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**Charakteristische Aspekte des Migrationsverhaltens
kutaner dendritischer Zellen im Humansystem**

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Literatur

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LITERATUR

1. Bergstresser, P. R., R. E. Tigelaar, J. H. Dees, and J. W. Streilein. 1983. Thy-1 antigen bearing dendritic cells populate murine epidermis. *J. Invest. Dermatol.* 81:286-288.
2. Romani, N., E. Tschachler, G. Schuler, W. Aberer, R. Ceredig, A. Elbe, K. Wolff, P. O. Fritsch, and G. Stingl. 1985. Morphological and phenotypical characterization of bone-marrow derived dendritic Thy-1-positive epidermal cells of the mouse. *J. Invest. Dermatol.* 85:91s-95s.
3. Tschachler, E., G. Schuler, J. Hutterer, H. Leibl, K. Wolff, and G. Stingl. 1983. Expression of Thy-1 antigen by murine epidermal cells. *J. Invest. Dermatol.* 81:282-285.
4. Stingl, G., K. C. Gunter, E. Tschachler, H. Yamada, R. I. Lechner, W. M. Yokoyama, G. Steiner, R. N. Germain, and E. M. Shevach. 1987. Thy-1+ dendritic epidermal cells belong to the T-cell lineage. *Proc. Natl. Acad. Sci. USA* 84:2430-2435.
5. Romani, N., G. Stingl, E. Tschachler, M. D. Witmer, R. M. Steinman, E. M. Shevach, and G. Schuler. 1985. The Thy-1 bearing cell of murine epidermis. A distinctive leukocyte perhaps related to natural killer cells. *J. Exp. Med.* 161:1368-1383.
6. Tschachler, E., N. Romani, G. Schuler, K. Wolff, and G. Stingl. 1986. Dendritic Thy-1-positive epidermal cells - a novel cell system within the mouse epidermis. In *Experimental and Clinical Photoimmunology*, Vol. 3. R. A. Daynes and G. G. Krueger, editors. CRC Press,
7. Stingl, L. A., D. N. Sauder, M. Iijima, K. Wolff, H. Pehamberger, and G. Stingl. 1983. Mechanisms of UV-B induced impairment of the antigen-presenting capacity of murine epidermal cells. *J. Immunol.* 130:1586-1591.
8. Steiner, G., F. Koning, A. Elbe, E. Tschachler, W. M. Yokoyama, E. M. Shevach, G. Stingl, and J. E. Coligan. 1988. Characterization of T cell receptors on resident murine dendritic epidermal T cells. *Eur. J. Immunol.* 18:1323-1328.
9. Lenz, A., M. Heine, G. Schuler, and N. Romani. 1993. Human and murine dermis contain dendritic cells. *J. Clin. Invest.* 92:2587-2596.
10. Langerhans, P. 1868. Über die Nerven der menschlichen Haut. *Virchows Arch. [A]* 44:325-337.
11. Birbeck, M. S., A. S. Breathnach, and J. D. Everall. 1961. An electron microscopic study of basal melanocytes and high level clear cells (Langerhans cell) in vitiligo. *J. Invest. Dermatol.* 37:51-64.
12. Klareskog, L., U. Malmnas-Tjernlund, U. Forsum, and P. A. Peterson. 1977. Epidermal Langerhans cells express Ia antigens. *Nature* 268:248-250.
13. Stingl, G., E. C. Wolff-Schreiner, W. J. Pichler, F. Gschnait, and W. Knapp. 1977. Epidermal Langerhans cells bear Fc and C3 receptors. *Nature* 268:245-246.
14. Stingl, G., S. I. Katz, L. Clements, I. Green, and E. M. Shevach. 1978. Immunologic functions of Ia-bearing epidermal Langerhans cells. *J. Immunol.* 121:2005-2013.
15. Stingl, G., K. Tamaki, and S. I. Katz. 1980. Origin and function of epidermal Langerhans cells. *Immunol. Rev.* 53:149-174.
16. Braathen, L. R. and E. Thorsby. 1980. Studies on human epidermal Langerhans cells. I. Allo-activating and antigen-presenting capacity. *Scand. J. Immunol.* 11:401
17. Tsuchida, T., M. Iijima, H. Fujiwara, H. Pehamberger, G. M. Shearer, and S. I. Katz. 1984. Epidermal Langerhans cells can function as stimulatory cells but not as accessory cells in CTL induction. *J. Immunol.* 132:1163-1168.
18. Faure, M., A. Frappaz, D. Schmitt, C. Dezutter-Dambuyant, and J. Thivolet. 1984. Role of HLA-DR bearing Langerhans and epidermal indeterminate cells in the in vitro generation of alloreactive cytotoxic T cells in man. *Cell. Immunol.* 83:271-279.
19. Wolff, K. 1991. The fascinating story that began in 1868. In *Epidermal Langerhans Cells*. G. Schuler, editor. CRC Press Inc. Boca Raton, FL. 1-21.
20. Stingl, G., N. Romani, and K. Wolff. 1987. Langerhans' cells: A distinctive member of bone marrow-derived dendritic cells. *Adv. Dermatol.* 2:269-282.
21. Wolff, K. and G. Stingl. 1983. The Langerhans Cell. *J. Invest. Dermatol.* 80:17s-21s.
22. Steinman, R. M. 1991. The dendritic cell system and its role in immunogenicity. *Annu. Rev. Immunol.* 9:271-296.

23. Pugh, C. W., G. G. MacPherson, and H. W. Steer. 1983. Characterization of nonlymphoid cells derived from rat peripheral lymph. *J. Exp. Med.* 157:1758-1779.
24. Steinman, R. M., D. S. Lustig, and Z. A. Cohn. 1974. Identification of a novel cell type in peripheral lymphoid organs of mice. III. Functional properties in vivo. *J. Exp. Med.* 139:1431-1445.
25. Katz, S. I., K. Tamaki, and D. H. Sachs. 1979. Epidermal Langerhans cells are derived from cells originating in bone marrow. *Nature* 282:324-326.
26. Inaba, K., M. Inaba, M. Deguchi, K. Hagi, R. Yasumizu, S. Ikebara, S. Muramatsu, and R. M. Steinman. 1993. Granulocytes, macrophages, and dendritic cells arise from a common major histocompatibility complex class II-negative progenitor in mouse bone marrow. *Proc. Natl. Acad. Sci. USA* 90:3038-3042.
27. Barclay, A. N. and G. Mayrhofer. 1981. Bone marrow origin of ia-positive cells in the medulla of rat thymus. *J. Exp. Med.* 153:1666.
28. Inaba, K., R. M. Steinman, M. W. Pack, H. Aya, M. Inaba, T. Sudo, S. Wolpe, and G. Schuler. 1992. Identification of proliferating dendritic cell precursors in mouse blood. *J. Exp. Med.* 175:1157-1167.
29. Inaba, K., M. Inaba, N. Romani, H. Aya, M. Deguchi, S. Ikebara, S. Muramatsu, and R. M. Steinman. 1992. Generation of large numbers of dendritic cells from mouse bone marrow cultures supplemented with granulocyte/macrophage colony-stimulating factor. *J. Exp. Med.* 176:1693-1702.
30. Caux, C., C. Dezutter-Dambuyant, D. Schmitt, and J. Banchereau. 1992. GM-CSF and TNF- α cooperate in the generation of dendritic Langerhans cells. *Nature* 360:258-261.
31. Romani, N., S. Gruner, D. Brang, E. Kämpgen, A. Lenz, B. Trockenbacher, G. Konwalinka, P. O. Fritsch, R. M. Steinman, and G. Schuler. 1994. Proliferating dendritic cell progenitors in human blood. *J. Exp. Med.* 180:83-93.
32. Schuler, G., N. Romani, H. Stössel, and K. Wolff. 1991. Structural organization and biological properties of Langerhans cells. In *Epidermal Langerhans cells*. G. Schuler, editor. CRC Press Inc. Boca Raton, FL. 87-137.
33. Steinman, R. M., G. Schuler, N. Romani, and G. Kaplan. 1988. Dendritic Cells. In *Atlas of Blood Cells - Function and Pathology*, Vol. 1. D. Zucker-Franklin, M. F. Greaves, C. E. Grossi, and A. M. Marmont, editors. Edi. Ermes and Lea & Febiger, Milano, Philadelphia. 361-377.
34. Romani, N., P. Fritsch, and G. Schuler. 1991. Identification and phenotype of epidermal Langerhans cells. In *Epidermal Langerhans Cells*. G. Schuler, editor. CRC Press, Boca Raton. 49-86.
35. Reis e Sousa, C., P. D. Stahl, and J. M. Austyn. 1993. Phagocytosis of antigens by Langerhans cells in vitro. *J. Exp. Med.* 178:509-519.
36. Romani, N., M. Witmer-Pack, M. Crowley, S. Koide, G. Schuler, K. Inaba, and R. M. Steinman. 1991. Langerhans cells as immature dendritic cells. In *Epidermal Langerhans cells*. G. Schuler, editor. CRC Press, Inc. Boca Raton, FL. 191-216.
37. Breathnach, S. M. 1991. Origin, cell lineage, ontogeny, tissue distribution and kinetics of Langerhans cells. In *Epidermal Langerhans Cells*. G. Schuler, editor. CRC Press Inc. Boca Raton, FL. 23-47.
38. Nestle, F. O., X.-G. Zheng, C. B. Thompson, L. A. Turka, and B. J. Nickoloff. 1993. Characterization of dermal dendritic cells obtained from normal human skin reveals phenotypic and functionally distinctive subsets. *J. Immunol.* 151:6535-6545.
39. Pope, M., M. G. H. Betjes, H. Hirmand, L. Hoffman, and R. M. Steinman. 1995. Both dendritic cells and memory T lymphocytes emigrate from organ cultures of human skin and form distinctive dendritic-T-cell conjugates. *J. Invest. Dermatol.* 104:11-17.
40. Holt, P. G., M. A. Schon-Hegrad, and J. Oliver. 1988. MHC class II antigen-bearing dendritic cells in pulmonary tissues of the rat. Regulation of antigen presentation activity by endogenous macrophage populations. *J. Exp. Med.* 167:262-274.
41. Rochester, C. L., E. M. Goodell, J. K. Stoltzborg, and W. E. Bowers. 1988. Dendritic cells from rat lung are potent accessory cells. *Am. Rev. Respir. Dis.* 138:121-128.
42. Sertl, K., T. Takemura, E. Tschachler, V. J. Ferrans, M. A. Kaliner, and E. M. Shevach. 1986. Dendritic cells with antigen-presenting capability reside in airway epithelium, lung parenchyma, and visceral pleura. *J. Exp. Med.* 163:436-451.
43. Pollard, A. M. and M. F. Lipscomb. 1990. Characterization of murine lung dendritic cells: similarities to Langerhans cells and thymic dendritic cells. *J. Exp. Med.* 172:159-167.



44. Nicod, L. P., M. F. Lipscomb, J. C. Weissler, C. R. Lyons, J. Alberton, and G. B. Toews. 1987. Mononuclear cells in human lung parenchyma: characterization of a potent accessory cell not obtained by bronchoalveolar lavage. *Am. J. Respir. Dis.* 136:818-823.
45. Nicod, L. P., G. B. Toews, and J. C. Weissler. 1989. Separation of potent and poorly functional human lung accessory cells based on autofluorescence. *J. Leukocyte Biol.* 45:458-465.
46. Hart, D. N. J. and J. W. Fabre. 1981. Demonstration and characterization of Ia-positive dendritic cells in the interstitial connective tissues of rat heart and other tissues, but not brain. *J. Exp. Med.* 154:347-361.
47. Larsen, C. P., P. J. Morris, and J. M. Austyn. 1990. Migration of dendritic leukocytes from cardiac allografts into host spleens. A novel pathway for initiation of rejection. *J. Exp. Med.* 171:307-314.
48. Austyn, J. M., D. F. Hankins, C. P. Larsen, P. J. Morris, A. S. Rao, and J. A. Roake. 1994. Isolation and characterization of dendritic cells from mouse heart and kidney. *J. Immunol.* 152:2401-2410.
49. Klinkert, W. E. F., J. H. LaBadie, and W. E. Bowers. 1982. Accessory and stimulating properties of dendritic cells and macrophages isolated from various rat tissues. *J. Exp. Med.* 156:1-19.
50. Lu, L., J. Woo, A. S. Rao, Y. Li, S. C. Watkins, S. Qian, T. E. Starzl, A. J. Demetris, and A. W. Thomson. 1994. Propagation of dendritic cell progenitors from normal mouse liver using granulocyte/macrophage colony-stimulating factor and their maturational development in the presence of type-1 collagen. *J. Exp. Med.* 179:1823-1834.
51. Hoefsmit, E. C. M., A. M. Duijvestijn, and E. W. A. Kamperdijk. 1982. Relation between Langerhans cells, veiled cells, and interdigitating cells. *Immunobiology* 161:255-265.
52. Pavli, P., C. E. Woodhams, W. F. Doe, and D. A. Hume. 1990. Isolation and characterization of antigen-presenting dendritic cells from the mouse intestinal lamina propria. *Immunology* 70:40-47.
53. Pavli, P., D. A. Hume, E. Van de Pol, and W. F. Doe. 1993. Dendritic cells, the major antigen-presenting cells of the human colonic lamina propria. *Immunology* 78:132-141.
54. Knight, S. C., B. M. Balfour, J. O'Brien, L. Buttifant, T. Sumerska, and J. Clark. 1982. Role of veiled cells in lymphocyte activation. *Eur. J. Immunol.* 12:1057-1060.
55. Drexhage, H. A., H. Mullink, J. de Groot, J. Clarke, and B. M. Balfour. 1979. A study of cells present in peripheral lymph of pigs with special reference to a type of cell resembling the Langerhans cells. *Cell Tissue Res.* 202:407-430.
56. Mason, D. W., C. W. Pugh, and M. Webb. 1981. The rat mixed lymphocyte reaction: roles of a dendritic cell in intestinal lymph and T cell subsets defined by monoclonal antibodies. *Immunology* 44:75-87.
57. Rhodes, J. M. and R. Agger. 1987. Comparison of membrane antigens of mouse dendritic cell types. *Immunology letters* 16:981-997.
58. Bujdoso, R., J. Hopkins, B. M. Dutia, P. Young, and I. McConnell. 1989. Characterization of sheep afferent lymph dendritic cells and their role in antigen carriage. *J. Exp. Med.* 170:1285-1302.
59. Young, J. W. and R. M. Steinman. 1988. Accessory cell requirements for the mixed-leukocyte reaction and polyclonal mitogens, as studied with a new technique for enriching blood dendritic cells. *Cell. Immunol.* 111:167-182.
60. Van Voorhis, W. C., R. M. Steinman, L. S. Hair, J. Luban, M. D. Witmer, S. Koide, and Z. A. Cohn. 1983. Specific antimononuclear phagocyte monoclonal antibodies, Application to the purification of dendritic cells and the tissue localization of macrophages. *J. Exp. Med.* 158:126-145.
61. Nickoloff, B. J., R. S. Mitra, K. Lee, L. A. Turka, J. Green, C. Thompson, and Y. Shimizu. 1993. Discordant expression of CD28 ligands, BB-1, and B7 on keratinocytes *in vitro* and psoriatic cells *in vivo*. *Am. J. Pathol.* 142:1029-1040.
62. O'Doherty, U., R. M. Steinman, M. Peng, P. U. Cameron, S. Gezelter, I. Kopeloff, W. J. Swiggard, M. Pope, and N. Bhardwaj. 1993. Dendritic cells freshly isolated from human blood express CD4 and mature into typical immunostimulatory dendritic cells after culture in monocyte-conditioned medium. *J. Exp. Med.* 178:1067-1078.
63. O'Doherty, U., M. Peng, S. Gezelter, W. J. Swiggard, M. Betjes, N. Bhardwaj, and R. M. Steinman. 1994. Human blood contains two subsets of dendritic cells, one immunologically mature and the other immature. *Immunology* 82:487-493.
64. Guillermot, F. P., P. D. Oliver, B. M. Peault, and N. M. LeDourain. 1984. Cells expressing Ia antigens in the avian thymus. *J. Exp. Med.* 160:1803-1819.

65. Witmer, M. D. and R. M. Steinman. 1984. The anatomy of peripheral lymphoid organs with emphasis on accessory cells: light microscopic, immunocytochemical studies of mouse spleen, lymph node and Peyer's patch. *Am. J. Anat.* 170:465-481.
66. Dijkstra, C. D. 1982. Characterization of nonlymphoid cells in rat spleen, with special reference to strongly Ia-positive branched cells in T-cell areas. *J. Reticuloendothel. Soc.* 32:167-178.
67. Austyn, J. M., J. W. Kupiec-Weglinski, D. F. Hankins, and P. J. Morris. 1988. Migration patterns of dendritic cells in the mouse. Homing to T cell-dependent areas of spleen and binding within marginal zone. *J. Exp. Med.* 167:646-651.
68. Steinman, R. M. and Z. A. Cohn. 1973. Identification of a novel cell type in peripheral lymphoid organs of mice. I. Morphology, quantitation, tissue distribution. *J. Exp. Med.* 137:1142-1162.
69. Steinman, R. M. and Z. A. Cohn. 1974. Identification of a novel cell type in peripheral lymphoid organs of mice. II. Functional properties in vitro. *J. Exp. Med.* 139:380-397.
70. London, L. and J. P. McKeam. 1987. Activation and growth of colony-stimulating factor-dependent cell lines is cell cycle stage dependent. *J. Exp. Med.* 166:1419-1436?
71. Crowley, M. T., K. Inaba, M. D. Witmer-Pack, S. Gezelter, and R. M. Steinman. 1990. Use of the fluorescence activated cell sorter to enrich dendritic cells from mouse spleen. *J. Immunol. Methods* 133:55-66.
72. Romani, N., N. Bhardwaj, M. Pope, F. Koch, W. J. Swiggard, U. O'Doherty, M. D. Witmer-Pack, L. Hoffman, G. Schuler, K. Inaba, and R. M. Steinman. 1995. Dendritic Cells. In *Handbook of Experimental Immunology*. D. M. Weir, L. A. Herzenberg, and C. Blackwell, editors. Blackwell, Oxford.
73. Glass, C. K., O. V. Devary, and M. G. Rosenfeld. 1990. Multiple cell type-specific proteins differentially regulate target sequence recognition by the α retinoic acid receptor. *Cell* 63:729-738.
74. Kraal, G., M. Breel, M. Janse, and G. Bruin. 1986. Langerhans' cells, veiled cells, and interdigitating cells in the mouse recognized by a monoclonal antibody. *J. Exp. Med.* 163:981-997.
75. Metlay, J. P., M. D. Witmer-Pack, R. Agger, M. T. Crowley, D. Lawless, and R. M. Steinman. 1990. The distinct leukocyte integrins of mouse spleen dendritic cells as identified with new hamster monoclonal antibodies. *J. Exp. Med.* 171:1753-1771.
76. Agger, R., M. T. Crowley, and M. D. Witmer-Pack. 1990. The surface of dendritic cells in the mouse as studied with monoclonal antibodies. *Int. Rev. Immunol.* 6:89-101.
77. Heufler, C., F. Koch, and G. Schuler. 1988. Granulocyte-macrophage colony-stimulating factor and interleukin-1 mediate the maturation of murine epidermal Langerhans cells into potent immunostimulatory dendritic cells. *J. Exp. Med.* 167:700-705.
78. Witmer-Pack, M. D., W. Olivier, J. Valinsky, G. Schuler, and R. M. Steinman. 1987. Granulocyte/macrophage colony-stimulating factor is essential for the viability and function of cultured murine epidermal Langerhans cells. *J. Exp. Med.* 166:1484-1498.
79. Romani, N., A. Lenz, H. Glassel, H. Stössel, U. Stanzi, O. Majdic, P. Fritsch, and G. Schuler. 1989. Cultured human Langerhans cells resemble lymphoid dendritic cells in phenotype and function. *J. Invest. Dermatol.* 93:600-609.
80. Schuler, G. and R. M. Steinman. 1985. Murine epidermal Langerhans cells mature into potent immunostimulatory dendritic cells in vitro. *J. Exp. Med.* 161:526-546.
81. Shimada, S., S. W. Caughman, S. O. Sharow, D. Stephany, and S. I. Katz. 1987. Enhanced antigen-presenting capacity of cultured Langerhans' cells is associated with markedly increased expression of Ia antigen. *J. Immunol.* 139:2551-2556.
82. Teunissen, M. B. M., J. Wormmeester, S. R. Krieg, P. J. Peters, I. M. C. Vogels, M. L. Kapsenberg, and J. D. Bos. 1990. Human epidermal Langerhans cells undergo profound morphological and phenotypical changes during in vitro culture. *J. Invest. Dermatol.* 94:166-173.
83. Witmer-Pack, M. D., J. Valinsky, W. Olivier, and R. M. Steinman. 1988. Quantitation of surface antigens on cultured murine epidermal Langerhans cells: rapid and selective increase in the level of surface MHC products. *J. Invest. Dermatol.* 90:387-394.
84. Tang, A. and M. C. Udey. 1991. Inhibition of epidermal Langerhans cell function by low dose ultraviolet B radiation: Ultraviolet B radiation selectively modulates ICAM-1 (CD54) expression by murine Langerhans cells. *J. Immunol.* 146:3347-3355.
85. Larsen, C. P., S. C. Ritchie, T. C. Pearson, P. S. Linsley, and R. P. Lowry. 1992. Functional expression of the costimulatory molecule, B7/BB1, on murine dendritic cell populations. *J. Exp. Med.* 176:1215-1220.

86. Symington, F. W., W. Brady, and P. S. Linsley. 1993. Expression and function of B7 on human epidermal Langerhans cells. *J. Immunol.* 150:1286-1295.
87. Inaba, K., M. Witmer-Pack, M. Inaba, K. S. Hathcock, H. Sakuta, M. Azuma, H. Yagita, K. Okumura, P. S. Linsley, S. Ikehara, S. Muramatsu, R. J. Hodes, and R. M. Steinman. 1994. The tissue distribution of the B7-2 costimulator in mice: Abundant expression on dendritic cells in situ and during maturation in vitro. *J. Exp. Med.* 180:1849-1860.
88. Caux, C., B. Vanbervliet, C. Massacrier, M. Azuma, K. Okumura, L. L. Lanier, and J. Banchereau. 1994. B70/B7-2 is identical to CD86 and is the major functional ligand for CD28 expressed on human dendritic cells. *J. Exp. Med.* 180:1841-1847.
89. Inaba, K., G. Schuler, M. D. Witmer, J. Valinski, B. Atassi, and R. M. Steinman. 1986. Immunologic properties of purified epidermal Langerhans cells. Distinct requirements for stimulation of unprimed and sensitized T lymphocytes. *J. Exp. Med.* 164:605-613.
90. Inaba, K., N. Romani, and R. M. Steinman. 1989. An antigen-independent contact mechanism as an early step in T cell-proliferative responses to dendritic cells. *J. Exp. Med.* 170:527-542.
91. Heufler, C., C. Humborg, R. M. Steinman, M. C. Nussenzweig, and G. Schuler. 1995. Molecular strategies to identify dendritic cell-specific molecules. In J. Banchereau, D. Schmitt, and L. Valette, editors. Plenum Press, New York.
92. Puré, E., K. Inaba, M. T. Crowley, L. Tardelli, M. D. Witmer-Pack, G. Ruberti, G. Fathman, and R. M. Steinman. 1990. Antigen processing by epidermal Langerhans cells correlates with the level of biosynthesis of major histocompatibility complex class II molecules and expression of invariant chain. *J. Exp. Med.* 172:1459-1469.
93. Romani, N., S. Koide, M. Crowley, M. Witmer-Pack, A. M. Livingstone, C. G. Fathman, K. Inaba, and R. M. Steinman. 1989. Presentation of exogenous protein antigens by dendritic cells to T cell clones: intact protein is presented best by immature epidermal Langerhans cells. *J. Exp. Med.* 169:1169-1178.
94. Inaba, K., J. P. Metlay, M. T. Crowley, and R. M. Steinman. 1990. Dendritic cells pulsed with protein antigens in vitro can prime antigen-specific, MHC-restricted T cells in situ. *J. Exp. Med.* 172:631-640.
95. Kämpgen, E., N. Koch, F. Koch, P. Stöger, C. Heufler, G. Schuler, and N. Romani. 1991. Class II major histocompatibility complex molecules of murine dendritic cells: Synthesis, sialylation of invariant chain, and antigen processing capacity are down-regulated upon culture. *Proc. Natl. Acad. Sci. USA* 88:3014-3018.
96. Roth, P. and E. R. Stanley. 1992. The biology of CSF-1 and its receptor. *Curr. Top. Microbiol. Immunol.* 181:141-167.
97. Koide, S. L., K. Inaba, and R. M. Steinman. 1987. Interleukin-1 enhances T-dependent immune responses by amplifying the function of dendritic cells. *J. Exp. Med.* 165:515-530.
98. Koch, F., C. Heufler, E. Kämpgen, D. Schneeweiss, G. Böck, and G. Schuler. 1990. Tumor necrosis factor alpha maintains the viability of murine epidermal Langerhans cells in culture but in contrast to granulocyte/macrophage colony-stimulating factor without inducing their functional maturation. *J. Exp. Med.* 171:159-171.
99. Inaba, K., M. D. Witmer-Pack, M. Inaba, S. Muramatsu, and R. M. Steinman. 1988. The function of Ia+ dendritic cells and Ia- dendritic cell precursors in thymocyte mitogenesis to lectin and lectin plus interleukin 1. *J. Exp. Med.* 167:149-162.
100. Zaghouani, H., R. Steinman, R. Nonacs, H. Shah, W. Gerhard, and C. Bona. 1993. Presentation of a viral T cell epitope expressed in the CDR3 region of a self immunoglobulin molecule. *Science* 259:224-227.
101. Sallusto, F. and A. Lanzavecchia. 1994. Efficient presentation of soluble antigen by cultured human dendritic cells is maintained by granulocyte/macrophage colony-stimulating factor plus interleukin 4 and downregulated by tumor necrosis factor α. *J. Exp. Med.* 179:1109-1118.
102. Moll, H., H. Fuchs, C. Blank, and M. Röllinghoff. 1993. Langerhans cells transport *Leishmania major* from the infected skin to the draining lymph node for presentation to antigen-specific T cells. *Eur. J. Immunol.* 23:1595-1601.
103. Demotz, S., H. M. Grey, and A. Sette. 1990. The minimal number of class II MHC-antigen complexes needed for T cell activation. *Science* 249:1028-1030.
104. Romani, N., K. Inaba, E. Pure, M. Crowley, M. Witmer-Pack, and R. M. Steinman. 1989. A small number of anti-CD3 molecules on dendritic cells stimulates DNA synthesis in mouse T lymphocytes. *J. Exp. Med.* 169:1153-1168.
105. Bhardwaj, N., J. W. Young, A. J. Nisanian, J. Baggers, and R. M. Steinman. 1993. Small amounts of superantigen, when presented on dendritic cells, are sufficient to initiate T cell responses. *J. Exp. Med.* 178:633-642.

106. Inaba, K., M. Inaba, M. Naito, and R. M. Steinman. 1993. Dendritic cell progenitors phagocytose particulates, including bacillus Calmette-Guerin organisms, and sensitize mice to mycobacterial antigens in vivo. *J. Exp. Med.* 178:479-488.
107. Stössel, H., F. Koch, E. Kämpgen, P. Stöger, A. Lenz, C. Heufler, N. Romani, and G. Schuler. 1990. Disappearance of certain acidic organelles (endosomes and Langerhans cell granules) accompanies loss of antigen processing capacity upon culture of epidermal Langerhans cells. *J. Exp. Med.* 172:1471-1482.
108. Kleijmeer, M. J., V. M. J. Oorschot, and H. J. Geuze. 1994. Human resident Langerhans cells display a lysosomal compartment enriched in MHC class II. *J. Invest. Dermatol.* 103:516-523.
109. Koch, F., B. Trockenbacher, E. Kämpgen, O. Grauer, H. Stössel, A. M. Livingstone, G. Schuler, and N. Romani. 1995. Antigen processing in populations of mature dendritic cells is caused by subsets of incompletely matured cells. *J. Immunol.* 155:93-100.
110. Brodsky, F. M. and L. E. Guagliardi. 1991. The cell biology of antigen processing and presentation. *Annu. Rev. Immunol.* 9:707-744.
111. Becker, D., A. B. Reske-Kunz, J. Knop, and K. Reske. 1991. Biochemical properties of MHC class II molecules endogenously synthesized and expressed by mouse Langerhans cells. *Eur. J. Immunol.* 21:1213
112. Cresswell, P. 1994. Assembly, transport, and function of MHC class II molecules. *Annu. Rev. Immunol.* 12:259-293.
113. Crowley, M., K. Inaba, and R. M. Steinman. 1990. Dendritic cells are the principal cells in mouse spleen bearing immunogenic fragments of foreign proteins. *J. Exp. Med.* 172:383-386.
114. Macatonia, S. E., S. C. Knight, A. J. Edwards, S. Griffiths, and P. Fryer. 1987. Localization of antigen on lymph node dendritic cells after exposure to the contact sensitizer fluorescein isothiocyanate. *J. Exp. Med.* 166:1654-1667.
115. Hauser, C. 1990. Cultured epidermal Langerhans cells activate effector T cells for contact sensitivity. *J. Invest. Dermatol.* 95:436-440.
116. Hauser, C. and S. I. Katz. 1988. Activation and expansion of hapten- and protein-specific T helper cells from nonsensitized mice. *Proc. Natl. Acad. Sci. USA* 85:5625-5628.
117. Toews, G. B., P. R. Bergstresser, and J. W. Streilein. 1980. Epidermal Langerhans cell density determines whether contact hypersensitivity or unresponsiveness follows skin painting with DNFB. *J. Immunol.* 124:445-453.
118. Streilein, J. W. 1989. Antigen-presenting cells in the induction of contact hypersensitivity in mice: Evidence that Langerhans cells are sufficient but not required. *J. Invest. Dermatol.* 93:443-448.
119. Tse, Y. and K. D. Cooper. 1990. Cutaneous dermal la⁺ cells are capable of initiating delayed type hypersensitivity responses. *J. Invest. Dermatol.* 94:267-272.
120. Koch, F., E. Kämpgen, B. Trockenbacher, C. Heufler, P. Stöger, N. Romani, and G. Schuler. 1992. Tumor Necrosis Factor alpha (TNF alpha) induces loss of immunogenic peptides from MHC class II molecules and thus interrupts the antigen presenting function of epidermal Langerhans cells. *J. Invest. Dermatol.* 89:510(Abstr.)
121. Vermeer, M. and J. W. Streilein. 1990. Ultraviolet B light-induced alterations in epidermal Langerhans cells are mediated in part by tumor necrosis factor-alpha. *Photodermatol. Photoimmunol. Photomed.* 7:258-265.
122. Barker, C. F. and R. E. Billingham. 1968. The role of afferent lymphatics in the rejection of skin homografts. *J. Exp. Med.* 128:197-221.
123. Frey, J. R. and P. Wenk. 1957. Experimental studies on the pathogenesis of contact eczema in guinea pigs. *Arch. Allergy Appl. Immunol.* 11:81-100.
124. Larsen, C. P., R. M. Steinman, M. Witmer-Pack, D. F. Hankins, P. J. Morris, and J. M. Austyn. 1990. Migration and maturation of Langerhans cells in skin transplants and explants. *J. Exp. Med.* 172:1483-1493.
125. Bergstresser, P. R., G. B. Toews, and J. W. Streilein. 1980. Natural and perturbed distributions of Langerhans cells: Responses to ultraviolet light, heterotopic skin grafting, and dinitrofluorobenzene sensitization. *J. Invest. Dermatol.* 75:73-77.
126. Botham, P. A., N. J. Rattray, S. T. Walsh, and E. J. Riley. 1987. Control of the immune response to contact sensitizing chemicals by cutaneous antigen-presenting cells. *Br. J. Dermatol.* 117:1-9.
127. Weinlich, G., N. Sepp, F. Koch, G. Schuler, and N. Romani. 1990. Evidence that Langerhans cells rapidly disappear from the epidermis in response to contact sensitizers but not to tolerogens / non-sensitizers. *Arch. Dermatol. Res.* 281:556(Abstr.)

128. Lenz, A., C. P. Larsen, J. M. Austyn, P. Fritsch, N. Romani, and G. Schuler. 1991. Human dermal dendritic cells: characterization by means of a novel isolation method. *Arch. Derm. Res.* in press (abstract).
129. Okamoto, H. and M. L. Kripke. 1987. Effector and suppressor circuits of the immune response are activated in vivo by different mechanisms. *Proc. Natl. Acad. Sci. USA* 84:3841-3846.
130. Kripke, M. L., C. G. Munn, A. Jeevan, J.-M. Tang, and C. Bucana. 1990. Evidence that cutaneous antigen-presenting cells migrate to regional lymph nodes during contact sensitization. *J. Immunol.* 145:2833-2838.
131. Inaba, K. and R. M. Steinman. 1986. Accessory cell-T lymphocyte interactions. Antigen-dependent and -independent clustering. *J. Exp. Med.* 163:247-261.
132. Freudenthal, P. S. and R. M. Steinman. 1990. The distinct surface of human blood dendritic cells, as observed after an improved isolation method. *Proc. Natl. Acad. Sci. USA* 87:7698-7702.
133. Young, J. W., L. Koulova, S. A. Soergel, E. A. Clark, R. M. Steinman, and B. Dupont. 1992. The B7/BB1 antigen provides one of several costimulatory signals for the activation of CD4⁺ T lymphocytes by human blood dendritic cells in vitro. *J. Clin. Invest.* 90:229-237.
134. Crowley, M. T., K. Inaba, M. Witmer-Pack, and R. M. Steinman. 1989. The cell surface of mouse dendritic cells: FACS analyses of dendritic cells from different tissues including thymus. *Cell. Immunol.* 118:108-125.
135. Rudensky, A. Y., P. Preston-Hurlburt, S. Hong, A. Barlow, and C. A. J. Janeway. 1993. Sequence analysis of peptides bound to MHC class II molecules. *Nature* 353:622.
136. Valitutti, S., S. Müller, M. Cella, E. Padovan, and A. Lanzavecchia. 1995. Serial triggering of many T-cell receptors by a few peptide-MHC-complexes. *Nature* 375:148-151.
137. Sauder, D. N., C. A. Dinarello, and V. B. Morhenn. 1984. Langerhans cell production of interleukin-1. *J. Invest. Dermatol.* 82:605-607.
138. Heufler, C., G. Topar, F. Koch, B. Trockenbacher, E. Kämpgen, N. Romani, and G. Schuler. 1992. Cytokine gene expression in murine epidermal cell suspensions: Interleukin 1b and macrophage inflammatory protein 1a are selectively expressed in Langerhans cells but are differentially regulated in culture. *J. Exp. Med.* 176:1221-1226.
139. Heufler, C., F. Koch, U. Stanzl, G. Topar, M. Wysocka, G. Trinchieri, A. Enk, R. M. Steinman, N. Romani, and G. Schuler. 1996. Interleukin-12 is produced by dendritic cells and mediates TH1 development as well as Interferon-gamma production by TH1 cells. *Eur. J. Immunol.* (In Press)
140. Macatonia, S. E., N. A. Hosken, M. Litton, P. Vieira, C.-S. Hsieh, J. A. Culpepper, M. Wysocka, G. Trinchieri, K. M. Murphy, and A. O'Garra. 1995. Dendritic cells produce IL-12 and direct the development of Th1 cells from naive CD4⁺ T cells. *J. Immunol.* 154:5071-5079.
141. Steinman, R. M. and J. W. Young. 1991. Signals arising from antigen-presenting cells. *Current Opinion in Immunology* 3:361-372.
142. Mueller, D. L., M. K. Jenkins, and R. H. Schwartz. 1989. Clonal expansion versus functional clonal inactivation: A costimulatory signalling pathway determines the outcome of T cell antigen receptor occupancy. *Ann. Rev. Immunol.* 7:445-480.
143. June, C. H., J. A. Ledbetter, P. S. Linsley, and C. B. Thompson. 1990. Role of the CD28 receptor in T-cell activation. *Immunol. Today* 11:211-216.
144. Koulova, L., E. A. Clark, G. Shu, and B. Dupont. 1991. The CD28 ligand B7/BB1 provides costimulatory signal for alloactivation of CD4⁺ T cells. *J. Exp. Med.* 173:759-762.
145. Galvin, F., G. J. Freeman, Z. Razi-Wolf, W. Hall,Jr., B. Benacerraf, L. Nadler, and H. Reiser. 1992. Murine B7 antigen provides a sufficient costimulatory signal for antigen-specific and MHC-restricted T cell activation. *J. Immunol.* 149:3802-3808.
146. Engel, P., J. G. Gribben, G. J. Freeman, L.-J. Zhou, Y. Nozawa, M. Abe, L. M. Nadler, H. Wakasa, and T. F. Tedder. 1994. The B7-2 (B70) costimulatory molecule expressed by monocytes and activated B lymphocytes is the CD86 differentiation antigen. *Blood* 84:1402-1407.
147. Lanier, L. L., S. O'Fallon, C. Somoza, J. H. Phillips, P. S. Linsley, K. Okumura, D. Ito, and M. Azuma. 1995. CD80 (B7) and CD86 (B70) provide similar costimulatory signals for T cell proliferation, cytokine production, and generation of CTL. *J. Immunol.* 154:97-105.

148. Enk, A. H. and S. I. Katz. 1994. Heat-stable antigen is an important costimulatory molecule on epidermal Langerhans' cells. *J. Immunol.* 152:3264-3270.
149. Kashihara, M., M. Ueda, Y. Horiguchi, F. Furukawa, M. Hanaoka, and S. Imamura. 1986. A monoclonal antibody specifically reactive to human Langerhans cells. *J. Invest. Dermatol.* 87:602-612.
150. Azuma, M., D. Ito, H. Yagita, K. Okumura, J. H. Phillips, L. L. Lanier, and C. Somoza. 1993. B70 antigen is a second ligand for CTLA-4 and CD28. *Nature* 366:76-79.
151. Zhou, L.-J., R. Schwarting, H. M. Smith, and T. F. Tedder. 1992. A novel cell-surface molecule expressed by human interdigitating reticulum cells, Langerhans cells, and activated lymphocytes is a new member of the Ig superfamily. *J. Immunol.* 149:735-742.
152. Duijvestijn, A. M., E. Horst, S. T. Pals, B. N. Rouse, A. C. Steere, L. J. Picker, C. J. L. M. Meijer, and E. C. Butcher. 1988. High endothelial differentiation in human lymphoid and inflammatory tissues defined by monoclonal antibody HECA-452. *Amer. J. Pathol.* 130:147-155.
153. Schlingemann, R. O., G. M. Dingjan, J. J. Emeis, J. Blok, S. O. Wamaar, and D. J. Ruiter. 1985. Monoclonal antibody PAL-E specific for endothelium. *Lab. Invest.* 52:71-76.
154. Graf, D., U. Korthäuer, H. W. Mages, G. Senger, and R. A. Kroczeck. 1992. Cloning of TRAP, a ligand for CD40 on human T cells. *Eur. J. Immunol.* 22:3191-3194.
155. Fithian, E., P. Kung, G. Goldstein, M. Rubenfeld, C. Fenoglio, and R. Edelson. 1981. Reactivity of Langerhans cells with hybridoma antibody. *Proc. Natl. Acad. Sci. USA* 78:2541-2544.
156. Murphy, G. F., S. Sato, A. K. Bhan, T. Harrist, and M. C. Mihm. 1981. Characterization of Langerhans cells by the use of monoclonal antibodies. *Lab. Invest.* 45:465.
157. Rowden, G. 1977. Immuno-electron microscopic studies of surface receptors and antigens of human Langerhans cells. *Br. J. Dermatol.* 97:593-608.
158. Ryan, T. J. 1989. Structure and function of lymphatics. *J. Invest. Dermatol.* Supplement:18S-24S.
159. Sauter, B., K. Wolff, and K. Rappersberger. 1995. Histogenesis of Kaposi sarcoma. Immunomorphological comparison with endothelial cells from normal skin, cutaneous hemangiomas, and lymphangiomas. *Am. J. Pathol.* (In Press)
160. Luger, T. A. and T. Schwarz. 1991. Epidermal cell derived secretory regulins. In *Epidermal Langerhans Cells*. G. Schuler, editor. CRC Press, Boca Raton. 217-251.
161. Ortner, U. 1994. Modulation und Migration von Langerhanszellen in vitro und in vivo / Modulation and migration of Langerhans cells in vitro and in vivo. 1 p.
162. Tracey, K. J., H. W. Kirk, K. R. Manogue, Y. Fong, D. G. Hesse, H. T. Nguyen, G. C. Kuo, B. Beutler, R. S. Cotran, A. Cerami, and S. F. Lowry. 1988. Cachectin/tumor necrosis factor induces cachexia, anemia and inflammation. *J. Exp. Med.* 167:1211-1227.
163. Mohler, K. M., D. S. Torrance, C. A. Smith, R. G. Goodwin, K. E. Stremler, V. P. Fung, H. Madani, and M. B. Widmer. 1993. Soluble tumor necrosis factor (TNF) receptors are effective therapeutic agents in lethal endotoxemia and function simultaneously as both TNF carriers and TNF antagonists. *J. Immunol.* 151:1548-1561.
164. Carter, D. B., M. R. Deibel,Jr., C. J. Dunn, C. C. Tomich, A. L. Laborde, J. L. Slightom, A. E. Berger, M. J. Bienkowski, F. F. Sun, R. N. McEwan, P. K. W. Harris, A. W. Yem, G. A. Waszak, J. G. Chosay, L. C. Sieu, M. M. Hardee, H. A. Zurcher-Neely, I. M. Reardon, R. L. Heinrikson, S. E. Truesdell, J. A. Shelley, T. E. Eessalu, B. M. Taylor, and D. E. Tracey. 1990. Purification, cloning, expression and biological characterization of an interleukin-1 receptor antagonist protein. *Nature* 344:633-638.
165. Takeichi, M. 1990. Cadherins: A molecular family important in selective cell-cell adhesion. *Annu. Rev. Biochem.* 59:237-252.
166. Lewis, J. E., P. J. Jensen, and M. J. Wheelock. 1994. Cadherin function is required for human keratinocytes to assemble desmosomes and stratify in response to calcium. *J. Invest. Dermatol.* 102:870-877.
167. Tang, A., M. Amagai, L. G. Granger, J. R. Stanley, and M. C. Udey. 1993. Adhesion of epidermal Langerhans cells to keratinocytes mediated by E-cadherin. *Nature* 361:82-85.
168. Blauvelt, A., S. I. Katz, and M. C. Udey. 1995. Human Langerhans cells express E-cadherin. *J. Invest. Dermatol.* 104:293-296.
169. Schwarzenberger, K. and M. C. Udey. 1995. Modulation of Langerhans cell E-cadherin expression during the initiation phase of contact sensitivity reactions. *J. Cell. Biochem.* 21A:14(Abstr.)

170. Pals, S. T., F. Hogervorst, G. D. Keizer, T. Thepen, E. Horst, and C. G. Figdor. 1989. Identification of a widely distributed 90-kDa glycoprotein that is homologous to the hermes-1 human lymphocyte homing receptor. *J. Immunol.* 143:851
171. Van Kooyk, Y., P. Van de Wiel-van Kemenade, P. Weder, T. W. Kuipers, and C. G. Figdor. 1989. Enhancement of LFA-1-mediated cell adhesion by triggering through CD2 or CD3 on T lymphocytes. *Nature* 342:811-813.
172. Shimizu, Y., G. A. Van Sechteren, R. Siraganian, L. Wahl, and S. Shaw. 1989. Dual role of the CD44 molecule in T cell adhesion and activation. *J. Immunol.* 143:2457-2463.
173. Romani, N., D. Reider, M. Heuer, S. Ebner, B. Eibl, D. Niederwieser, and G. Schuler. 1996. Generation of mature dendritic cells from human blood: An improved method with special regard to clinical applicability. *J. Immunol. Methods* (In Press)
174. Bender, A., M. Sapp, G. Schuler, R. M. Steinman, and N. Bhardwaj. 1996. Improved methods for the generation of dendritic cells from nonproliferating progenitors in human blood. *J. Immunol. Methods* (In Press)
175. Shimizu, Y. and S. Shaw. 1991. Lymphocyte interactions with extracellular matrix. *FASEB J.* 5:2292-2299.
176. Jalkanen, S., R. F. Bargatze, J. d. Toyos, and E. C. Butcher. 1987. Lymphocyte recognition of high endothelium: antibodies to distinct epitopes of an 85-95 kD glycoprotein antigen differentially inhibit lymphocyte binding to lymph node, mucosal, or synovial endothelial cells. *J. Cell. Biol.* 105:983-991.
177. Mackay, C. R., H. J. Terpe, R. Stauder, W. L. Marston, H. Stark, and U. Günthert. 1993. Expression and modulation of CD44 variant isoforms in humans. *J. Cell. Biol.*
178. Aiba, S., S. Nakagawa, H. Ozawa, K. Miyake, H. Yagita, and H. Tagami. 1993. Up-regulation of a4 integrin on activated Langerhans cells: Analysis of adhesion molecules on Langerhans cells relating to their migration from skin to draining lymph nodes. *J. Invest. Dermatol.* 100:143-147.
179. Cruz, P. D., Jr., R. E. Tigelaar, and P. R. Bergstresser. 1990. Langerhans cells that migrate to skin after intravenous infusion regulate the induction of contact hypersensitivity. *J. Immunol.* 144:2486-2492.
180. Picker, L. J., J. R. Treer, B. Ferguson-Darnell, P. A. Collins, P. R. Bergstresser, and L. W. M. M. Terstappen. 1993. Control of lymphocyte recirculation in man: II. Differential regulation of the cutaneous lymphocyte-associated antigen, a tissue-selective homing receptor for skin-homing T cells. *J. Immunol.* 150:1122-1136.
181. Berg, E. L., T. Yoshino, L. S. Rott, M. K. Robinson, R. A. Warnock, T. K. Kishimoto, L. J. Picker, and E. C. Butcher. 1991. The cutaneous lymphocyte antigen is a skin lymphocyte homing receptor for the vascular lectin endothelial cell-leukocyte adhesion molecule 1. *J. Exp. Med.* 174:1461-1466.
182. Jalkanen, S., S. Saari, H. Kalimo, K. Lammintausta, E. Vainio, R. Leino, A. M. Duijvestijn, and K. Kalimo. 1990. Lymphocyte migration into the skin: The role of lymphocyte homing receptor (CD44) and endothelial cell antigen (HECA-452). *J. Invest. Dermatol.* 94:786-792.
183. Koszik, F., D. Strunk, I. Simonitsch, L. J. Picker, G. Stingl, and E. Payer. 1994. Expression of monoclonal antibody HECA-452-defined E-selectin ligands on Langerhans cells in normal and diseased skin. *J. Invest. Dermatol.* 102:773-780.
184. Larsen, C. P., S. C. Ritchie, R. Hendrix, P. S. Linsley, K. S. Hathcock, R. J. Hodes, R. P. Lowry, and T. C. Pearson. 1994. Regulation of immunostimulatory function and costimulatory molecule (B7-1 and B7-2) expression on murine dendritic cells. *J. Immunol.* 152:5208-5219.
185. Hart, D. N. J., G. C. Starling, V. L. Calder, and N. S. Fernando. 1993. B7/BB-1 is a leucocyte differentiation antigen on human dendritic cells induced by activation. *Immunology* 79:616-620.
186. Linsley, P. S., W. Brady, M. Urnes, L. S. Grosmaire, N. K. Damle, and J. A. Ledbetter. 1991. CTLA-4 is a second receptor for the B cell activation antigen B7. *J. Exp. Med.* 174:561-569.
187. Zhou, L.-J. and T. F. Tedder. 1995. Human blood dendritic cells selectively express CD83, a member of the immunoglobulin superfamily. *J. Immunol.* 154:3821-3835.
188. Furue, M., M. Nindl, K. Kawabe, K. Nakamura, Y. Ishibashi, and K. Sagawa. 1992. Epitopes for CD1a, CD1b, and CD1c antigens are differentially mapped on Langerhans cells, dermal dendritic cells, keratinocytes, and basement membrane zone in human skin. *J. Am. Acad. Dermatol.* 27:419-426.
189. Auböck, J., N. Romani, G. Grubauer, and P. Fritsch. 1986. Expression of HLA-DR antigens on keratonocytes is a common feature of diseased skin. *Br. J. Dermatol.* 114:456

190. Aiba, S. and H. Tagami. 1984. HLA-DR antigen expression on the keratinocyte surface in dermatoses characterized by lymphocytic exocytosis. *Br. J. Dermatol.* 111:285
191. Nickoloff, B. J., T. Y. Basham, and T. C. Merigan. 1985. Keratinocyte class II histocompatibility antigen expression. *Br. J. Dermatol.* 112:373
192. Basham, T. Y., B. J. Nickoloff, T. C. Merigan, and V. B. Morhenn. 1984. Recombinant gamma interferon induces HLA-DR expression on cultured human keratinocytes. *J. Invest. Dermatol.* 83:88-90.
193. Auböck, J., D. Niederwieser, N. Romani, P. Fritsch, and C. Huber. 1985. Human interferon gamma induces expression of HLA-DR on keratinocytes and melanocytes. *Arch. Derm. Res.* 277:270-276.
194. Kolde, G. and J. Knop. 1987. Different cellular reaction patterns of epidermal Langerhans cells after application of contact sensitizing, toxic, and tolerogenic compounds. A comparative ultrastructural and morphometric time-course analysis. *J. Invest. Dermatol.* 89:19-23.
195. Hanau, D., M. Fabre, D. A. Schmitt, J.-L. Stampf, J.-C. Garaud, T. Bieber, E. Grosshans, C. Benezra, and J.-P. Cazenave. 1987. Human epidermal Langerhans cells internalize by receptor-mediated endocytosis T6 (CD1 "NA1/34") surface antigen. Birbeck granules are involved in the intracellular traffic of the antigen. *J. Invest. Dermatol.* 89:172-177.
196. Hanau, D., M. Fabre, D. A. Schmitt, J.-C. Garaud, G. Pauly, M.-M. Tongio, S. Mayer, and J.-P. Cazenave. 1987. Human epidermal Langerhans cells cointernalize by receptor-mediated endocytosis "nonclassical" major histocompatibility complex class I molecules (T6 antigens) and class II molecules (HLA-DRXantigens). *Proc. Natl. Acad. Sci. USA* 84:2901-2906.
197. Ray, A., D. Schmitt, C. Dezutter-Dambuyant, M.-C. Fargier, and J. Thivolet. 1989. Reappearance of CD1a antigenic sites after endocytosis on human Langerhans cells evidenced by immunogoldrelabeling. *J. Invest. Dermatol.* 92:217-224.
198. Bartosik, J. 1992. Cytomembrane-derived Birbeck granules transport horseradish peroxidase to the endosomal compartment in the human Langerhans cells. *J. Invest. Dermatol.* 99:53-58.
199. Heufler, C., F. Koch, D. Schneeweiss, and G. Schuler. 1988. Granulocyte-macrophage colony-stimulating factor (GM-CSF) and interleukin-1 (IL-1) mediate the maturation of murine epidermal Langerhans cells into potent immunostimulatory dendritic cells in vitro. *J. Invest. Dermatol.* 90:569(Abstr.)
200. Heine, M. 1993. Studien zur Funktion kutaner antigenpräsentierender Zellen mit Hilfe eines neuen Organkulturmodells / Studies on the function of cutaneous antigen presenting cells by means of a novel organ culture model. 1 p.
201. Chen, H., C. Ma, J. Yuan, Y. Wang, and W. K. Silvers. 1986. Occurrence of donor Langerhans cells in mouse and rat chimeras and their replacement in skin grafts. *J. Invest. Dermatol.* 86:630-633.
202. Holt, P. G., S. Haining, D. J. Nelson, and J. D. Sedgwick. 1994. Origin and steady-state turnover of class II MHC-bearing dendritic cells in the epithelium of the conducting airways. *J. Immunol.* (In Press)
203. Knight, S. C., J. Krejci, M. Malkovsky, V. Colizzi, A. Gautam, and G. L. Asherson. 1985. The role of dendritic cells in the initiation of immune responses to contact sensitizers. I. In vivo exposure to antigen. *Cell. Immunol.* 94:427-434.
204. Kinnaird, A., S. W. Peters, J. R. Foster, and I. Kimber. 1989. Dendritic cell accumulation in draining lymph nodes during the induction phase of contact allergy in mice. *Int. Arch. Allergy Appl. Immunol.* 89:202-210.
205. Cumberbatch, M., S. J. Gould, S. W. Peters, and I. Kimber. 1991. MHC class II expression by Langerhans' cells and lymph node dendritic cells: Possible evidence for maturation of Langerhans' cells following contact sensitization. *Immunology* 74:414-419.
206. Silberberg, I. R., L. Baer, and S. A. Rosenthal. 1976. The role of Langerhans cells in allergic contact hypersensitivity. A review of findings in man and guinea pigs. *J. Invest. Dermatol.* 66:210-217.
207. Kurimoto, I. and J. W. Streilein. 1993. Studies of contact hypersensitivity induction in mice with optimal sensitizing doses of hapten. *J. Invest. Dermatol.* 101:132-136.
208. Cumberbatch, M. and I. Kimber. 1992. Dermal tumour necrosis factor-a induces dendritic cell migration to draining lymph nodes, and possibly provides one stimulus for Langerhans' cell migration. *Immunology* 75:257-263.
209. Cumberbatch, M., I. Fielding, and I. Kimber. 1994. Modulation of epidermal Langerhans' cell frequency by tumour necrosis factor-a. *Immunology* 81:395-401.

210. Enk, A. H. and S. I. Katz. 1992. Early molecular events in the induction phase of contact sensitivity. *Proc. Natl. Acad. Sci. USA* 89:1398-1402.
211. Enk, A. H., V. L. Angeloni, M. C. Udey, and S. I. Katz. 1993. An essential role for Langerhans cell-derived IL-1 β in the initiation of primary immune responses in skin. *J. Immunol.* 150:3698-3704.
212. Matsue, H., P. D. Cruz,Jr., P. R. Bergstresser, and A. Takashima. 1992. Langerhans cells are the major source of mRNA for IL-1 β and MIP-1 α among unstimulated mouse epidermal cells. *J. Invest. Dermatol.* 99:537-541.
213. Schreiber, S., O. Kilgus, E. Payer, R. Kutil, A. Elbe, C. Mueller, and G. Stingl. 1992. Cytokine pattern of Langerhans cells isolated from murine epidermal cell cultures. *J. Immunol.* 149:3525-3534.
214. Trede, N., R. S. Geha, and T. Chatila. 1991. Transcriptional activation of IL-1 β and TNF-alpha genes by MHC class II ligands. *J. Immunol.* 146:2310
215. Halliday, G. M. and A. D. Lucas. 1993. Protein kinase C transduces the signal for Langerhans' cell migration from the epidermis. *Immunology* 79:621-626.
216. Cumberbatch, M. and I. Kimber. 1995. Tumour necrosis factor-alpha is required for accumulation of dendritic cells in draining lymph nodes and for optimal contact sensitization. *Immunology* 84:31-35.
217. Zanella, M. 1996. Epidermale Langerhanszellen als Initiatorzellen für antimikrobielle Immunantworten: Einflub von proinflammatorischen Zytokinen und Bakterienprodukten auf die Migration von murinen Langerhanszellen. 1 p.
218. Moodycliffe, A. M., I. Kimber, and M. Norval. 1992. The effect of ultraviolet B irradiation and urocanic acid isomers on dendritic cell migration. *Immunology* 77:394-399.
219. Cumberbatch, M., R. C. Scott, D. A. Basketter, R. J. Dearman, and I. Kimber. 1993. Influence of sodium lauryl sulphate on 2,4-dinitrochlorobenzene-induced lymph node activation. *Toxicology* 77:181
220. Schwarzenberger, K. and M. C. Udey. 1996. In situ modulation of Langerhans cell E-cadherin expression by contact allergens and proinflammatory cytokines. *J. Invest. Dermatol.* (In Press)
221. Gabrilovich, D. I., G. M. Woods, S. Patterson, J. J. Harvey, and S. C. Knight. 1994. Retrovirus-induced immunosuppression via blocking of dendritic cell migration and down-regulation of adhesion molecules. *Immunology* 82:82-87.
222. Gunthert, U., M. Hofmann, and W. Rudy. 1991. A new variant of glycoprotein CD44 confers metastatic potential to rat carcinoma cells. *Cell* 65:13
223. Le Varlet, B., C. Dezutter-Dambuyant, M. J. Staquet, P. Delorme, and D. Schmitt. 1991. Human epidermal Langerhans cells express integrins of the b1 subfamily. *J. Invest. Dermatol.* 96:518-522.
224. Le Varlet, B., M. J. Staquet, C. Dezutter-Dambuyant, P. Delorme, and D. Schmitt. 1992. In vitro adhesion of human epidermal Langerhans cells to laminin and fibronectin occurs through b1 integrin receptors. *J. Leukocyte Biol.* 51:415-420.
225. Price, A., I. Kimber, and A. Ager. 1995. The expression of VLA-4 and VLA-6 by Langerhans cells:their potential role in regulating Langerhans cell migration. *J. Invest. Dermatol.* 105:869(Abstr.)
226. Berg, E. L., M. K. Robinson, O. Mannson, E. C. Butcher, and J. Magnani. 1991. A carbohydrate domain common to both sialyl Le and sialyl Lewis X is recognized by the endothelial cell leukocyte molecule ELAM-1. *J. Biol. Chem.* 266:14869
227. Larkin, M., T. J. Athern, M. S. Stoll, M. Shaffer, D. Sako, J. O'Brian, C. T. Yuen, A. M. Lawson, R. A. Childs, K. M. Barone, P. R. Langer-Safer, A. Hasegawa, M. Kiso, G. R. Larsen, and T. Feizi. 1992. Spectrum of sialylated and non sialylated fuco-oligosaccharides bound by the endothelial leukocyte adhesion molecule E-Selectin. *J. Biol. Chem.* 267:13661
228. Philips, M. L., E. Nudelman, F. C. A. Gaeta, M. Perez, A. K. Singhal, S. Hakomori, and J. C. Paulson. 1990. ELAM-1 mediates cell adhesion by recognition of a carbohydrate ligand, sialyl Lewis x. *Science* 250:1130
229. Yasaka, N., K. Nakamura, M. Furue, and K. Tamaki. 1995. Expression of cutaneous lymphocyte-associated antigen on human Langerhans cells. *J. Invest. Dermatol.* 105:865(Abstr.)
230. Symington, F. W., E. H. Holmes, and B. E. Symington. 1992. Human epidermal keratinocyte expression of sialyl-Lewis X. *J. Invest. Dermatol.* 99:601-607.
231. Kobayashi, Y., M.-J. Staquet, C. Dezutter-Dambuyant, and D. Schmitt. 1994. Development of motility of Langerhans cell through extracellular matrix by *in vitro* hapten contact. *Eur. J. Immunol.* 24:2254-2257.

232. Sozzani, S., F. Sallusto, W. Luini, D. Zhou, L. Piemonti, P. Allavena, J. van Damme, S. Valitutti, A. Lanzavecchia, and A. Mantovani. 1995. Migration of dendritic cells in response to formyl peptides, C5a, and a distinct set of chemokines. *J. Immunol.* 155:3292-3295.

