for human use. *J. med. Virol.*, **29**, 74–78
- Morgan, S.M., Wilkinson, G.W.G., Floettmann, E., Blake, N. & Rickinson, A.B. (1996) A recombinant adenovirus expressing an Epstein-Barr virus (EBV) target antigen can selectively reactivate rare components of EBV cytotoxic T-lymphocyte memory *in vitro*. *J. Virol.*, **70**, 2394–2402
- Morgello, S. (1992) Epstein-Barr and human immunodeficiency viruses in acquired immunodeficiency syndrome-related primary central nervous system lymphoma. *Am. J. Pathol.*, **141**, 441–450
- Morgenlander, J.C. (1996) A syndrome of concurrent central and peripheral nervous system involvement due to Epstein-Barr virus infection. *Muscle Nerve*, **19**, 1037–1039
- Mori, M., Watanabe, M., Tanaka, S., Mimori, K., Kuwano, H. & Sugimachi, K. (1994) Epstein-Barr virus-associated carcinomas of the esophagus and stomach. *Arch. Pathol. Lab. Med.*, **118**, 998–1001
- Morrow, R.H., Jr (1985) Epidemiological evidence for the role of falciparum malaria in the pathogenesis of Burkitt's lymphoma. In: Lenoir, G., O'Connor, G. & Olweny, C.L.M., eds, *Burkitt's Lymphoma: A Human Cancer Model* (IARC Scientific Publications No. 60), Lyon, IARC, pp. 177–186
- Morrow, R.H., Kisuule, A., Pike, M.C. & Smith, P.G. (1976) Burkitt's lymphoma in the Mengo districts of Uganda: Epidemiologic features and their relationship to malaria. *J. natl Cancer Inst.*, **56**, 479–483
- Mosialos, G., Yamashiro, S., Baughman, R.W., Matsudaira, P., Vara, L., Matsumura, F., Kieff, E. & Birkenbach, M. (1994) Epstein-Barr virus infection induces expression in B lymphocytes of a novel gene encoding an evolutionarily conserved 55-kilodalton actin-bundling protein. *J. Virol.*, **68**, 7320–7328
- Mosialos, G., Birkenbach, M., Yalamanchili, R., VanArsdale, T., Ware, C. & Kieff, E. (1995) The Epstein-Barr virus transforming protein LMP1 engages signaling proteins for the tumor necrosis factor receptor family. *Cell*, **80**, 389–399
- Mosier, D.E. (1996) Viral pathogenesis in hu-PBL-SCID mice. *Sem. Immunol.*, **8**, 255–262
- Mosmann, T.R. & Coffman, R.L. (1989) Heterogeneity of cytokine secretion patterns and functions of helper T cells. *Adv. Immunol.*, **46**, 111–147
- Moss, B. (1996) Genetically engineered poxviruses for recombinant gene expression, vaccination, and safety. *Proc. natl Acad. Sci. USA*, **93**, 11341–11348
- Moss, D.J., Rickinson, A.B. & Pope, J.H. (1978) Long-term T-cell-mediated immunity to Epstein-Barr virus in man. I. Complete regression of virus-induced transformation in cultures of seropositive donor leukocytes. *Int. J. Cancer*, **22**, 662–668
- Moss, D.J., Rickinson, A.B. & Pope, J.H. (1979) Long-term T-cell-mediated immunity to Epstein-Barr virus in man. III. Activation of cytotoxic T cells in virus-infected leukocyte cultures. *Int. J. Cancer*, **23**, 618–625
- Moss, D.J., Burrows, S.R., Castelino, D.J., Kane, R.G., Pope, J.H., Rickinson, A.B., Alpers, M.P. & Heywood, P.F. (1983a) A comparison of Epstein-Barr virus-specific T-cell immunity in malaria-endemic and nonendemic regions of Papua New Guinea. *Int. J. Cancer*, **31**, 727–732

- Moss, D.J., Chan, S.H., Burrows, S.R., Chew, T.S., Kane, R.G., Staples, J.A. & Kunaratnam, N. (1983b) Epstein-Barr virus specific T-cell response in nasopharyngeal carcinoma patients. *Int. J. Cancer*, **32**, 301–305
- Moss, D.J., Bishop, C.J., Burrows, S.R. & Ryan, J.M. (1985) T Lymphocytes in infectious mononucleosis. I. T Cell death *in vitro*. *Clin. exp. Immunol.*, **60**, 61–69
- Moss, D.J., Misko, I.S., Burrows, S.R., Burman, K., McCarthy, R. & Sculley, T.B. (1988) Cytotoxic T-cell clones discriminate between A- and B-type Epstein-Barr virus transformants. *Nature*, **331**, 719–721
- Moss, D.J., Schmidt, C., Elliott, S., Suhrbier, A., Burrows, S. & Khanna, R. (1996) Strategies involved in developing an effective vaccine for EBV-associated diseases. *Adv. Cancer Res.*, **69**, 213–245
- Motz, M., Deby, G., Jilg, W. & Wolf, H. (1986) Expression of the Epstein-Barr virus major membrane proteins in Chinese hamster ovary cells. *Gene*, **44**, 353–359
- Mselati, J.C., Buriot, D. & Nezelof, C. (1983) Primary immunologic deficiencies and cancer. Five anatomo-clinical case reports. *Arch. fr. Pediatr.*, **40**, 163–169
- Mueller, N.E. (1987) The epidemiology of Hodgkin's disease. In: Selby, P. & McElwain, T.J., eds, *Hodgkin's Disease*, Oxford, Blackwell Scientific Publications, pp. 68–93
- Mueller, N.E. (1996) Hodgkin's disease. In: Schottenfeld, D. & Fraumeni, J.F., Jr, eds, *Cancer Epidemiology and Prevention*, 2nd Ed., New York, Oxford University Press, pp. 893–919
- Mueller, N.E. (1997) Epstein-Barr virus and Hodgkin's disease: An epidemiological paradox. *Epstein-Barr Virus Rep.*, **4**, 1–2
- Mueller, N.E., Evans, A., Harris, N.L., Comstock, G.W., Jellum, E., Magnus, K., Orentreich, N., Polk, B.F. & Vogelmann, J. (1989) Hodgkin's disease and Epstein-Barr virus. Altered antibody pattern before diagnosis. *New Engl. J. Med.*, **320**, 689–695
- Mueller, N.E., Mohar, A., Evans, A., Harris, N.L., Comstock, G.W., Jellum, E., Magnus, K., Orentreich, N., Polk, B.F. & Vogelmann, J. (1991) Epstein-Barr virus antibody patterns preceding the diagnosis of non-Hodgkin's lymphoma. *Int. J. Cancer*, **49**, 387–393
- Mueller, B.U., Butler, K.M., Higham, M.C., Husson, R.N., Montrella, K.A., Pizzo, P.A., Feuerstein, I.M. & Manjunath, K. (1992) Smooth muscle tumors in children with human immunodeficiency virus infection. *Pediatrics*, **90**, 460–463
- Mueller-Lantzsch, N., Georg, B., Yamamoto, N. & zur Hausen, H. (1980) Epstein-Barr virus-induced proteins. III. Analysis of polypeptides from P3HR-1-EBV-superinfected NC37 cells by immunoprecipitation. *Virology*, **102**, 231–233
- Muir, C.S. (1971) Nasopharyngeal carcinoma in non-Chinese populations with special reference to south-east Asia and Africa. *Int. J. Cancer*, **8**, 351–363
- Muir, C.S. & Shanmugaratnam, K. (1967) *Cancer of the Nasopharynx* (UICC Monograph Series No. 1), New York, Medical Examination Publishing Co.
- Muir, C., Waterhouse, J., Mack, T., Powell, J. & Whelan, S., eds (1987) *Cancer Incidence in Five Continents, Vol. V* (IARC Scientific Publications No. 88), Lyon, IARC
- Muñoz, N., Davidson, R.J.L., Witthoff, B., Ericsson, J.E. & de Thé, G. (1978) Infectious mononucleosis and Hodgkin's disease. *Int. J. Cancer*, **22**, 10–13

- Muñoz, A., Schragar, L.K., Bacellar, H., Speizer, I., Vermund, S.H., Detels, R., Saah, A.J., Kingsley, L.A., Semnara, D. & Phair, J.P. (1993) Trends in the incidence of outcomes defining acquired immunodeficiency syndrome (AIDS) in the Multicenter AIDS Cohort Study: 1985–1991. *Am. J. Epidemiol.*, **137**, 423–438
- Murphy, F.A. (1989) The promise and challenge of vaccinia-vectored vaccines. *Res. Virol.*, **140**, 463–465
- Murphy, J.K., Young, L.S., Bevan, I.S., Lewis, F.A., Dockey, D., Ironside, J.W., O'Brien, C.J. & Wells, M. (1990) Demonstration of Epstein-Barr virus in primary brain lymphoma by in situ DNA hybridization in paraffin wax embedded tissue. *J. clin Pathol.*, **43**, 220–223
- Murray, R.J., Kurilla, M.G., Brooks, J.M., Thomas, W.A., Rowe, M., Kieff, E. & Rickinson, A.B. (1992a) Identification of target antigens for the human cytotoxic T-cell response to Epstein-Barr virus (EBV); implications for the immune control of EBV-positive malignancies. *J. exp. Med.*, **176**, 157–168
- Murray, P.G., Young, L.S., Rowe, M. & Crocker, J. (1992b) Immunohistochemical demonstration of the Epstein-Barr virus-encoded latent membrane protein in paraffin sections of Hodgkin's disease. *J. Pathol.*, **166**, 1–5
- Murray, P.G., Niedobitek, G., Kremmer, E., Grässer, F., Reynolds, G.M., Cruchley, A., Williams, D.M., Müller-Lantzsch, N. & Young, L.S. (1996) In situ detection of the Epstein-Barr virus-encoded nuclear antigen 1 in oral hairy leukoplakia and virus-associated carcinomas. *J. Pathol.*, **178**, 44–47
- Myers, J.L., Kurtin, P.J., Katzenstein, A.-L.A., Tazelaar, H.D., Colby, T.V., Strickler, J.G., Lloyd, R.V. & Isaacson, P.G. (1995) Lymphomatoid granulomatosis. Evidence of immunophenotypic diversity and relationship to Epstein-Barr virus infection. *Am. J. surg. Pathol.*, **19**, 1300–1312
- Nagao, T., Ishida, Y., Sugano, I., Tajima, Y., Masuzaki, O., Hino, T., Konno, A., Kondo, Y. & Nagao, K. (1996) Epstein-Barr virus-associated undifferentiated carcinoma with lymphoid stroma of the salivary gland in Japanese patients: Comparison with benign lymphoepithelial lesion. *Cancer*, **78**, 695–703
- Nakagomi, H., Dolcetti, R., Bejarano, M.T., Pisa, P., Kiessling, R. & Masucci, M.G. (1994) The Epstein-Barr virus latent membrane protein-1 (LMP1) induces interleukin-10 production in Burkitt lymphoma lines. *Int. J. Cancer*, **57**, 240–244
- Nakamine, H., Okano, M., Taguchi, Y., Pirruccello, S.J., Davis, J.R., Beysel, K.W., Kleveland, K., Sanger, W.G., Fordyce, R.R. & Purtilo, D.T. (1991) Hematopathologic features of Epstein-Barr virus-induced human B-lymphoproliferation in mice with severe combined immunodeficiency. A model of lymphoproliferative disease in immunocompromised patients. *Lab. Invest.*, **65**, 389–399
- Nakanishi, M., Kikuta, H., Tomizawa, K., Kojima, K., Ishizaka, A., Okano, M., Sakiyama, Y. & Matsumoto, S. (1993) Distinct clonotypic Epstein-Barr virus-induced fatal lymphoproliferative disorder in a patient with Wiskott-Aldrich syndrome. *Cancer*, **72**, 1376–1381
- Nakhleh, R.E., Manivel, J.C., Copenhaver, C.M., Sung, J.H. & Strickler, J.G. (1991) *In situ* hybridization for the detection of Epstein-Barr virus in central nervous system lymphomas. *Cancer*, **67**, 444–448
- Nalesnik, M.A. & Starzl, T.E. (1994) Epstein-Barr virus, infectious mononucleosis, and post-transplant lymphoproliferative disorders. *Transplant. Sci.*, **4**, 61–79

- Nalesnik, M.A., Locker, J., Jaffe, R., Reyes, J., Cooper, M., Fung, J. & Starzl, T.E. (1992) Experience with posttransplant lymphoproliferative disorders in solid organ transplant recipients. *Clin. Transplant.*, **6**, 249–252
- Nam, J.-M., McLaughlin, J.K. & Blot, W.J. (1992) Cigarette smoking, alcohol, and nasopharyngeal carcinoma: A case-control study among US whites. *J. natl Cancer Inst.*, **84**, 619–622
- ten Napel, C.H.H., van Egten-Bijker, J., Halie, M.R., Langenhuisen, M.M.A.C. & The, T.H. (1980) Cytomegalovirus-specific immune response and the cellular immune status of malignant lymphoma. *J. clin. lab. Immunol.*, **4**, 145–151
- Nash, A.A., Usherwood, E.J. & Stewart, J.P. (1996) Immunological features of murine gamma-herpesvirus infection. *Sem. Virol.*, **7**, 125–130
- Nasrin, N., Taiba, K., Hannan, N., Hannan, M. & al-Sedairy, S. (1994) A molecular study of EBV DNA and *p53* mutations in nasopharyngeal carcinoma of Saudi Arab patients. *Cancer Lett.*, **82**, 189–198
- National Cancer Control Office, Nanjing Institute of Geography (1979) *Atlas of Cancer Mortality in the People's Republic of China*, Shanghai, China Map Press
- National Cancer Control Office (1980) *Summary Data of the Cancer Mortality Survey in the People's Republic of China*, Beijing, Ministry of Public Health
- Neri, A., Barriga, F., Inghirami, G., Knowles, D.M., Neequaye, J., Magrath, I.T. & Dalla-Favera, R. (1991) Epstein-Barr virus infection precedes clonal expansion in Burkitt's and acquired immunodeficiency syndrome-associated lymphoma. *Blood*, **77**, 1092–1095
- Neubauer, R.H., Rabin, H., Strand, B.C., Nonoyama, M. & Nelson-Rees, W.A. (1979a) Establishment of a lymphoblastoid cell line and isolation of an Epstein-Barr virus-related virus of gorilla origin. *J. Virol.*, **31**, 845–848
- Neubauer, R.H., Rabin, H., Strand, B.C., Lapin, B.A., Yakovleva, L.A. & Indzie, E. (1979b) Antibody responses to Herpesvirus papio antigens in baboons with lymphoma. *Int. J. Cancer*, **23**, 186–192
- Nevo, S., Meyer, W. & Altman, M. (1971) Carcinoma of nasopharynx in twins. *Cancer*, **28**, 807–809
- Nicholls, J.M., Pittaluga, S., Chung, L.P. & So, K.C. (1994) The association between carcinoma of the tonsil and Epstein-Barr virus — A study using radiolabelled in situ hybridization. *Pathology*, **26**, 94–98
- Nicholls, J.M., Agathangelou, A., Fung, K., Zeng, X. & Niedobitek, G. (1997) The association of squamous cell carcinomas of the nasopharynx with Epstein-Barr virus shows geographic variation reminiscent of Burkitt's lymphoma. *J. Pathol.* (in press)
- Nicholson, A.G., Wotherspoon, A.C., Diss, T.C., Singh, N., Butcher, D.N., Pan, L.X., Isaacson, P.G. & Corrin, B. (1996) Lymphomatoid granulomatosis: Evidence that some cases represent Epstein-Barr virus-associated B-cell lymphoma. *Histopathology*, **29**, 317–324
- Niederman, J.C., McCollum, R.W., Henle, G. & Henle, W. (1968) Infectious mononucleosis. *J. Am. med. Assoc.*, **203**, 139–143
- Niedobitek, G., Finn, T., Herbst, H. & Stein, H. (1989a) Detection of viral genomes in the liver by in situ hybridization using ³⁵S-, bromodeoxyuridine-, and biotin-labeled probes. *Am. J. Pathol.*, **134**, 633–639
- Niedobitek, G., Hamilton-Dutoit, S., Herbst, H., Finn, T., Vetner, M., Pallesen, G. & Stein, H. (1989b) Identification of Epstein-Barr virus-infected cells in tonsils of acute infectious mononucleosis by in situ hybridization. *Hum. Pathol.*, **20**, 796–799

- Niedobitek, G., Young, L.S., Lau, R., Brooks, L., Greenspan, D., Greenspan, J.S. & Rickinson, A.B. (1991a) Epstein-Barr virus infection in oral hairy leukoplakia: Virus replication in the absence of a detectable latent phase. *J. gen. Virol.*, **72**, 3035–3046
- Niedobitek, G., Hansmann, M.L., Herbst, H., Young, L.S., Dienemann, D., Hartmann, C.A., Finn, T., Pitteroff, S., Welt, A., Anagnostopoulos, I., Friedrich, R., Lobeck, H., Sam, C.K., Araujo, I., Rickinson, A.B. & Stein, H. (1991b) Epstein-Barr virus and carcinomas: Undifferentiated carcinomas but not squamous cell carcinomas of the nasopharynx are regularly associated with the virus. *J. Pathol.*, **165**, 17–24
- Niedobitek, G., Herbst, H., Young, L.S., Brooks, L., Masucci, M.G., Crocker, J., Rickinson, A.B. & Stein, H. (1992a) Patterns of Epstein-Barr virus infection in non-neoplastic lymphoid tissue. *Blood*, **79**, 2520–2526
- Niedobitek, G., Herbst, H., Young, L.S., Rowe, M., Dienemann, D., Germer, C. & Stein, H. (1992b) Epstein-Barr virus and carcinomas. Expression of the viral genome in an undifferentiated gastric carcinoma. *Diagn. mol. Pathol.*, **1**, 103–108
- Niedobitek, G., Young, L.S., Sam, C.K., Brooks, L., Prasad, U. & Rickinson, A.B. (1992c) Expression of Epstein-Barr virus genes and of lymphocyte activation molecules in undifferentiated nasopharyngeal carcinomas. *Am. J. Pathol.*, **140**, 879–887
- Niedobitek, G., Fahraeus, R., Herbst, H., Latza, U., Ferszt, A., Klein, G. & Stein, H. (1992d) The Epstein-Barr virus encoded membrane protein (LMP) induces phenotypic changes in epithelial cells. *Virchows Arch. B Cell Pathol.*, **62**, 55–59
- Niedobitek, G., Rowlands, D.C., Young, L.S., Herbst, H., Williams, A., Hall, P., Padfield, J., Rooney, N. & Jones, E.L. (1993a) Overexpression of p53 in Hodgkin's disease: Lack of correlation with Epstein-Barr virus infection. *J. Pathol.*, **169**, 207–212
- Niedobitek, G., Agathangelou, A., Barber, P., Smallman, L.A., Jones, E.L. & Young, L.S. (1993b) p53 Overexpression and Epstein-Barr virus infection in undifferentiated and squamous cell nasopharyngeal carcinomas. *J. Pathol.*, **170**, 457–461
- Niedobitek, G., Agathanoggelou, A., Finerty, S., Tierney, R., Watkins, P., Jones, E.L., Morgan, A., Young, L.S. & Rooney, N. (1994) Latent Epstein-Barr virus infection in cottontop tamarins: A possible model for Epstein-Barr virus infection in humans. *Am. J. Pathol.*, **145**, 969–978
- Niedobitek, G., Agathangelou, A., Rowe, M., Jones, E.L., Jones, D.B., Turyaguma, P., Oryema, J., Wright, D.H. & Young, L.S. (1995) Heterogeneous expression of Epstein-Barr virus latent proteins in endemic Burkitt's lymphoma. *Blood*, **86**, 659–665
- Niedobitek, G., Kremmer, E., Herbst, H., Whitehead, L., Dawson, C.W., Niedobitek, E., von Ostau, C., Rooney, N., Grässer, F.A. & Young, L.S. (1997a) Immunohistochemical detection of the Epstein-Barr virus-encoded latent membrane protein 2A (LMP2A) in Hodgkin's disease and infectious mononucleosis. *Blood*, **90**, 1664–1672
- Niedobitek, G., Agathangelou, A., Herbst, H., Whitehead, L., Wright, D.H. & Young, L.S. (1997b) Epstein-Barr virus (EBV) infection in infectious mononucleosis: virus latency, replication and phenotype of EBV-infected cells. *J. Pathol.*, **182**, 151–159
- Niedobitek, G., Mutimer, D.J., Williams, A., Whitehead, L., Wilson, P., Rooney, N., Young, L.S. & Hübscher, S.G. (1997c) Epstein-Barr virus infection and malignant lymphomas in liver transplant recipients. *Int. J. Cancer* (in press)

- Ning, J.-P., Yu, M.C., Wang, Q.-S. & Henderson, B.E. (1990) Consumption of salted fish and other risk factors for nasopharyngeal carcinoma (NPC) in Tianjin, a low-risk region for NPC in the People's Republic of China. *J. natl Cancer Inst.*, **82**, 291–296
- Nkrumah, F.K. (1984) Changes in the presentation of Burkitt's lymphoma in Ghana over a 15-year period (1969–82). In: Williams, A.O., O'Connor, G.T., de Thé, G.B. & Johnson, C.A., eds, *Virus-associated Cancers in Africa* (IARC Scientific Publications No. 63), Lyon, IARC, pp. 665–674
- Nkrumah, F.K. & Perkins, I.V. (1976) Sick cell trait, hemoglobin C trait, and Burkitt's lymphoma. *Am. J. trop. Med. Hyg.*, **25**, 633–636
- Nkrumah, F., Henle, W., Henle, G., Herberman, R., Perkins, V. & Depue, R. (1976) Burkitt's lymphoma: Its clinical course in relation to immunologic reactivities to Epstein-Barr virus and tumor-related antigens. *J. natl Cancer Inst.*, **57**, 1051–1056
- Nolan, L.A. & Morgan, A.J. (1995) The Epstein-Barr virus open reading frame BDLF3 codes for a 100–150 kDa glycoprotein. *J. gen. Virol.*, **76**, 1381–1392
- Nonkwelo, C.B. & Long, W.K. (1993) Regulation of Epstein-Barr virus *Bam*HI-H divergent promoter by DNA methylation. *Virology*, **197**, 205–215
- Nonkwelo, C., Henson, E.B.D. & Sample, J. (1995) Characterization of the Epstein-Barr virus Fp promoter. *Virology*, **206**, 183–195
- Nonkwelo, C., Skinner, J., Bell, A., Rickinson, A. & Sample, J. (1996) Transcription start sites downstream of the Epstein-Barr virus (EBV) Fp promoter in early-passage Burkitt lymphoma cells define a fourth promoter for expression of the EBV EBNA-1 protein. *J. Virol.*, **70**, 623–627
- Nonkwelo, C., Ruf, I.K. & Sample, J. (1997) The Epstein-Barr virus EBNA-1 promoter Qp requires an initiator-like element. *J. Virol.*, **71**, 354–361
- Nonoyama, M. & Pagano, J.S. (1971) Detection of Epstein-Barr viral genome in nonreproductive cells. *Nature new Biol.*, **233**, 103–106
- Nonoyama, M. & Pagano, J.S. (1973) Homology between Epstein-Barr virus DNA and viral DNA from Burkitt's lymphoma and nasopharyngeal carcinoma determined by DNA–DNA reassociation kinetics. *Nature*, **242**, 44–47
- Nonoyama, M., Huang, C.H., Pagano, J.S., Klein, G. & Singh, S. (1973) DNA of Epstein-Barr virus detected in tissue of Burkitt's lymphoma and nasopharyngeal carcinoma. *Proc. natl Acad. Sci. USA*, **70**, 3265–3268
- North, J.R., Morgan, A.J. & Epstein, M.A. (1980) Observations on the EB virus envelope and virus-determined membrane antigen (MA) polypeptides. *Int. J. Cancer*, **26**, 231–240
- North, J.R., Morgan, A.J., Thompson, J.L. & Epstein, M.A. (1982) Purified Epstein-Barr virus M_r 340,000 glycoprotein induces potent virus-neutralizing antibodies when incorporated in liposomes. *Proc. natl Acad. Sci. USA*, **79**, 7504–7508
- Nuebling, C.M. & Mueller-Lantzsch, N. (1991) Identification of the gene product encoded by the *Pst*I repeats (IR4) of the Epstein-Barr virus genome. *Virology*, **185**, 519–523
- Nuebling, C.M., Buck, M., Boos, H., von Deimling, A. & Mueller-Lantzsch, N. (1992) Expression of Epstein-Barr virus membrane antigen gp350/220 in *E. coli* and in insect cells. *Virology*, **191**, 443–447
- Nutting, P.A., Freeman, W.L., Risser, D.R., Helgerson, S.D., Paisano, R., Hisnanick, J., Beaver, S.K., Peters, I., Carney, J.P. & Speers, M.A. (1993) Cancer incidence among American Indians and Alaska natives, 1980 through 1987. *Am. J. public Health*, **83**, 1589–1598

- Oba, D.E. & Hutt-Fletcher, L.M. (1988) Induction of antibodies to the Epstein-Barr virus glycoprotein gp85 with a synthetic peptide corresponding to a sequence in the BXLF2 open reading frame. *J. Virol.*, **62**, 1108–1114
- O'Connor, G. (1961) Malignant lymphoma in African children. Cancer. II. A pathological entity. *Cancer*, **14**, 270–283
- O'Connor, G.T. & Davies, J.N.P. (1960) Malignant tumors in African children with special reference to malignant lymphomas. *J. Pediatr.*, **56**, 526–535
- O'Connor, G., Rappaport, H. & Smith, E.B. (1965) Childhood lymphoma resembling Burkitt's tumor in the United States. *Cancer*, **18**, 411–417
- Oda, K., Tamaru, J., Takenouchi, T., Mikata, A., Nunomura, M., Saitoh, N., Sarashina, H. & Nakajima, N. (1993) Association of Epstein-Barr virus with gastric carcinoma with lymphoid stroma. *Am. J. Pathol.*, **143**, 1063–1071
- Odeku, E.L., Adeloye, A. & Osuntokun, B.O. (1973) The neurological picture of Burkitt's lymphoma in Ibadan. *Afr. J. med. Sci.*, **4**, 119–126
- O'Grady, J., Stewart, S., Elton, R.A. & Krajewski, A.S. (1994) Epstein-Barr virus in Hodgkin's disease and site of origin of tumour. *Lancet*, **343**, 265–266
- Ohno, S., Luka, J., Lindahl, T. & Klein, G. (1977) Identification of a purified complement-fixing antigen as the Epstein-Barr-virus determined nuclear antigen (EBNA) by its binding to metaphase chromosomes. *Proc. natl Acad. Sci. USA*, **74**, 1605–1609
- Ohno, S., Luka, J., Falk, L.A. & Klein, G. (1978) Serological reactivities of human and baboon sera against EBNA and *Herpesvirus papio*-determined nuclear antigen (HUPNA). *Eur. J. Cancer*, **78**, 954–960
- Ohshima, K., Kikuchi, M., Eguchi, F., Masuda, Y., Sumiyoshi, Y., Mohtai, H., Takeshita, M. & Kimura, N. (1990) Analysis of Epstein-Barr viral genomes in lymphoid malignancy using Southern blotting, polymerase chain reaction and in situ hybridization. *Virchows Arch. B*, **59**, 383–390
- Ohshima, K., Kikuchi, M., Masuda, Y., Sumiyoshi, Y., Eguchi, F., Mohtai, H., Takeshita, M. & Kimura, N. (1991) Epstein-Barr viral genomes in carcinoma metastatic to lymph nodes. Association with nasopharyngeal carcinoma. *Acta. pathol. jpn.*, **41**, 437–443
- Okan, I., Wang, Y., Chen, F., Hu, L.F., Imreh, S., Klein, G. & Wiman, K.G. (1995) The EBV-encoded LMP1 protein inhibits p53-triggered apoptosis but not growth arrest. *Oncogene*, **11**, 1027–1031
- Okano, M., Mizuno, F., Osato, T., Takahashi, Y., Sakiyama, Y. & Matsumoto, S. (1984) Wiskott-Aldrich syndrome and Epstein-Barr virus-induced lymphoproliferation (Letter to the Editor). *Lancet*, **ii**, 933–934
- Okano, M., Taguchi, Y., Nakamine, H., Pirruccello, S.J., Davis, J.R., Belisel, K.W., Kleveland, K.L., Sanger, W.G., Fordyce, R.R. & Purtilo, D.T. (1990) Characterization of Epstein-Barr virus-induced lymphoproliferation derived from human peripheral blood mononuclear cells transferred to severe combined immunodeficient mice. *Am. J. Pathol.*, **137**, 517–522
- Okano, M., Kikuta, H., Abo, W., Koizumi, S., Aya, T., Yano, S., Takada, K., Mizuno, F. & Osato, T. (1992) Frequent association of Epstein-Barr virus in Japanese patients with Burkitt's lymphoma. *Jpn. J. clin. Oncol.*, **22**, 320–324
- Okazaki, W., Purchase, H.G. & Burmester, B.R. (1970) Protection against Marek's disease by vaccination with a herpesvirus of turkeys. *Avian Dis.*, **14**, 413–429

- Old, L.J., Boyse, E.A., Oettgen, H.P., de Harven, E., Geering, G., Williamson, B. & Clifford, P. (1966) Precipitating antibody in human serum to an antigen present in cultured Burkitt lymphoma cell. *Proc. natl Acad. Sci. USA*, **56**, 1699–1704
- O'Leary, G. & Kennedy, S.M. (1995) Association of Epstein-Barr virus with sinonasal angio-centric T- cell lymphoma. *J. clin. Pathol.*, **48**, 946-949
- Olisa, E.G., Kovi, J., Kennedy, J., Kish, M.H., Lanava, T.S. & Williams, A.O. (1976) Hodgkin's disease in American Negroes: Histologic classification of the disease in 143 untreated patients, and age distribution. *Am. J. clin. Pathol.*, **66**, 537–544
- Olsen, J.H., Plough Jensen, S., Hink, M., Faurbo, K., Breum, N.O. & Møller-Jensen, O.M. (1984) Occupational formaldehyde exposure and increased nasal cancer risk in man. *Int. J. Cancer*, **34**, 639–644
- Olurin, O. & Williams, A.O. (1972) Orbito-ocular tumors in Nigeria. *Cancer*, **30**, 580–587
- Olweny, C.L.M., Atine, I., Kaddu-Mukasa, A., Owor, R., Andersson-Anvret, M., Klein, G., Henle, W. & de Thé, G. (1977) Epstein-Barr virus genome studies in Burkitt's and non-Burkitt's lymphomas in Uganda. *J. natl Cancer Inst.*, **58**, 1191–1196
- Ono, K., Tanabe, S., Naito, M., Doi, T. & Kato, S. (1970) Antigen common to a herpes type virus from chickens with Marek's disease and EB virus from Burkitt's lymphoma cells. *Biken J.*, **13**, 213–217
- Ooi, E.E., Ren, E.C. & Chan, S.H. (1997) Association between microsatellites within the human MHC and nasopharyngeal carcinoma. *Int. J. Cancer (Prev. Oncol.)*, **74**, 229–232
- Opelz, G. & Henderson, R. (1993) Incidence of non-Hodgkin lymphoma in kidney and heart transplant recipients. *Lancet*, **342**, 1514–1516
- Opstelten, D. & Osmond, D.G. (1983) Pre-B cells in the mouse bone marrow: Immunofluorescence stathmokinetic studies of the proliferation of cytoplasmic μ -chain-bearing cells in normal mice. *J. Immunol.*, **131**, 2635–2640
- Orlowski, R. & Miller, G. (1991) Single-stranded structures are present within plasmids containing the Epstein-Barr virus latent origin of replication. *J. Virol.*, **65**, 677–686
- Osato, T. & Imai, S. (1996) Epstein-Barr virus and gastric carcinoma. *Sem. Cancer Biol.*, **7**, 175–182
- Osato, T., Mizuno, F., Imai, S., Aya, T., Koizumi, S., Kinoshita, T., Tokuda, H., Ito, Y., Hirai, N., Hirota, M., Ohigashi, H., Koshimizu, K., Kofi-Tsekpo, W.M., Were, J.B.O. & Mugambi, M. (1987) African Burkitt's lymphoma and an Epstein-Barr virus-enhancing plant *Eurphoria tirucalli* (Letter to the Editor). *Lancet*, **i**, 1257–1258
- Osato, T., Imai, S., Kinoshita, T., Aya, T., Sugiura, M., Koizumi, S. & Mizuno, F. (1990) Epstein Barr virus, Burkitt's lymphoma, and an African tumor promoter. *Adv. exp. Med. Biol.*, **278**, 147–150
- Osmond, D.G., Priddle, S. & Rico-Vargas, S. (1990) Proliferation of B cell precursors in bone marrow of pristane-conditioned and malaria-infected mice. Implications for B cell oncogenesis. *Curr. Top. Microbiol. Immunol.*, **166**, 149–157
- Osuntokun, B.O., Osuntokun, O., Adeloye, A. & Odeku, E.L. (1973) Primary neuro-ophthalmological presentation of Burkitt's lymphoma. *Afr. J. med. Sci.*, **4**, 111–117
- Ott, G., Ott, M.M., Feller, A.C., Seidl, S. & Müller-Hermelink, H.K. (1992) Prevalence of Epstein-Barr virus DNA in different T-cell lymphoma entities in a European population. *Int. J. Cancer*, **51**, 562-567

- Ott, G., Kirchner, T. & Müller-Hermelink, H.K. (1994) Monoclonal Epstein-Barr virus genomes but lack of EBV-related protein expression in different types of gastric carcinoma. *Histopathology*, **25**, 323–329
- Oudejans, J.J., van den Brule, A.J., Jiwa, N.M., de Bruin, P.C., Ossenkoppele, G.J., van der Valk, P., Walboomers, J.M. & Meijer, C.J. (1995a) BHRF1, the Epstein-Barr virus (EBV) homologue of the bcl-2 protooncogene, is transcribed in EBV-associated B-cell lymphomas and in reactive lymphocytes. *Blood*, **86**, 1893–1902
- Oudejans, J.J., Jiwa, M., van den Brule, A.J.C., Grässer, F.A., Horstman, A., Vos, W., Kluin, P.M., van der Valk, P., Walboomers, J.M.M. & Meijer, C.J.L.M. (1995b) Detection of heterogeneous Epstein-Barr virus gene expression patterns within individual post-transplantation lymphoproliferative disorders. *Am. J. Pathol.*, **147**, 923–933
- Packham, G., Brimmell, M., Cook, D., Sinclair, A.J. & Farrell, P.J. (1993) Strain variation in Epstein-Barr virus immediate early genes. *Virology*, **192**, 541–550
- Pagano, J.S., Huang, C.H. & Levine, P. (1973) Absence of Epstein-Barr viral DNA in American Burkitt's lymphoma. *New Engl. J. Med.*, **289**, 1395–1399
- Pagano, J.S., Huang, C.-H., Klein, G., de Thé, G., Shanmugaratnam, K. & Yang, C.-S. (1975) Homology of Epstein-Barr viral DNA in nasopharyngeal carcinomas from Kenya, Taiwan, Singapore and Tunisia. In: de Thé, G., Epstein, M.A. & zur Hausen, H., eds, *Oncogenesis and Herpesviruses II* (IARC Scientific Publications No. 11), Lyon, IARC, pp. 179–190
- Palazzo, J.P., Lundquist, K., Mitchell, D., Mittal, K.R., Hann, H.-W.L., Munoz, S., Moritz, M.J., Jacobs, J.M. & Martin, P. (1993) Rapid development of lymphoma following liver transplantation in a recipient with hepatitis B and primary hemochromatosis. *Am. J. Gastroenterol.*, **88**, 102–104
- Pallesen, G., Hamilton-Dutoit, S.J., Rowe, M. & Young, L.S. (1991a) Expression of Epstein-Barr virus latent gene products in tumour cells of Hodgkin's disease. *Lancet*, **337**, 320–322
- Pallesen, G., Hamilton-Dutoit, S.J., Rowe, M., Lisse, I., Ralfkiaer, E., Sandvej, K. & Young, L.S. (1991b) Expression of Epstein-Barr virus replicative proteins in AIDS-related non-Hodgkin's lymphoma cells. *J. Pathol.*, **165**, 289–299
- Pallesen, G., Sandvej, K., Hamilton-Dutoit, S.J., Rowe, M. & Young, L.S. (1991c) Activation of Epstein-Barr virus replication in Hodgkin and Reed-Sternberg cells. *Blood*, **78**, 1162–1165
- Pallesen, G., Hamilton-Dutoit, S.J. & Zhou, X. (1993) The association of Epstein-Barr virus (EBV) with T cell lymphoproliferations and Hodgkin's disease: Two new developments in the EBV field. *Adv. Cancer Res.*, **62**, 179–239
- Pan, L., Diss, T.C., Peng, H., Lu, Q., Wotherspoon, A.C., Thomas, J.A. & Isaacson, P.G. (1993) Epstein-Barr virus (EBV) in enteropathy-associated T-cell lymphoma (EATL). *J. Pathol.*, **170**, 137–143
- Papadopoulos, E.B., Ladanyi, M., Emanuel, D., Mackinnon, S., Boulad, F., Carabasi, M.H., Castro-Malaspina, H., Childs, B.H., Gillio, A.P., Small, T.N., Young, J.W., Kernan, N.A. & O'Reilly, R.J. (1994) Infusions of donor leukocytes to treat Epstein-Barr virus-associated lymphoproliferative disorders after allogeneic bone marrow transplantation. *New Engl. J. Med.*, **330**, 1185–1191
- Parker, G.A., Crook, T., Bain, M., Sara, E.A., Farrell, P.J. & Allday, M.J. (1996) Epstein-Barr virus nuclear antigen (EBNA)3C is an immortalizing oncoprotein with similar properties to adenovirus E1A and papillomavirus E7. *Oncogene*, **13**, 2541–2549

- Parkin, D.M., ed. (1986) *Cancer Occurrence in Developing Countries* (IARC Scientific Publications No. 75), Lyon, IARC
- Parkin, D.M. & Iscovich, J. (1997) Risk of cancer in migrants and their descendants in Israel: II. Carcinomas and germ-cell tumours. *Int. J. Cancer*, **70**, 654–660
- Parkin, D.M., Muir, C.S., Whelan, S.L., Gao, Y.-T., Ferlay, J. & Powell, J., eds (1992) *Cancer Incidence in Five Continents*, Vol. VI (IARC Scientific Publications No. 120), Lyon, IARC
- Parkin, D.M., Whelan, S.L., Ferlay, J., Raymond, L. & Young, J., eds (1997) *Cancer Incidence in Five Continents*, Vol. VII (IARC Scientific Publications No. 143), Lyon, IARC
- Pastore, C., Carbone, A., Gloghini, A., Volpe, G., Saglio, G. & Gaidano, G. (1996) Association of 6q deletions with AIDS-related diffuse large cell lymphoma. *Leukemia*, **10**, 1051–1053
- Patarroyo, M., Blazar, B., Pearson, G., Klein, E. & Klein, G. (1980) Induction of the EBV cycle in B-lymphocyte-derived lines is accompanied by increased natural killer (NK) sensitivity and the expression of EBV-related antigen(s) detected by the ADCC reaction. *Int. J. Cancer*, **26**, 365–371
- Pathmanathan, R. (1997) Pathology. In: Chong, V.F.H. & Tsao, S.Y., eds, *Nasopharyngeal Carcinoma*, Singapore, Armour Publishing, pp. 6–13
- Pathmanathan, R., Prasad, U., Chandrika, G., Sadler, R., Flynn, K. & Raab-Traub, N. (1995a) Undifferentiated, nonkeratinizing, and squamous cell carcinoma of the nasopharynx. Variants of Epstein-Barr virus-infected neoplasia. *Am. J. Pathol.*, **146**, 1355–1367
- Pathmanathan, R., Prasad, U., Sadler, R., Flynn, K. & Raab-Traub, N. (1995b) Clonal proliferations of cells infected with Epstein-Barr virus in preinvasive lesions related to nasopharyngeal carcinoma. *New Engl. J. Med.*, **333**, 693–698
- Patton, D.F., Wilkowski, C.W., Hanson, C.A., Shapiro, R., Gajl-Peczalska, K.J., Filipovich, A.H. & McClain, K.L. (1990) Epstein-Barr virus — Determined clonality in posttransplant lymphoproliferative disease. *Transplantation*, **49**, 1080–1084
- Paul, C.C., Keller, J.R., Armpriester, J.M. & Baumann, M.A. (1990) Epstein-Barr virus transformed B lymphocytes produce interleukin-5. *Blood*, **75**, 1400–1403
- Payne, S., Kernohan, N.M. & Walker, F. (1995) Absence of in situ hybridization evidence for latent- or lytic-phase Epstein-Barr virus infection of preinvasive squamous lesions of the cervix. *J. Pathol.*, **176**, 221–226
- Pearson, G., Dewey, F., Klein, G., Henle, G. & Henle, W. (1970) Relation between neutralization of Epstein-Barr virus and antibodies to cell-membrane antigens induced by the virus. *J. natl Cancer Inst.*, **45**, 989–995
- Pearson, G.R., Johansson, B. & Klein, G. (1978a) Antibody-dependent cellular cytotoxicity against Epstein-Barr virus-associated antigens in African patients with nasopharyngeal carcinoma. *Int. J. Cancer*, **22**, 120–125
- Pearson, G.R., Coates, H.L., Neel, H.B., Levine, P., Ablashi, D. & Easton, J. (1978b) Clinical evaluation of EBV serology in American patients with nasopharyngeal carcinoma. In: de Thé, G. & Ito Y., eds, *Nasopharyngeal Carcinoma: Etiology and Control* (IARC Scientific Publications No. 20), Lyon, IARC, pp. 439–448
- Pearson, G.R., Qualtiere, L.F., Klein, G., Norin, T. & Bal, I.S. (1979) Epstein-Barr virus-specific antibody-dependent cellular cytotoxicity in patients with Burkitt's lymphoma. *Int. J. Cancer*, **24**, 402–406

- Pearson, G.R., Vroman, B., Chase, B., Sculley, T., Hummel, M. & Kieff, E. (1983a) Identification of polypeptide components of the Epstein-Barr virus early antigen complex with monoclonal antibodies. *J. Virol.*, **47**, 193–201
- Pearson, G.R., Weiland, L.H., Neel, H.B., III, Taylor, W., Earle, J., Mulrone, S.E., Goepfert, H., Lanier, A., Talvot, M.L., Pilch, B., Goodman, M., Huang, A., Levine, P.H., Hyams, V., Moran, E., Henle, G. & Henle, W. (1983b) Application of Epstein-Barr virus (EBV) serology to the diagnosis of North American nasopharyngeal carcinoma. *Cancer*, **51**, 260–268
- Pearson, G.R., Luka, J., Petti, L., Sample, J., Birkenbach, M., Braun, D. & Kieff, E. (1987) Identification of an Epstein-Barr virus early gene encoding a second component of the restricted early antigen complex. *Virology*, **160**, 151–161
- Pedersen, C., Gerstoft, J., Lundgren, J.D., Skinhøj, P., Bottzauw, J., Geisler, C., Hamilton-Dutoit, J., Thorsen, S., Lisse, I., Ralfkiaer, E. & Pallesen, G. (1991) HIV-associated lymphoma: Histopathology and association with Epstein-Barr virus genome related to clinical, immunological and prognostic features. *Eur. J. Cancer*, **27**, 1416–1423
- Peh, S.C., Sandvej, K. & Pallesen, G. (1995) Epstein-Barr virus (EBV) in Malaysian upper-aerodigestive-tract lymphoma: Incidence and sub-type. *Int. J. Cancer*, **61**, 327–332
- Pellicci, P.G., Knowles, D.M., Magrath, I. & Dalla-Favera, R. (1986) Chromosomal breakpoints and structural alterations of the c-myc locus differ in endemic and sporadic forms of Burkitt lymphoma. *Proc. natl Acad. Sci. USA*, **83**, 2984–2988
- Peng, M. & Lundgren, E. (1992) Transient expression of the Epstein-Barr virus *LMP1* gene in human primary B cells induces cellular activation and DNA synthesis. *Oncogene*, **7**, 1775–1782
- Perlmann, C., Saemundsen, A.K. & Klein, G. (1982) A fraction of Epstein-Barr virus virion DNA is methylated in and around the *EcoRI*-J fragment. *Virology*, **123**, 217–221
- Pesano, R.L. & Pagano, J.S. (1986) Herpesvirus papio contains a plasmid origin of replication that acts in *cis* interspecies with Epstein-Barr virus trans-activating function. *J. Virol.*, **60**, 1159–1162
- Petti, L. & Kieff, E. (1988) A sixth Epstein-Barr virus nuclear protein (EBNA3B) is expressed in latently infected growth-transformed lymphocytes. *J. Virol.*, **62**, 2173–2178
- Petti, L., Sample, J., Wang, F. & Kieff, E. (1988) A fifth Epstein-Barr virus nuclear protein (EBNA3C) is expressed in latently infected growth-transformed lymphocytes. *J. Virol.*, **62**, 1330–1338
- Petti, L., Sample, C. & Kieff, E. (1990) Subnuclear localization and phosphorylation of Epstein-Barr virus latent infection nuclear proteins. *Virology*, **176**, 563–574
- Pflugfelder, S.C., Crouse, C.A., Monroy, D., Yen, M., Rowe, M. & Atherton, S.S. (1993) Epstein-Barr virus and the lacrimal gland pathology of Sjögren's syndrome. *Am. J. Pathol.*, **143**, 49–64
- Pfüller, R. & Hammerschmidt, W. (1996) Plasmid-like replicative intermediates of the Epstein-Barr virus lytic origin of DNA replication. *J. Virol.*, **70**, 3423–3431
- Philip, T. (1985) Burkitt's lymphoma in Europe. In: Lenoir, G.M., O'Connor, G.T. & Olweny, C.L.M., eds, *Burkitt's Lymphoma: A Human Cancer Model* (IARC Scientific Publications No. 60), Lyon, IARC, pp. 107–118
- Pike, M.C., Williams, E.H. & Wright, B. (1967) Burkitt's tumour in the West Nile District, Uganda, 1961–65. *Br. med. J.*, **ii**, 395–399

- Pike, M.C., Morrow, R.H., Kisuule, A. & Mafigiri, J. (1970) Burkitt's lymphoma and sickle cell trait. *Br. J. prev. soc. Med.*, **24**, 39–41
- Pisani, P., Parkin, D.M., Muñoz, N. & Ferlay, J. (1997) Cancer and infection: Estimates of the attributable fraction in 1990. *Cancer Epidemiol. Biomarkers Prev.*, **6**, 387–400
- Pither, R.J., Zhang, C.X., Shiels, C., Tarlton, J., Finerty, S. & Morgan, A.J. (1992a) Mapping of B-cell epitopes on the polypeptide chain of the Epstein-Barr virus major envelope glycoprotein and candidate vaccine molecule gp340. *J. Virol.*, **66**, 1246–1251
- Pither, R.J., Nolan, L., Tarlton, J., Walford, J. & Morgan A.J. (1992b) Distribution of epitopes within the amino acid sequence of the Epstein-Barr virus major envelope glycoprotein, gp340, recognized by hyperimmune rabbit sera. *J. gen. Virol.*, **73**, 1409–1415
- Pittaluga, S., Loke, S.L., So, K.C., Cheung, K.N. & Ma, L. (1992) Clonal Epstein-Barr virus in lymphoepithelioma-like carcinoma of the stomach: demonstration of viral genome by in situ hybridization and Southern blot analysis. *Mod. Pathol.*, **5**, 661–664
- Pittaluga, S., Wong, M.P., Chung, L.P. & Loke, S.-L. (1993) Clonal Epstein-Barr virus in lymphoepithelioma-like carcinoma of the lung. *Am. J. surg. Pathol.*, **17**, 678–682
- Poirier, S., Ohshima, H., de Thé, G., Hubert, A., Bourgade, M.C. & Bartsch, H. (1987) Volatile nitrosamine levels in common foods from Tunisia, south China and Greenland, high-risk areas for nasopharyngeal carcinoma (NPC). *Int. J. Cancer*, **39**, 293–296
- Poirier, S., Bouvier, G., Malaveille, C., Ohshima, H., Shao, Y.M., Hubert, A., Zeng, Y., de Thé, G. & Bartsch, H. (1989) Volatile nitrosamine levels and genotoxicity of food samples from high-risk areas for nasopharyngeal carcinoma before and after nitrosation. *Int. J. Cancer*, **44**, 1088–1094
- Polack, A., Delius, H., Zimmer, U. & Bornkamm, G.W. (1984a) Two deletions in the Epstein-Barr virus genome of the Burkitt lymphoma nonproducer line Raji. *Virology*, **133**, 146–157
- Polack, A., Hartl, G., Zimmer, U., Freese, U.-K., Laux, G., Takaki, K., Hohn, B., Gissman, L. & Bornkamm, G.W. (1984b) Complete set of overlapping cosmid clones of M-ABA virus derived from nasopharyngeal carcinoma and its similarity to other Epstein-Barr virus isolates. *Gene*, **27**, 279–288
- Polack, A., Feederle, R., Klobeck, G. & Hörtnagel, K. (1993) Regulatory elements in the immunoglobulin kappa locus induce *c-myc* activation and the promoter shift in Burkitt's lymphoma cells. *EMBO J.*, **12**, 3913–3920
- Polack, A., Hörtnagel, K., Pajic, A., Christoph, B., Baier, B., Falk, M., Mautner, J., Geltinger, C., Bornkamm, G.W. & Kempkes, B. (1996) *c-myc* Activation renders proliferation of Epstein-Barr virus (EBV)-transformed cells independent of EBV nuclear antigen 2 and latent membrane protein 1. *Proc. natl Acad. Sci. USA*, **93**, 10411–10416
- Polito, P., Cilia, A.M., Gloghini, A., Cozzi, M., Perin, T., De Paoli, P., Gaidano, G. & Carbone, A. (1995) High frequency of EBV association with non-random abnormalities of the chromosome region 1q21-25 in AIDS-related Burkitt's lymphoma-derived cell lines. *Int. J. Cancer*, **61**, 370–374
- Polvino-Bodnar, M., Kiso, J. & Schaffer, P.A. (1988) Mutational analysis of Epstein-Barr virus nuclear antigen 1 (EBNA 1). *Nucleic Acids Res.*, **16**, 3415–3435
- Pomponi, R., Cariati, R., Zancai, P., De Paoli, P., Rizzo, S., Tedeschi, R.M., Pivetta, B., De Vita, S., Boiocchi, M. & Dolcetti, R. (1996) Retinoids irreversibly inhibit in vitro growth of Epstein-Barr virus-immortalized B lymphocytes. *Blood*, **88**, 3147–3159

- Pope, J.H., Horne, M.K. & Scott, W. (1968) Transformation of foetal human leukocytes *in vitro* by filtrates of a human leukaemic cell line containing herpes-like virus. *Int. J. Cancer*, **3**, 857–866
- Pope, J.H., Horne, J.M.K. & Wetters, E.J. (1969) Significance of a complement-fixing antigen associated with herpes-like virus and detected in the Raji cell line. *Nature*, **222**, 186–187
- Poppema, S. & Visser, L. (1994) Epstein-Barr virus positivity in Hodgkin's disease does not correlate with an HLA A2-negative phenotype. *Cancer*, **73**, 3059–3063
- Poppema, S., van Imhoff, G., Torensma, R. & Smit, J. (1985) Lymphadenopathy morphologically consistent with Hodgkin's disease associated with Epstein-Barr virus infection. *Am. J. clin. Pathol.*, **84**, 385–390
- Poulsen, L.O., Christensen, J.H., Sørensen, B., Ebbesen, P., Pallesen, G. & Grunnet, N. (1991) Immunologic observations in close relatives of two sisters with mammary Burkitt's lymphoma. *Cancer*, **68**, 1031–1034
- Pour, P., Kruger, F.W., Cardesa, A., Althoff, J. & Mohr, U. (1973) Carcinogenic effect of di-*n*-propylnitrosamine in Syrian golden hamsters. *J. natl Cancer Inst.*, **51**, 1019–1027
- Preciado, M.V., De Matteo, E., Diez, B., Menárguez, J. & Grinstein, S. (1995) Presence of Epstein-Barr virus and strain type assignment in Argentine childhood Hodgkin's disease. *Blood*, **86**, 3922–3929
- Prévot, S., Hamilton-Dutoit, S., Audouin, J., Walter, P., Pallesen, G. & Diebold, J. (1992) Analysis of African Burkitt's and high-grade B cell non-Burkitt's lymphoma for Epstein-Barr virus genomes using *in situ* hybridization. *Br. J. Haematol.*, **80**, 27–32
- Prévot, S., Nérès, J. & de Saint Maur, P.P. (1994) Detection of Epstein Barr virus in an hepatic leiomyomatous neoplasm in an adult human immunodeficiency virus 1-infected patient. *Virchows Arch.*, **425**, 321–325
- Provisor, A.J., Iacuone, J.J., Chilcote, R.R., Neiburger, R.G., Crussi, F.G. & Baehner, R.L. (1975) Acquired agammaglobulinemia after a life-threatening illness with clinical and laboratory features of infectious mononucleosis in three related male children. *New Engl. J. Med.*, **293**, 62–65
- Puglielli, M.T., Woisetschlaeger, M. & Speck, S.H. (1996) *oriP* is essential for EBNA gene promoter activity in Epstein-Barr virus-immortalized lymphoblastoid cell lines. *J. Virol.*, **70**, 5758–5768
- Pulvertaft, R.J.V. (1965) A study of malignant tumours in Nigeria by short-term tissue culture. *J. clin. Pathol.*, **18**, 261
- Purtilo, D.T. (1976) Pathogenesis and phenotypes of an X-linked recessive lymphoproliferative syndrome. *Lancet*, **ii**, 882–885
- Purtilo, D.T. (1981) X-Linked lymphoproliferative syndrome. *Arch. Pathol. Lab. Med.*, **105**, 119–121
- Purtilo, D.T. (1991) X-Linked lymphoproliferative disease (XLP) as a model of Epstein-Barr virus-induced immunopathology. *Semin. Immunopathol.*, **13**, 181–197
- Purtilo, D.T. & Sakamoto, K. (1981) Epstein-Barr virus and human disease: Immune responses determine the clinical and pathologic expression. *Hum. Pathol.*, **12**, 677–679
- Purtilo, D.T., Falk, K., Pirruccello, S.J., Nakamine, H., Kleveland, K., Davis, J.R., Okano, M., Taguchi, Y., Sanger, W.G. & Beisel, K.W. (1991) SCID mouse model of Epstein-Barr virus induced lymphomagenesis of immunodeficient humans. *Int. J. Cancer*, **47**, 510–517

- Qu, L. & Rowe, D.T. (1992) Epstein-Barr virus latent gene expression in uncultured peripheral blood lymphocytes. *J. Virol.*, **66**, 3715–3724
- Qualtièrre, L.F. & Pearson, G.R. (1980) Radioimmune precipitation study comparing the Epstein-Barr virus-induced membrane antigens expressed on P₃HR-1 virus-superinfected Raji cells to those expressed on cells in a B-95 virus-transformed producer culture activated with tumor-promoting agent (TPA). *Virology*, **102**, 360–369
- Qualtièrre, L.F., Decoteau, J.F. & Hassan Nasr-El-Din, M. (1987) Epitope mapping of the major Epstein-Barr virus outer envelope glycoprotein gp350/220. *J. gen. Virol.*, **68**, 535–543
- Quintanilla-Martínez, L., Gamboa-Domínguez, A., Gamez-Ledesma, I., Angeles-Angeles, A. & Mohar, A. (1995) Association of Epstein-Barr virus latent membrane protein and Hodgkin's disease in Mexico. *Mod. Pathol.*, **8**, 675–679
- Raab-Traub, N. (1992a) Epstein-Barr virus infection in nasopharyngeal carcinoma. *Infect. Agents Dis.*, **1**, 173–184
- Raab-Traub, N. (1992b) Epstein-Barr virus and nasopharyngeal carcinoma. *Semin. Cancer Biol.*, **3**, 297–307
- Raab-Traub, N. & Flynn, K. (1986) The structure of the termini of the Epstein-Barr virus as a marker of clonal cellular proliferation. *Cell*, **47**, 883–889
- Raab-Traub, N., Dambaugh, T. & Kieff, E. (1980) DNA of Epstein-Barr virus VIII: B95-8, the previous prototype, is an unusual deletion derivative. *Cell*, **22**, 257–267
- Raab-Traub, N., Hood, R., Yang, C.-S., Henry, B. & Pagano, J.S. (1983) Epstein-Barr virus transcription in nasopharyngeal carcinoma. *J. Virol.*, **48**, 580–590
- Raab-Traub, N., Flynn, K., Pearson, G., Huang, A., Levine, P., Lanier, A. & Pagano, J. (1987) The differentiated form of nasopharyngeal carcinoma contains Epstein-Barr virus DNA. *Int. J. Cancer*, **39**, 25–29
- Raab-Traub, N., Rajadurai, P., Flynn, K. & Lanier, A.P. (1991) Epstein-Barr virus infection in carcinoma of the salivary gland. *J. Virol.*, **65**, 7032–7036
- Rabbitts, T.H., Forster, A., Hamlyn, P. & Baer, R. (1984) Effect of somatic mutation within translocated *c-myc* genes in Burkitt's lymphoma. *Nature*, **309**, 592–597
- Rabin, H., Neubauer, R.H., Hopkins, R.F. & Levy, B.M. (1977) Characterization of lymphoid cell lines established from multiple Epstein-Barr virus (EBV)-induced lymphomas in a cotton-topped marmoset. *Int. J. Cancer*, **20**, 44–50
- Rabkin, C.S., Hilgartner, M.W., Hedberg, K.W., Aledort, L.M., Hatzakis, A., Eichinger, S., Eyster, M.E., White, G.C., II, Kessler, C.M., Lederman, M.M., de Moerloose, P., Bray, G.L., Cohen, A.R., Andes, W.A., Manco-Johnson, M., Schramm, W., Kroner, B.L., Blattner, W.A. & Goedert, J.J. (1992) Incidence of lymphomas and other cancers in HIV-infected and HIV-uninfected patients with hemophilia. *J. Am. med. Assoc.*, **267**, 1090–1094
- Raffeld, M., Yano, T., Hoang, A.T., Lewis, B., Clark, H.M., Otsuki, T. & Dang, C.V. (1995) Clustered mutations in the transcriptional activation domain of *myc* in 8q24 translocated lymphomas and their functional consequences. *Curr. Top. Microbiol. Immunol.*, **194**, 265–272
- Ragona, G., Ernberg, I. & Klein, G. (1980) Induction and biological characterization of the EBV-virus (EBV) carried by the Jijoye lymphoma line. *Virology*, **101**, 553–557
- Ragona, G., Sirianni, M.C., Soddu, S., Vercelli, B., Sebastiani, G., Piccoli, M. & Aiuti, F. (1986) Evidence for dysregulation in the control of Epstein-Barr virus latency in patients with AIDS-related complex. *Clin. exp. Immunol.*, **66**, 17–24

- Ragot, T., Finerty, S., Watkins, P.E., Perricaudet, M. & Morgan, A.J. (1993) Replication-defective recombinant adenovirus expressing the Epstein-Barr virus (EBV) envelope glycoprotein gp340/220 induces protective immunity against EBV-induced lymphomas in the cottontop tamarin. *J. gen. Virol.*, **74**, 501–507
- Rajpert-de Meyts, E., Hørding, U., Nielsen, H.W. & Skakkebaek, N.E. (1994) Human papillomavirus and Epstein-Barr virus in the etiology of testicular germ cell tumours. *Acta pathol. microbiol. immunol. scand.*, **102**, 38–42
- Randhawa, P.S., Markin, R.S., Starzl, T.E. & Demetris, A.J. (1990) Epstein-Barr virus-associated syndromes in immunosuppressed liver transplant recipients. Clinical profile and recognition on routine allograft biopsy. *Am. J. surg. Pathol.*, **14**, 538–547
- Randhawa, P.S., Jaffe, R., Demetris, A.J., Nalesnik, M., Starzl, T.E., Chen, Y.-Y. & Weiss, L.M. (1992) Expression of Epstein-Barr virus-encoded small RNA (by the EBER-1 gene) in liver specimens from transplant recipients with post-transplantation lymphoproliferative disease. *New Engl. J. Med.*, **327**, 1710–1714
- Randhawa, P.S., Magnone, M., Jordan, M., Shapiro, R., Demetris, A.J. & Nalesnik, M. (1996) Renal allograft involvement by Epstein-Barr virus associated post-transplant lymphoproliferative disease. *Am. J. surg. Pathol.*, **20**, 563–571
- Rangan, S.R.S., Martin, L.N., Bozelka, B.E., Wang, N. & Gormus, B.J. (1986) Epstein-Barr virus-related herpesvirus from a rhesus monkey (*Macaca mulatta*) with malignant lymphoma. *Int. J. Cancer*, **38**, 425–432
- Raphael, M.M., Audouin, J., Lamine, M., Delecluse, H.-J., Vuillaume, M., Lenoir, G.M., Gisselbrecht, C., Lennert, K., Diebold, J. & the French Study Group of Pathology for HIV-associated Tumors (1994) Immunophenotypic and genotypic analysis of acquired immunodeficiency syndrome-related non-Hodgkin's lymphomas. Correlation with histologic features in 36 cases. *Am. J. clin. Pathol.*, **101**, 773–782
- Rasheed, S., Rongey, R.W., Bruszweski, J., Nelson-Rees, W.A., Rabin, H., Neubauer, R.H., Esra, G. & Gardner, M.B. (1997) Establishment of a cell line with associated Epstein-Barr-like virus from a leukemic orangutan. *Science*, **198**, 407–409
- Rawlins, D.R., Milman, G., Hayward, S.D. & Hayward, G.S. (1985) Sequence-specific DNA binding of the Epstein-Barr virus nuclear antigen (EBNA-1) to clustered sites in the plasmid maintenance region. *Cell*, **42**, 859–868
- Rea, D., Fourcade, C., Leblond, V., Rowe, M., Joab, I., Edelman, L., Bitker, M.O., Gandjbakhch, I., Suberbielle, C., Farcet, J.-P. & Raphael, M. (1994) Patterns of Epstein-Barr virus latent and replicative gene expression in Epstein-Barr virus B cell lymphoproliferative disorders after organ transplantation. *Transplantation*, **58**, 317–324
- Reedman, B.M. & Klein, G. (1973) Cellular localization of an Epstein-Barr virus (EBV)-associated complement-fixing antigen in producer and non-producer lymphoblastoid cell lines. *Int. J. Cancer*, **11**, 499–520
- Reedman, B.M., Klein, G., Pope, J.H., Walters, M.K., Hilgers, J., Singh, S. & Johansson, B. (1974) Epstein-Barr virus-associated complement-fixing and nuclear antigens in Burkitt lymphoma biopsies. *Int. J. Cancer*, **13**, 755–763
- Regaud, C. (1921) Discussion in Reverchon, L. & Coutard, H., Hypopharynx lymphoepithelioma treated by roentgen therapy. *Bull. Soc. fr. Otorhinolaryngol.*, **34**, 209 (in French)
- Reisman, D. & Sugden, B. (1986) *trans*-Activation of an Epstein-Barr viral transcriptional enhancer by the Epstein-Barr viral nuclear antigen 1. *Mol. cell. Biol.*, **6**, 3838–3846

- Reisman, D., Yates, J. & Sugden, B. (1985) A putative origin of replication of plasmids derived from Epstein-Barr virus is composed of two *cis*-acting components. *Mol. cell. Biol.*, **5**, 1822–1832
- Requena, L., Sánchez Yus, E., Jiménez, E. & Roo, E. (1994) Lymphoepithelioma-like carcinoma of the skin: A light-microscopic and immunohistochemical study. *J. cutaneous Pathol.*, **21**, 541–548
- Resnick, L., Herbst, J.S., Ablashi, D.V., Atherton, S., Frank, B., Rosen, L. & Horwitz, S.N. (1988) Regression of oral hairy leukoplakia after orally administered acyclovir therapy. *J. Am. med. Assoc.*, **259**, 384–388
- Reth, M. (1989) Antigen receptor tail clue. *Nature*, **338**, 383–384
- Revoltella, R.P., Vigneti, E., Fruscalzo, A., Park, M., Ragona, G., Rocchi, G. & Calef, E. (1989) Epstein-Barr virus DNA sequences in precursor monocyte-macrophage cell lines established from the bone marrow of children with maturation defects of haematopoiesis. *J. gen. Virol.*, **70**, 1203–1215
- Reynes, M., Aubert, J.P., Cohen, J.H.M., Audouin, J., Tricottet, V., Diebold, J. & Kazatchkine, M.D. (1985) Human follicular dendritic cells express CR1, CR2, and CR3 complement receptor antigens. *J. Immunol.*, **135**, 2687–2694
- Reynolds, D.J., Banks, P.M. & Gulley, M.L. (1995) New characterization of infectious mononucleosis and a phenotypic comparison with Hodgkin's disease. *Am. J. Pathol.*, **146**, 379–388
- Rhodes, G., Rumpold, H., Kurki, P., Patrick, K.M., Carson, D.A. & Vaughan, J.H. (1987) Auto-antibodies in infectious mononucleosis have specificity for the glycine-alanine repeating region of the Epstein-Barr virus nuclear antigen. *J. exp. Med.*, **165**, 1026–1040
- Rickinson, A.B. (1995) Immune intervention against virus-associated human cancers. *Ann. Oncol.*, **6** (Suppl. 1), S69–S71
- Rickinson, A.B. & Epstein, M.A. (1978) Sensitivity of the transforming and replicative functions of Epstein-Barr virus to inhibition by phosphonoacetate. *J. gen. Virol.*, **40**, 409–420
- Rickinson, A.B. & Kieff, E. (1996) Epstein-Barr virus. In: Fields, B.N., Knipe, D.M. & Howley, P.M., eds, *Fields Virology*, 3rd Ed., Vol. 2, Philadelphia, Lippincott-Raven, pp. 2397–2476
- Rickinson, A.B., Finerty, S. & Epstein, M.A. (1978) Inhibition by phosphonoacetate of the in vitro outgrowth of Epstein-Barr virus genome-containing cell lines from the blood of infectious mononucleosis patients. In: de Thé, G., Henle, W. & Rapp, F., eds, *Oncogenesis and Herpesviruses III* (IARC Scientific Publications No. 24), Lyon, IARC, pp. 721–728
- Rickinson, A.B., Moss, D.J. & Pope, J.H. (1979) Long-term C-cell-mediated immunity to Epstein-Barr virus in man. II. Components necessary for regression in virus-infected leukocyte cultures. *Int. J. Cancer*, **23**, 610–617
- Rickinson, A.B., Moss, D.J., Pope, J.H. & Ahlberg, N. (1980a) Long-term T-cell-mediated immunity to Epstein-Barr virus in man. IV. Development of T-cell memory in convalescent infectious mononucleosis patients. *Int. J. Cancer*, **25**, 59–65
- Rickinson, A.B., Wallace, L.E. & Epstein, M.A. (1980b) HLA-restricted T-cell recognition of Epstein-Barr virus-infected B cells. *Nature*, **283**, 865–867
- Rickinson, A.B., Moss, D.J., Wallace, L.E., Rowe, M., Misko, I.S., Epstein, M.A. & Pope, J.H. (1981a) Long-term T-cell-mediated immunity to Epstein-Barr virus. *Cancer Res.*, **41**, 4216–4221

- Rickinson, A.B., Moss, D.J., Allen, D.J., Wallace, L.E., Rowe, M. & Epstein, M.A. (1981b) Reactivation of Epstein-Barr virus-specific cytotoxic T cells by *in vitro* stimulation with the autologous lymphoblastoid cell line. *Int. J. Cancer*, **27**, 593–601
- Rickinson, A.B., Rowe, M., Hart, I.J., Yao, Q.Y., Henderson, L.E., Rabin, H. & Epstein, M.A. (1984) T-Cell-mediated regression of 'spontaneous' and of Epstein-Barr virus-induced B-cell transformation *in vitro*: Studies with cyclosporin A. *Cell. Immunol.*, **87**, 646–658
- Rickinson, A.B., Young, L.S. & Rowe, M. (1987) Influence of the Epstein-Barr virus nuclear antigen EBNA 2 on the growth phenotype of virus-transformed B cells. *J. Virol.*, **61**, 1310–1317
- Rickinson, A.B., Murray, R.J., Brooks, J., Griffin, H., Moss, D.J. & Masucci, M.G. (1992) T Cell recognition of Epstein-Barr virus associated lymphomas. *Cancer Surv.*, **13**, 53–80
- Ricksten, A., Kallin, B., Alexander, H., Dillner, J., Fåhraeus, R., Klein, G., Lerner, R. & Rymo, L. (1988) *Bam*HI E region of the Epstein-Barr virus genome encodes three transformation-associated nuclear proteins. *Proc. natl Acad. Sci. USA*, **85**, 995–999
- Riddler, S.A., Breinig, M.C. & McKnight, J.L.C. (1994) Increased levels of circulating Epstein-Barr virus (EBV)-infected lymphocytes and decreased EBV nuclear antigen antibody responses are associated with the development of posttransplant lymphoproliferative disease in solid-organ transplant recipients. *Blood*, **84**, 972–984
- Ries, L.A.G., Kosary, C.L., Hankey, B.F., Miller, B.A., Harras, A. & Edwards, B.K. (1997) *SEER Cancer Statistics Review, 1973–1994* (NIH Publ. No. 97-2789), Bethesda, National Cancer Institute
- Rinaldo, C.R., Jr, Kingsley, L.A., Lyter, D.W., Rabin, B.S., Atchison, R.W., Bodner, A.J., Weiss, S.H. & Saxinger, W.C. (1986) Association of HTLV-III with Epstein-Barr virus infection and abnormalities of T lymphocytes in homosexual men. *J. infect. Dis.*, **154**, 556–561
- Robertson, E. & Kieff, E. (1995) Reducing the complexity of the transforming Epstein-Barr virus genome to 64 kilobase pairs. *J. Virol.*, **69**, 983–993
- Robertson, E.S., Tomkinson, B. & Kieff, E. (1994) An Epstein-Barr virus with a 58-kilobase-pair deletion that includes BARF0 transforms B lymphocytes *in vitro*. *J. Virol.*, **68**, 1449–1458
- Robertson, E.S., Grossman, S., Johannsen, E., Miller, C., Lin, J., Tomkinson, B. & Kieff, E. (1995a) Epstein-Barr virus nuclear protein 3C modulates transcription through interaction with the sequence-specific DNA-binding protein Jκ. *J. Virol.*, **69**, 3108–3116
- Robertson, K.D., Hayward, S.D., Ling, P.D., Samid, D. & Ambinder, R.F. (1995b) Transcriptional activation of the Epstein-Barr virus latency C promoter after 5-azacytidine treatment: Evidence that demethylation at a single CpG site is crucial. *Mol. cell. Biol.*, **15**, 6150–6159
- Robertson, K.D., Barletta, J., Samid, D. & Ambinder, R.F. (1995c) Pharmacologic activation of expression of immunodominant viral antigens: A new strategy for the treatment of Epstein-Barr-virus-associated malignancies. *Curr. Top. Microbiol. Immunol.*, **194**, 145–154
- Robertson, E.S., Lin, J. & Kieff, E. (1996) The amino-terminal domains of Epstein-Barr virus nuclear proteins 3A, 3B, and 3C interact with RBPJκ. *J. Virol.*, **70**, 3068–3074
- Robinson, J.E., Smith, D. & Niederman, J. (1981) Plasmacytic differentiation of circulating Epstein-Barr virus-infected B lymphocytes during acute infectious mononucleosis. *J. exp. Med.*, **153**, 235–244

- Rocchi, G., Tosato, G., Papa, G. & Ragona, G. (1975) Antibodies to Epstein-Barr virus-associated nuclear antigen and to other viral and non-viral antigens in Hodgkin's disease. *Int. J. Cancer*, **16**, 323-328
- Roeser, H.P., Pope, J.H., Biggs, J.S.G. & Cooke, R.A. (1977) Burkitt's lymphoma in Australia. *Med. J. Aust.*, **1**, 372-374
- Rogers, R.P., Strominger, J.L. & Speck, S.H. (1992) Epstein-Barr virus in B lymphocytes: Viral gene expression and function in latency. *Adv. Cancer Res.*, **58**, 1-26
- Roizman, B., Desrosiers, R.C., Fleckenstein, B., Lopez, C., Minson, A.C. & Studdert, M.J. (1992) The family Herpesviridae: An update. *Arch. Virol.*, **123**, 425-449
- Rooney, C., Howe, J.G., Speck, S.H. & Miller, G. (1989) Influence of Burkitt's lymphoma and primary B cells on latent gene expression by the nonimmortalizing P3J-HR-1 strain of Epstein-Barr virus. *J. Virol.*, **63**, 1531-1539
- Rooney, C.M., Smith, C.A., Ng, C.Y.C., Loftin, S., Li, C., Krance, R.A., Brenner, M.K. & Heslop, H.E. (1995) Use of gene-modified virus-specific T lymphocytes to control Epstein-Barr-virus-related lymphoproliferation. *Lancet*, **345**, 9-13
- Rooney, C.M., Smith, C.A. & Heslop, H.E. (1997) Control of virus-induced lymphoproliferation: Epstein-Barr virus-induced lymphoproliferation and host immunity. *Mol. Med. Today*, **3**, 24-30
- Rosdahl, N., Larsen, S.O. & Clemmesen, J. (1974) Hodgkin's disease in patients with previous infectious mononucleosis: 30 years' experience. *Br. med. J.*, **ii**, 253-256
- Rosén, A., Gergely, P., Jondal, M., Klein, G. & Britton, S. (1977) Polyclonal Ig production after Epstein-Barr virus infection of human lymphocytes *in vitro*. *Nature*, **267**, 52-54
- Rosenberg, S.A. (1982) National Cancer Institute sponsored study of classifications of non-Hodgkin's lymphomas. Summary and description of a working formulation for clinical usage. *Cancer*, **49**, 2112-2135
- Rothwell, R.I. (1979) Juvenile nasopharyngeal carcinoma in Sabah (Malaysia). *Clin. Oncol.*, **5**, 353-358
- Rouah, E., Rogers, B.B., Wilson, D.R., Kirkpatrick, J.B. & Buffone, G.J. (1990) Demonstration of Epstein-Barr virus in primary central nervous system lymphomas by the polymerase chain reaction and *in situ* hybridization. *Hum. Pathol.*, **21**, 545-550
- Roush, G.C., Walrath, J., Stayner, L.T., Kaplan, S.A., Flannery, J.T. & Blair, A. (1987) Nasopharyngeal cancer, sinonasal cancer, and occupations related to formaldehyde: A case-control study. *J. natl Cancer Inst.*, **79**, 1221-1224
- Rousselet, G. & Tursz, T. (1992) CD23 and the Epstein-Barr virus. *Res. Immunol.*, **143**, 456-459
- Rousset, F., Garcia, E., Defrance, T., Péronne, C., Vezzio, N., Hsu, D.-H., Kastelein, R., Moore, K.W. & Banchereau, J. (1992) Interleukin 10 is a potent growth and differentiation factor for activated human B lymphocytes. *Proc. natl Acad. Sci. USA*, **89**, 1890-1893
- Rowe, D.T., Rowe, M., Evan, G.J., Wallace, L.E., Farrell, P.J. & Rickinson, A.B. (1986) Restricted expression of EBV latent genes and T-lymphocyte-detected membrane antigen in Burkitt's lymphoma cells. *EMBO J.*, **5**, 2599-2607
- Rowe, M., Rowe, D.T., Gregory, C.D., Young, L.S., Farrell, P.J., Rupani, H. & Rickinson, A.B. (1987a) Differences in B cell growth phenotype reflect novel patterns of Epstein-Barr virus latent gene expression in Burkitt's lymphoma cells. *EMBO J.*, **6**, 2743-2751

- Rowe, M., Evans, H.S., Young, L.S., Hennessy, K., Kieff, E. & Rickinson, A.B. (1987b) Monoclonal antibodies to the latent membrane protein of Epstein-Barr virus reveal heterogeneity of the protein and inducible expression in virus-transformed cells. *J. gen. Virol.*, **68**, 1575–1586
- Rowe, M., Young, L.S., Cadwallader, K., Petti, L., Kieff, E. & Rickinson, A.B. (1989) Distinction between Epstein-Barr virus type A (EBNA 2A) and type B (EBNA 2B) isolates extends to the EBNA 3 family of nuclear proteins. *J. Virol.*, **63**, 1031–1039
- Rowe, M., Lear, A.L., Croom-Carter, D., Davies, A.H. & Rickinson, A.B. (1992) Three pathways of Epstein-Barr virus gene activation from EBNA1-positive latency in B lymphocytes. *J. Virol.*, **66**, 122–131
- Rowe, M., Peng-Pilon, M., Huen, D.S., Hardy, R., Croom-Carter, D., Lundgren, E. & Rickinson, A.B. (1994) Upregulation of *bcl-2* by the Epstein-Barr virus latent membrane protein LMP1: A B-cell-specific response that is delayed relative to NF- κ B activation and to induction of cell surface markers. *J. Virol.*, **68**, 5602–5612
- Rowe, M., Khanna, R., Jacob, C.A., Argat, V., Kelly, A., Powis, S., Belich, M., Croom-Carter, D., Lee, S., Burrows, S.R., Trowsdale, J., Moss, D.J. & Rickinson, A.B. (1995) Restoration of endogenous antigen processing in Burkitt's lymphoma cells by Epstein-Barr virus latent membrane protein-1: Coordinate up-regulation of peptide transporters and HLA-class I antigen expression. *Eur. J. Immunol.*, **25**, 1374–1384
- Rowlands, D.C., Ito, M., Mangham, D.C., Reynolds, G., Herbst, H., Hallissey, M.T., Fielding, J.W., Newbold, K.M., Jones, E.L., Young, L.S. & Niedobitek, G. (1993) Epstein-Barr virus and carcinomas: Rare association of the virus with gastric adenocarcinomas. *Br. J. Cancer*, **68**, 1014–1019
- Ryon, J.J., Hayward, S.D., MacMahon, E.M.E., Mann, R.B., Ling, Y., Charache, P., Phelan, J.A., Miller, G. & Ambinder, R.F. (1993) In situ detection of lytic Epstein-Barr virus infection: Expression of the *NotI* early gene and viral interleukin-10 late gene in clinical specimens. *J. infect. Dis.*, **168**, 345–351
- Sabourin, J.-C., Kanavaros, P., Briere, J., Lescs, M.-C., Petrella, T., Zafrani, E.S. & Gaulard, P. (1993) Epstein-Barr virus (EBV) genomes and EBV-encoded latent membrane protein (LMP) in pulmonary lymphomas occurring in nonimmunocompromised patients. *Am. J. surg. Pathol.*, **17**, 995–1002
- Sadler, R.H. & Raab-Traub, N. (1995a) Structural analyses of the Epstein-Barr virus *Bam*HI A transcripts. *J. Virol.*, **69**, 1132–1141
- Sadler, R.H. & Raab-Traub, N. (1995b) The Epstein-Barr virus 3.5-kilobase latent membrane protein 1 mRNA initiates from a TATA-less promoter within the first terminal repeat. *J. Virol.*, **69**, 4577–4581
- Saemundsen, A.K., Kallin, B. & Klein, G. (1980) Effect of *n*-butyrate on cellular and viral DNA synthesis in cells latently infected with Epstein-Barr virus. *Virology*, **107**, 557–561
- Saemundsen, A.K., Berkel, A.I., Henle, W., Henle, G., Anvret, M., Sanal, Ö, Ersoy, F., Çaglar, M. & Klein, G. (1981) Epstein-Barr-virus-carrying lymphoma in a patient with ataxia-telangiectasia. *Br. med. J.*, **282**, 425–427
- Saemundsen, A.K., Albeck, H., Hansen, J.P.H., Nielsen, N.H., Anvret, M., Henle, W., Henle, G., Thomsen, K.A., Kristensen, H.K. & Klein, G. (1982) Epstein-Barr virus in nasopharyngeal and salivary gland carcinomas of Greenland Eskimos. *Br. J. Cancer*, **46**, 721–728

- Saiki, Y., Ohtani, H., Naito, Y., Miyazawa, M. & Nagura, H. (1996) Immunophenotypic characterization of Epstein-Barr virus-associated gastric carcinoma: Massive infiltration by proliferating CD8⁺ T-lymphocytes. *Lab. Invest.*, **75**, 67–76
- Sakai, T. & Honjo, T. (1997) Transcriptional activity of EBNA2 through RBP-J. *Nippon Rinsho*, **55**, 293–298 (in Japanese)
- Sakamoto, K., Freed, H.J. & Purtilo, D.T. (1980) Antibody responses to Epstein-Barr virus in families with the X-linked lymphoproliferative syndrome. *J. Immunol.*, **125**, 921–925
- Salaman, M.H., Wedderburn, N. & Bruce-Chwatt, L.J. (1969) The immunodepressive effect of a murine plasmodium and its interaction with murine oncogenic viruses. *J. gen. Microbiol.*, **59**, 383–391
- Salloum, E., Cooper, D.L., Howe, G., Lacy, J., Tallini, G., Crouch, J., Schultz, M. & Murren, J. (1996) Spontaneous regression of lymphoproliferative disorders in patients treated with methotrexate for rheumatoid arthritis and other rheumatic diseases. *J. clin. Oncol.*, **14**, 1943–1949
- Sam, C.K., Prasad, U. & Pathmanathan, R. (1989) Serological markers in the diagnosis of histopathological types of nasopharyngeal carcinoma. *Eur. J. surg. Oncol.*, **15**, 357–360
- Sam, C.K., Brooks, L.A., Niedobitek, G., Young, L.S., Prasad, U. & Rickinson, A.B. (1993) Analysis of Epstein-Barr virus infection in nasopharyngeal biopsies from a group at high risk of nasopharyngeal carcinoma. *Int. J. Cancer*, **53**, 957–962
- Sample, J. & Kieff, E. (1990) Transcription of the Epstein-Barr virus genome during latency in growth-transformed lymphocytes. *J. Virol.*, **64**, 1667–1674
- Sample, J., Hummel, M., Braun, D., Birkenbach, M. & Kieff, E. (1986) Nucleotide sequences of mRNAs encoding Epstein-Barr virus nuclear proteins: A probable transcriptional initiation site. *Proc. natl Acad. Sci. USA*, **83**, 5096–5100
- Sample, J., Liebowitz, D. & Kieff, E. (1989) Two related Epstein-Barr virus membrane proteins are encoded by separate genes. *J. Virol.*, **63**, 933–937
- Sample, J., Young, L., Martin, B., Chatman, T., Kieff, E. & Rickinson, A. (1990) Epstein-Barr virus types 1 and 2 differ in their EBNA-3A, EBNA-3B, and EBNA-3C genes. *J. Virol.*, **64**, 4084–4092
- Sample, J., Henson, E.B.D. & Sample, C. (1992) The Epstein-Barr virus nuclear protein 1 promoter active in type I latency is autoregulated. *J. Virol.*, **66**, 4654–4661
- Sample, J., Kieff, E.F. & Kieff, E.D. (1994) Epstein-Barr virus types 1 and 2 have nearly identical LMP-1 transforming genes. *J. gen. Virol.*, **75**, 2741–2746
- Sandberg, M., Hammerschmidt, W. & Sugden, B. (1997) Characterization of LMP-1's association with TRAF1, TRAF2, and TRAF3. *J. Virol.*, **71**, 4649–4656
- Sander, C.A., Medeiros, L.J., Weiss, L.M., Yano, T., Sneller, M.C. & Jaffe, E.S. (1992) Lymphoproliferative lesions in patients with common variable immunodeficiency syndrome. *Am. J. surg. Pathol.*, **16**, 1170–1182
- Sandvej, K., Krenács, L., Hamilton-Dutoit, S.J., Rindum, J.L., Pindborg, J.J. & Pallesen, G. (1992) Epstein-Barr virus latent and replicative gene expression in oral hairy leukoplakia. *Histopathology*, **20**, 387–395
- Santucci, M., Gallo, O., Calzolari, A. & Bondi, R. (1993) Detection of Epstein-Barr viral genome in tumor cells of Warthin's tumor of parotid gland. *Am. J. clin. Pathol.*, **100**, 662–665

- Sato, H., Takimoto, T., Hatano, M., Pagano, J.S. & Raab-Traub, N. (1989) Epstein-Barr virus with transforming and early antigen-inducing ability originating from nasopharyngeal carcinoma: Mapping of the viral genome. *J. gen. Virol.*, **70**, 717–727
- Savoie, A., Perpête, C., Carpentier, L., Joncas, J. & Alfieri, C. (1994) Direct correlation between the load of Epstein-Barr virus-infected lymphocytes in the peripheral blood of pediatric transplant patients and risk of lymphoproliferative disease. *Blood*, **83**, 2715–2722
- Saw, D., Lau, W.H., Ho, J.H., Chan, J.K. & Ng, C.S. (1986) Malignant lymphoepithelial lesion of the salivary gland. *Hum. Pathol.*, **17**, 914–923
- Sbih-Lammali, F., Djennaoui, D., Belaoui, H., Bouguermouh, A., Decaussin, G. & Ooka, T. (1996) Transcriptional expression of Epstein-Barr virus genes and proto-oncogenes in North African nasopharyngeal carcinoma. *J. med. Virol.*, **49**, 7–14
- Schaefer, O., Hildes, J.A., Medd, L.M. & Cameron, D.G. (1975) The changing pattern of neoplastic disease in Canadian Eskimos. *Can. med. Assoc. J.*, **112**, 1399–1404
- Schaefer, B.C., Strominger, J.L. & Speck, S.H. (1995) Redefining the Epstein-Barr virus-encoded nuclear antigen EBNA-1 gene promoter and transcription initiation site in group I Burkitt lymphoma cell lines. *Proc. natl Acad. Sci. USA*, **92**, 10565–10569
- Schaefer, B.C., Strominger, J.L. & Speck, S.H. (1997) Host-cell-determined methylation of specific Epstein-Barr virus promoters regulates the choice between distinct viral latency programs. *Mol. cell. Biol.*, **17**, 364–377
- Schendel, D.J., Reinhardt, C., Nelson, P.J., Maget, B., Pullen, L., Bornkamm, G.W. & Steinle, A. (1992) Cytotoxic T lymphocytes show HLA-C-restricted recognition of EBV-bearing cells and allorecognition of HLA class I molecules presenting self-peptides. *J. Immunol.*, **149**, 2406–2414
- Schimke, R.N., Collins, D. & Cross, D. (1987) Nasopharyngeal carcinoma, aplastic anemia, and various malignancies in a family: Possible role of Epstein-Barr virus. *Am. J. med. Genet.*, **27**, 195–202
- Schlager, S., Speck, S.H. & Woisetschläger, M. (1996) Transcription of the Epstein-Barr virus nuclear antigen 1 (EBNA1) gene occurs before induction of the BCR2 (Cp) EBNA gene promoter during the initial stages of infection in B cells. *J. Virol.*, **70**, 3561–3570
- Schmauz, R. & Templeton, A.C. (1972) Nasopharyngeal carcinoma in Uganda. *Cancer*, **29**, 610–621
- Schmid, C., Pan, L., Diss, T. & Isaacson, P.G. (1991) Expression of B-cell antigens by Hodgkin's and Reed-Sternberg cells. *Am. J. Pathol.*, **139**, 701–707
- Schmincke, A. (1921) Lymphoepithelial tumours. *Beitr. path. Anat.*, **68**, 161–170 (in German)
- Schneider, R.J., Safer, B., Munemitsu, S.M., Samuel, C.E. & Shenk, T. (1985) Adenovirus VA1 RNA prevents phosphorylation of the eukaryotic initiation factor 2 α subunit subsequent to infection. *Proc. natl Acad. Sci. USA*, **82**, 4321–4325
- de Schryver, A., Klein, G., Henle, G., Henle, W., Cameron, H.M., Santesson, L. & Clifford, P. (1972) EB-virus associated serology in malignant disease: Antibody levels to viral capsid antigens (VCA), membrane antigens (MA) and early antigens (EA) in patients with various neoplastic conditions. *Int. J. Cancer*, **9**, 353–364
- de Schryver, A., Klein, G., Hewetson, J., Rocchi, G., Henle, W., Henle, G., Moss, D.J. & Pope, J.H. (1974) Comparison of EBV neutralization tests based on abortive infection or transformation of lymphoid cells and their relation to membrane reactive antibodies (anti-MA). *Int. J. Cancer*, **13**, 353–362

- Schultz, L.D., Tanner, J., Hofmann, K.J., Emini, E.A., Condra, J.H., Jones, R.E., Kieff, E. & Ellis, R.W. (1987) Expression and secretion in yeast of a 400-kDa envelope glycoprotein derived from Epstein-Barr virus. *Gene*, **54**, 113–123
- Schuster, V., Grimm, T., Kress, W., Seidenspinner, S., Belohradsky, B.H., Müller, P. & Kreth, H.W. (1995) X-Chromosomal-recessive lymphoproliferative disease (XLP): Molecular and genetic studies. *Klin.-Pädiatr.*, **207**, 271–276 (in German)
- Schuster, V., Seidenspinner, S. & Kreth, H.W. (1996) Detection of a nuclear antigen 2 (EBNA2)-variant Epstein-Barr virus strain in two siblings with fatal lymphoproliferative disease. *J. med. Virol.*, **48**, 114–120
- Schweisguth, F. & Posakony, J. (1992) Suppressor of hairless, the Drosophila homolog of the mouse recombination signal-binding protein gene, controls sensory organ cell fates. *Cell*, **69**, 1199–1212
- Scott, J.K. & Smith, G.P. (1990) Searching for peptide ligands with an epitope library. *Science*, **249**, 386–390
- Seeley, J., Svedmyr, E., Weiland, O., Klein, G., Moller, E., Eriksson, E., Andersson, K. & van der Waal, L. (1981) Epstein Barr virus selective T cells in infectious mononucleosis are not restricted to HLA-A and B antigens. *J. Immunol.*, **127**, 293–300
- Seemayer, T.A., Gross, T.G., Maarten Egeler, R., Pirruccello, S.J., Davis, J.R., Kelly, C.M., Okano, M., Lanyi, A. & Sumegi, J. (1995) X-linked lymphoproliferative disease: Twenty-five years after the discovery. *Pediatr. Res.*, **38**, 471–478
- Seigneurin, J.M., Lavoue, M.F., Genoulaz, O., Bornkamm, G.W. & Lenoir, G.M. (1987) Antibody response against the Epstein-Barr virus-coded nuclear antigen 2 (EBNA2) in different groups of individuals. *Int. J. Cancer*, **40**, 349–353
- ten Seldam, R.E.J., Cooke, R. & Atkinson, L. (1966) Childhood lymphoma in the territories of Papua and New Guinea. *Cancer*, **19**, 437–446
- Selves, J., Meggetto, F., Brousset, P., Voigt, J.-J., Pradère, B., Grasset, D., Icart, J., Mariamé, B., Knecht, H. & Delsol, G. (1996a) Inflammatory pseudotumor of the liver. Evidence for follicular dendritic reticulum cell proliferation associated with clonal Epstein-Barr virus. *Am. J. surg. Pathol.*, **20**, 747–753
- Selves, J., Bibeau, F., Brousset, P., Meggetto, F., Mazerolles, C., Voigt, J.-J., Pradere, B., Chiotasso, P. & Delsol, G. (1996b) Epstein-Barr virus latent and replicative gene expression in gastric carcinoma. *Histopathology*, **28**, 121–127
- Serafini-Cessi, F., Malagolini, N., Nanni, M., Dall'Olio, F., Campadelli-Fiume, G., Tanner, J. & Kieff, E. (1989) Characterization of N- and O-linked oligosaccharides of glycoprotein 350 from Epstein-Barr virus. *Virology*, **170**, 1–10
- Serraino, D., Franceschi, S., Talamini, R., Barra, S., Negri, E., Carbone, A. & La Vecchia, C. (1991) Socioeconomic indicators, infectious diseases and Hodgkin's disease. *Int. J. Cancer*, **47**, 352–357
- Se Thoe, S.Y., Wong, K.K., Pathmanathan, R., Sam, C.K., Cheng, H.M. & Prasad, U. (1993) Elevated secretory IgA antibodies to Epstein-Barr virus (EBV) and presence of EBV DNA and EBV receptors in patients with cervical carcinoma. *Gynecol. Oncol.*, **50**, 168–172
- Shah, W.A., Ambinder, R.F., Hayward, G.S. & Hayward, S.D. (1992) Binding of EBNA-1 to DNA creates a protease-resistant domain that encompasses the DNA recognition and dimerization functions. *J. Virol.*, **66**, 3355–3362

- Shanmugaratnam, K. & Sobin, L.H., eds (1991) *Histological Typing of Tumours of the Upper Respiratory Tract and Ear*, 2nd Ed., Berlin, Springer-Verlag
- Shanmugaratnam, K., Tye, C.Y., Goh, E.H. & Chia, K.B. (1978) Etiological factors in nasopharyngeal carcinoma: A hospital-based, retrospective, case-control, questionnaire study. In: de Thé, G. & Ito, Y., eds, *Nasopharyngeal Carcinoma: Etiology and Control* (IARC Scientific Publications No. 20), Lyon, IARC, pp. 199–212
- Shanmugaratnam, K., Chan, S.H., de Thé, G., Goh, J.E., Khor, T.H., Simons, M.J. & Tye, C.Y. (1979) Histopathology of nasopharyngeal carcinoma. Correlations with epidemiology, survival rates and other biological characteristics. *Cancer*, **44**, 1029–1044
- Shao, Y.M., Poirier, S., Ohshima, H., Malaveille, C., Zeng, Y., de Thé, G. & Bartsch, H. (1988) Epstein-Barr virus activation in Raji cells by extracts of preserved food from high risk areas for nasopharyngeal carcinoma. *Carcinogenesis*, **9**, 1455–1457
- Shapiro, R.S., McClain, K., Frizzera, G., Gajl-Peczalska, K.J., Kersey, J.H., Blazar, B.R., Arthur, D.C., Patton, D.F., Greenberg, J.S., Burke, B., Ramsay, N.K.C., McGlave, P. & Filipovich, A.H. (1988) Epstein-Barr virus associated B cell lymphoproliferative disorders following bone marrow transplantation. *Blood*, **71**, 1234–1243
- Shaw, J.E. (1985) The circular intracellular form of Epstein-Barr virus DNA is amplified by the virus-associated DNA polymerase. *J. Virol.*, **53**, 1012–1015
- Shek, T.W.H., Luk, I.S.C., Ng, I.O.L. & Lo, C.Y. (1996) Lymphoepithelioma-like carcinoma of the thyroid gland: Lack of evidence of association with Epstein-Barr virus. *Hum. Pathol.*, **27**, 851–853
- Sheldon, P.J., Hemsted, E.H., Papamichail, M. & Holborow, E.J. (1973) Thymic origin of atypical lymphoid cells in infectious mononucleosis. *Lancet*, **i**, 1153–1155
- Shi, S.-R., Cote, R.J. & Taylor, C.R. (1997) Antigen retrieval immunohistochemistry: Past, present and future. *J. Histochem. Cytochem.*, **45**, 327–343
- Shibata, D. & Weiss, L.M. (1992) Epstein-Barr virus-associated gastric adenocarcinoma. *Am. J. Pathol.*, **140**, 769–774
- Shibata, D., Hansmann, M.-L., Weiss, L.M. & Nathwani, B.N. (1991a) Epstein-Barr virus infections and Hodgkin's disease: A study of fixed tissues using the polymerase chain reaction. *Hum. Pathol.*, **22**, 1262–1267
- Shibata, D., Tokunaga, M., Uemura, Y., Sato, E., Tanaka, S. & Weiss, L.M. (1991b) Association of Epstein-Barr virus with undifferentiated gastric carcinomas with intense lymphoid infiltration. Lymphoepithelioma-like carcinoma. *Am. J. Pathol.*, **139**, 469–474
- Shibata, D., Weiss, L.M., Hernandez, A.M., Nathwani, B.N., Bernstein, L. & Levine, A.M. (1993) Epstein-Barr virus-associated non-Hodgkin's lymphoma in patients infected with the human immunodeficiency virus. *Blood*, **81**, 2102–2109
- Shimizu, N., Tanabe-Tochikura, A., Kuroiwa, Y. & Takada, K. (1994) Isolation of Epstein-Barr virus (EBV)-negative cell clones from the EBV-positive Burkitt's lymphoma (BL) line Akata: Malignant phenotypes of BL cells are dependent on EBV. *J. Virol.*, **68**, 6069–6073
- Shin, W.S., Kang, M.W., Kang, J.H., Choi, M.K., Ahn, B.M., Kim, J.K., Sun, H.S. & Min, K.-W. (1996) Epstein-Barr virus-associated gastric adenocarcinomas among Koreans. *Am. J. clin. Pathol.*, **105**, 174–181

- Shiramizu, B., Barriga, F., Neequaye, J., Jafri, A., Dalla-Favera, R., Neri, A., Guttiérrez, M., Levine, P. & Magrath, I. (1991) Patterns of chromosomal breakpoint locations in Burkitt's lymphoma: Relevance to geography and Epstein-Barr virus association. *Blood*, **77**, 1516–1526
- Shiramizu, B., Herndier, B.G. & McGrath, M.S. (1994) Identification of a common clonal human immunodeficiency virus integration site in human immunodeficiency virus-associated lymphomas. *Cancer Res.*, **54**, 2069–2072
- Shope, T.C. & Miller, G. (1975) EB virus: Malignant lymphoma in cottontop marmosets following inoculation and recovery of the virus from cells of an experimental tumor maintained in organ culture. In: Ito, Y. & Dutcher, R.M., eds, *Comparative Leukemia Research 1973, Leukemogenesis* (Bibliography in Haematology, No. 40), Tokyo, University of Tokyo Press, pp. 375–383
- Shope, T., Dechairo, D. & Miller, G. (1973) Malignant lymphoma in cottontop marmosets after inoculation with Epstein-Barr virus. *Proc. natl Acad. Sci. USA*, **70**, 2487–2491
- Shope, T.C., Khalifa, A.S., Smith, S.T. & Cushing, B. (1982) Epstein-Barr virus antibody in childhood Hodgkin's disease. *Am. J. Dis. Child.*, **136**, 701–703
- Shore, H. (1961) O'Nyong-nyong fever: An epidemic virus disease in East Africa. III. Some clinical and epidemiological observations in the northern province of Uganda. *Trans. R. Soc. trop. Med. Hyg.*, **55**, 361–373
- Silins, S.L. & Sculley, T.B. (1994) Modulation of vimentin, the CD40 activation antigen and Burkitt's lymphoma antigen (CD77) by the Epstein-Barr virus nuclear antigen EBNA-4. *Virology*, **202**, 16–24
- Simons, M.J. & Shanmugaratnam, K., eds (1982) *The Biology of Nasopharyngeal Carcinoma* (UICC Technical Report Series, Vol. 71), Geneva, International Union Against Cancer, pp. 46–54
- Simons, M.J., Wee, G.B., Goh, E.H., Chan, S.H., Shanmugaratnam, K., Day, N.E. & de Thé, G. (1976) Immunogenetic aspects of nasopharyngeal carcinoma. IV. Increased risk in Chinese of nasopharyngeal carcinoma associated with a Chinese-related HLA profile (A2, Singapore 2). *J. natl Cancer Inst.*, **57**, 977–980
- Simons, M.J., Wee, G.B., Singh, D., Dharmalingam, S., Yong, N.K., Chau, J.C.W., Ho, J.H.C., Day, N.E. & de Thé, G. (1977) Immunogenetic aspects of nasopharyngeal carcinoma (NPC). V. Confirmation of a Chinese-related HLA profile (A2, Singapore 2) associated with an increased risk in Chinese for NPC. *Natl Cancer Inst. Monogr.*, **47**, 147–151
- Simons, M.J., Chan, S.H., Wee, G.B., Shanmugaratnam, K., Goh, E.H., Ho, J.H.C., Chau, J.C.W., Dharmalingam, S., Prasad, U., Betuel, H., Day, N.E. & de Thé, G. (1978) Nasopharyngeal carcinoma and histocompatibility antigens. In: de Thé, G. & Ito Y., eds, *Nasopharyngeal Carcinoma: Etiology and Control* (IARC Scientific Publications No. 20), Lyon, IARC, pp. 271–282
- Simons, M.J., Chan, S.H. & Ou, B.X. (1980) Nasopharyngeal carcinoma (NPC), including analysis of HLA gene patterns in Chinese patients with cervical and hepatocellular carcinoma. In: Davis, W., Harrap, K.R., & Stathopoulos, G., eds, *Advances in Tumour Prevention, Detection and Characterization*, Vol. 5, *Human Cancer. Its Characterization and Treatment*, Amsterdam, Excerpta Medica, pp. 369–378
- Sinclair, A.J. & Farrell, P.J. (1995) Host cell requirements for efficient infection of quiescent primary B lymphocytes by Epstein-Barr virus. *J. Virol.*, **69**, 5461–5468

- Sinclair, A.J., Palmero, I., Peters, G. & Farrell, P.J. (1994) EBNA-2 and EBNA-LP cooperate to cause G₀ to G₁ transition during immortalization of resting human B lymphocytes by Epstein-Barr virus. *EMBO J.*, **13**, 3321–3328
- Sinha, S.K., Todd, S.C., Hedrick, J.A., Speiser, C.L., Lambris, J.D. & Tsoukas, C.D. (1993) Characterization of the EBV/C3d receptor on the human Jurkat T cell line: Evidence for a novel transcript. *J. Immunol.*, **150**, 5311–5320
- Sista, N.D., Barry, C., Sampson, K. & Pagano, J. (1995) Physical and functional interaction of the Epstein-Barr virus BZLF1 transactivator with the retinoic acid receptors RAR α and RXR α . *Nucleic Acids Res.*, **23**, 1729–1736
- Sixbey, J.W. & Pagano, J.S. (1985) Epstein-Barr virus transformation of human B lymphocytes despite inhibition of viral polymerase. *J. Virol.*, **53**, 299–301
- Sixbey, J.W. & Yao, Q.-Y. (1992) Immunoglobulin A — Induced shift of Epstein-Barr virus tissue tropism. *Science*, **255**, 1578–1580
- Sixbey, J.W., Vesterinen, E.H., Nedrud, J.G., Raab-Traub, N., Walton, L.A. & Pagano, J.S. (1983) Replication of Epstein-Barr virus in human epithelial cells infected in vitro. *Nature*, **306**, 480–483
- Sixbey, J.W., Nedrud, J.G., Raab-Traub, N., Hanes, R.A. & Pagano, J.S. (1984) Epstein-Barr virus replication in oropharyngeal epithelial cells. *New Engl. J. Med.*, **310**, 1225–1230
- Sixbey, J.W., Lemon, S.M. & Pagano, J.S. (1986) A second site for Epstein-Barr virus shedding: The uterine cervix. *Lancet*, **ii**, 1122–1124
- Sixbey, J.W., Davis, D.S., Young, L.S., Hutt-Fletcher, L., Tedder, T.F. & Rickinson, A.B. (1987) Human epithelial cell expression of an Epstein-Barr virus receptor. *J. gen. Virol.*, **68**, 805–811
- Sixbey, J.W., Shirley, P., Chesney, P.J., Buntin, D.M. & Resnick, L. (1989) Detection of a second widespread strain of Epstein-Barr virus. *Lancet.*, **ii**, 761–765
- Sjöblom, A., Nerstedt, A., Jansson, A. & Rymo, L. (1995a) Domains of the Epstein-Barr virus nuclear antigen 2 (EBNA2) involved in the transactivation of the latent membrane protein 1 and the EBNA Cp promoters. *J. gen. Virol.*, **76**, 2669–2678
- Sjöblom, A., Jansson, A., Yang, W., Laín, S., Nilsson, T. & Rymo, L. (1995b) PU box-binding transcription factors and a POU domain protein cooperate in the Epstein-Barr virus (EBV) nuclear antigen 2-induced transactivation of the EBV latent membrane protein 1 promoter. *J. gen. Virol.*, **76**, 2679–2692
- Skare, J., Farley, J., Strominger, J.L., Fresen, K.O., Cho, M.S. & zur Hausen, H. (1985) Transformation by Epstein-Barr virus requires DNA sequences in the region of BamHI fragments Y and H. *J. Virol.*, **55**, 286–297
- Skare, J.C., Milunsky, A., Byron, K.S. & Sullivan, J.L. (1987) Mapping the X-linked lymphoproliferative syndrome. *Proc. natl Acad. Sci. USA*, **84**, 2015–2018
- Skare, J., Wu, B.-L., Madan, S., Pulijaal, V., Purtilo, D., Haber, D., Nelson, D., Sylla, B., Grierson, H., Nitowsky, H., Glaser, J., Wissink, J., White, B., Holden, J., Housman, D., Lenoir, G., Wyandt, H. & Milunsky, A. (1993) Characterization of three overlapping deletions causing X-linked lymphoproliferative disease. *Genomics*, **16**, 254–255
- Slivnick, D.J., Ellis, T.M., Nawrocki, J.F. & Fisher, R.I. (1990) The impact of Hodgkin's disease on the immune system. *Semin. Oncol.*, **17**, 673–682
- Smith, E.C. & Elmes, B.G.T. (1934) Malignant disease in natives of Nigeria. *Ann. trop. Med. Parasitol.*, **28**, 461–512

- Smith, P.R. & Griffin, B.E. (1991) Differential expression of Epstein Barr viral transcripts for two proteins (TP1 and LMP) in lymphocyte and epithelial cells. *Nucleic Acids Res.*, **19**, 2435–2440
- Smith, P.R. & Griffin, B.E. (1992) Transcription of Epstein-Barr virus gene EBNA-1 from different promoters in nasopharyngeal carcinoma and B-lymphoblastoid cells. *J. Virol.*, **66**, 706–714
- Smith, P.R., Gao, Y., Karran, L. Jones, M.D., Snudden D. & Griffin, B.E. (1993) Complex nature of the major viral polyadenylated transcripts in Epstein-Barr virus-associated tumors. *J. Virol.*, **67**, 3217–3225
- Snudden, D.K., Hearing, J., Smith, P.R., Grässer, F.A. & Griffin, B.E. (1994) EBNA-1, the major nuclear antigen of Epstein-Barr virus, resembles 'RGG' RNA binding proteins. *EMBO J.*, **13**, 4840–4847
- Snudden, D.K., Smith, P.R., Lai, D., Ng, M.H. & Griffin, B.E. (1995) Alterations in the structure of the EBV nuclear antigen, EBNA1, in epithelial cell tumors. *Oncogene*, **10**, 1545–1552
- Sobrinho-Simões, M.A. & Areias, M.A. (1978) Relative high frequency of childhood Hodgkin's disease in the north of Portugal. *Cancer*, **42**, 1952–1956
- Sohier, R. & de Thé, G. (1971) Complement fixation with a soluble antigen: Large differences in activity between the sera of Burkitt's lymphoma, rhinopharyngeal cancers and infectious mononucleosis. *C.R. Acad. Sci. Hebd. Séances Acad. Sci.*, **273**, 121–124 (in French)
- Sohier, R. & de Thé, G. (1972) Evolution of complement-fixing antibody titers with the development of Burkitt's lymphoma. *Int. J. Cancer*, **9**, 524–528
- Spencer, C.A. & Groudine, M. (1991) Control of *c-myc* regulation in normal and neoplastic cells. *Adv. Cancer Res.*, **56**, 1–48
- Spruck, C.H., III, Tsai, Y.C., Huang, D.P., Yang, A.S., Rideout, W.M., III, Gonzalez-Zulueta, M., Choi, P., Lo, K.-W., Yu, M.C. & Jones, P.A. (1992) Absence of p53 gene mutations in primary nasopharyngeal carcinomas. *Cancer Res.*, **52**, 4787–4790
- Sriamporn, S., Vatanasapt, V., Pisani, P., Yongchaiyudha, S. & Rungpitarangsri, V. (1992) Environmental risk factors for nasopharyngeal carcinoma: A case-control study in north-eastern Thailand. *Cancer Epidemiol. Biomarkers Prev.*, **1**, 345–348
- Srinivas, S.K. & Sixbey, J.W. (1995) Epstein-Barr virus induction of recombinase-activating genes RAG1 and RAG2. *J. Virol.*, **69**, 8155–8158
- Sriskandan, S., Labrecque, L.G. & Schofield, J. (1996) Diffuse pneumonia associated with infectious mononucleosis: Detection of Epstein-Barr virus in lung tissue by in situ hybridization. *Clin. infect. Dis.*, **22**, 578–579
- Staal, S.P., Ambinder, R., Beschorner, W.E., Hayward, G.S. & Mann, R. (1989) A survey of Epstein-Barr virus DNA in lymphoid tissue. Frequent detection in Hodgkin's disease. *Am. J. clin. Pathol.*, **91**, 1–5
- Stanley, R. (1997) Clinical presentation and diagnosis. In: Chong, V.F.H. & Tsao, S.Y., eds, *Nasopharyngeal Carcinoma*, Singapore, Armour Publishing (in press)
- Stansfeld, A., Diebold, J., Kapanci, Y., Kelenyi, G., Lennert, K., Mioduszewska, O., Noel, H., Rilke, F., Sundstrom, C., van Unnik, J. & Wright, D. (1988) Updated Kiel classification for lymphomas. *Lancet*, **i**, 292–293

- Starzl, T.E., Nalesnik, M.A., Porter, K.A., Ho, M., Iwatsuki, S., Griffith, B.P., Rosenthal, J.T., Hakala, T.R., Shaw, B.W., Jr, Hardesty, R.L., Atchinson, R.W., Jaffe, R. & Bahnson, H.T. (1984) Reversibility of lymphomas and lymphoproliferative lesions developing under cyclosporin-steroid therapy. *Lancet*, **i**, 583–587
- Stayner, L.T., Elliott, L, Blade, L, Keenlyside, R. & Halperin, W. (1988) A retrospective cohort mortality study of workers exposed to formaldehyde in the garment industry. *Am. J. ind. Med.*, **13**, 667–681
- Steinitz, R., Parkin, D.M., Young, J.L., Bieber, C.A. & Katz, L. (1989) *Cancer Incidence in Jewish Migrants to Israel, 1961–1981* (IARC Scientific Publications No. 98), Lyon, IARC
- Sternås, L., Eliasson, L., Lerner, R. & Klein, G. (1986) Quantitation of Epstein-Barr virus (EBV)-determined nuclear antigen (EBNA) by a two-site enzyme immunoassay, in parallel with EBV-DNA. *J. immunol. Meth.*, **89**, 151–158
- Steven, N.M., Leese, A.M., Annels, N.E., Lee, S.P. & Rickinson, A.B. (1996) Epitope focusing in the primary cytotoxic T cell response to Epstein-Barr virus and its relationship to T cell memory. *J. exp. Med.*, **184**, 1801–1813
- Steven, N.M., Annels, N.E., Kumar, A., Leese, A.M., Kurilla, M.G. & Rickinson, A.B. (1997) Immediate early and late lytic cycle proteins are frequent targets of the Epstein-Barr virus-induced cytotoxic T cell response. *J. exp. Med.*, **185**, 1605–1617
- Stevens, D.A., Kottaridis, S.D. & Luginbuhl, R.E. (1971) Investigation of antigenic relationship of Marek's disease, herpes virus and EB virus (herpes-type virus). *J. comp. Pathol.*, **81**, 137–140
- Stevens, D.A., O'Connor, G.T., Levine, P.H. & Rosen, R.B. (1972) Acute leukemia with 'Burkitt's lymphoma cells' and Burkitt's lymphoma. Simultaneous onset in American siblings; description of a new entity. *Ann. intern. Med.*, **76**, 967–973
- Stewart, J.P. & Arrand, J.R. (1993) Expression of the Epstein-Barr virus latent membrane protein in nasopharyngeal carcinoma biopsy specimens. *Hum. Pathol.*, **24**, 239–242
- Stinson, W.D. (1940) Epidermoid carcinoma of the nasopharynx occurring in two young brothers. *Ann. Otolaryngol.*, **49**, 536–539
- Stolzenberg, M.C., Debouze, S., Ng, M., Sham, J., Choy, D., Bouguermouh, A., Chan, K.H. & Ooka, T. (1996) Purified recombinant deoxyribonuclease in serological diagnosis of nasopharyngeal carcinoma. *Int. J. Cancer*, **66**, 337–341
- Strang, G. & Rickinson, A.B. (1987a) In vitro expansion of Epstein-Barr virus-specific HLA-restricted cytotoxic T cells direct from the blood of infectious mononucleosis patients. *Immunology*, **62**, 647–654
- Strang, G. & Rickinson, A.B. (1987b) Multiple HLA class I-dependent cytotoxicities constitute the 'non-HLA-restricted' response in infectious mononucleosis. *Eur. J. Immunol.*, **17**, 1007–1013
- Straus, S.E., Tosato, G., Armstrong, G., Lawley, T., Preble, O.T., Henle, W., Davey, R., Pearson, G., Epstein, J., Brus, I. & Blaese, R.M. (1985) Persisting illness and fatigue in adults with evidence of Epstein-Barr virus infection. *Ann. intern. Med.*, **102**, 7–16
- Su, I.-J., Lin, K.-H., Chen, C.-J., Tien, H.-F., Hsieh, H.-C., Lin, D.-T. & Chen, J.-Y. (1990) Epstein-Barr virus-associated peripheral T-cell lymphoma of activated CD8 phenotype. *Cancer*, **66**, 2557–2562

- Su, I.-J., Chen, R.-L., Lin, D.-T., Lin, K.-S. & Chen, C.-C. (1994) Epstein-Barr virus (EBV) infects T lymphocytes in childhood EBV-associated hemophagocytic syndrome in Taiwan. *Am. J. Pathol.*, **144**, 1219–1225
- Subar, M., Neri, A., Inghirami, G., Knowles, D.M. & Dalla-Favera, R. (1988) Frequent *c-myc* oncogene activation and infrequent presence of Epstein-Barr virus genome in AIDS-associated lymphoma. *Blood*, **72**, 667–671
- Sugano, H., Sakamoto, G., Sawaki, S. & Hirayama, T. (1978) Histopathological types of nasopharyngeal carcinoma in a low-risk area: Japan. In: de Thé, G. & Ito Y., eds, *Nasopharyngeal Carcinoma: Etiology and Control* (IARC Scientific Publications No. 20), Lyon, IARC, pp. 27–39
- Sugden, B. & Warren, N. (1989) A promoter of Epstein-Barr virus that can function during latent infection can be transactivated by EBNA-1, a viral protein required for viral DNA replication during latent infection. *J. Virol.*, **63**, 2644–2649
- Sugden, B., Phelps, M. & Domoradzki, J. (1979) Epstein-Barr virus DNA is amplified in transformed lymphocytes. *J. Virol.*, **31**, 590–595
- Sugiura, M., Imai, S., Tokunaga, M., Koizumi, S., Uchizawa, M., Okamoto, K. & Osato, T. (1996) Transcriptional analysis of Epstein-Barr virus gene expression in EBV-positive gastric carcinoma: Unique viral latency in the tumour cells. *Br. J. Cancer*, **74**, 625–631
- Sullivan, J.L. & Woda, B.A. (1989) X-Linked lymphoproliferative syndrome. *Immunodeficiency Rev.*, **1**, 325–347
- Sun, Y., Hegameyer, G., Cheng, Y.J., Hildesheim, A., Chen, J.Y., Chen, I.H., Cao, Y., Yao, K.T. & Colburn, N.H. (1992) An infrequent point mutation of the p53 gene in human nasopharyngeal carcinoma. *Proc. natl Acad. Sci. USA*, **89**, 6516–6520
- Sun, Y., Hegameyer, G. & Colburn, N.H. (1993) Nasopharyngeal carcinoma shows no detectable retinoblastoma susceptibility gene alterations. *Oncogene*, **8**, 791–795
- Sun, Y., Hildesheim, A., Lanier, A.E., Cao, Y., Yao, K.T., Raab-Traub, N. & Yang, C.S. (1995) No point mutation but decreased expression of the p16/MTS1 tumor suppressor gene in nasopharyngeal carcinomas. *Oncogene*, **10**, 785–788
- Sundar, S.K., Levine, P.H., Ablashi, D.V., Leiseca, S.A., Armstrong, G.R., Cicmane, J.L., Parker, G.A. & Nonoyama, M. (1981) Epstein-Barr virus-induced malignant lymphoma in a white-lipped marmoset. *Int. J. Cancer*, **27**, 107–111
- Sung, N.S., Kenney, S., Gutsch, D. & Pagano, J.S. (1991) EBNA-2 transactivates a lymphoid-specific enhancer in the *Bam*HI C promoter of Epstein-Barr virus. *J. Virol.*, **65**, 2164–2169
- Sung, N.S., Wilson, J., Davenport, M., Sista, N.D. & Pagano, J.S. (1994) Reciprocal regulation of the Epstein-Barr virus *Bam*HI-F promoter by EBNA-1 and an E2F transcription factor. *Mol. cell. Biol.*, **14**, 7144–7152
- Sunil-Chandra, N.P., Efstathiou, S. & Nash, A.A. (1992) Murine gammaherpesvirus 68 establishes a latent infection in mouse B lymphocytes *in vivo*. *J. gen. Virol.*, **73**, 3275–3279
- Sutkowski, N., Palkama, T., Ciurli, C., Sekaly, R.-P., Thorley-Lawson, D.A. & Huber, B.T. (1996a) An Epstein-Barr virus-associated superantigen. *J. exp. Med.*, **184**, 971–980
- Sutkowski, N., Thorley-Lawson, D.A. & Huber, B.T. (1996b) The interplay of herpesviruses in AIDS: Superantigen sharing. *Trends Microbiol.*, **4**, 89–91
- Svedmyr, E. & Jondal, M. (1975) Cytotoxic effector cells specific for B cell lines transformed by Epstein-Barr virus are present in patients with infectious mononucleosis. *Proc. natl Acad. Sci. USA*, **72**, 1622–1626

- Svedmyr, E., Ernberg, I., Seeley, J., Weiland, O., Masucci, G., Tsukuda, K., Szigeti, R., Masucci, M.G., Blomgren, H., Berthold, W., Henle, W. & Klein, G. (1984) Virologic, immunologic, and clinical observations on a patient during the incubation, acute, and convalescent phases of infectious mononucleosis. *Clin. Immunol. Immunopathol.*, **30**, 437–450
- Swaminathan, S., Tomkinson, B. & Kieff, E. (1991) Recombinant Epstein-Barr virus with small RNA (EBER) genes deleted transforms lymphocytes and replicates *in vitro*. *Proc. natl Acad. Sci. USA*, **88**, 1546–1550
- Swaminathan, S., Hesselton, R., Sullivan, J. & Kieff, E. (1993) Epstein-Barr virus recombinants with specifically mutated BCRF1 genes. *J. Virol.*, **67**, 7406–7413
- Swerdlow, S.H. (1992) Post-transplant lymphoproliferative disorders: A morphologic, phenotypic and genotypic spectrum of disease. *Histopathology*, **20**, 373–385
- Swinnen, L.J. (1996) Lymphoproliferative disorders following organ transplantation: Clinical syndromes and treatment options. *Epstein-Barr Virus Rep.*, **3**, 141–145
- Sylla, B.S., Wang, Q., Hayoz, D., Lathrop, G.M. & Lenoir, G.M. (1989) Multipoint linkage mapping of the Xq25-q26 region in a family affected by the X-linked lymphoproliferative syndrome. *Clin. Genet.*, **36**, 459–462
- Szekely, L., Selivanova, G., Magnusson, K.P., Klein, G. & Wiman, K.G. (1993) EBNA-5, an Epstein-Barr virus-encoded nuclear antigen, binds to the retinoblastoma and p53 proteins. *Proc. natl Acad. Sci. USA*, **90**, 5455–5459
- Szekely, L., Pokrovskaja, K., Jiang, W.-Q., de Thé, H., Ringertz, N. & Klein, G. (1996) The Epstein-Barr virus-encoded nuclear antigen EBNA-5 accumulates in PML-containing bodies. *J. Virol.*, **70**, 2562–2568
- Takada, K. (1984) Cross-linking of cell surface immunoglobulins induces Epstein-Barr virus in Burkitt lymphoma lines. *Int. J. Cancer*, **33**, 27–32
- Takada, K. & Ono, Y. (1989) Synchronous and sequential activation of latently infected Epstein-Barr virus genomes. *J. Virol.*, **63**, 445–449
- Takada, K., Shimizu, N., Tanabe-Tochikura, A. & Kuroiwa, Y. (1995) Pathogenic role of Epstein-Barr virus in human cancer. *Intervirology*, **38**, 214–220
- Takahashi, H., Takeshita, T., Morein, B., Putney, S., Germain, R.N. & Berzofsky, J.A. (1990) Induction of CD8⁺ cytotoxic T cells by immunization with purified HIV-1 envelope protein in iscoms. *Nature*, **344**, 873–875
- Takeshita, M., Akamatsu, M., Ohshima, K., Suzumiya, J., Kikuchi, M., Kimura, N., Uike, N. & Okamura, T. (1996) Angiocentric immunoproliferative lesions of the lymph node. *Am J. clin. Pathol.*, **106**, 69–77
- Takimoto, T., Ogura, H., Sato, H., Umeda, R. & Hatano, M. (1985) Isolation of transforming and early antigen-inducing EBV from nasopharyngeal carcinoma hybrid cells (NPC-KT). *J. natl Cancer Inst.*, **74**, 57–60
- Takimoto, T., Tanaka, S., Ishikawa, S. & Umeda, R. (1989) The human nasopharynx as a reservoir for Epstein-Barr virus. *Auris Nasus Larynx*, **16**, 109–115
- Tamaru, J., Hummel, M., Marafioti, T., Kalvelage, B., Leoncini, L., Minacci, C., Tosi, P., Wright, D. & Stein, H. (1995) Burkitt's lymphomas express VH genes with a moderate number of antigen-selected somatic mutations. *Am. J. Pathol.*, **147**, 1398–1407
- Tamura, S., Yamazaki, A., Kunimoto, M., Takemura, K., Tabata, T., Hinuma, Y. & Yoshie, O. (1992) Impaired long-term T cell immunity to Epstein-Barr virus in patients with nasopharyngeal carcinoma. *Jpn. J. Cancer Res.*, **83**, 445–449

- Tamura, S., Kunimoto, M., Tabata, T. & Yoshie, O. (1993) Genotypic analysis of Epstein-Barr virus associated with nasopharyngeal carcinoma of Japanese patients. *Jpn. J. Cancer Res.*, **84**, 246–249
- Tanaka, T., Komatsubara, S., Miyoshi, I., Hiraki, S., Tada, S., Kubonishi, I., Hujii, M. & Sezaki, T. (1976) Non-African Burkitt's lymphoma in a young woman. *Acta pathol. jpn.*, **26**, 619–628
- Tannenbaum, S.R., Bishop, W., Yu, M.C. & Henderson, B.E. (1985) Attempts to isolate N-nitroso compounds from Chinese-style salted fish. *Natl Cancer Inst. Monogr.*, **69**, 209–211
- Tanner, J.E. & Tosato, G. (1992) Regulation of B-cell growth and immunoglobulin gene transcription by interleukin-6. *Blood*, **79**, 452–459
- Tanner, J., Weis, J., Fearon, D., Whang, Y. & Kieff, E. (1987) Epstein-Barr virus gp350/220 binding to the B lymphocyte C3d receptor mediates adsorption, capping and endocytosis. *Cell*, **50**, 203–213
- Tanner, J., Whang, Y., Sample, J., Sears, A. & Kieff, E. (1988) Soluble gp350/220 and deletion mutant glycoproteins block Epstein-Barr virus adsorption to lymphocytes. *J. Virol.*, **62**, 4452–4464
- Tanner, J.E., Alfieri, C., Chatila, T.A. & Diaz-Mitoma, F. (1996) Induction of interleukin-6 after stimulation of human B-cell CD21 by Epstein-Barr virus glycoproteins gp350 and gp220. *J. Virol.*, **70**, 570–575
- Tao, Q., Srivastava, G., Chan, A.C.L., Chung, L.P., Loke, S.L. & Ho, F.C.S. (1995) Evidence for lytic infection by Epstein-Barr virus in mucosal lymphocytes instead of nasopharyngeal epithelial cells in normal individuals. *J. med. Virol.*, **45**, 71–77
- Tao, Q., Srivastava, G., Dickens, P. & Ho, F.C. (1996) Detection of Epstein-Barr virus-infected mucosal lymphocytes in nasal polyps. *Am. J. Pathol.*, **149**, 1111–1118
- Tartaglia, J., Perkus, M.E., Taylor, J., Norton, E.K., Audonnet, J-C., Cox, W.I., Davis, S.W., Van der Hoeven, J., Meignier, B., Riviere, M., Languet, B. & Paoletti, E. (1992) NYVAC: A highly attenuated strain of vaccinia virus. *Virology*, **188**, 217–232
- Taub, R., Kirsch, I., Morton, C., Lenoir, G., Swan, D., Tronick, S., Aaronson, S. & Leder, P. (1982) Translocation of the c-myc gene into the immunoglobulin heavy chain locus in human Burkitt lymphoma and murine plasmacytoma cells. *Proc. natl Acad. Sci. USA*, **79**, 7837–7841
- Taylor, N., Flemington, E., Kolman, J.L., Baumann, R.P., Speck, S.H. & Miller, G. (1991) ZEBRA and a Fos-GCN4 chimeric protein differ in their DNA-binding specificities for sites in the Epstein-Barr virus BZLF1 promoter. *J. Virol.*, **65**, 4033–4041
- Taylor, J., Weinberg, R., Tartaglia, J., Richardson, C., Alkhatib, G., Briedis, D., Appel, M., Norton, E. & Paoletti, E. (1992) Nonreplicating viral vectors as potential vaccines: Recombinant canarypox virus expressing measles virus fusion (F) and hemagglutinin (HA) glycoproteins. *Virology*, **187**, 321–328
- Tefuarani, N., Vince, J.D., Murthy, D.P., Sengupta, S.K. & White, J.C. (1988) Childhood malignant tumours in Papua New Guinea. *Ann. trop. Paediatr.*, **8**, 201–206
- Telford, E.A.R., Studdert, M.J., Agius, C.T., Watson, M.S., Aird, H.C. & Davison, A.J. (1993) Equine herpesvirus 2 and 5 are γ -herpesviruses. *Virology*, **195**, 492–499
- Teoh, R., McGuire, L., Wong, K. & Chin, D. (1989) Increased incidence of thymoma in Chinese myasthenia gravis: Possible relationship with Epstein-Barr virus. *Acta neurol. scand.*, **80**, 221–225

- de Thé, G. (1977) Is Burkitt's lymphoma related to perinatal infection by Epstein-Barr virus? *Lancet*, **i**, 335–337
- de Thé, G. & Ito, Y., eds (1978) *Nasopharyngeal Carcinoma: Etiology and Control* (IARC Scientific Publications No. 20), Lyon, IARC
- de Thé, G., Ho, H.C., Kwan, H.C., Desgranges, C. & Favre, M.C. (1970) Nasopharyngeal carcinoma (NPC). I. Types of cultures derived from tumour biopsies and non-tumorous tissues of Chinese patients with special reference to lymphoblastoid transformation. *Int. J. Cancer*, **6**, 189–206
- de Thé, G., Ablashi, D.V., Liabeuf, A. & Mourali, N. (1973) Nasopharyngeal carcinoma (NPC). VI. Presence of an EBV nuclear antigen in fresh tumour biopsies. Preliminary results. *Bio-medicine*, **19**, 349–352
- de Thé, G., Ho, J.H.C., Ablashi, D.V., Day, N.E., Macario, A.J.L., Martin-Berthelon, M.C., Pearson, G. & Sohler, R. (1975) Nasopharyngeal carcinoma. IX. Antibodies to EBNA and correlation with response to other EBV antigens in Chinese patients. *Int. J. Cancer*, **16**, 713–721
- de Thé, G., Geser, A. & Day, N.E. (1978a) Epidemiological evidence for a causal relationship between Epstein-Barr virus and Burkitt's lymphoma from a Ugandan prospective study. *Nature*, **274**, 756–761
- de Thé, G., Lavoué, M.-F. & Muenz, L. (1978b) Differences in EBV antibody titres of patients with nasopharyngeal carcinoma originating from high, intermediate and low incidence areas. In: de Thé, G. & Ito, Y., eds, *Nasopharyngeal Carcinoma: Etiology and Control* (IARC Scientific Publications No. 20), Lyon, IARC, pp. 471–481
- Theodorakis, P., D'Sa-Eipper, C., Subramanian, T. & Chinnadurai, G. (1996) Unmasking of a proliferation-restraining activity of the anti-apoptosis protein EBV BHRF1. *Oncogene*, **12**, 1707–1713
- Thijs, A. (1957) Remarks on malignant tumours among natives of the Belgian Congo and Ruanda-Urundi: 2536 cases. *Ann. Soc. belge Med. trop.*, **37**, 483–514 (in French)
- Thomas, J.A., Hotchin, N.A., Allday, M.J., Amlot, P., Rose, M., Yacoub, M. & Crawford, D.H. (1990) Immunohistology of Epstein-Barr virus-associated antigens in B cell disorders from immunocompromised individuals. *Transplantation*, **49**, 944–953
- Thomas, J.A., Felix, D.H., Wray, D., Southam, J.C., Cubie, H.A. & Crawford, D.H. (1991a) Epstein-Barr virus gene expression and epithelial cell differentiation in oral hairy leukoplakia. *Am. J. Pathol.*, **139**, 1369–1380
- Thomas, J.A., Allday, M.J. & Crawford, D.H. (1991b) Epstein-Barr virus-associated lymphoproliferative disorders in immunocompromised individuals. *Adv. Cancer Res.*, **57**, 329–380
- Thomason, R.W., Craig, F.E., Banks, P.M., Sears, D.L., Myerson, G.E. & Gulley, M.L. (1996) Epstein-Barr virus and lymphoproliferation in methotrexate-treated rheumatoid arthritis. *Mod. Pathol.*, **9**, 261–266
- Thorley-Lawson, D.A. (1980) The suppression of Epstein-Barr virus infection *in vitro* occurs after infection but before transformation of the cell. *J. Immunol.*, **124**, 745–751
- Thorley-Lawson, D.A. (1981) The transformation of adult but not newborn human lymphocytes by Epstein Barr virus and phytohemagglutinin is inhibited by interferon: The early suppression by T cells of Epstein Barr infection is mediated by interferon. *J. Immunol.*, **126**, 829–833

- Thorley-Lawson, D.A. & Geilinger, K. (1980) Monoclonal antibodies against the major glycoprotein (gp350/220) of Epstein-Barr virus neutralize infectivity. *Proc. natl Acad. Sci. USA*, **77**, 5307–5311
- Thorley-Lawson, D.A. & Poodry, C.A. (1982) Identification and isolation of the main component (gp350-gp220) of Epstein-Barr virus responsible for generating neutralizing antibodies *in vivo*. *J. Virol.*, **43**, 730–736
- Tierney, R.J., Steven, N., Young, L.S. & Rickinson, A.B. (1994) Epstein-Barr virus latency in blood mononuclear cells: Analysis of viral gene transcription during primary infection and in the carrier state. *J. Virol.*, **68**, 7374–7385
- Timens, W., Boes, A., Vos, H. & Poppema, S. (1991) Tissue distribution of the C3d/EBV-receptor: CD21 monoclonal antibodies reactive with a variety of epithelial cells, medullary thymocytes, and peripheral T-cells. *Histochemistry*, **95**, 605–611
- Timmons, C.F., Dawson, D.B., Richards, C.S., Andrews, W.S. & Katz, J.A. (1995) Epstein-Barr virus-associated leiomyosarcomas in liver transplantation recipients. Origin from either donor or recipient tissue. *Cancer*, **76**, 1481–1489
- Tirelli, U., Crivellari, D., Galligioni, E., Veronesi, A., Trovò, M.G., Tumolo, S., Grigoletto, E., Volpe, R. & Carbone, A. (1984) Malignant lymphoma, undifferentiated, Burkitt's type in north-east Italy. *Clin. Oncol.*, **10**, 129–140
- Tirelli, U., Errante, D., Dolcetti, R., Gloghini, A., Serraino, D., Vaccher, E., Franceschi, S., Boiocchi, M. & Carbone, A. (1995) Hodgkin's disease and human immunodeficiency virus infection: Clinicopathologic and virologic features of 114 patients from the Italian Cooperative Group on AIDS and Tumors. *J. clin. Oncol.*, **13**, 1758–1767
- Tischendorf, P., Shramek, G.J., Balagtas, R.C., Deinhardt, F., Knospe, W.H., Noble, G.R. & Maynard, J.E. (1970) Development and persistence of immunity to Epstein-Barr virus in man. *J. infect. Dis.*, **122**, 401–409
- Toczyski, D.P. & Steitz, J.A. (1991) EAP, a highly conserved cellular protein associated with Epstein-Barr virus small RNAs (EBERs). *EMBO J.*, **10**, 459–466
- Tokunaga, M., Land, C.E., Uemura, Y., Tokudome, T., Tanaka, S. & Sato, E. (1993) Epstein-Barr virus in gastric carcinoma. *Am. J. Pathol.*, **143**, 1250–1254
- Tomita, Y., Ohsawa, M., Kanno, H., Hashimoto, M., Ohnishi, A., Nakanishi, H. & Aozasa, K. (1996) Epstein-Barr virus in Hodgkin's disease patients in Japan. *Cancer*, **77**, 186–192
- Tomkinson, B. & Kieff, E. (1992a) Use of second-site homologous recombination to demonstrate that Epstein-Barr virus nuclear protein 3B is not important for lymphocyte infection or growth transformation *in vitro*. *J. Virol.*, **66**, 2893–2903
- Tomkinson, B. & Kieff, E. (1992b) Second-site homologous recombination in Epstein-Barr virus: Insertion of type 1 EBNA 3 genes in place of type 2 has no effect on *in vitro* infection. *J. Virol.*, **66**, 780–789
- Tomkinson, B., Robertson, E. & Kieff, E. (1993) Epstein-Barr virus nuclear proteins EBNA-3A and EBNA-3C are essential for B-lymphocyte growth transformation. *J. Virol.*, **67**, 2014–2025
- Tong, X., Yalamanchili, R., Harada, S. & Kieff, E. (1994) The EBNA-2 arginine-glycine domain is critical but not essential for B-lymphocyte growth transformation; the rest of region 3 lacks essential interactive domains. *J. Virol.*, **68**, 6188–6197

- Tong, X., Wang, F., Thut, C.J. & Kieff, E. (1995) The Epstein-Barr virus nuclear protein 2 acidic domain can interact with TFIIB, TAF40, and RPA70 but not with TATA-binding protein. *J. Virol.*, **69**, 585–588
- Top, F.H., Jr, Büscher, E.L., Bancroft, W.H. & Russell, P.K. (1971a) Immunization with live types 7 and 4 adenovirus vaccines. II. Antibody response and protective effect against acute respiratory disease due to adenovirus type 7. *J. infect. Dis.*, **124**, 155–160
- Top, F.H., Jr, Grossman, R.A., Bartelloni, P.J., Segal, H.E., Dudding, B.A., Russell, P.K., & Büscher, E.L. (1971b) Immunization with live types 7 and 4 adenovirus vaccines. I. Safety, infectivity, antigenicity, and potency of adenovirus type 7 vaccine in humans. *J. infect. Dis.*, **124**, 148–154
- Törnell, J., Farzad, S., Espander-Jansson, A.F., Mateika, G., Isaksson, O. & Rymo, L. (1996) Expression of Epstein-Barr nuclear antigen 2 in kidney tubule cell induces tumor in transgenic mice. *Oncogene*, **12**, 1521–1528
- Torsteinsdottir, S., Andersson, M.L., Avila-Carino, J., Ehlin-Henriksson, B., Masucci, M.G., Klein, G. & Klein, E. (1989) Reversion of tumorigenicity and decreased agarose clonability after EBV conversion of an IgH/myc translocation-carrying BL line. *Int. J. Cancer*, **43**, 273–278
- Tosato, G., Magrath, I., Koski, I., Dooley, N. & Blaese, M. (1979) Activation of suppressor T cells during Epstein-Barr-virus-induced infectious mononucleosis. *New Engl. J. Med.*, **301**, 1133–1137
- Touitou, R., Cochet, C. & Joab, I. (1996) Transcriptional analysis of the Epstein-Barr virus interleukin-10 homologue during the lytic cycle. *J. gen. Virol.*, **77**, 1163–1168
- Trivedi, P., Hu, L.F., Chen, F., Christensson, B., Masucci, M.G., Klein, G. & Winberg, G. (1994) Epstein-Barr virus (EBV)-encoded membrane protein LMP1 from a nasopharyngeal carcinoma is non-immunogenic in a murine model system, in contrast to a B cell-derived homologue. *Eur. J. Cancer*, **30A**, 84–88
- Trivedi, P., Zhang, Q.-J., Chen, F., Minarovits, J., Ekman, M., Biberfeld, P., Klein, G. & Winberg, G. (1995) Parallel existence of Epstein-Barr virus (EBV) positive and negative cells in a sporadic case of Burkitt lymphoma. *Oncogene*, **11**, 505–510
- Trumper, P.A., Epstein, M.A., Giovanella, B.C. & Finerty, S. (1977) Isolation of infectious EB virus from the epithelial tumour cells of nasopharyngeal carcinoma. *Int. J. Cancer*, **20**, 655–662
- Tsai, C.-N., Liu, S.-T. & Chang, Y.-S. (1995) Identification of a novel promoter located within the Bam HI Q region of the Epstein-Barr virus genome for the EBNA 1 gene. *DNA cell. Biol.*, **14**, 767–776
- Tsai, C.-C., Chen, C.-L. & Hsu, H.-C. (1996a) Expression of Epstein-Barr virus in carcinomas of major salivary glands: A strong association with lymphoepithelioma-like carcinoma. *Hum. Pathol.*, **27**, 258–262
- Tsai, S.-T., Jin, Y.-T. & Su, I.-J. (1996b) Expression of EBER1 in primary and metastatic nasopharyngeal carcinoma tissues using in situ hybridization: A correlation with WHO histologic subtypes. *Cancer*, **77**, 231–236
- Tsang, S.-F., Wang, F., Izumi, K.M. & Kieff, E. (1991) Delineation of the cis-acting element mediating EBNA-2 transactivation of latent infection membrane protein expression. *J. Virol.*, **65**, 6765–6771

- Tsang, W.Y.W., Chan, J.K.C., Yip, T.T.C., Ng, C.S., Wong, K.F., Poon, Y.F. & Ma, V.W.S. (1994) In situ localization of Epstein-Barr virus encoded RNA in non-nasal/nasopharyngeal CD56-positive and CD56-negative T-cell lymphomas. *Hum. Pathol.*, **25**, 758-765
- Tun, T., Hamaguchi, Y., Matsunami, N., Furukawa, T., Honjo, T. & Kawaichi, M. (1994) Recognition sequence of a highly conserved DNA binding protein RBB-J kappa. *Nucleic Acids Res.*, **22**, 965-971
- Turner, A.M., Berdoukas, V.A., Tobias, V.H., Ziegler, J.B., Toogood, I.R., Mulley, J.C., Skare, J. & Purtilo, D.T. (1992) Report on the X-linked lymphoproliferative disease in an Australian family. *J. Paediatr. Child Health*, **28**, 184-189
- Tyan, Y.-S., Liu, S.-T., Ong, W.-R., Chen, M.-L., Shu, C.-H. & Chang, Y.-S. (1993) Detection of Epstein-Barr virus and human papillomavirus in head and neck tumors. *J. clin. Microbiol.*, **31**, 53-56
- Tynell, E., Aurelius, E., Brandell, A., Julander, I., Wood, M., Yao, Q.-Y., Rickinson, A., Åkerlund, B. & Andersson, J. (1996) Acyclovir and prednisolone treatment of acute infectious mononucleosis: A multicenter, double-blind, placebo-controlled study. *J. infect. Dis.*, **174**, 324-331
- Uccini, S., Monardo, F., Ruco, L.P., Baroni, C.D., Faggioni, A., Agliano, A.M., Gradilone, A., Manzari, V., Vago, L., Costanzi, G., Carbone, A., Boiocchi, M. & De Re, V. (1989) High frequency of Epstein-Barr virus genome in HIV-positive patients with Hodgkin's disease (Letter to the Editor). *Lancet*, **i**, 1458
- Uccini, S., Monardo, F., Stoppacciaro, A., Gradilone, A., Agliano, A.M., Faggioni, A., Manzari, V., Vago, L., Costanzi, G., Ruco, L.P. & Baroni, C.D. (1990) High frequency of Epstein-Barr virus genome detection in Hodgkin's disease of HIV-positive patients. *Int. J. Cancer*, **46**, 581-585
- Uen, W.C., Luka, J. & Pearson, G.T. (1988) Development of an enzyme-linked immunosorbent assay (ELISA) for detecting IgA antibodies to the Epstein-Barr virus. *Int. J. Cancer*, **41**, 479-482
- Uhara, H., Sato, Y., Mukai, K., Akao, I., Matsuno, Y., Furuya, S., Hoshikawa, T., Shimosato, Y. & Saida, T. (1990) Detection of Epstein-Barr virus DNA in Reed-Sternberg cells of Hodgkin's disease using the polymerase chain reaction and in situ hybridization. *Jpn. J. Cancer Res.*, **81**, 272-278
- Ulaeto, D., Wallace, L., Morgan, A., Morein, B. & Rickinson, A.B. (1988) In vitro T cell responses to a candidate Epstein-Barr virus vaccine: Human CD4⁺ T cell clones specific for the major envelope glycoprotein gp340. *Eur. J. Immunol.*, **18**, 1689-1697
- University Health Physicians and PHLS Laboratories (1971) A joint investigation: Infectious mononucleosis and its relationship to EB virus antibody. *Br. med. J.*, **iv**, 643-646
- Van der Weid, T. & Langhorne, J. (1993) The role of cytokines produced in the immune response to the erythrocytic stages of mouse malarial. *Immunobiology*, **189**, 397-418
- Vasef, M.A., Kamel, O.W., Chen, Y.-Y., Medeiros, L.J. & Weiss, L.M. (1995) Detection of Epstein-Barr virus in multiple sites involved by Hodgkin's disease. *Am. J. Pathol.*, **147**, 1408-1415
- Vasef, M.A., Weiss, L.M., Chen, Y.-Y. & Medeiros, L.J. (1996) Gastric lymphoepithelioma-like carcinoma and jejunal B-cell MALT lymphoma with large cell transformation. *Am. J. Clin. Pathol.*, **105**, 560-566

- Vaughan, T.L., Strader, C., Davis, S. & Daling, J.R. (1986a) Formaldehyde and cancers of the pharynx, sinus and nasal cavity: I. Occupational exposures. *Int. J. Cancer*, **38**, 677–683
- Vaughan, T.L., Strader, C., Davis, S. & Daling, J.R. (1986b) Formaldehyde and cancers of the pharynx, sinus and nasal cavity: II. Residential exposures. *Int. J. Cancer*, **38**, 685–688
- Vaughan, T.L., Shapiro, J.A., Burt, R.D., Swanson, G.M., Bewick, M., Lynch, C.F. & Lyon, J.L. (1996) Nasopharyngeal cancer in a low-risk population: Defining risk factors by histological type. *Cancer Epidemiol. Biomarkers Prev.*, **5**, 587–593
- Veltri, R.W., Shah, S.H., McClung, J.E., Klingberg, W.G. & Sprinkle, P.M. (1983) Epstein-Barr virus, fatal infectious mononucleosis, and Hodgkin's disease in siblings. *Cancer*, **51**, 509–520
- Venkitaraman, A.R., John, T.J., Rangad, F., Singh, A.D., Date, A. & Lenoir, G. (1983) Epstein-Barr virus-associated Burkitt's lymphoma in India. *Trop. geogr. Med.*, **35**, 273–277
- Vestlev, P.M., Pallesen, G., Sandvej, K., Hamilton-Dutoit, S.J. & Bendtzen, S.M. (1992) Prognosis of Hodgkin's disease is not influenced by Epstein-Barr virus latent membrane protein (Letter to the Editor). *Int. J. Cancer*, **50**, 670–671
- Vieira, P., de Waal-Malefyt, R., Dang, M.-N., Johnson, K.E., Kastelein, R., Fiorentino, D.F., deVries, J.E., Roncarolo, M.-G., Mosmann, T.R. & Moore, K.W. (1991) Isolation and expression of human cytokine synthesis inhibitory factor cDNA clones: Homology to Epstein-Barr virus open reading frame BCRF1. *Proc. natl Acad. Sci. USA*, **88**, 1172–1176
- Voevodin, A.F., Lapin, B.A., Yakovleva, A., Ponomarjeva, T.I. & Agrba, Z. (1979) Prevalence of antibodies to soluble antigen of Epstein-Barr virus producing cells (P3HR-1) in the sera of hamadryas baboons of the high lymphoma incidence stock. *Exp. Pathol.*, **17**, 517–520
- Voevodin, A.F., Yakovleva, L.A., Lapin, B.A. & Ponomarjeva, T.I. (1983) Increased antibody responses to Herpes virus papio (HVP) antigens in pre-lymphomatous baboons (*Papio hamadryas*) of the Sukhumi high lymphoma stock. *Int. J. Cancer*, **32**, 637–639
- Voevodin, A.F., Ponomarjeva, T.I. & Lapin, B.A. (1985) Seroepizootiology of the Herpesvirus *Papio* (HVP) infection in healthy baboons (*Papio hamadryas*) of high and low lymphoma risk populations. *Exp. Pathol.*, **27**, 33–39
- Vonka, V., Vlcková, I., Zavadová, H., Kouba, K., Lazovská, J. & Duben, J. (1972) Antibodies to EB virus capsid antigen and to soluble antigen of lymphoblastoid cells in infectious mononucleosis patients. *Int. J. Cancer*, **9**, 529–535
- Wakasugi, N., Tagaya, Y., Wakasugi, H., Mitsui, A., Maeda, M., Yodoi, J. & Tursz, T. (1990) Adult T-cell leukemia-derived factor/thioredoxin, produced by both human T-lymphotropic virus type I- and Epstein-Barr virus-transformed lymphocytes, acts as an autocrine growth factor and synergizes with interleukin 1 and interleukin 2. *Proc. natl Acad. Sci. USA*, **87**, 8282–8286
- Walker, R.C., Marshall, W.F., Strickler, J.G., Wiesner, R.H., Velosa, J.A., Habermann, T.M., McGregor, C.G. & Paya, C.V. (1995) Pretransplantation assessment of the risk of lymphoproliferative disorder. *Clin. infect. Dis.*, **20**, 1346–1353
- Wallace, L.E., Moss, D.J., Rickinson, A.B., McMichael, A.J. & Epstein, M.A. (1981) Cytotoxic T cell recognition of Epstein-Barr virus-infected B cells. II. Blocking studies with monoclonal antibodies to HLA determinants. *Eur. J. Immunol.*, **11**, 694–699
- Wallace, L.E., Rickinson, A.B., Rowe, M. & Epstein, M.A. (1982a) Epstein-Barr virus-specific cytotoxic T-cell clones restricted through a single HLA antigen. *Nature*, **297**, 413–415

- Wallace, L.E., Rickinson, A.B., Rowe, M., Moss, D.J., Allen, D.J. & Epstein, M.A. (1982b) Stimulation of human lymphocytes with irradiated cells of the autologous Epstein-Barr virus-transformed cell line. I. Virus-specific and nonspecific components of the cytotoxic response. *Cell. Immunol.*, **67**, 129–140
- Wallace, L.E., Rowe, M., Hill Gaston, J.S., Rickinson, A.B. & Epstein, M.A. (1982c) Cytotoxic T cell recognition of Epstein-Barr virus-infected B cells. III. Establishment of HLA-restricted cytotoxic T cell lines using interleukin 2. *Eur. J. Immunol.*, **12**, 1012–1018
- Wallace, L.E., Wright, J., Ulaeto, D.O., Morgan, A.J. & Rickinson, A.B. (1991) Identification of two T-cell epitopes on the candidate Epstein-Barr virus vaccine glycoprotein gp340 recognized by CD4⁺ T-cell clones. *J. Virol.*, **65**, 3821–3828
- Waller, E.K., Ziemianska, M., Bangs, C.D., Cleary, M., Weissman, I. & Kamel, O.W. (1993) Characterization of posttransplant lymphomas that express T-cell-associated markers: Immunophenotypes, molecular genetics, cytogenetics, and heterotransplantation in severe combined immunodeficient mice. *Blood*, **82**, 247–261
- Walling, D.M., Neese Edmiston, S.N., Sixbey, J.W., Abdel-Hamid, M., Resnick, L. & Raab-Traub, N. (1992) Coinfection with multiple strains of the Epstein-Barr virus in human immunodeficiency virus-associated hairy leukoplakia. *Proc. natl Acad. Sci. USA*, **89**, 6560–6564
- Walls, D. & Perricaudet, M. (1991) Novel downstream elements upregulate transcription initiated from an Epstein-Barr virus latent promoter. *EMBO J.*, **10**, 143–151
- Walsh, S.V., Egan, L.J., Connolly, C.E., Stevens, F.M., Egan, E.L. & McCarthy, C.F. (1995) Enteropathy-associated T-cell lymphoma in the west of Ireland: Low-frequency of Epstein-Barr virus in these tumors. *Mod. Pathol.*, **8**, 753–757
- Walter, J., Möller, P., Moldenhauer, G., Schirmacher, V., Pawlita, M. & Wolf, J. (1992) Local growth of a Burkitt's lymphoma versus disseminated invasive growth of the autologous EBV-immortalized lymphoblastoid cells and their somatic cell hybrids in SCID mice. *Int. J. Cancer*, **50**, 265–273
- Waltzer, L., Logeat, F., Brou, C., Israel, A., Sergeant, A. & Manet, E. (1994) The human J kappa recombination signal sequence binding protein (RBP-J kappa) targets the Epstein-Barr virus EBNA2 protein to its DNA responsive elements. *EMBO J.*, **13**, 5633–5638
- Waltzer, L., Bourillot, P.Y., Sergeant, A. & Manet, E. (1995) RBP-J κ repression activity is mediated by a co-repressor and antagonized by the Epstein-Barr virus transcription factor EBNA2. *Nucleic Acids Res.*, **23**, 4939–4935
- Waltzer, L., Perricaudet, M., Sergeant, A. & Manet, E. (1996) Epstein-Barr virus EBNA3A and EBNA3C proteins both repress RBP-J κ -EBNA2-activated transcription by inhibiting the binding of RBP-J κ to DNA. *J. Virol.*, **70**, 5909–5915
- Wang, D., Liebowitz, D. & Kieff, E. (1985) An EBV membrane protein expressed in immortalized lymphocytes transforms established rodent cells. *Cell*, **43**, 831–840
- Wang, F., Petti, L., Braun, D., Seung, S. & Kieff, E. (1987a) A bicistronic Epstein-Barr virus mRNA encodes two nuclear proteins in latently infected, growth-transformed lymphocytes. *J. Virol.*, **61**, 945–954
- Wang, F., Gregory, C.D., Rowe, M., Rickinson, A.B., Wang, D., Birkenbach, M., Kikutani, H., Kishimoto, T. & Kieff, E. (1987b) Epstein-Barr virus nuclear antigen 2 specifically induces expression of the B-cell activation antigen CD23. *Proc. natl Acad. Sci. USA*, **84**, 3452–3456

- Wang, D., Liebowitz, D. & Kieff, E. (1988a) The truncated form of the Epstein-Barr virus latent-infection membrane protein expressed in virus replication does not transform rodent fibroblasts. *J. Virol.*, **62**, 2337–2346
- Wang, D., Liebowitz, D., Wang, F., Gregory, C., Rickinson, A., Larson, R., Springer, T. & Kieff, E. (1988b) Epstein-Barr virus latent infection membrane protein alters the human B-lymphocyte phenotype: Deletion of the amino terminus abolishes activity. *J. Virol.*, **62**, 4173–4184
- Wang, F., Gregory, C., Sample, C., Rowe, M., Liebowitz, D., Murray, R., Rickinson, A. & Kieff, E. (1990a) Epstein-Barr virus latent membrane protein (LMP1) and nuclear proteins 2 and 3C are effectors of phenotypic changes in B lymphocytes: EBNA-2 and LMP1 cooperatively induce CD23. *J. Virol.*, **64**, 2309–2318
- Wang, F., Tsang, S.-F., Kurilla, M.G., Cohen, J.I. & Kieff, E. (1990b) Epstein-Barr virus nuclear antigen 2 transactivates latent membrane protein LMP1. *J. Virol.*, **64**, 3407–3416
- Wang, F., Kikutani, H., Tsang, S.-F., Kishimoto, T. & Kieff, E. (1991) Epstein-Barr virus nuclear protein 2 transactivates a *cis*-acting CD23 DNA element. *J. Virol.*, **65**, 4101–4106
- Wara, W.M., Wara, D.W., Phillips, T.L. & Ammann, A.J. (1975) Elevated IgA in carcinoma of the nasopharynx. *Cancer*, **35**, 1313–1315
- Waterhouse, J., Muir, C.S., Shanmugaratnam, K. & Powell, J., eds (1982) *Cancer Incidence in Five Continents, Vol. IV* (IARC Scientific Publications No. 42), Lyon, IARC
- Watry, D., Hedrick, J.A., Siervo, S., Rhodes, G., Lamberti, J.J., Lambris, J.D. & Tsoukas, C.D. (1991) Infection of human thymocytes by Epstein-Barr virus. *J. exp. Med.*, **173**, 971–980
- Weber, B., Brunner, M., Preiser, W. & Doerr, H.W. (1996) Evaluation of 11 enzyme immunoassays for the detection of immunoglobulin M antibodies to Epstein-Barr virus. *J. virol. Meth.*, **57**, 87–93
- Wedderburn, N. (1970) Effect of concurrent malarial infection on development of virus-induced lymphoma in Balb/c mice. *Lancet*, **ii**, 1114–1116
- Wedderburn, N., Edwards, J.M.B., Desgranges, C., Fontaine, C., Cohen, B. & de Thé, G. (1984) Infectious mononucleosis-like response in common marmosets infected with Epstein-Barr virus. *J. infect. Dis.*, **150**, 878–882
- Wei, M.X., Moulin, J.C., Decaussin, G., Berger, F. & Ooka, T. (1994) Expression and tumorigenicity of the Epstein-Barr virus *BARF1* gene in human Louckes B-lymphocyte cell line. *Cancer Res.*, **54**, 1843–1848
- Weinberg, E., Hoisington, S., Eastman, A.Y., Rice, D.K., Malfetano, J. & Ross, J.S. (1993) Uterine cervical lymphoepithelial-like carcinoma. Absence of Epstein-Barr virus genomes. *Am. J. clin. Pathol.*, **99**, 195–199
- Weinreb, M., Day, P.J.R., Niggli, F., Green, E.K., Nyong'o, A.O., Othieno-Abinya, N.A., Riyat, M.S., Raafat, F. & Mann, J.R. (1996a) The consistent association between Epstein-Barr virus and Hodgkin's disease in children in Kenya. *Blood*, **87**, 3828–3836
- Weinreb, M., Day, P.J., Niggli, F., Powell, J.E., Raafat, F., Hesseling, P.B., Schneider, J.W., Hartley, P.S., Tzortzatou-Stathopoulou, F., Khalek, E.R.A., Mangoud, A., El-Safy, U.R., Madanat, F., Al Sheyyab, M., Mpofu, C., Revesz, T., Rafii, R., Tiedemann, K., Waters, K.D., Barrantes, J.C., Nyongo, A., Riyat, M.S. & Mann, J.R. (1996b) The role of Epstein-Barr virus in Hodgkin's disease from different geographical areas. *Arch. Dis. Child.*, **74**, 27–31

- Weis, K., Rambaud, S., Lavau, C., Jansen, J., Carvalho, T., Carmo-Fonseca, M., Lamond, A. & Dejean, A. (1994) Retinoic acid regulates aberrant nuclear localization of PML-RAR α in acute promyelocytic leukemia cells. *Cell*, **76**, 345–356
- Weiss, L.M. & Movahed, L.A. (1989) In situ demonstration of Epstein-Barr viral genomes in viral-associated B cell lymphoproliferations. *Am. J. Pathol.*, **134**, 651–659
- Weiss, L.M., Strickler, J.G., Warnke, R.A., Purtilo, D.T. & Sklar, J. (1987) Epstein-Barr viral DNA in tissues of Hodgkin's disease. *Am. J. Pathol.*, **129**, 86–91
- Weiss, L.M., Warnke, R.A. & Sklar, J. (1988) Clonal antigen receptor gene rearrangements and Epstein-Barr viral DNA in tissues of Hodgkin's disease. *Hematol. Oncol.*, **6**, 233–238
- Weiss, L.M., Movahed, L.A., Warnke, R.A. & Sklar, J. (1989a) Detection of Epstein-Barr viral genomes in Reed-Sternberg cells of Hodgkin's disease. *New Engl. J. Med.*, **320**, 502–506
- Weiss, L.M., Movahed, L.A., Butler, A.E., Swanson, S.A., Frierson, H.F., Jr, Cooper, P.H., Colby, T.V. & Mills, S.E. (1989b) Analysis of lymphoepithelioma and lymphoepithelioma-like carcinomas for Epstein-Barr viral genomes by in situ hybridization. *Am. J. surg. Pathol.*, **13**, 625–631
- Weiss, L.M., Chen, Y.-Y., Liu, X.-F. & Shibata, D. (1991) Epstein-Barr virus and Hodgkin's disease: A correlative in situ hybridization and polymerase chain reaction study. *Am. J. Pathol.*, **139**, 1259–1265
- Weiss, L.M., Gaffey, M.J., Chen, Y.-Y. & Frierson, H.F., Jr (1992a) Frequency of Epstein-Barr viral DNA in 'western' sinonasal and Waldeyer's ring non-Hodgkin's lymphomas. *Am. J. surg. Pathol.*, **16**, 156–162
- Weiss, L.M., Jaffe, E.S., Liu, X.F., Chen, Y.-Y., Shibata, D. & Medeiros, L.J. (1992b) Detection and localization of Epstein-Barr viral genomes in angioimmunoblastic lymphadenopathy and angioimmunoblastic lymphadenopathy-like lymphoma. *Blood*, **79**, 1789–1795
- Weissmann, D.J., Ferry, J.A., Harris, N.L., Louis, D.N., Delmonico, F. & Spiro, I. (1995) Post-transplantation lymphoproliferative disorders in solid organ recipients and predominantly aggressive tumors of host origin. *Am. J. Pathol.*, **103**, 748–755
- Wen, S., Shimizu, N., Yoshiyama, H., Mizugaki, Y., Shinozaki, F. & Takada, K. (1996) Association of Epstein-Barr virus (EBV) with Sjögren's syndrome: Differential EBV expression between epithelial cells and lymphocytes in salivary glands. *Am. J. Pathol.*, **149**, 1511–1517
- Wen, S., Mizugaki, Y., Shinozaki, F. & Takada, K. (1997) Epstein-Barr virus (EBV) infection in salivary gland tumors: Lytic EBV infection in nonmalignant epithelial cells surrounded by EBV-positive T-lymphoma cells. *Virology*, **227**, 484–487
- Weng, Y.-M., Hotchkiss, J.H. & Babish, J.G. (1992) N-Nitrosamine and mutagenicity formation in Chinese salted fish after digestion. *Food Addit. Contam.*, **9**, 29–37
- Werner, J., Wolfe, H., Apodaca, J. & zur Hausen, H. (1975) Lymphoproliferative disease in a cotton-top marmoset after inoculation with infectious mononucleosis derived Epstein-Barr virus. *Int. J. Cancer*, **15**, 1000–1008
- West, S., Hildesheim, A. & Dosemeci, M. (1993) Non-viral risk factors for nasopharyngeal carcinoma in the Philippines: Results from a case-control study. *Int. J. Cancer*, **55**, 722–727
- Whang, Y., Silberklang, M., Morgan, A., Munshi, S., Lenny, A.B., Ellis, R.W. & Kieff, E., (1987) Expression of the Epstein-Barr virus gp350/220 gene in rodent and primate cells. *J. Virol.*, **61**, 1796–1807

- White, C.A., Cross, S.M., Kurilla, M.G., Kerr, B.M., Schmidt, C., Misko, I.S., Khanna, R. & Moss, D.J. (1996) Recruitment during infectious mononucleosis of CD3⁺CD4⁺CD8⁺ virus-specific cytotoxic T cells which recognise Epstein-Barr virus lytic antigen BHRF1. *Virology*, **219**, 489–492
- Whittle, H.C., Brown, J., Marsh, K., Greenwood, B.M., Seidelin, P., Tighe, H. & Wedderburn, L. (1984) T-Cell control of Epstein-Barr virus infected B-cells is lost during *P. falciparum* malaria. *Nature*, **312**, 449–450
- WHO (1969) Burkitt's lymphoma. *WHO Bull.*, **40**
- Williams, A.O. (1966) Haemoglobin genotypes, ABO blood groups and Burkitt's tumour. *J. med. Genet.*, **3**, 177–179
- Williams, M.C. (1967) Implications of the geographical distribution of Burkitt's lymphoma. In: Burchenal, J.H. & Burkitt, D.P., eds, *Treatment of Burkitt's Lymphoma* (UICC Monograph Series Vol. 8), Berlin, Springer-Verlag, pp. 42–51
- Williams, A.O. (1975) Tumours of children in Ibadan, Nigeria. *Cancer*, **36**, 370–378
- Williams, D.L. & Kowalski, D. (1993) Easily unwound DNA sequences and hairpin structures in the Epstein-Barr virus origin of plasmid replication. *J. Virol.*, **67**, 2707–2715
- Williams, E.H. & de Thé, G. (1974) Familial aggregation in nasopharyngeal carcinoma (Letter to the Editor). *Lancet*, **ii**, 295
- Williams, E.H., Spit, P. & Pike, M.C. (1969) Further evidence of space-time clustering of Burkitt's lymphoma patients in the West Nile District of Uganda. *Br. J. Cancer*, **23**, 235–246
- Williams, L.L., Rooney, C.M., Conley, M.E., Brenner, M.K., Krance, R.A. & Heslop, H.E. (1993) Correction of Duncan's syndrome by allogeneic bone marrow transplantation. *Lancet*, **342**, 587–588
- Wilson, J.B., Weinberg, W., Johnson, R., Yuspa, S. & Levine, A.J. (1990) Expression of the BNLF-1 oncogene of Epstein-Barr virus in the skin of transgenic mice induces hyperplasia and aberrant expression of keratin 6. *Cell*, **61**, 1315–1327
- Wilson, A.D., Shooshstari, M., Finerty, S., Watkins, P. & Morgan, A.J. (1996a) Virus-specific cytotoxic T cell responses are associated with immunity of the cottontop tamarin to Epstein-Barr virus (EBV). *Clin. exp. Immunol.*, **103**, 199–205
- Wilson, W.H., Kingma, D.W., Raffeld, M., Wittes, R.E. & Jaffe, E.S. (1996b) Association of lymphomatoid granulomatosis with Epstein-Barr viral infection of B lymphocytes and response to interferon- α 2b. *Blood*, **87**, 4531–4537
- Wilson, J.B., Bell, J.L. & Levine, A.J. (1996c) Expression of Epstein-Barr virus nuclear antigen-1 induces B cell neoplasia in transgenic mice. *EMBO J.*, **15**, 3117–3126
- Winnett, A., Thomas, S.J., Brabin, B.J., Bain, C., Alpers, M.A. & Moss, D.J. (1997) Familial Burkitt's lymphoma in Papua New Guinea. *Br. J. Cancer*, **75**, 757–761
- Witter, R.L., Nazerian, K., Purchase, H.G. & Burgoyne, G.H. (1970) Isolation from turkeys of a cell-associated herpesvirus antigenically related to Marek's disease virus. *Am. J. vet. Res.*, **31**, 525–538
- Wöckel, W., Höfler, G., Popper, H.H. & Morresi, A. (1995) Lymphoepithelioma-like carcinoma of the lung. *Pathol. Res. Pract.*, **191**, 1170–1174
- Woisetschlaeger, M., Yandava, C.N., Furmanski, L.A., Strominger, J.L. & Speck, S.H. (1990) Promoter switching in Epstein-Barr virus during the initial stages of infection of B lymphocytes. *Proc. natl Acad. Sci. USA*, **87**, 1725–1729

- Wolf, H., zur Hausen, H. & Becker, V. (1973) EB viral genomes in epithelial nasopharyngeal carcinoma cells. *Nature new Biol.*, **244**, 245–257
- Wolf, H., Haus, M. & Wilmes, E. (1984) Persistence of Epstein-Barr virus in the parotid gland. *J. Virol.*, **51**, 795–798
- Wong, K.M. & Levine, A.J. (1986) Identification and mapping of Epstein-Barr virus early antigens and demonstration of a viral gene activator that functions in trans. *J. Virol.*, **60**, 149–156
- Wong, M.P., Chung, L.P., Yuen, S.T., Leung, S.Y., Chan, S.Y., Wang, E. & Fu, K.H. (1995) In situ detection of Epstein-Barr virus in non-small cell lung carcinomas. *J. Pathol.*, **177**, 233–240
- Worth, R.M. & Valentine, R. (1967) Nasopharyngeal carcinoma in New South Wales, Australia. In: Muir, C.S. & Shanmugaratnam, K., eds, *Cancer of the Nasopharynx* (UICC Monograph Series, Vol. 1), Geneva, UICC, pp. 73–76
- Wright, D.H. (1964) Burkitt's tumor — A post mortem study of 50 cases. *Br. J. Surg.*, **51**, 245–251
- Wright, D.H. (1966) Burkitt's tumour in England. A comparison with childhood lymphosarcoma. *Int. J. Cancer*, **1**, 503–514
- Wright, D.H. (1970) Gross distribution and hematology. In: Burkitt, D.P. & Wright, D.H., eds, *Burkitt's Lymphoma*, Edinburgh, E. & S. Livingstone, pp. 64–81
- Wright, D.H. & Roberts, M. (1966) The geographical distribution of Burkitt's tumour compared with the geographical distribution of other types of malignant lymphoma in Uganda. *Br. J. Cancer*, **20**, 469–474
- Wu, S.-B., Hwang, S.-J., Chang, A.-S., Hsieh, T., Hsu, M.-M., Hsieh R.-P. & Chen, C.-J. (1989) Human leukocyte antigen (HLA) frequency among patients with nasopharyngeal carcinoma in Taiwan. *Anticancer Res.*, **9**, 1649–1654
- Wu, T.-C., Mann, R.B., Charache, P., Hayward, S.D., Staal, S., Lambe, B.C. & Ambinder, R.F. (1990) Detection of EBV gene expression in Reed-Sternberg cells of Hodgkin's disease. *Int. J. Cancer*, **46**, 801–804
- Wu, T.-C., Mann, R.B., Epstein, J.I., MacMahon, E., Lee, W.A., Charache, P., Hayward, S.D., Kurman, R.J., Hayward, G.S. & Ambinder, R.F. (1991) Abundant expression of EBER-1 small nuclear RNA in nasopharyngeal carcinoma. A morphologically distinctive target for detection of Epstein-Barr virus in formalin-fixed paraffin-embedded carcinoma specimens. *Am. J. Pathol.*, **138**, 1461–1469
- Wu, T.T., Swerdlow, S.H., Locker, J., Bahler, D., Randhawa, P., Yunis, E.J., Dickman, P.S. & Nalesnik, M.A. (1996) Recurrent Epstein-Barr virus-associated lesions in organ transplant recipients. *Hum. Pathol.*, **27**, 157–164
- Wutzler, P., Farber, I., Sprossig, M., Sauerbrei, A., Wutke, K., Hoche, D., Rudiger, K.D., Wockel, W. & Scheibner, K. (1983) Antibodies against herpesviruses in patients with Hodgkin's disease. *Arch. Geschwulstforsch.*, **53**, 417–422
- Wutzler, P., Meerbach, A., Färber, I., Wolf, H. & Scheibner, K. (1995) Malignant lymphomas induced by an Epstein-Barr virus-related herpesvirus from *Macaca arctoides* — A rabbit model. *Arch. Virol.*, **140**, 1979–1995

- Yalamanchili, R., Tong, X., Grossman, S., Johannsen, E., Mosialos, G. & Kieff, E. (1994) Genetic and biochemical evidence that EBNA 2 interaction with a 63-kDa cellular GTG-binding protein is essential for B lymphocyte growth transformation by EBV. *Virology*, **204**, 634–641
- Yamamoto, N., Mitsuma, T. & Vogt, A. (1982) Tumor promoter 12-*O*-tetradecanoylphorbol 13-acetate: Effect on complement and Epstein-Barr virus receptors in human lymphoblastoid cell lines. *J. natl Cancer Inst.*, **68**, 385–390
- Yang, C.-S., Hsu, Y.V., Chan, T.-K., Yen, Y.-S., Chu, C.-T. & Tu, S.-M. (1982) Expression of Epstein-Barr virus genome in nude mouse grown nasopharyngeal carcinoma cells. *J. Formosan med. Assoc.*, **81**, 882–891
- Yao, Q.Y., Rickinson, A.B. & Epstein, M.A. (1985a) Oropharyngeal shedding of infectious Epstein-Barr virus in healthy virus-immune donors. A prospective study. *Chin. med. J.*, **98**, 191–196
- Yao, Q.Y., Rickinson, A.B. & Epstein, M.A. (1985b) A re-examination of the Epstein-Barr virus carrier state in healthy seropositive individuals. *Int. J. Cancer*, **35**, 35–42
- Yao, Q.Y., Rickinson, A.B., Gaston, J.S.H. & Epstein, M.A. (1985c) *In vitro* analysis of the Epstein-Barr virus: Host balance in long-term renal allograft recipients. *Int. J. Cancer*, **35**, 43–49
- Yao, Q.Y., Ogan, P., Rowe, M., Wood, M. & Rickinson, A.B. (1989a) Epstein-Barr virus-infected B cells persist in the circulation of acyclovir-treated virus carriers. *Int. J. Cancer*, **43**, 67–71
- Yao, Q.Y., Ogan, P., Rowe, M., Wood, M. & Rickinson, A.B. (1989b) The Epstein-Barr virus: Host balance in acute infectious mononucleosis patients receiving acyclovir anti-viral therapy. *Int. J. Cancer*, **43**, 61–66
- Yao, G.Q., Grill, S., Egan, W. & Cheng, Y.C. (1993) Potent inhibition of Epstein-Barr virus by phosphorothioate oligodeoxynucleotides without sequence specification. *Antimicrob. Agents Chemother.*, **37**, 1420–1425
- Yao, G.-Q., Liu, S.-H., Chou, E., Kukhanova, M., Chu, C.K. & Cheng, Y.-C. (1996) Inhibition of Epstein-Barr virus replication by a novel L-nucleoside, 2'-fluoro-5-methyl-beta-L-arabinofuranosyluracil. *Biochem. Pharmacol.*, **51**, 941–947
- Yates, J.L. & Guan, N. (1991) Epstein-Barr virus-derived plasmids replicate only once per cell cycle and are not amplified after entry into cells. *J. Virol.*, **65**, 483–488
- Yates, J., Warren, N., Reisman, D. & Sugden, B. (1984) A *cis*-acting element from the Epstein-Barr viral genome that permits stable replication of recombinant plasmids in latently infected cells. *Proc. natl Acad. Sci. USA*, **81**, 3806–3810
- Yates, J.L., Warren, N. & Sugden, B. (1985) Stable replication of plasmids derived from Epstein-Barr virus in various mammalian cells. *Nature*, **313**, 812–815
- Ye, B.H., Rao, P.H., Chaganti, R.S. & Dalla-Favera, R. (1993) Cloning of bcl-6, the locus involved in chromosome translocations affecting band 3q27 in B-cell lymphoma. *Cancer Res.*, **53**, 2732–2735
- Yeung, W.M., Zong, Y.S., Chiu, C.T., Chan, K.H., Sham, J.S., Choy, D.T. & Ng, M.H. (1993) Epstein-Barr virus carriage by nasopharyngeal carcinoma *in situ*. *Int. J. Cancer*, **53**, 746–750
- Yokoyama, S., Staunton, D., Fisher, R., Amiot, M., Fortin, J.J. & Thorley-Lawson, D.A. (1991) Expression of the blast-1 activation/adhesion molecule and its identification as CD48. *J. Immunol.*, **146**, 2192–2200

- Yoneda, N., Tatsumi, E., Kawanishi, M., Teshigawara, K., Masuda, S., Yamamura, Y., Inui, A., Yoshino, G., Oimomi, M., Baba, S. & Yamaguchi, N. (1990) Detection of Epstein-Barr virus genome in benign polyclonal proliferative T cells of a young male patient. *Blood*, **76**, 172–177
- Yoshiyama, H., Shimizu, N. & Takada, K. (1995) Persistent Epstein-Barr virus infection in a human T-cell line: Unique program of latent virus expression. *EMBO J.*, **14**, 3706–3711
- Yoshizaki, T., Takimoto, T., Takeshita, H., Tanaka, S., Furukawa, M., Seiki, M. & Sato, H. (1994) Epstein-Barr virus lytic cycle spreads via cell fusion in a nasopharyngeal carcinoma hybrid cell line. *Laryngoscope*, **104**, 91–94
- Yoshizawa, K., Kiyosawa, K., Yamada, S., Furuta, K., Yabu, K., Kitano, K., Akamatsu, T., Nakayama, J., Katsuyama, T., Matsunami, H., Kawasaki, S., Makuuchi, M., Nanba, K. & Furuta, S. (1993) Establishment of Epstein-Barr virus-associated lymphoma cell line SUBL with t(2;3)(p11;q27) from a liver transplant patient. *Cancer Genet. Cytogenet.*, **71**, 155–163
- Young, L.S., Clark, D., Sixbey, J.W. & Rickinson, A.B. (1986) Epstein-Barr virus receptors on human pharyngeal epithelia. *Lancet*, **i**, 240–242
- Young, L.S., Yao, Q.Y., Rooney, C.M., Sculley, T.B., Moss, D.J., Rupani, H., Laux, G., Bornkamm, G.W. & Rickinson, A.B. (1987) New type B isolates of Epstein-Barr virus from Burkitt's lymphoma and from normal individuals in endemic areas. *J. gen. Virol.*, **68**, 2853–2862
- Young, L.S., Dawson, C.W., Clar, D., Rupani, H., Busson, P., Tursz, T., Johnson, A. & Rickinson, A.B. (1988) Epstein-Barr virus gene expression in nasopharyngeal carcinoma. *J. gen. Virol.*, **69**, 1051–1065
- Young, L.S., Alfieri, C., Hennessy, K., Evans, H., O'Hara, C., Anderson, K.C., Ritz, J., Shapiro, R.S., Rickinson, A., Kieff, E. & Cohen, J.I. (1989a) Expression of Epstein-Barr virus transformation-associated genes in tissues of patients with EBV lymphoproliferative disease. *New Engl. J. Med.*, **321**, 1080–1085
- Young, L.S., Finerty, S., Brooks, L., Scullion, F., Rickinson, A.B. & Morgan, A.J. (1989b) Epstein-Barr virus gene expression in malignant lymphomas induced by experimental virus infection of cottontop tamarins. *J. Virol.*, **63**, 1967–1974
- Young, L.S., Dawson, C.W., Brown K.W. & Rickinson, A.B. (1989c) Identification of a human epithelial cell surface protein sharing an epitope with the C3d/Epstein-Barr virus receptor molecule of B lymphocytes. *Int. J. Cancer*, **43**, 786–794
- Young, L.S., Lau, R., Rowe, M., Niedobitek, G., Packham, G., Shanahan, F., Rowe, D.T., Greenspan, D., Greenspan, J.S., Rickinson, A.B. & Farrell, P.J. (1991) Differentiation-associated expression of the Epstein-Barr virus BZLF1 transactivator protein in oral hairy leukoplakia. *J. Virol.*, **65**, 2868–2874
- Yu, M.C., Ho, J.H.C., Ross, R.K. & Henderson, B.E. (1981) Nasopharyngeal carcinoma in Chinese — Salted fish or inhaled smoke? *Prev. Med.*, **10**, 15–24
- Yu, M.C., Ho, J.H.C., Lai, S.-H. & Henderson, B.E. (1986) Cantonese-style salted fish as a cause of nasopharyngeal carcinoma: Report of a case-control study in Hong Kong. *Cancer Res.*, **46**, 956–961
- Yu, M.C., Mo, C.-C., Chong, W.-X., Yeh, F.-S. & Henderson, B.E. (1988) Preserved foods and nasopharyngeal carcinoma: A case-control study in Guangxi, China. *Cancer Res.*, **48**, 1954–1959

- Yu, M.C., Huang, T.-B. & Henderson, B.E. (1989a) Diet and nasopharyngeal carcinoma: A case-control study in Guangzhou, China. *Int. J. Cancer*, **43**, 1077-1082
- Yu, M.C., Nichols, P.W., Zou, X.-N., Estes, J. & Henderson, B.E. (1989b) Induction of malignant nasal cavity tumours in Wistar rats fed Chinese salted fish. *Br. J. Cancer*, **60**, 198-201
- Yu, M.C., Garabrant, D.H., Huang, T.-B. & Henderson, B.E. (1990) Occupational and other non-dietary risk factors for nasopharyngeal carcinoma in Guangzhou, China. *Int. J. Cancer*, **45**, 1033-1039
- Yuen, S.T., Chung, L.P., Leung, S.Y., Luk, I.S.C., Chan, S.Y. & Ho, J. (1994) In situ detection of Epstein-Barr virus in gastric and colorectal adenocarcinomas. *Am. J. surg. Pathol.*, **18**, 1158-1163
- Zajac-Kaye, M., Yu, B. & Ben-Baruch, N. (1990) Downstream regulatory elements in the c-myc gene. *Curr. Top. Microbiol. Immunol.*, **166**, 279-284
- Zalani, S., Holley-Guthrie, E. & Kenney, S. (1996) Epstein-Barr viral latency is disrupted by the immediate-early BRLF1 protein through a cell-specific mechanism. *Proc. natl Acad. Sci. USA*, **93**, 9194-9199
- Zarate-Osorno, A., Roman, L.N., Kingma, D.W., Meneses-Garcia, A. & Jaffe, E.S. (1994) Hodgkin's disease in Mexico. Prevalence of Epstein-Barr virus sequences and correlations with histologic subtype. *Cancer*, **75**, 1360-1366
- Zech, L., Haglund, U., Nilsson, K. & Klein, G. (1976) Characteristic chromosomal abnormalities in biopsies and lymphoid-cell lines from patients with Burkitt and non-Burkitt lymphomas. *Int. J. Cancer*, **17**, 47-56
- Zeng, Y. (1985) Seroepidemiological studies on nasopharyngeal carcinoma in China. *Adv. Cancer Res.*, **44**, 121-138
- Zeng, Y. (1987) Prospective studies on nasopharyngeal carcinoma and Epstein-Barr virus inducers. In: Wagner, G. & Zhang, Y.-H., eds, *Cancer of the Liver, Esophagus, and Nasopharynx*, New York, Springer-Verlag, pp. 164-169
- Zeng, Y., Shang, M., Liu, C.R., Chen, S.W., Wei, J.N., Zhu, J.S. & Zai, H.G. (1979) Detection of anti Epstein-Barr virus IgA in NPC patients in 8 provinces and cities in China. *Chin. Oncol.*, **1**, 2-7
- Zeng, Y., Liu, Y., Liu, C., Chen, S., Wei, J., Zhu, J. & Zai, H. (1980) Application of an immunoenzymatic method and an immunoradiographic method for a mass survey of nasopharyngeal carcinoma. *Intervirology*, **13**, 162-168
- Zeng, Y., Shen, S., Pi, G., Ma, J.L., Zhang, Q., Zhao, M.G. & Dong, H.J. (1981) Application of anticomplement immunoenzymatic method for the detection of EBNA in carcinoma cells and normal epithelial cells from the nasopharynx. In: Grundmann, E., Krueger, G.R.F. & Ablashi, D.V., eds, *Cancer Campaign*, Vol. 5, *Nasopharyngeal Carcinoma*, Stuttgart, Gustav Fischer Verlag, pp. 2-7
- Zeng, Y., Zhang, L.G., Li, H.Y., Jan, M.G., Zhang, Q., Wu, Y.C., Wang, Y.S. & Su, G.R. (1982) Serological mass survey for early detection of nasopharyngeal carcinoma in Wuzhou City, China. *Int. J. Cancer*, **29**, 139-141
- Zeng, Y., Zhong, J.M. & Li, L.Y. (1983a) Antibody-positive persons in Zangwu County, China. *Intervirology*, **20**, 190-194
- Zeng, Y., Zhong, J.M., Mo, Y.K. & Miao, X.C. (1983b) Epstein-Barr virus early antigen induction in Raji cells by Chinese medicinal herbs. *Intervirology*, **19**, 201-204

- Zeng, Y., Zhang, L.G. & Wu, Y.C. (1985) Prospective studies on nasopharyngeal carcinoma in Epstein-Barr virus IgA/VCA antibodies-positive persons in Wuzhon City. *China Int. J. Cancer*, **36**, 545–547
- Zeng, Y., Hong, D., Jianming, J., Naiqin, H., Pingjun, L., Wenjun, P., Yuying, H., Yue, L., Peizhong, W. & de Thé, G. (1993) A 10-year prospective study on nasopharyngeal carcinoma in Wuzhou City and Zangwu County, Guangxi, China. In: Tursz, T., Pagano, J., Ablashi, D.V., de Thé, G., Lenoir, G. & Pearson, G.R., eds, *The Epstein-Barr Virus and Associated Diseases* (Colloque INSERM No. 225), Paris, INSERM/John Libbey Eurotext Ltd, pp. 735–741
- Zhang, P.F., Klutch, M., Armstrong, G., Qualtiere, L., Pearson, G. & Marcus-Sekura, C.J. (1991) Mapping of the epitopes of Epstein-Barr virus gp350 using monoclonal antibodies and recombinant proteins expressed in *Escherichia coli* defines three antigenic determinants. *J. gen. Virol.*, **72**, 2747–2755
- Zhang, Q., Brooks, L., Busson, P., Wang, F., Charron, D., Kieff, E., Rickinson, A.B. & Tursz, T. (1994a) Epstein-Barr virus (EBV) latent membrane protein 1 increases HLA class II expression in an EBV-negative B cell line. *Eur. J. Immunol.*, **24**, 1467–1470
- Zhang, Q., Gutsch, D. & Kenney, S. (1994b) Functional and physical interaction between p53 and BZLF1: Implications for Epstein-Barr virus latency. *Mol. cell. Biol.*, **14**, 1929–1938
- Zhao, B., Marshall, D.R. & Sample, C.E. (1996) A conserved domain of the Epstein-Barr virus nuclear antigens 3A and 3C binds to a discrete domain of κ . *J. Virol.*, **70**, 4228–4236
- Zheng, Y., Ohshima, H., Bouvier, G., Roy, P., Zhong, J., Li, B., Brouet, I., de Thé, G. & Bartsch, H. (1993) Urinary excretion of nitrosamino acids and nitrate by inhabitants of high- and low-risk areas for nasopharyngeal carcinoma in southern China. *Cancer Epidemiol. Biomarkers Prev.*, **2**, 195–200
- Zheng, X., Yan, L., Nilsson, B., Eklund, G. & Drettner, B. (1994a) Epstein-Barr virus infection, salted fish and nasopharyngeal carcinoma. A case-control study in southern China. *Acta oncol.*, **33**, 867–872
- Zheng, Y.M., Tuppin, P., Hubert, A., Jeannel, D., Pan, Y.J., Zeng, Y. & de Thé, G. (1994b) Environmental and dietary risk factors for nasopharyngeal carcinoma: A case-control study in Zangwu County, Guangxi, China. *Br. J. Cancer*, **69**, 508–514
- Zheng, X., Hu, L., Chen, F. & Christensson, B. (1994c) Expression of Ki67 antigen, epidermal growth factor receptor and Epstein-Barr virus-encoded latent membrane protein (LMP1) in nasopharyngeal carcinoma. *Eur. J. Cancer B Oral Oncol.*, **30B**, 290–295
- Zheng, X., Luo, Y., Christensson, B. & Drettner, B. (1994d) Induction of nasal and nasopharyngeal tumours in Sprague-Dawley rats fed with Chinese salted fish. *Acta otolaryngol.*, **114**, 98–104
- Zhou, X.-G., Hamilton-Dutoit, S.J., Yan, Q.-H. & Pallesen, G. (1993) The association between Epstein-Barr virus and Chinese Hodgkin's disease. *Int. J. Cancer*, **55**, 359–363
- Zhou, X.-G., Hamilton-Dutoit, S.J., Yan, Q.-H. & Pallesen, G. (1994) High frequency of Epstein-Barr virus in Chinese peripheral T-cell lymphoma. *Histopathology*, **24**, 115–122
- Zhu, K., Levine, R.S., Brann, E.A., Gnepp, D.R. & Baum, M.K. (1995) A population-based case-control study of the relationship between cigarette smoking and nasopharyngeal cancer (United States). *Cancer Causes Control*, **6**, 507–512
- Ziegler, J.L., Bluming, A.Z., Morrow, R.H., Fass, L. & Carbone, P.P. (1970) Central nervous system involvement in Burkitt's lymphoma. *Blood*, **36**, 718–728

- Ziegler, J.L., Andersson, M., Klein, G. & Henle, W. (1976) Detection of Epstein-Barr virus DNA in American Burkitt's lymphoma. *Int. J. Cancer*, **17**, 701–706
- Ziegler, J.L., Newton, R., Katongole-Mbidde, E., Mbulataiye, S., DeCock, K., Wobinga, H., Mugerwa, J., Katabira, E., Jaffe, H., Parkin, D.M., Reeves, G., Weiss, R. & Beral, V. (1997) Risk factors for Kaposi's sarcoma in HIV positive subjects in Uganda. *AIDS*, **11**, 1619–1626
- Zimber, U., Adldinger, H.K., Lenoir, G.M., Vuillaume, M., Knebel-Doerberitz, M.V., Laux, G., Desgranges, C., Wittmann, P., Freese, U.-K., Schneider, U. & Bornkamm, G.W. (1986) Geographical prevalence of two types of Epstein-Barr virus. *Virology*, **154**, 56–66
- Zimber-Strobl, U., Suentzenich, K.O., Laux, G., Eick, D., Cordier, M., Calender, A., Billaud, M., Lenoir, G.M. & Bornkamm, G.W. (1991) Epstein-Barr virus nuclear antigen 2 activates transcription of the terminal protein gene. *J. Virol.*, **65**, 415–423
- Zimber-Strobl, U., Kremmer, E., Grässer, F., Marschall, G., Laux, G. & Bornkamm, G.W. (1993) The Epstein-Barr virus nuclear antigen 2 interacts with an EBNA2 responsive *cis*-element of the terminal protein 1 gene promoter. *EMBO J.*, **12**, 167–175
- Zimber-Strobl, U., Strobl, L.J., Meitinger, C., Hinrichs, R., Sakai, T., Furukawa, T., Honjo, T. & Bornkamm, G.W. (1994) Epstein-Barr virus nuclear antigen 2 exerts its transactivating function through interaction with recombination signal binding protein RBP-J κ , the homologue of *Drosophila* suppressor of hairless. *EMBO J.*, **13**, 4973–4982
- Zimber-Strobl, U., Kempkes, B., Marschall, G., Zeidler, R., van Kooten, C., Bancherau, J., Bornkamm, G.W. & Hammerschmidt, W. (1996) Epstein-Barr virus latent membrane protein (LMP1) is not sufficient to maintain proliferation of B cells but both it and activated CD40 can prolong their survival. *EMBO J.*, **15**, 7070–7078
- Zutter, M.M., Martin, P.J., Sale, G.E., Shulman, H.M., Fisher, L., Thomas, E.D. & Durnam, D.M. (1988) Epstein-Barr virus lymphoproliferation after bone marrow transplantation. *Blood*, **72**, 520–529