

7. Literaturverzeichnis

- Achtman, M. (1990) Molecular epidemiology of epidemic bacterial meningitis. *Rev Med Microbiol* **1**: 29-38.
- Achtman, M. (1991) Clonal properties of meningococci from epidemic meningitis. *Trans R Soc Trop Med Hyg* **85, Supplement 1**: 24-31.
- Achtman, M. (1994) Clonal spread of serogroup A meningococci. A paradigm for the analysis of microevolution in bacteria. *Mol Microbiol* **11**: 15-22.
- Achtman, M. (1995) Epidemic spread and antigenic variability of *Neisseria meningitidis*. *Trends Microbiol* **3**: 186-192.
- Achtman, M., Kusecek, B., Morelli, G., Eickmann, K., Wang, J., Crowe, B., et al. (1992) A comparison of the variable antigens expressed by clone IV-1 and subgroup III of *Neisseria meningitidis* serogroup A. *J Infect Dis* **165**: 53-68.
- Achtman, M., Neibert, M., Crowe, B.A., Strittmatter, W., Kusecek, B., Weyse, E., et al. (1988) Purification and characterization of eight class 5 outer membrane protein variants from a clone of *Neisseria meningitidis* serogroup A. *J Exp Med* **168**: 507-525.
- Ahn, B.Y., Dornfeld, K.J., Fagrelius, T.J., and Livingston, D.M. (1988) Effect of limited homology on gene conversion in a *Saccharomyces cerevisiae* plasmid recombination system. *Mol Cell Biol* **8**: 2442-2448.
- Aho, E.L., Dempsey, J.A.F., Hobbs, M.M., Klapper, D.G., and Cannon, J.G. (1991) Characterization of the *opa* (class 5) gene family of *Neisseria meningitidis*. *Mol Microbiol* **5**: 1429-1437.
- al-Gahtani, Y.M., el Bushra, H.E., al-Qarawi, S.M., al-Zubaidi, A.A., and Fontaine, R.E. (1995) Epidemiological investigation of an outbreak of meningococcal meningitis in Makkah (Mecca), Saudi Arabia, 1992. *Epidemiol Infect* **115**: 399-409.
- Ala'Aldeen, D.A.A., Stevenson, P., Griffiths, E., Gorringe, A.R., Irons, L.I., Robinson, A., et al. (1994) Immune responses in humans and animals to meningococcal transferrin-binding proteins: Implications for vaccine design. *Infect Immun* **62**: 2984-2990.
- Alexander, H.E. and Redman, W. (1953) Transformation of type specificity of meningococci. *J Exp Med* **97**: 797-806.
- Altschul, S.F., Gish, W., Miller, W., Myers, E.W., and Lipman, D.J. (1990) Basic local alignment search tool. *J Mol Biol* **215**: 403-410.
- Altschul, S.F., Madden, T.L., Schaffer, A.A., Zhang, J., Zhang, Z., Miller, W., et al. (1997) Gapped BLAST and PSI-BLAST: a new generation of protein database search programs. *Nucleic Acids Res* **25**: 3389-3402.
- Andersen, B.M., Skjærten, F., and Solberg, O. (1979) Electron microscopical study of *Neisseria meningitidis* releasing various amounts of free endotoxin. *Acta Pathologica et Microbiologica Scandinavica Section B Sect. B* **87**: 109-115.
- Anderson, B.F., Baker, H.M., Norris, G.E., Rice, D.W., and Baker, E.N. (1989) Structure of human lactoferrin: crystallographic structure analysis and refinement at 2.8 Å resolution. *J Mol Biol* **209**: 711-734.

- Anderson, J.E., Sparling, P.F., and Cornelissen, C.N. (1994) Gonococcal transferrin-binding protein 2 facilitates but is not essential for transferrin utilization. *J Bacteriol* **176**: 3162-3170.
- Anon. (1996) Centers for Disease Control and Prevention. Serogroup Y meningococcal disease - Illinois, Connecticut, and selected areas, United States, 1989-1996. *MMWR* **45**: 1010-1013.
- Arber, W. and Dussoix, D. (1962) Host specificity of DNA produced by *Escherichia coli* I. Host controlled modification of bacteriophage lambda. *J Mol Biol* **5**: 18-36.
- Atwood, K.C., Schneider, L.K., and Ryan, F.J. (1951) Periodic selection in *Escherichia coli*. *Proc Natl Acad Sci (U S A)* **37**: 146-155.
- Auriol, J., Guesdon, J.-L., Guibourdenche, M., and Riou, J.Y. (1995) Characterization of serogroup A *Neisseria meningitidis* strains by rRNA gene restriction patterns and PCR: Correlation with the results of serotyping, subtyping and multilocus enzyme electrophoresis. *FEMS Immunol Med Microbiol* **10**: 219-226.
- Avery, O.T., MacLeod, C.M., and McCarty, M. (1944) Studies on the chemical nature of the substance inducing transformation of pneumococcal types. *J Exp Med* **79**: 137-158.
- Aycock, W.L. and Mueller, J.H. (1950) Meningococcus carrier rates and meningitis incidence. *Bacteriol Rev* **14**: 115-160.
- Bachellier, S., Clément, J.-M., Hofnung, M., and Gilson, E. (1997) Bacterial interdispersed mosaic elements (BIMEs) are a major source of sequence polymorphism in *Escherichia coli* intergenic regions including specific associations with a new insertion sequence. *Genetics* **145**: 551-562.
- Bachellier, S., Perrin, D., Hofnung, M., and Gilson, E. (1993) Bacterial interspersed mosaic elements (BIMEs) are present in the genome of *Klebsiella*. *Mol Microbiol* **7**: 537-544.
- Bandelt, H.-J. and Dress, A.W.M. (1992) Split decomposition: A new and useful approach to phylogenetic analysis of distance data. *Molecular Phylogenetics & Evolution* **1**: 242-252.
- Barcus, V.A. and Murray, N.E. (1995) Barriers to recombination: restriction. In *Population genetics of bacteria*. Baumberg, S., Young, J.P.W., Wellington, E.M.H., and Saunders, J.R. (eds). Cambridge: Cambridge University press, pp. 31-58.
- Bart, A., Schuurman, I.G.A., Achtman, M., Caugant, D.A., Dankert, J., and van der Ende, A. (1998) Random amplified polymorphic DNA (RAPD) genotyping of serogroup A meningococci yields similar results to multilocus enzyme electrophoresis (MEE) and reveals new genotypes. *J Clin Microbiol* **36**: 1746-1749.
- Belland, R.J., Chen, T., Swanson, J., and Fischer, S.H. (1992) Human neutrophil response to recombinant Neisserial Opa proteins. *Mol Microbiol* **6**: 1729-1737.
- Belland, R.J., Morrison, S.G., van der Ley, P., and Swanson, J. (1989) Expression and phase variation of gonococcal P.II genes in *Escherichia coli* involves ribosomal frameshifting and slipped-strand mispairing. *Mol Microbiol* **3**: 777-786.
- Berish, S.A., Kapczynski, D.R., and Morse, S.A. (1990) Nucleotide sequence of the Fbp gene from *Neisseria meningitidis*. *Nucleic Acids Res* **18**, No 15: 4596-4596.
- Berlyn, M.K.B., Brooks Low, K., and Rudd, K.E. (1996) Linkage map of *Escherichia coli* K-12, edition 9. In *Escherichia coli and Salmonella*. Neidhardt, F.C., Curtiss III, R., Ingraham, J.L., Lin, E.C.C., Brooks Low, K., Magasanik, B., et al. (eds). Washington, D.C.: ASM press, pp. 1715-1902.

- Bessen, D. and Gotschlich, E.C. (1986) Interactions of gonococci with HeLa cells: attachment, detachment, replication, penetration, and the role of protein II. *Infection & Immunity* **54**: 154-160.
- Bhat, K.S., Gibbs, C.P., Barrera, O., Morrison, S.G., Jähnig, F., Stern, A., et al. (1991) The opacity proteins of *Neisseria gonorrhoeae* strain MS11 are encoded by a family of 11 complete genes. *Mol Microbiol* **5**: 1889-1901.
- Bihlmaier, A., Römling, U., Meyer, T.F., Tümmeler, B., and Gibbs, C.P. (1991) Physical and genetic map of the *Neisseria gonorrhoeae* strain MS11-N198 chromosome. *Mol Microbiol* **5**: 2529-2539.
- Biswas, G.D., Sox, T., Blackman, E., and Sparling, P.F. (1977) Factors affecting genetic transformation of *Neisseria gonorrhoeae*. *J Bacteriol* **129**: 983-992.
- Biswas, G.D. and Sparling, F. (1995) Characterization of *lbpA*, the structural gene for a lactoferrin receptor in *Neisseria gonorrhoeae*. *Infect Immun* **63**: 2958-2967.
- Blake, M.S. and Gotschlich, E.C. (1984) Purification and partial characterization of the opacity-associated proteins of *Neisseria gonorrhoea*. *J Exp Med* **159**: 452-462.
- Blakebrough, I.S., Greenwood, B.M., Whittle, H.C., Bradley, A.K., and Gilles, H.M. (1982) The epidemiology of infections due to *Neisseria meningitidis* and *Neisseria lactamica* in a Northern Nigerian community. *J Infect Dis* **146**: 626-637.
- Boulton, I.C., Gorringe, A.R., Allison, N., Robinson, A., Gorinsky, Joannou, C.L., et al. (1998) Transferrin-binding protein B isolated from *Neisseria meningitidis* discriminates between apo and diferric human transferrin. *Biochem J* **334**: 269-273.
- Bowler, L.D., Zhang, Q.-Y., Riou, J.-Y., and Spratt, B.G. (1994) Interspecies recombination between the *penA* genes of *Neisseria meningitidis* and commensal *Neisseria* species during the emergence of penicillin resistance in *N. meningitidis*: natural events and laboratory simulation. *J Bacteriol* **176**: 333-337.
- Breslauer, K.J., Frank, R., Blocker, H., and Marky, L.A. (1986) Predicting DNA duplex stability from the base sequence. *Proc Natl Acad Sci (U S A)* **83**: 3746-3750.
- Brieske, N., Schenker, M., Schnibbe, T., Quentin-Millet, M.-J., and Achtman, M. (1999) Human antibody responses to A and C capsular polysaccharides, IgA1 protease and transferrin-binding protein complex stimulated by infection with *Neisseria meningitidis* of subgroup IV-1 or ET-37 complex. *Vaccine* **17**: 731-744.
- Bygraves, J.A. and Maiden, M.C.J. (1992) Analysis of the clonal relationships between strains of *Neisseria meningitidis* by pulsed field gel electrophoresis. *J Gen Microbiol* **138**: 523-531.
- Campbell, L.A. and Yasbin, R.E. (1979) Deoxyribonucleic acid repair capacities of *Neisseria gonorrhoeae*: absence of photoreactivation. *J Bacteriol* **140**: 1109-1111.
- Campbell, L.A. and Yasbin, R.E. (1984a) A DNA excision repair system for *Neisseria gonorrhoeae*. *Mol Gen Genet* **193**: 561-563.
- Campbell, L.A. and Yasbin, R.E. (1984b) Mutagenesis of *Neisseria gonorrhoeae*: absence of error-prone repair. *J Bacteriol* **160**: 288-293.
- Cannon, J.G. and Sparling, P.F. (1984) The genetics of the gonococcus. *Ann Rev Genet* **38**: 111-133.
- Carbonetti, N.H., Simnad, V.I., Seifert, H.S., So, M., and Sparling, P.F. (1988) Genetics of protein I of *Neisseria gonorrhoeae*: construction of hybrid porins. *Proc Natl Acad Sci (U S A)* **85**: 6841-6845.

- Cartwright, K. (1995) Meningococcal carriage and disease. In *Meningococcal disease*. Cartwright, K. (ed). Chichester: John Wiley & Sons, pp. 115-146.
- Cartwright, K.A.V., Stuart, J.M., Jones, D.M., and Noah, N.D. (1987) The Stonehouse survey: nasopharyngeal carriage of meningococci and *Neisseria lactamica*. *Epidemiol Infect* **99**: 591-601.
- Catlin, B.W. (1960) Transformation of *Neisseria meningitidis* by deoxyribonucleates from cells and from culture slime. *J Bacteriol* **79**: 579-590.
- Caugant, D.A., Bol, P., Høiby, E.A., Zanen, H.C., and Frøholm, L.O. (1990) Clones of serogroup B *Neisseria meningitidis* causing systemic disease in the Netherlands, 1958-1986. *J Infect Dis* **162**: 867-874.
- Caugant, D.A., Frøholm, L.O., Bøvre, K., Holten, E., Frasch, C.E., Mocca, L.F., et al. (1986) Intercontinental spread of a genetically distinctive complex of clones of *Neisseria meningitidis* causing epidemic disease. *Proc Natl Acad Sci (U S A)* **83**: 4927-4931.
- Caugant, D.A., Høiby, E.A., Magnus, P., Scheel, O., Hoel, T., Bjune, G., et al. (1994) Asymptomatic carriage of *Neisseria meningitidis* in a randomly sampled population. *J Clin Microbiol* **32**: 323-330.
- Caugant, D.A., Levin, B.R., and Selander, R.K. (1981) Genetic diversity and temporal variation in the *E. coli* population of a human host. *Genetics* **98**: 467-490.
- Caugant, D.A., Mocca, L.F., Frasch, C.E., Frøholm, L.O., Zollinger, W.D., and Selander, R.K. (1987) Genetic structure of *Neisseria meningitidis* populations in relation to serogroup, serotype, and outer membrane protein pattern. *J Bacteriol* **169**: 2781-2792.
- Chaussee, M.S. and Hill, S.A. (1998) Formation of single-stranded DNA during DNA transformation of *Neisseria gonorrhoeae*. *J Bacteriol* **180**: 5117-5122.
- Claverys, J.P. and Lacks, S.A. (1986) Heteroduplex deoxyribonucleic acid base mismatch repair in bacteria. *Microbiol Rev* **50**: 133-165.
- Clewell, D.B. and Gawron-Burke, C. (1986) Conjugative transposons and the dissemination of antibiotic resistance in streptococci. *Ann Rev Microbiol* **40**: 635-659.
- Connell, T.D., Black, W.J., Kawula, T.H., Barritt, D.S., Dempsey, J.A., Kverneland, K.Jr., et al. (1988) Recombination among protein II genes of *Neisseria gonorrhoeae* generates new coding sequences and increases structural variability in the protein II family. *Mol Microbiol* **2**: 227-236.
- Connell, T.D., Shaffer, D., and Cannon, J.G. (1990) Characterization of the repertoire of hypervariable regions in the protein II (*opa*) gene family of *Neisseria gonorrhoeae*. *Mol Microbiol* **4**: 439-449.
- Cornelissen, C.N., Anderson, J.E., and Sparling, P.F. (1997) Characterization of the diversity and the transferrin-binding domain of gonococcal transferrin-binding protein 2. *Infect Immun* **65**: 822-828.
- Cornelissen, C.N., Biswas, G.D., Tsai, J., Paruchuri, D.K., Thompson, S.A., and Sparling, P.F. (1992) Gonococcal transferrin-binding protein 1 is required for transferrin utilization and is homologous to TonB-dependent outer membrane receptors. *J Bacteriol* **174**: 5788-5797.
- Cornelissen, C.N. and Sparling, P.F. (1994) Iron piracy: Acquisition of transferrin-bound iron by bacterial pathogens. *Mol Microbiol* **14**: 843-850.

- Correia, F.F., Inouye, S., and Inouye, M. (1988) A family of small repeated elements with some transposon-like properties in the genome of *Neisseria gonorrhoeae*. *J Biol Chem* **263**: 12194-12198.
- Craig, N.L. (1996) Transposition. In *Escherichia coli and Salmonella*. Neidhardt, F.C., Ingraham, J.L., Lin, E.C.C., Brooks Low, K., Magasanik, B., Reznikoff, W.S., et al. (eds). Washington, D.C.: ASM press, pp. 2339-2362.
- Crowe, B.A., Wall, R.A., Kusecek, B., Neumann, B., Olyhoek, T., Abdillahi, H., et al. (1989) Clonal and variable properties of *Neisseria meningitidis* isolated from cases and carriers during and after an epidemic in the Gambia, West Africa. *J Infect Dis* **159**: 686-700.
- Danner, D.B., Deich, R.A., Siseo, K.L., and Smith, H.O. (1980) An eleven-basepair sequence determines the specificity of DNA uptake in *Haemophilus* transformation. *Gene* **11**: 311-318.
- DasGupta, C. and Radding, C.M. (1982) Lower fidelity of RecA protein catalysed homologous pairing with a superhelical substrate. *Nature* **295**: 71-73.
- De La Fuente, L. and Vázquez, J.A. (1994) Genetic structures of non-penicillinase-producing *Neisseria gonorrhoeae* strains in relation to auxotype and serovar class. *J Infect Dis* **170**: 696-700.
- de Vos, W.M., Venema, G., Canosi, U., and Trautner, T.A. (1981) Plasmid transformation in *Bacillus subtilis*: fate of plasmid DNA. *Molecular & General Genetics* **181**: 424-433.
- Dehio, C., Gray-Owen, S.D., and Meyer, T.F. (1998) The role of neisserial Opa proteins in interactions with host cells. *Trends Microbiol* **6**: 489-495.
- Dempsey, J.A.F. and Cannon, J.G. (1994) Locations of genetic markers on the physical map of the chromosome of *Neisseria gonorrhoeae* FA1090. *J Bacteriol* **176**: 2055-2060.
- Dempsey, J.A.F., Wallace, A.B., and Cannon, J.G. (1995) The physical map of the chromosome of a serogroup A strain of *Neisseria meningitidis* shows complex rearrangements relative to the chromosomes of two mapped strains of the closely related species *N. gonorrhoeae*. *J Bacteriol* **177**: 6390-6400.
- DeVoe, I.W. and Gilchrist, J.E. (1973) Release of endotoxin in the form of cell wall blebs during in vitro growth of *Neisseria meningitidis*. *J Exp Med* **138**: 1156-1167.
- Dorward, D.W. and Garon, C.F. (1989a) DNA-binding proteins in cells and membrane blebs of *Neisseria gonorrhoeae*. *J Bacteriol* **171**: 4196-4201.
- Dorward, D.W., Garon, C.F., and Judd, R.C. (1989b) Export and intercellular transfer of DNA via membrane blebs of *Neisseria gonorrhoeae*. *J Bacteriol* **171**: 2499-2505.
- DuBose, R.F., Dykhuizen, D.E., and Hartl, D.L. (1988) Genetic exchange among natural isolates of bacteria: Recombination within the *phoA* gene of *Escherichia coli*. *Proc Natl Acad Sci (U S A)* **85**: 7036-7040.
- Dussoix, D. and Arber, W. (1962) Host specificity of DNA produced by *Escherichia coli* II. Control over acceptance of DNA from infecting phage lambda. *J Mol Biol* **5**: 37-49.
- Dykhuizen, D. (1992) Periodic selection. In *Encyclopedia of Microbiology*. AnonymousNew York: Academic Press, Inc., pp. 351-355.
- Elkins, C., Thomas, C.E., Steven Seifert, H., and Sparling, P.F. (1991) Species-specific uptake of DNA by gonococci is mediated by a 10-base-pair sequence. *J Bacteriol* **173**: 3911-3913.

- Embley, T.M. (1991) The linear PCR reaction: a simple and robust method for sequencing amplified RNA genes. *Lett Appl Microbiol* **13**: 171-174.
- Enright, M.C. and Spratt, B.G. (1998) A multilocus sequence typing scheme for *Streptococcus pneumoniae*: identification of clones associated with serious invasive disease. *Microbiology* **144**: 3049-3060.
- Facius, D., Fussenegger, M., and Meyer, T.F. (1996) Sequential action of factors involved in natural competence for transformation of *Neisseria gonorrhoeae*. *FEMS Microbiol Lett* **137**: 159-164.
- Facius, D. and Meyer, T.F. (1993) A novel determinant (*comA*) essential for natural transformation competence in *Neisseria gonorrhoeae* and the effect of a *comA* defect on pilin variation. *Mol Microbiol* **10**: 699-712.
- Feavers, I.M., Heath, A.B., Bygraves, J.A., and Maiden, M.C.J. (1992) Role of horizontal genetic exchange in the antigenic variation of the class 1 outer membrane protein of *Neisseria meningitidis*. *Mol Microbiol* **6**: 489-495.
- Feil, E., Carpenter, G., and Spratt, B.G. (1995) Electrophoretic variation in adenylate kinase of *Neisseria meningitidis* is due to inter- and intraspecies recombination. *Proc Natl Acad Sci (U S A)* **92**: 10535-10539.
- Feil, E., Zhou, J.J., Smith, J.M., and Spratt, B.G. (1996) A comparison of the nucleotide sequences of the *adk* and *recA* genes of pathogenic and commensal *Neisseria* species: Evidence for extensive interspecies recombination within *adk*. *J Mol Evol* **43**: 631-640.
- Ferreirós, C.M., Ferrón, L., and Criado, M.T. (1994) In vivo human immune response to transferrin-binding protein 2 and other iron-regulated proteins of *Neisseria meningitidis*. *FEMS Immunol Med Microbiol* **8**: 63-68.
- Firth, N., Ippen-Ihler, K., and Skurray, R.A. (1996) Structure and function of the F factor and mechanism of conjugation. In *Escherichia coli and Salmonella*. Neidhardt, F.C., Curtiss III, R., Ingraham, J.L., Lin, E.C.C., Brooks Low, K., Magasanik, B., et al. (eds). Washington, D.C.: ASM press, pp. 2377-2401.
- Fleischmann, R.D., Adams, M.D., White, O., Clayton, R.A., Kirkness, E.F., Kerlavage, A.R., et al. (1995) Whole-genome random sequencing and assembly of *Haemophilus influenzae* Rd. *Science* **269**: 496-512.
- Foster, P.L. (1995) Adaptive mutation. In *Population genetics of bacteria*. Baumberg, S., Young, J.P.W., Wellington, E.M.H., and Saunders, J.R. (eds). Cambridge: University press, pp. 13-30.
- Fox, A.J., Jones, D.M., Gary, S.J., Caugant, D.A., and Saunders, N.A. (1991) An epidemiologically valuable typing method for *Neisseria meningitidis* by analysis of restriction fragment length polymorphisms. *J Med Microbiol* **34**: 265-270.
- Frasch, C.E., Zollinger, W.D., and Poolman, J.T. (1985) Serotype antigens of *Neisseria meningitidis* and a proposed scheme for designation of serotypes. *Rev Infect Dis* **7**: 504-510.
- Fraser, P.K., Bailey, G.K., and Abbot, J.D. (1973) The meningococcal carrier-rate. *Lancet* **i**: 1235
- Froholm, L.O. and Bovre, K. (1973) Electron microscopical and cultural features of *Neisseria meningitidis* competence mutants. *Acta Pathologica et Microbiologica Scandinavica Section B* **81**: 525-537.
- Frosch, M. and Meyer, T.F. (1992) Transformation-mediated exchange of virulence determinants by co-cultivation of pathogenic Neisseriae. *FEMS Microbiol Lett* **100**: 345-350.

Literaturverzeichnis

- Frosch, M., Weisgerber, C., and Meyer, T.F. (1989) Molecular characterization and expression in *Escherichia coli* of the gene complex encoding the polysaccharide capsule of *Neisseria meningitidis* group B. *Proc Natl Acad Sci (U S A)* **86**: 1669-1673.
- Fussenegger, M., Facius, D., Meier, J., and Meyer, T.F. (1996a) A novel peptidoglycan-linked lipoprotein (ComL) that functions in natural transformation competence of *Neisseria gonorrhoeae*. *Mol Microbiol* **19**: 1095-1105.
- Fussenegger, M., Kahrs, A.F., Facius, D., and Meyer, T.F. (1996b) Tetrapac (*tpc*), a novel genotype of *Neisseria gonorrhoeae* affecting epithelial cell invasion, natural transformation competence and cell separation. *Mol Microbiol* **19**: 1357-1372.
- Fussenegger, M., Rudel, T., Barten, R., Ryll, R., and Meyer, T.F. (1997) Transformation competence and type-4 pilus biogenesis in *Neisseria gonorrhoeae* - a review. *Gene* **192**: 125-134.
- Gäher, M., Einsiedler, K., Crass, T., and Bautsch, W. (1996) A physical and genetic map of *Neisseria meningitidis* B1940. *Mol Microbiol* **19**: 249-259.
- Genco, C.A. and Desai, P.J. (1996) Iron acquisition in the pathogenic *Neisseria*. *Trends Microbiol* **4**: 179-184.
- Gibbs, C.P., Reimann, B.-Y., Schultz, E., Kaufmann, A., Haas, R., and Meyer, T.F. (1989) Reassortment of pilin genes in *Neisseria gonorrhoeae* occurs by two distinct mechanisms. *Nature* **338**: 651-652.
- Gilson, E., Clement, J.M., Brutlag, D., and Hofnung (1984) A family of dispersed repetitive extragenic palindromic DNA sequences in *E. coli*. *EMBO J* **3**: 1417-1421.
- Gomez, J.A., Criado, M.T., Ferreiros, C.M., Transferrin, Iron, Neisseria, m., et al. (1998) Cooperation between the components of the meningococcal transferrin receptor, TbpA and TbpB, in the uptake of transferrin iron by the 37-kda ferric-binding protein (FbpA). *Res Microbiol* **149**: 381-387.
- Goodman, S.D. and Scocca, J.J. (1988) Identification and arrangement of the DNA sequence recognized in specific transformation of *Neisseria gonorrhoeae*. *Proc Natl Acad Sci (U S A)* **85**: 6982-6986.
- Goodman, S.D. and Scocca, J.J. (1991) Factors influencing the specific interaction of *Neisseria gonorrhoeae* with transforming DNA. *J Bacteriol* **173**: 5921-5923.
- Gray-Owen, S.D. and Schryvers, A.B. (1996) Bacterial transferrin and lactoferrin receptors. *Trends Microbiol* **4**: 185-191.
- Griffiths, E., Stevenson, P., Byfield, P., Ala'Aldeen, D.A., Borriello, S.P., Holland, J., et al. (1993) Antigenic relationships of transferrin-binding proteins from *Neisseria meningitidis*, *N. gonorrhoeae* and *Haemophilus influenzae* : Cross-reactivity of antibodies to NH₂-terminal peptides. *FEMS Microbiol Lett* **109**: 85-92.
- Griffiths, E., Stevenson, P., and Ray, A. (1990) Antigenic and molecular heterogeneity of the transferrin-binding protein of *Neisseria meningitidis*. *FEMS Microbiol Lett* **69**: 31-36.
- Guerinot, M.L. (1994) Microbial iron transport. *Annu Rev Microbiol* **48**: 743-772.
- Guibourdenche, M., Giorgini, D., Guèye, A., Larrière, M., Riou, J.-Y., and Taha, M.-K. (1997) Genetic analysis of meningococcal population using polymorphism of *pilA/pilB* locus: a molecular approach for meningococcal epidemiology. *J Clin Microbiol* **35**: 745-750.
- Guibourdenche, M., Høiby, E.A., Riou, J.-Y., Varaine, F., Joguet, C., and Caugant, D.A. (1996) Epidemics of serogroup A *Neisseria meningitidis* of subgroup III in Africa, 1989-1994. *Epidemiol Infect* **116**: 115-120.

Literaturverzeichnis

- Haas, R. and Meyer, T.F. (1986) The repertoire of silent pilus genes in *Neisseria gonorrhoeae*: evidence for gene conversion. *Cell* **44**: 107-115.
- Haas, R., Velt, S., and Meyer, T.F. (1992) Silent pilin genes of *Neisseria gonorrhoeae* MS11 and occurrence of related hypervariant sequences among other gonococcal isolates. *Mol Microbiol* **6**: 197-208.
- Hakenbeck, R. (1998) Mosaic genes and their role in penicillin resistant *Streptococcus pneumoniae*. *Electrophoresis* **19**: 597-601.
- Halter, R., Pohlner, J., and Meyer, T.F. (1989) Mosaic-like organization of IgA protease genes in *Neisseria gonorrhoeae* generated by horizontal genetic exchange *in vivo*. *EMBO J* **8**: 2737-2744.
- Hammerschmidt, S., Hilse, R., van Putten, J.P.M., Gerardy-Schahn, R., Unkmeir, A., and Frosch, M. (1996a) Modulation of cell surface sialic acid expression in *Neisseria meningitidis* via a transposable genetic element. *EMBO J* **15**: 192-198.
- Hammerschmidt, S., Müller, A., Sillmann, H., Müllenhoff, M., Borrow, R., Fox, A., et al. (1996b) Capsule phase variation in *Neisseria meningitidis* serogroup B by slipped-strand misspairing in the polysialyltransferase gene (*siaD*): correlation with bacterial invasion and the outbreak of meningococcal disease. *Mol Microbiol* **20**: 1211-1220.
- Hassan-King, M.K.A., Wall, R.A., and Greenwood, B.M. (1988) Meningococcal carriage, meningococcal disease and vaccination. *J Infection* **16**: 55-59.
- Hebeler, B.H. and Young, F.E. (1975) Autolysis of *Neisseria gonorrhoeae*. *J Bacteriol* **122**: 385-392.
- Heubner, J.O.L. (1896) Beobachtungen und Versuche über den Meningokokkus intracellularis (Weichselbaum-Jaeger). *Jb Kinderheilk* **43**: 1-22.
- Higgins, C.F., Ames, G.F., Barnes, W.M., Clement, J.M., and Hofnung, M. (1982) A novel intercistronic regulatory element of prokaryotic operons. *Nature* **298**: 760-762.
- Hill, S.A., Morrison, S.G., and Swanson, J. (1990) The role of direct oligonucleotide repeats in gonococcal pilin gene variation. *Mol Microbiol* **4**: 1341-1352.
- Hobbs, M.M., Seiler, A., Achtman, M., and Cannon, J.G. (1994) Microevolution within a clonal population of pathogenic bacteria: recombination, gene duplication and horizontal genetic exchange in the *opa* gene family of *Neisseria meningitidis*. *Mol Microbiol* **12**: 171-180.
- Holliday, R. (1964) A mechanism for gene conversion in fungi. *Genet Res* **282**-304.
- Huson, D.H. (1998) SplitsTree: Analyzing and visualizing evolutionary data. *BIOINFORMATICS* **14**: 68-73.
- Imrey, P.B., Jackson, L.A., Ludwinski, P.H., England, A.C.3., Fella, G.A., Fox, B.C., et al. (1995) Meningococcal carriage, alcohol consumption, and campus bar patronage in a serogroup C meningococcal disease outbreak. *J Clin Microbiol* **33**: 3133-3137.
- James, J.F., Lammel, C.J., Draper, D.L., and Brooks, G.F. (1980) Attachment of *Neisseria gonorrhoeae* phenotype variants to eukaryotic cells and tissues. In *Genetics and Immunobiology of Pathogenic Neisseria*. Danielson, D. and Normark, S. (eds). Sweden: University of Umea, pp. 213-216.
- Jennings, M.P., Hood, D., Peak, I., Virji, M., Moxon, E.R., Hood, D.W., et al. (1995) Molecular analysis of a locus for the biosynthesis and phase-variable expression of the lacto-N-neotetraose terminal lipopolysaccharide structure in *Neisseria meningitidis*. *Mol Microbiol* **18**: 729-740.

Literaturverzeichnis

- Jonsson, A.-B., Nyberg, G., and Normark, S. (1991) Phase variation of gonococcal pili by frameshift mutation in *pilC*, a novel gene for pilus assembly. *EMBO J* **10**: 477-488.
- Jonsson, A.B., Rahman, M., and Normark, S. (1995) Pilus biogenesis gene, *pilC*, of *Neisseria gonorrhoeae*: *pilC1* and *pilC2* are each part of a larger duplication of the gonococcal genome and share upstream and downstream homologous sequences with *opa* and *pil* loci. *Microbiology* **141**: 2367-2377.
- Kiefer, F. (1896) Zur Differentialdiagnose des Erregers der epidemischen Cerebrospinalmeningitis und der Gonorrhoe. *Berl klin Wochens* **33**: 628-630.
- Kingsbury, D.T. (1967) Deoxyribonucleic acid homologies among species of the genus *Neisseria*. *J Bacteriol* **94**: 870-874.
- Knapp, J.S., Zenilman, J.M., Biddle, J.W., Perkins, G.H., DeWitt, W.E., Thomas, M.L., et al. (1987) Frequency and distribution in the United States of strains of *Neisseria gonorrhoeae* with plasmid-mediated, high-level resistance to tetracycline. *J Infect Dis* **155**: 819-822.
- Knight, A.I., Ni, H., Cartwright, K.A.V., and McFadden, J.J. (1992) Identification and characterization of a novel insertion sequence, IS1106, downstream of the *porA* gene in B15 *Neisseria meningitidis*. *Mol Microbiol* **6**: 1565-1573.
- Kobayashi, I. and Nakayama, Y. (1998) Restriction-modification gene complexes as selfish gene entities: Roles of a regulatory system in their establishment, maintenance, and apoptotic mutual exclusion. *Proc Natl Acad Sci (U S A)* **95**: 6442-6447.
- Koomey, M., Gotschlich, E.C., Robbins, K., Bergstrom, S., and Swanson, J. (1987) Effects of *recA* mutations on pilus antigenic variation and phase transitions in *Neisseria gonorrhoeae*. *Genetics* **117**: 391-398.
- Kowalczykowaki, S.C., Dixon, D.A., Eggleston, A.K., Lauder, S.D., and Rehrauer, W.M. (1994) Biochemistry of homologous recombination in *Escherichia coli*. *Microbiol Rev* **58**: 401-465.
- Krawiec, S. and Riley, M. (1990) Organization of the bacterial chromosome. *Microbiological Reviews* **54**: 502-539.
- Kroll, J.S., Wilks, K.E., Farrant, J.L., Langford, and PR (1998) Natural genetic exchange between *Haemophilus* and *Neisseria*: intergeneric transfer of chromosomal genes between major human pathogens. *Proc Natl Acad Sci (U S A)* **95**: 12381-12385.
- Kupsch, E.-M., Knepper, B., Kuroki, T., Heuer, I., and Meyer, T.F. (1993) Variable opacity (Opa) outer membrane proteins account for the cell tropisms displayed by *Neisseria gonorrhoeae* for human leukocytes and epithelial cells. *EMBO J* **12**: 641-650.
- Lacks, S., Greenberg, B., and Carlson, C. (1967) Fate of donor DNA in pneumococcal transformation. *J Mol Biol* **327**-347.
- Lambden, P.R., Heckels, J.E., James, L.T., and Watt, P.J. (1979) Variation in surface protein composition associated with virulence properties in opacity types of *Neisseria gonorrhoea*. *J Gen Microbiol* **114**: 305-312.
- Lapeysonnie, L. (1963) La méningite cérébrospinale en Afrique. *Bull World Health Organ* **28, Suppl**: 53-114.
- Larsen, R.A., Thomas, M.G., and Postle, K. (1999) Protonmotive force, ExbB and ligand-bound FepA drive conformational changes in TonB. *Mol Microbiol* **31**: 1809-1824.

- Lawson, F.S., Billowes, F.M., and Dillon, J.A. (1995) Organization of carbamoyl-phosphate synthase genes in *Neisseria gonorrhoeae* includes a large, variable intergenic sequence which is also present in other *Neisseria* species. *Microbiology* **141**: 1183-1191.
- Lederberg, J. and Tatum, E.L. (1946) Gene recombination in *Escherichia coli*. *Nature* **158**: 558-558.
- Legrain, M., Findeli, A., Villeval, D., Quentin-Millet, M.J., and Jacobs, E. (1996) Molecular characterization of hybrid Tbp2 proteins from *Neisseria meningitidis*. *Mol Microbiol* **19**: 159-169.
- Legrain, M., Mazarin, V., Irwin, S.W., Bouchon, B., Quentin-Millet, M.-J., Jacobs, E., et al. (1993) Cloning and characterization of *Neisseria meningitidis* genes encoding the transferrin-binding proteins Tbp1 and Tbp2. *Gene* **130**: 73-80.
- Liskay, R.M., Letsou, A., and Stachelek, J.L. (1987) Homology requirement for efficient gene conversion between duplicated chromosomal sequences in mammalian cells. *Genetics* **115**: 161-167.
- Liu, S.-L. and Sanderson, K.E. (1995) Rearrangements in the genome of the bacterium *Salmonella typhi*. *Proc Natl Acad Sci (U S A)* **92**: 1018-1022.
- Liu, S.L., Hessel, A., and Sanderson, K.E. (1993) Genomic mapping with I-Ceu I, an intron-encoded endonuclease specific for genes for ribosomal RNA, in *Salmonella* spp., *Escherichia coli*, and other bacteria. *Proc Natl Acad Sci (U S A)* **90**: 6874-6878.
- Lloyd, R.G. and Brooks Low, K. (1996) Homologous recombination. In *Escherichia coli and Salmonella*. Neidhardt, F.C., Curtiss III, R., Ingraham, J.L., Lin, E.C.C., Brooks Low, K., Magasanik, B., et al. (eds). Washington, D.C: ASM press, pp. 2236-2255.
- Lomholt, H., Poulsen, K., Caugant, D.A., and Kilian, M. (1992) Molecular polymorphism and epidemiology of *Neisseria meningitidis* immunoglobulin A1 proteases. *Proc Natl Acad Sci (U S A)* **89**: 2120-2124.
- Lomholt, H., Poulsen, K., and Kilian, M. (1995) Comparative characterization of the *iga* gene encoding IgA1 protease in *Neisseria meningitidis*, *Neisseria gonorrhoeae* and *Haemophilus influenzae*. *Mol Microbiol* **15**: 495-506.
- Lorenz, M.G. and Wackernagel, W. (1994) Bacterial gene transfer by natural genetic transformation in the environment. *Microbiol Rev* **58**: 563-602.
- Luria, S. and Delbrück, M. (1943) Mutations of bacteria from virus sensitivity to virus resistance. *Genetics* **28**: 491-511.
- Maiden, M.C.J. (1993) Population genetics of a transformable bacterium: The influence of horizontal genetic exchange on the biology of *Neisseria meningitidis*. *FEMS Microbiol Lett* **112**: 243-250.
- Maiden, M.C.J., Bygraves, J.A., Feil, E., Morelli, G., Russell, J.E., Urwin, R., et al. (1998) Multilocus sequence typing: a portable approach to the identification of clones within populations of pathogenic microorganisms. *Proc Natl Acad Sci (U S A)* **95**: 3140-3145.
- Maiden, M.C.J. and Feavers, I.M. (1995) Population genetics and global epidemiology of the human pathogen *Neisseria meningitidis*. In *Population genetics of bacteria, Society for General Microbiology, Symposium 52*. Baumberg, S., Young, J.P.W., Saunders, S.R., and Wellington, E.M.H. (eds). Cambridge, UK: Cambridge University Press, pp. 269-293.
- Maiden, M.C.J., Malorny, B., and Achtman, M. (1996) A global gene pool in the neisseriae. *Mol Microbiol* **21**: 1297-1298.

- Makino, S., Putten, v.J.P.M., and Meyer, T.M. (1991) Phase variation of the opacity outer membrane protein controls invasion by *Neisseria gonorrhoeae* into human epithelial cells. *EMBO J* **10**: 1307-1315.
- Malorny, B., Morelli, G., Kusecek, B., Kolberg, J., and Achtman, M. (1998) Sequence diversity, 2-D protein structure and epitope mapping of neisserial Opa proteins. *J Bacteriol* **180**: 1323-1330.
- Masters, M. (1996) Generalized transduction. In *Escherichia coli and Salmonella*. Neidhardt, F.C., Curtiss III, R., Ingraham, J.L., Lin, E.C.C., Low, K.B., Magasanik, B., et al. (eds). Washington D.C.: ASM Press, pp. 2421-2441.
- Mastrantonio, P., Congiu, M.E., Selander, R.K., and Caugant, D.A. (1991) Genetic relationships among strains of *Neisseria meningitidis* causing disease in Italy, 1984-7. *Epidemiol Infect* **106**: 143-150.
- Maxam, A.M. and Gilbert, W. (1977) A new method for sequencing DNA. *Proc Natl Acad Sci (U S A)* **74**: 560-564.
- Maynard Smith, J., Smith, N.H., O'Rourke, M., and Spratt, B.G. (1993) How clonal are bacteria? *Proc Natl Acad Sci (U S A)* **90**: 4384-4388.
- McKane, M. and Milkman, R. (1995) Transduction, restriction and recombination patterns in *Escherichia coli*. *Genetics* **139**: 35-43.
- Meyer, T.F. (1999) Pathogenic neisseriae: Complexity of pathogen-host cell interplay. *Clin Infect Dis* **28**: 433-441.
- Meyer, T.F., Gibbs, C.P., and Haas, R. (1990) Variation and control of protein expression in *Neisseria*. *Ann Rev Microbiol* **44**: 451-477.
- Meyer, T.F., Pohlner, J., and van Putten, J.P.M. (1994) Biology of the pathogenic *Neisseriae*. *Curr Top Microbiol Immunol* **192**: 283-317.
- Mézard, C., Pompon, D., and Nicolas, A. (1992) Recombination between similar but not identical DNA sequences during yeast transformation occurs within short stretches of identity. *Cell* **70**: 659-670.
- Milkman, R. (1973) Electrophoretic variation in *Escherichia coli* from natural sources. *Science* **182**: 1024-1026.
- Milkman, R. and Bridges, M.M. (1990) Molecular evolution of the *Escherichia coli* chromosome. III. Clonal frames. *Genetics* **126**: 505-517.
- Moore, P.S. (1992) Meningococcal meningitis in sub-Saharan Africa: A model for the epidemic process. *Clin Infect Dis* **14**: 515-525.
- Moore, P.S., Reeves, M.W., Schwartz, B., Gellin, B.G., and Broome, C.V. (1989) Intercontinental spread of an epidemic group A *Neisseria meningitidis* strain. *Lancet* **ii**: 260-263.
- Morelli, G., Malorny, B., Müller, K., Seiler, A., Wang, J., del Valle, J., et al. (1997) Clonal descent and microevolution of *Neisseria meningitidis* during 30 years of epidemic spread. *Mol Microbiol* **25**: 1047-1064.
- Morelli, G., Malorny, B., Zurth, K., Seiler, A., Strutzberg, K., and Achtman, M. (1998) Microevolution of NIMEs (neisserial intergenic mosaic elements) flanking *opa* genes. Poster at the 11th International Pathogenic Neisseria Conference, 1-6.11.1998, Nice, France.
- Moxon, E.R., Rainey, P.B., Nowak, M.A., and Lenski, R.E. (1994) Adaptive evolution of highly mutable loci in pathogenic bacteria. *Curr Biol* **4**: 24-33.

- Mullis, K., Faloona, F., Scharf, S., Saiki, R., Horn, G., and Erlich, H. (1986) Specific enzymatic amplification of DNA *in vitro*: the polymerase chain reaction. *Cold Spring Harbor Symp Quant Biol* **51**: 263-265.
- Murakami, K., Gotschlich, E.C., and Seiff, M.E. (1989) Cloning and characterization of the structural gene for the class 2 protein of *Neisseria meningitidis*. *Infect Immun* **57**: 2318-2323.
- Murphy, G.L., Connell, T.D., Barritt, D.S., Koomey, M., and Cannon, J.G. (1989) Phase variation of gonococcal protein II: Regulation of gene expression by slipped-strand mispairing of a repetitive DNA sequence. *Cell* **56**: 539-547.
- Naito, T., Kusano, K., and Kobayashi, I. (1995) Selfish behavior of restriction-modification systems. *Science* **267**: 897-899.
- Naumann, M., Rudel, T., and Meyer, T.F. (1999) Host cell interactions and signalling with *Neisseria gonorrhoeae*. *Curr* **2**: 62-70.
- Nei, M. and Gojobori, T. (1986) Simple methods for estimating the numbers of synonymous and nonsynonymous nucleotide substitutions. *Molecular Biology & Evolution* **3**: 418-426.
- Neisser, A. (1879) Über eine der Gonorrhoe eigentümliche Micrococcusform. *Zentralbl Med Wiss* **17**: 497-500.
- O'Rourke, M. and Stevens, E. (1993) Genetic structure of *Neisseria gonorrhoeae* population: a non-clonal pathogen. *J Gen Microbiol* **139**: 2603-2611.
- Ochman, H. and Selander, R.K. (1984) Standard reference strains of *Escherichia coli* from natural populations. *J Bacteriol* **157**: 690-693.
- Ochman, H., Whittam, T.S., Caugant, D.A., and Selander, R.K. (1983) Enzyme polymorphism and genetic population structure in *Escherichia coli* and *Shigella*. *J Gen Microbiol* **129**: 2715-2726.
- Olyhoek, T., Crowe, B.A., and Achtman, M. (1987) Clonal population structure of *Neisseria meningitidis* serogroup A isolated from epidemics and pandemics between 1915 and 1983. *Rev Infect Dis* **9**: 665-692.
- Pajon, R., Chinea, G., Marrero, E., Gonzalez, D., and Guillen, G. (1997) Sequence analysis of the structural *tbpA* gene: protein topology and variable regions within neisserial receptors for transferrin iron acquisition. *Microb Pathog* **23**: 71-84.
- Peak, I.R.A., Jennings, M.P., Hood, D.W., Bisercic, M., and Moxon, E.R. (1996) Tetrameric repeats units associated with virulence factor phase variation in *Haemophilus* also occur in *Neisseria* spp. and *Moraxella catarrhalis*. *FEMS Microbiol Lett* **137**: 109-114.
- Peixuan, Z., Xujing, H., and Li, X. (1995) Typing *Neisseria meningitidis* by analysis of restriction fragment length polymorphisms in the gene encoding the class 1 outer membrane protein: Application to assessment of epidemics throughout the last 4 decades in China. *J Clin Microbiol* **33**: 458-462.
- Peltola, H. (1983) Meningococcal disease: Still with us. *Rev Infect Dis* **5**: 71-91.
- Pettersson, A., Maas, A., and Tommassen, J. (1994) Identification of the *iroA* gene product of *Neisseria meningitidis* as a lactoferrin receptor. *J Bacteriol* **176**: 1764-1766.
- Pettersson, A., Prinz, T., Umar, A., Van der Biezen, J., and Tommassen, J. (1998) Molecular characterization of LbpB, the second lactoferrin-binding protein of *Neisseria meningitidis*. *Mol Microbiol* **27**: 599-610.

Literaturverzeichnis

- Pettersson, A., van der Ley, P., Poolman, J.T., and Tommassen, J. (1993) Molecular characterization of the 98-kilodalton iron-regulated outer membrane protein of *Neisseria meningitidis*. *Infect Immun* **61**: 4724-4733.
- Pinner, R.W., Gellin, B.G., Bibb, W.F., Baker, C.N., Weaver, R., Hunter, S.B., et al. (1991) Meningococcal disease in the United States-1986. *J Infect Dis* **164**: 368-374.
- Poolman, J.T., de Marie, S., and Zanen, H.C. (1980) Variability of low-molecular-weight, heat-modifiable outer membrane proteins of *Neisseria meningitidis*. *Infect Immun* **30**: 642-648.
- Price, C. and Bickle, T.A. (1986) A possible role for DNA restriction in bacterial evolution. *Microbiological Sciences* **3**: 296-299.
- Radman, M. (1989) Mismatch repair and the fidelity of genetic recombination. *Genome* **31**: 68-73.
- Rayssiguier, C., Dohet, C., and Radman, M. (1991) Interspecific recombination between *Escherichia coli* and *Salmonella typhimurium* occurs by the RecABCD pathway. *Biochimie* **73**: 371-374.
- Rayssiguier, C., Thaler, D.S., and Radman, M. (1989) The barrier to recombination between *Escherichia coli* and *Salmonella typhimurium* is disrupted in mismatch-repair mutants. *Nature* **342**: 396-401.
- Redaschi, N. and Bickle, T.A. (1996) DNA restriction and modification systems. In *Escherichia coli and Salmonella*. Neidhardt, F.C., Curtiss III, R., Ingraham, J.L., Lin, E.C.C., Brooks Low, K., Magasanik, B., et al. (eds). Washington, DC: ASM press, pp. 773-781.
- Rest, R.F. and Shafer, W.M. (1989) Interactions of *Neisseria gonorrhoeae* with human neutrophils. *Clin Microbiol Rev* **2 Suppl**: S83-S91
- Riley, M. and Krawiec, S. (1987) Genome organization. In *Escherichia coli and Salmonella typhimurium cellular and molecular biology Vol. I*. Neidhardt, F.C. (ed). Washington, D.C.: American Society for Microbiology, pp. 967-981.
- Roberts, R.J. (1989) Restriction enzymes and their isoschizomers. *Nucleic Acids Res* **17 Suppl**: 347-387.
- Rokbi, B., Maitrewilmotte, G., Mazarin, V., Fourrichon, L., Lissolo, L., and Quentinmillet, M.J. (1995) Variable sequences in a mosaic-like domain of meningococcal *tbp2* encode immunoreactive epitopes. *FEMS Microbiol Lett* **132**: 277-283.
- Rokbi, B., Mazarin, V., Maitre-Wilmotte, G., and Quentin-Millet, M.-J. (1993) Identification of two major families of transferrin receptors among *Neisseria meningitidis* strains based on antigenic and genomic features. *FEMS Microbiol Lett* **110**: 51-58.
- Rozas, J. and Rozas, R. (1999) DnaSP version 3.0: an integrated program for molecular population genetics and molecular evolution analysis. *BIOINFORMATICS* **15**: 174-175.
- Rubnitz, J. and Subramani, S. (1984) The minimum amount of homology required for homologous recombination in mammalian cells. *Mol Cell Biol* **4**: 2253-2258.
- Saiki, R.K., Scharf, S., Faloona, F., Mullis, K.B., Horn, G.T., Erlich, H.A., et al. (1985) Enzymatic amplification of beta-globin genomic sequences and restriction site analysis for diagnosis of sickle cell anemia. *Science* **230**: 1350-1354.
- Sambrook, J., Fritsch, E.F., and Maniatis, T. (1989) *Molecular Cloning: a laboratory manual (second edition)*, Cold Spring Harbor, New York: Cold Spring Harbor Laboratory.
- Sanderson, K.E. (1976) Genetic relatedness in the family Enterobacteriaceae. *Annu Rev Microbiol* **30** : 327-349.

Literaturverzeichnis

- Sanger, F., Nicklen, S., and Coulson, A.R. (1977) DNA sequencing with chain-terminating inhibitors. *Proc Natl Acad Sci (U.S.A.)* **74**: 5463-5467.
- Sarkari, J., Pandit, N., Moxon, E.R., and Achtman, M. (1994) Variable expression of the Opc outer membrane protein in *Neisseria meningitidis* is caused by size variation of a promoter containing poly-cytidine. *Mol Microbiol* **13**: 207-217.
- Schmid, C.W. and Jelinek, W.R. (1982) The Alu family of dispersed repetitive sequences. *Science* **216**: 1065-1070.
- Scholten, R.J.P.M., Poolman, J.T., Valkenburg, H.A., Bijlmer, H.A., Dankert, J., and Caugant, D.A. (1994) Phenotypic and genotypic changes in a new clone complex of *Neisseria meningitidis* causing disease in the Netherlands, 1958-1990. *J Infect Dis* **169**: 673-676.
- Schryvers, A.B. and Morris, L.J. (1988) Identification and characterization of the human lactoferrin-binding protein from *Neisseria meningitidis*. *Infect Immun* **56**: 1144-1149.
- Schwartz, D.C. and Cantor, C.R. (1984) Separation of yeast chromosome-sized DNAs by pulsed field gradient gel electrophoresis. *Cell* **1984 May 37**: 67-75.
- Seifert, H.S. (1996) Questions about gonococcal pilus phase- and antigenic variation. *Mol Microbiol* **21**: 433-440.
- Seiler, A., Reinhardt, R., Sarkari, J., Caugant, D.A., and Achtman, M. (1996) Allelic polymorphism and site-specific recombination in the *opc* locus of *Neisseria meningitidis*. *Mol Microbiol* **19**: 841-856.
- Selander, R.K., Caugant, D.A., Ochman, H., Musser, J.M., Gilmour, M.N., and Whittam, T.S. (1986) Methods of multilocus enzyme electrophoresis for bacterial population genetics and systematics. *Applied Env Microbiol* **51**: 873-884.
- Selander, R.K. and Levin, B.R. (1980) Genetic diversity and structure in *Escherichia coli* populations. *Science* **210**: 545-547.
- Shapiro, J.A. (1997) Genome organization, natural genetic engineering and adaptive mutation. *TIG* **13**: 98-104.
- Shen, P. and Huang, H.V. (1986) Homologous recombination in *Escherichia coli*: dependence on substrate length and homology. *Genetics* **112**: 441-457.
- Smith, H.O., Tomb, J.F., Dougherty, B.A., Fleischmann, R.D., and Venter, J.C. (1995) Frequency and distribution of DNA uptake signal sequences in the *Haemophilus influenzae* Rd genome. *Science* **269**: 538-540.
- Sox, T.E., Mohammed, W., Blackman, E., Biswas, G., and Sparling, P.F. (1978) Conjugative plasmids in *Neisseria gonorrhoeae*. *J Bacteriol* **134**: 278-286.
- Sparling, P.F. (1966) Genetic transformation of *Neisseria gonorrhoeae* to streptomycin resistance. *J Bacteriol* **92**: 1364-1371.
- Spratt, B.G. (1988) Hybrid penicillin-binding proteins in penicillin-resistant strains of *Neisseria gonorrhoeae*. *Nature* **332**: 173-176.
- Spratt, B.G., Bowler, L.D., Zhang, Q.-Y., Zhou, J., and Maynard Smith, J. (1992) Role of inter-species transfer of chromosomal genes in the evolution of penicillin resistance in pathogenic and commensal *Neisseria* species. *J Mol Evol* **34**: 115-125.

- Spratt, B.G., Smith, N.H., Zhou, J., O'Rourke, M., and Feil, E. (1995) The population genetics of the pathogenic *Neisseria*. In *Population genetics of bacteria*. Baumberg, S., Young, J.P.W., Saunders, J.R., and Wellington, E.M.H. (eds). Cambridge: Cambridge University Press, pp. 143-160.
- Staden, R. (1996) The Staden sequence analysis package. *Molecular Biotechnology* **5**: 233-241.
- Stein, D.C., Gunn, J.S., Radlinska, M., and Piekarowicz, A. (1995) Restriction and modification systems of *Neisseria gonorrhoeae*. *Gene* **157**: 19-22.
- Stern, A., Brown, M., Nickel, P., and Meyer, T.F. (1986) Opacity genes in *Neisseria gonorrhoeae*: Control of phase and antigenic variation. *Cell* **47**: 61-71.
- Stern, A. and Meyer, T.F. (1987) Common mechanism controlling phase and antigenic variation in pathogenic neisseriae. *Mol Microbiol* **1**: 5-12.
- Steven, N. and Wood, M. (1995) The clinical spectrum of meningococcal disease. In *Meningococcal disease*. Cartwright, K. (ed). Chichester: John Wiley & Sons, pp. 177-205.
- Stewart, G.J. and Carlson, C.A. (1986) The biology of natural transformation. *Ann Rev Microbiol* **40**: 211-235.
- Struyv, M., Moons, M., and Tommassen, J. (1991) Carboxy-terminal phenylalanine is essential for the correct assembly of a bacterial outer membrane protein. *J Mol Biol* **218**: 141-148.
- Sugasawara, R.J., Cannon, J.G., Black, W.J., Nachamkin, I., Sweet, R.L., and Brooks, G.F. (1983) Inhibition of *Neisseria gonorrhoeae* attachment to HeLa cells with monoclonal antibody directed against a protein II. *Infect Immun* **42**: 980-985.
- Sugawara, N. and Haber, J.E. (1992) Characterization of double-strand break-induced recombination: homology requirements and single-stranded DNA formation. *Mol Cell Biol* **12**: 563-575.
- Suker, J., Feavers, I.M., Achtman, M., Morelli, G., Wang, J.-F., and Maiden, M.C.J. (1994) The *porA* gene in serogroup A meningococci: evolutionary stability and mechanism of genetic variation. *Mol Microbiol* **12**: 253-265.
- Swanson, J. (1978) Studies on gonococcus infection XII. Colony color and opacity variants of gonococci. *Infect Immun* **19**: 320-331.
- Swanson, J. (1982) Colony opacity and protein II compositions of gonococci. *Infect Immun* **37**: 359-368.
- Swanson, J. (1983) Gonococcal adherence: selected topics. *Rev Infect Dis* **5 Suppl 4**: S678-84.
- Swanson, J., Morrison, S., Barrera, O., and Hill, S. (1990) Pilus changes in transformation-defective gonococci. *J Exp Med* **171**: 2131-2139.
- Swanson, J.L. (1990) Some effects of LOS and Opa on surface properties of gonococci. In *Neisseriae 1990*. Achtman, M., Kohl, P., Marchal, C., Morelli, G., Seiler, A., and Thiesen, B. (eds). Berlin: Walter de Gruyter & Co, pp. 391-396.
- Swartley, J.S., Ahn, J.H., Liu, L.J., Kahler, C.M., and Stephens, D.S. (1996) Expression of sialic acid and polysialic acid in serogroup B *Neisseria meningitidis*: Divergent transcription of biosynthesis and transport operons through a common promoter region. *J Bacteriol* **178**: 4052-4059.
- Swartley, J.S., Marfin, A.A., Edupuganti, S., Liu, L.J., Cieslak, P., Perkins, B., et al. (1997) Capsule switching of *Neisseria meningitidis*. *Proc Natl Acad Sci (U S A)* **94**: 271-276.

Literaturverzeichnis

- Taha, M.K., So, M., Seifert, H.S., Billyard, E., and Marchal, C. (1988) Pilin expression in *Neisseria gonorrhoeae* is under both positive and negative transcriptional control. *EMBO J* **7**: 4367-4378.
- Tang, C.M., Hood, D.W., and Moron, E.R. (1998) Microbial genome sequencing and pathogenesis. *Curr Opin Microbiol* **1**: 12-16.
- Thompson, S.A. and Sparling, P.F. (1993) The RTX cytotoxin-related FrpA protein of *Neisseria meningitidis* is secreted extracellularly by meningococci and by HlyBD⁺ *Escherichia coli*. *Infect Immun* **61**: 2906-2911.
- Tinsley, C.R. and Heckels, J.E. (1986) Variation in the expression of pili and outer membrane protein by *Neisseria meningitidis* during the course of meningococcal infection. *J Gen Microbiol* **132**: 2483-2490.
- Tinsley, C.R. and Nassif, X. (1996) Analysis of the genetic differences between *Neisseria meningitidis* and *Neisseria gonorrhoeae*: Two closely related bacteria expressing two different pathogenicities. *Proc Natl Acad Sci (U S A)* **93**: 11109-11114.
- Tommassen, J., Struyvé, M., van Gelder, P., and de Cock, H. (1994) Biogenesis of outer membrane porin PhoE of *Escherichia coli*. In Anonymouspp. 276-281.
- van der Ley, P., Van der Biezen, J., Sutmuller, R., Hoogerhout, P., and Poolman, J.T. (1996) Sequence variability of FrpB, a major iron-regulated outer- membrane protein in the pathogenic neisseriae. *Microbiology* **142**: 3269-3274.
- Vázquez, J.A., Berrón, S., O'Rourke, M., Carpenter, G., Feil, E., Smith, N.H., et al. (1995) Interspecies recombination in nature: a meningococcus that has acquired a gonococcal PIB porin. *Mol Microbiol* **15**: 1001-1007.
- Vázquez, J.A., De La Fuente, L., Berrón, S., O'Rourke, M., Smith, N.H., Zhou, J., et al. (1993) Ecological separation and genetic isolation of *Neisseria gonorrhoeae* and *Neisseria meningitidis*. *Curr Biol* **9**: 567-572.
- Vedros, N.A. (1987) Development of meningococcal serogroups. In *Evolution of meningococcal disease. Vol. II*. Vedros, N.A. (ed). Boca Raton, FL: CRC Press, Inc., pp. 33-37.
- Vieusseux, M. (1806) Mémoire sur le maladie qui a régné à Genève au printemps de 1805. *J Med Chirurg Pharm* **11**: 163-182.
- Virji, M. and Heckels, J.E. (1986) The effect of protein II and pili on the interaction of *Neisseria gonorrhoeae* with human polymorphonuclear leucocytes. *J Gen Microbiol* **132**: 503-512.
- Virji, M., Makepeace, K., Ferguson, D.J.P., Achtman, M., and Moxon, E.R. (1993) Meningococcal Opa and Opc proteins: their role in colonization and invasion of human epithelial and endothelial cells. *Mol Microbiol* **10**: 499-510.
- Vonder Haar, R.A., Legrain, M., Kolbe, H.V.J., and Jacobs, E. (1994) Characterization of a highly structured domain in Tbp2 from *Neisseria meningitidis* involved in binding to human transferrin. *J Bacteriol* **176**: 6207-6213.
- Wang, J.-F., Caugant, D.A., Li, X., Hu, X., Poolman, J.T., Crowe, B.A., et al. (1992) Clonal and antigenic analysis of serogroup A *Neisseria meningitidis* with particular reference to epidemiological features of epidemic meningitis in China. *Infect Immun* **60**: 5267-5282.
- Wang, J.-F., Caugant, D.A., Morelli, G., Koumaré, B., and Achtman, M. (1993) Antigenic and epidemiological properties of the ET-37 complex of *Neisseria meningitidis*. *J Infect Dis* **167**: 1320-1329.

- Wang, J.-F., Morelli, G., Bopp, M., Kusecek, B., Achtman, M., Caugant, D.A., et al. (1991) Clonal and antigenic analyses of *Neisseria meningitidis* bacteria belonging to the ET37 complex isolated from Mali and elsewhere. In *Neisseriae 1990*. Achtman, M., Kohl, P., Marchal, C., Morelli, G., Seiler, A., and Thiesen, B. (eds). Berlin: Walter de Gruyter & Co, pp. 141-146.
- Ward, M.J., Lambden, P.R., and Heckels, J.E. (1992) Sequence analysis and relationships between meningococcal class 3 serotype proteins and other porins from pathogenic and non-pathogenic *Neisseria* species. *FEMS Microbiol Lett* **94**: 283-290.
- Watt, V.M., Ingles, C.J., Urdea, M.S., and Rutter, W.J. (1985) Homology requirements for recombination in *Escherichia coli*. *Proc Natl Acad Sci (U S A)* **82**: 4768-4772.
- Weel, J.F.L., Hopman, C.T.P., and van Putten, J.P.M. (1991) In situ expression and localization of *Neisseria gonorrhoeae* opacity proteins in infected epithelial cells: apparent role of Opa proteins in cellular invasion. *J Exp Med* **173** : 1395-1405.
- Weichselbaum, A. (1887) Ueber die Aetiologie der akuten Meningitis cerebro-spinalis. *Fortschr Med* **5**: 573-583.
- Welch, S. (1992) Transferrin saturation rate *in vivo*. In *Transferrin the Iron Carrier*. Welch, S. (ed). CRC Press, Boca Raton, FL, pp. 88-93.
- Whittam, T.S. (1995) Genetic population structure and pathogenicity in enteric bacteria. In *Population genetics of bacteria*. Baumberg, S., Young, J.P.W., Wellington, E.M.H., and Saunders, J.R. (eds). Cambridge: University press, pp. 217-245.
- Whittam, T.S., Ochman, H., and Selander, R.K. (1983) Multilocus genetic structure in natural populations of *Escherichia coli* . *Proc Natl Acad Sci (U S A)* **80**: 1751-1755.
- Wilkins, B.M. (1995) Gene transfer by bacterial conjugation:diversity of systems and functional specializations. In *Population genetics of bacteria*. Baumberg, S., Young, J.P.W., Wellington, E.M.H., and Saunders, J.R. (eds). Cambridge: University Press, pp. 59-88.
- Wilson, G.G. and Murray, N.E. (1991) Restriction and modification systems. *Annu Rev Genet* **25**: 585-627.
- Wilton, J., Ala'Aldeen, D., Palmer, H.M., and Borriello, S.P. (1993) Cloning and partial sequence of transferrin-binding protein 2 of *Neisseria meningitidis* using a novel method: Twin N-terminal PCR. *FEMS Microbiol Lett* **107**: 59-66.
- Wolff, K. and Stern, A. (1995) Identification and characterization of specific sequences encoding pathogenicity associated proteins in the genome of commensal *Neisseria* species. *FEMS Microbiol Lett* **125**: 255-263.
- Wolfgang, M., Lauer, P., Park, H.S., Brossay, L., Hebert, J., and Koomey, M. (1998a) PilT mutations lead to simultaneous defects in competence for natural transformation and twitching motility in piliated *Neisseria gonorrhoeae*. *Mol Microbiol* **29**: 321-330.
- Wolfgang, M., Park, H.S., Hayes, S.F., van Putten, J.P., and Koomey, M. (1998b) Suppression of an absolute defect in type IV pilus biogenesis by loss-of-function mutations in pilT, a twitching motility gene in *Neisseria gonorrhoeae*. *Proc Natl Acad Sci USA* **95**: 14973-14978.
- Wolfgang, M., van Putten, J.M., Hayes, S.F., and Koomey, M. (1999) The comP locus of *Neisseria gonorrhoeae* encodes a type IV prepilin that is dispensable for pilus biogenesis but essential for natural transformation. *Mol Microbiol* **31**: 1345-1357.
- Wollstein, M. (1907) Biological relationships of *Diplococcus intracellularis* and gonococcus. *J Exp Med* **9**: 588-605.

Literaturverzeichnis

- Woods, J.P. and Cannon, J.G. (1990) Variation in expression of class 1 and class 5 outer membrane proteins during nasopharyngeal carriage of *Neisseria meningitidis*. *Infect Immun* **58**: 569-572.
- Woods, J.P., Kersulyte, D., Tolan, R.W., Jr., Berg, C.M., and Berg, D.E. (1994) Use of arbitrarily primed polymerase chain reaction analysis to type disease and carrier strains of *Neisseria meningitidis* isolated during a university outbreak. *J Infect Dis* **169**: 1384-1389.
- Woods, J.P., Spinola, S.M., Strobel, S.M., and Cannon, J.G. (1988) Conserved lipoprotein H.8 of pathogenic *Neisseria* consists entirely of pentapeptide repeats. *Mol Microbiol* **3**: 43-48.
- Yakubu, D.E., Abadi, F.J.R., and Pennington, T.H. (1994) Molecular epidemiology of recent United Kingdom isolates of *Neisseria meningitidis* serogroup C. *Epidemiol Infect* **113**: 53-65.
- Yakubu, D.E. and Pennington, T.H. (1995) Epidemiological evaluation of *Neisseria meningitidis* serogroup B by pulsed-field gel electrophoresis. *FEMS Immunol Med Microbiol* **10**: 185-190.
- Yang, Y. and Ames, G.F. (1988) DNA gyrase binds to the family of prokaryotic repetitive extragenic palindromic sequences. *Proc Natl Acad Sci USA* **85**: 8850-8854.
- Zambrano, M.M., Siegele, D.A., Almirón, M., Tormo, A., and Kolter, R. (1993) Microbial competition: *Escherichia coli* mutants that take over stationary phase cultures. *Science* **259**: 1757-1760.
- Zhang, Q.-Y., DeRyckere, D., Lauer, P., and Koomey, M. (1992) Gene conversion in *Neisseria gonorrhoeae*: evidence for its role in antigenic variation. *Proc Natl Acad Sci (U S A)* **89**: 5366-5370.
- Zhou, J. and Spratt, B.G. (1992) Sequence diversity within the *argF*, *fbp* and *recA* genes of natural isolates of *Neisseria meningitidis*: interspecies recombination within the *argF* gene. *Mol Microbiol* **6**: 2135-2146.
- Zhou, J.J., Bowler, L.D., and Spratt, B.G. (1997) Interspecies recombination, and phylogenetic distortions, within the glutamine synthetase and shikimate dehydrogenase genes of *Neisseria meningitidis* and commensal *Neisseria* species. *Mol Microbiol* **23**: 799-812.
- Zinder, N.D. and Lederberg, J. (1952) Genetic exchange in *Salmonella*. *J Bacteriol* **64**: 679-699.