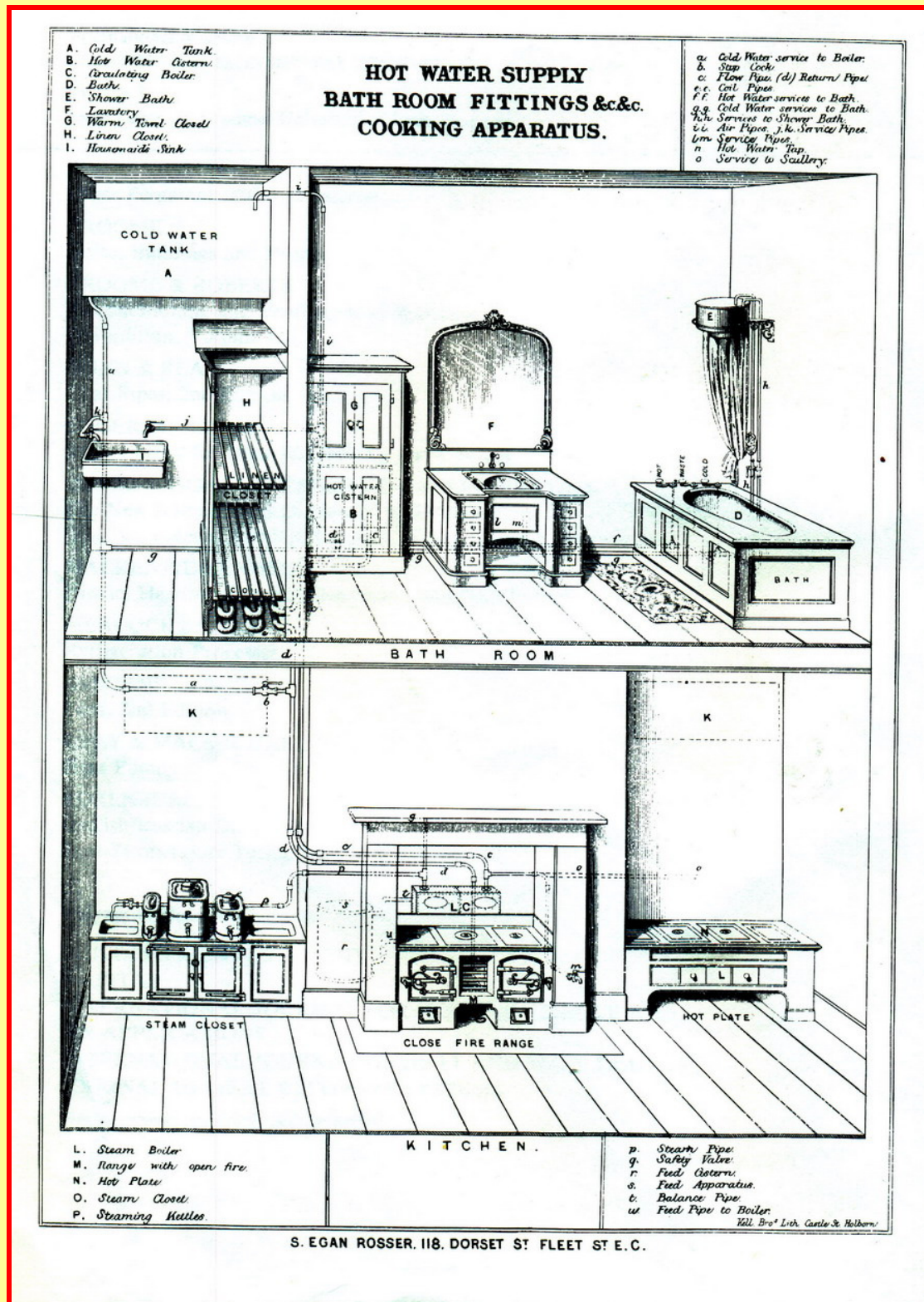


Chapter 1

HUMAN PHYSIOLOGY AND METABOLISM





Thermal comfort studies (Courtesy CIBS).

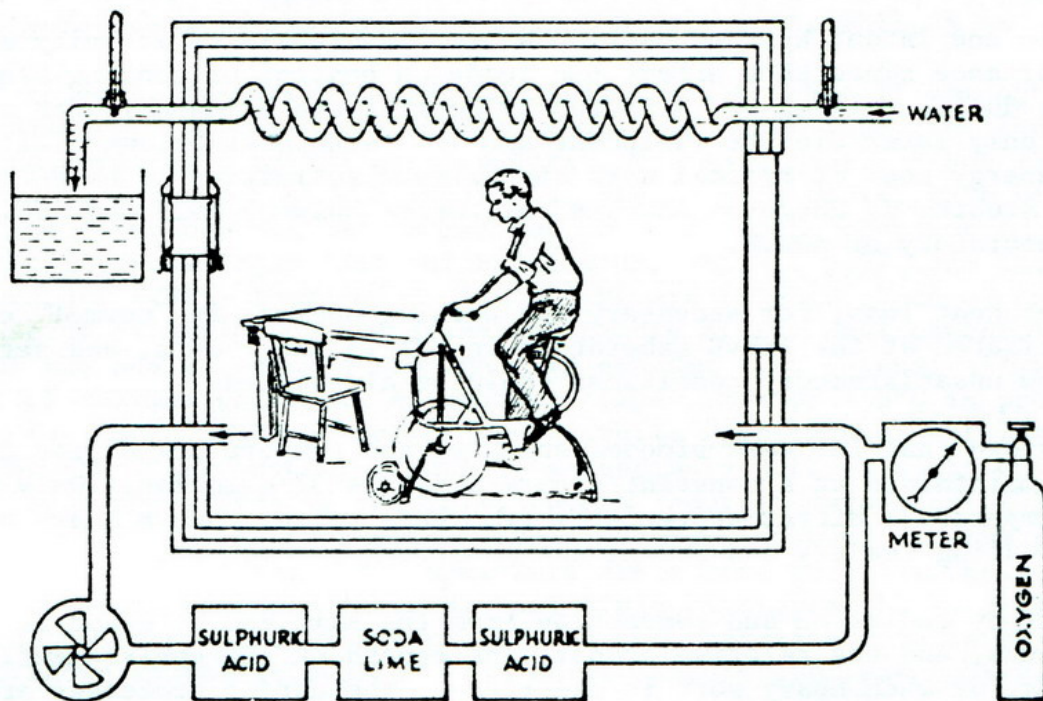


Fig. 1.1. The Atwater Human Calorimeter (1899).⁽⁹⁾
(Courtesy Durnin and Passmore.)

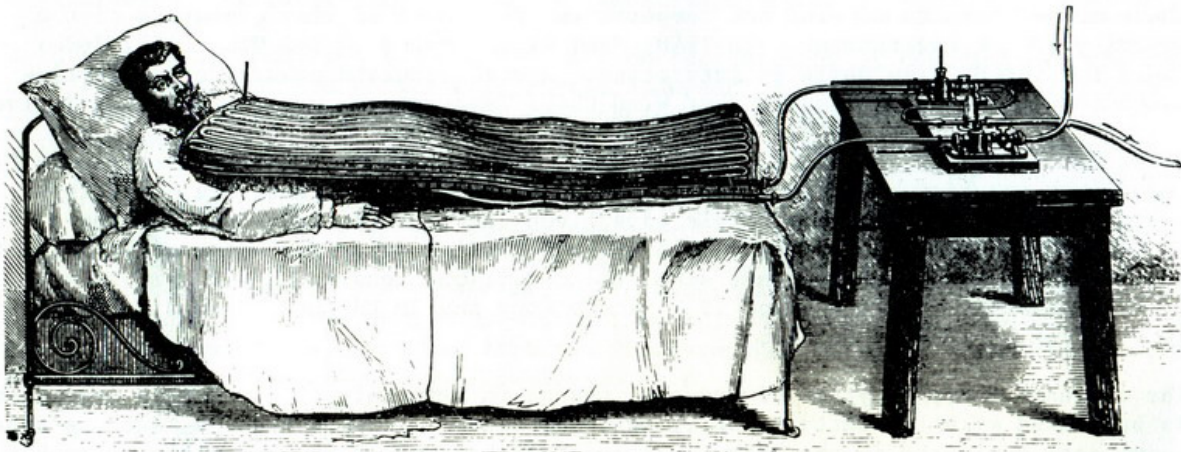


Fig. 1.2 Water-cooled Refrigerating Blanket (1879)⁽¹⁹⁾
(de Vries, *Victorian Inventions*).

REFERENCES

1. ASHAE: Guide 1956.
2. ASHRAE: Guide 1972.
3. Barker, A. H. (1912) *Heating*, Caxton Press, London.
4. Bedford, T. (1948) *Basic Principles of Heating and Ventilation*, Lewis, London.
5. Bernal, J. (1969) *Science in History*, Pelican Books.
6. Box, T. (1868) *Practical Treatise on Heat*, Spon, London.
7. Burns, R. S. (1850) *Practical Ventilation*, Blackwood, London.
8. De Chaumont, F. S. B. F. (1875) *Lectures on State Medicine*, Smith, Elda, London.
9. Durnin, J. V. and Passmore, R. (1967) *Energy, Work and Leisure*, Heinemann, London.
10. Fox, *et al.* (1973) Body temperatures in the elderly, *Brit. Med. J.*, (1) 200.
11. General Board of Health (1857) Report by Commissioners appointed to enquire into the warming and ventilation of dwellings, HMSO, London.
12. Hood, C. (1844) *Practical Treatise on Warming by Hot Water*, Whittaker, London.
13. Kollmar, A. and Liese, W. (1957) *Die Strahlungsheizung*, Oldenbourg, Munich.
14. McArdle, B. *et al.* (1947) Prediction of physiological effects of warm and hot environment, MRC Royal Naval Rep. No. 47.
15. Macpherson, R. K. (compiler) (1960) Physiological responses to hot environments, MRC Sp. Rep. 298, HMSO, London.
16. Péclét, E. (1861) *Traité de la chaleur* (3rd Ed.), Masson, Paris.
17. Playfair, J. (1822) *Works of John Playfair*, Vol. II, Constable, Edinburgh.
18. Thévenot, R. (1979) *History of refrigeration*, Inst. Inter. Refrig., Paris.
19. L. de Vries (ed.) *Victorian Inventions*, John Murray.

Chapter 2

HUMAN NEEDS AND COMFORT

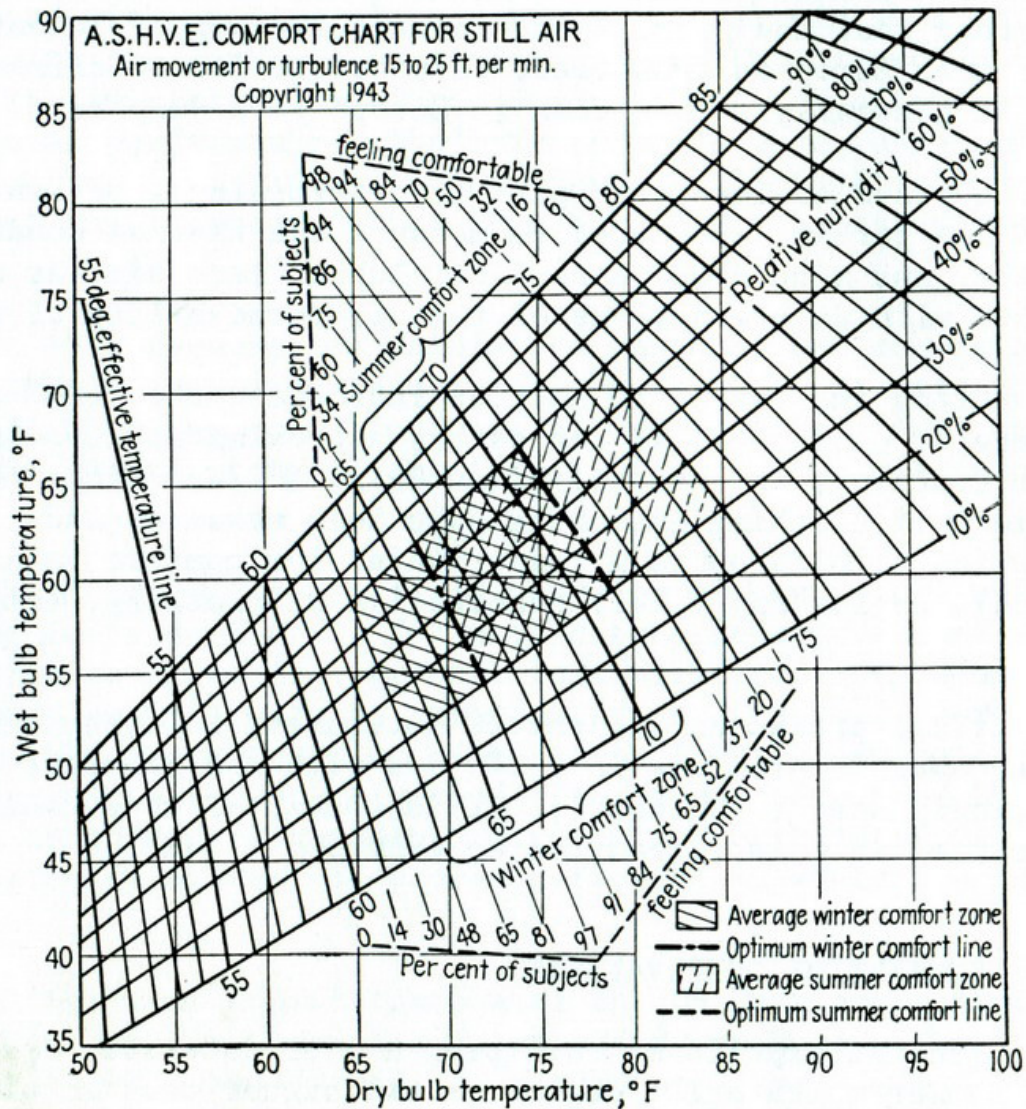


Fig. 2.1. ASHVE Comfort Chart for Still Air (Courtesy of ASHVE).

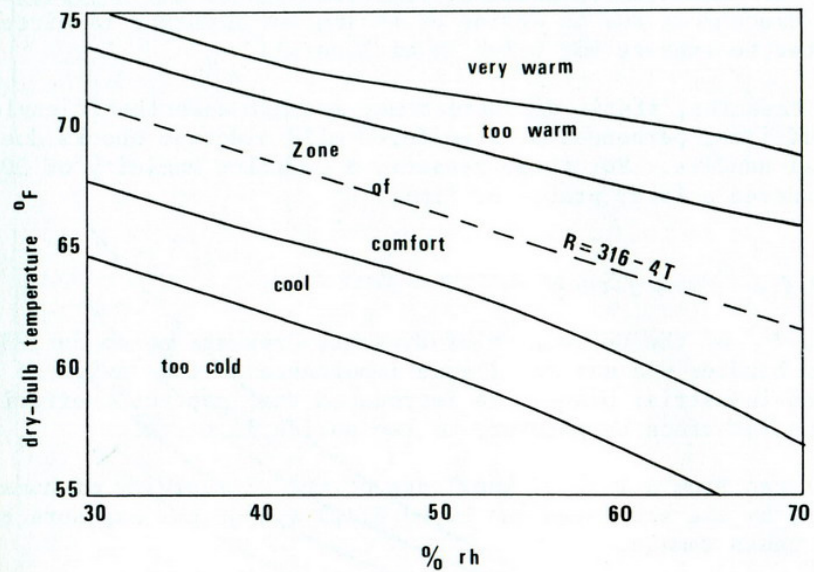


Fig. 2.2. Temperature-Humidity Chart plotted from J. W. Shepherd's Tests in the Experimental Room at Chicago Normal College, by Dr. E. V. Hill.⁽¹⁵⁾

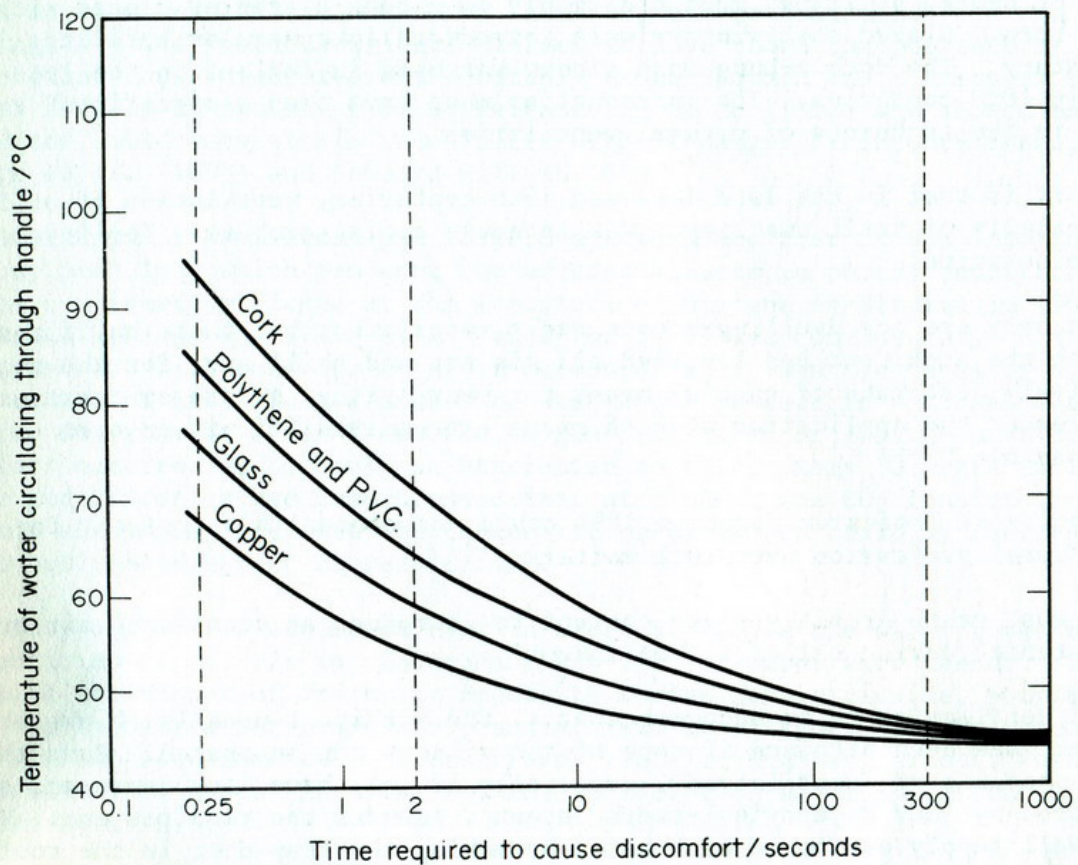


Fig. 2.3. The Relationship between Time and Temperature to Cause Discomfort in Adults Holding a Heated Handle. (Courtesy, B.S.I.)

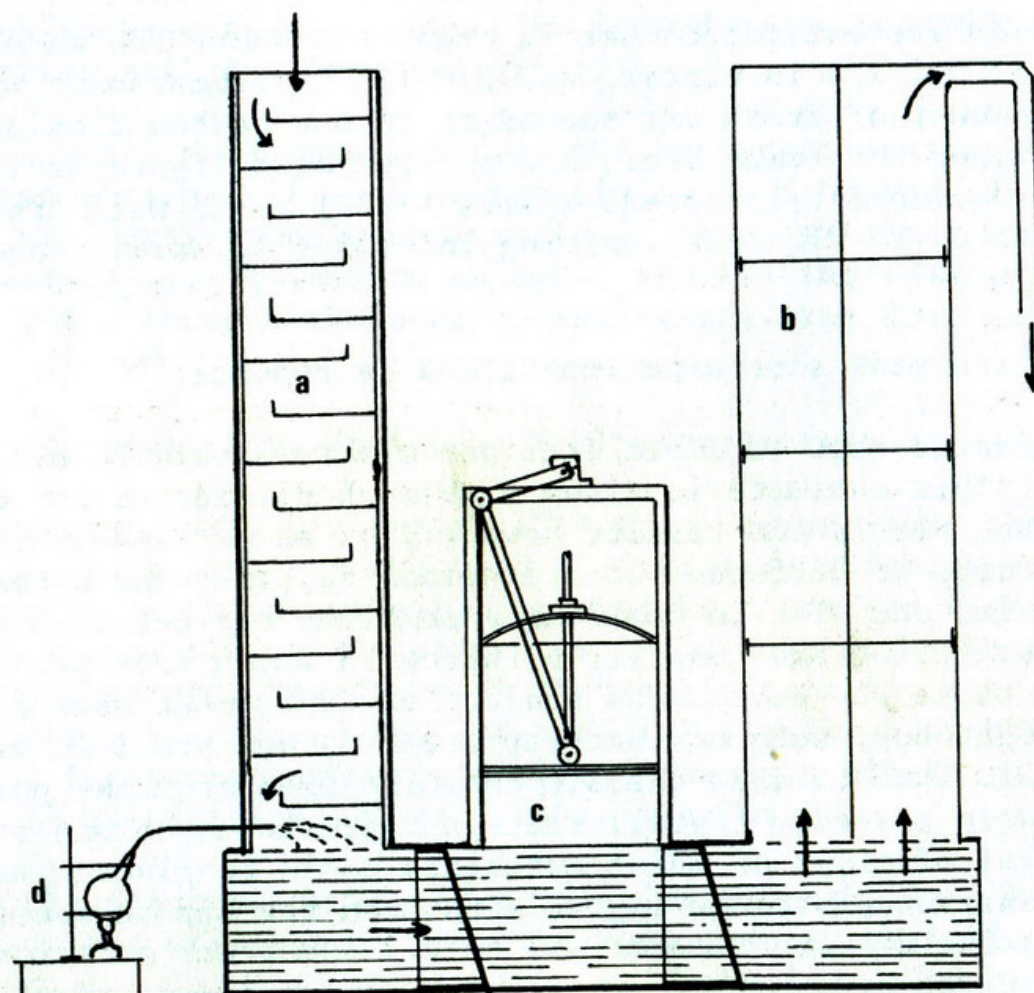


Fig. 2.4. Reid's Apparatus for Ventilation Trials.
(a) drying chamber
(b) glass chamber in which subjects sat
(c) pump
(d) flask for additives if required .

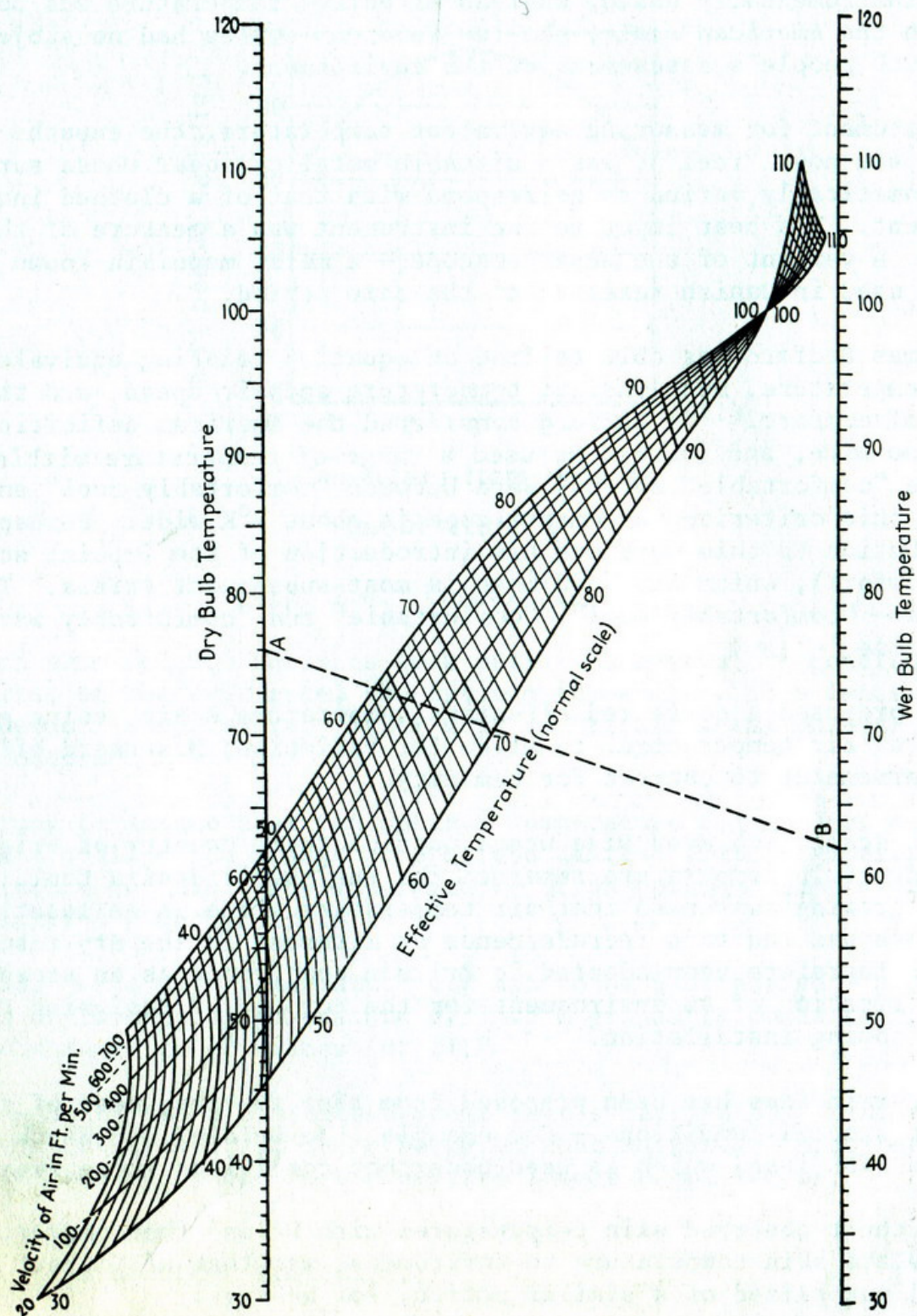


Fig. 2.5. Effective Temperature Chart (Courtesy of ASHVE)

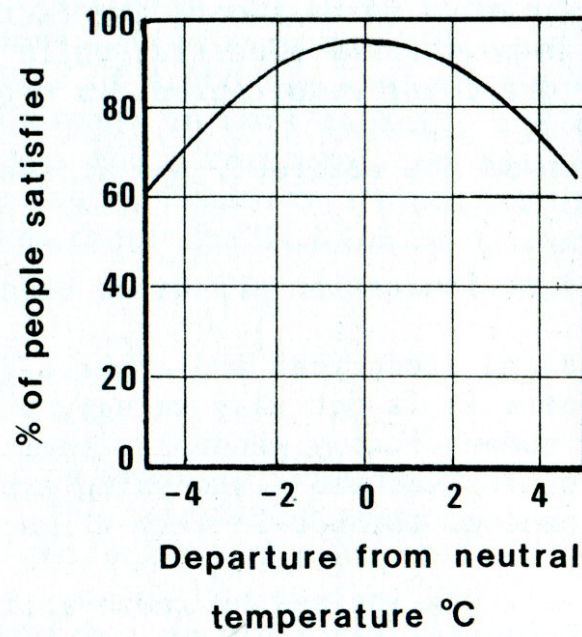


Fig. 2.6. Comfort Zone.



Fig. 2.7. Noise-measuring Truck of the City of New York, 1929. It was employed in observing and recording "noise levels" at one hundred and thirty-eight positions in the city.⁽³¹⁾

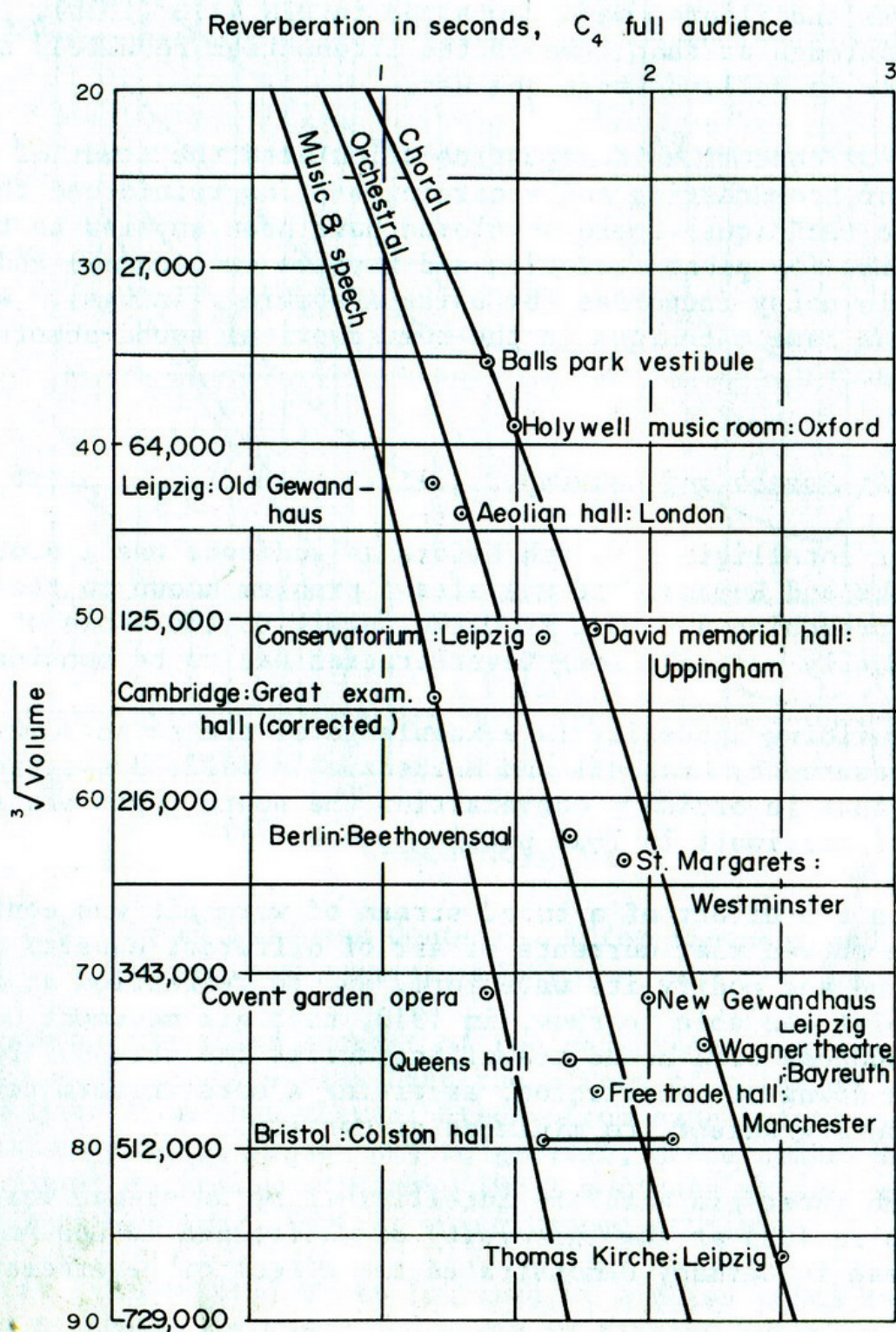


Fig. 2.8. Reverberation Values for Halls
Acknowledged Good for Musical Tone.⁽¹²⁾
(Courtesy, Methuen)

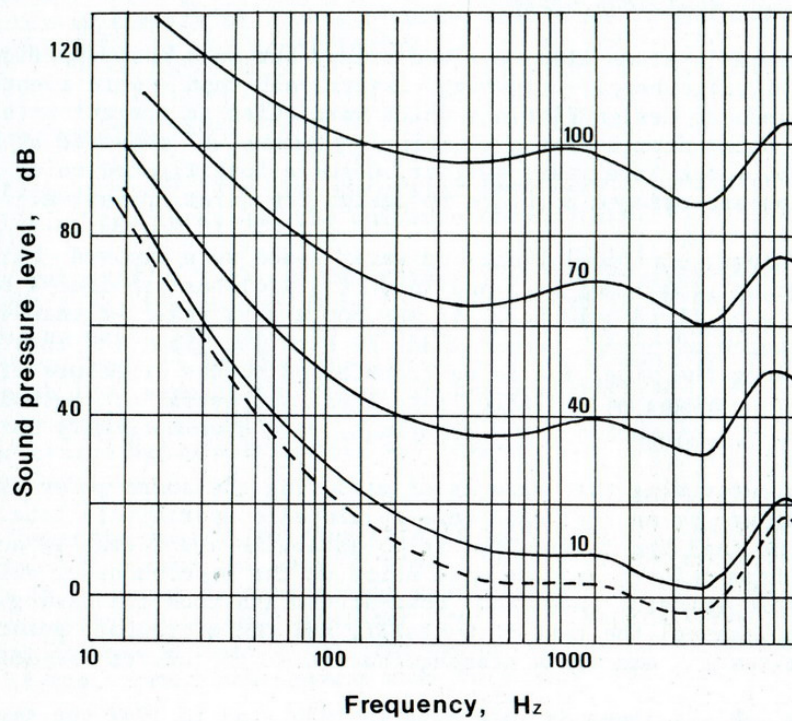


Fig. 2.9. Equal Loudness Contours, after Fletcher and Munson. (Courtesy, CIBS)



Fig. 2.10. View of Wolverhampton, Staffordshire in 1866, on the edge of the 'Black Country', the iron and steel district.

REFERENCES

1. Anon (1842) Heating, Ventilation, Lighting: Chambers' Information for the People, No. 92, Edinburgh.
2. Anon (1966) *Sound and Hearing*, Time-Life Books.
3. Adams, H. C. (1923) *Domestic Sanitation and House Drainage*, Hodder and Stoughton, London.
4. Angus, T. (1968) *Control of Indoor Climate*, Pergamon.
5. Arnott, N. (1838) *On Warming and Ventilating*, Longman, London.
6. Arnott, N. (1829) *Elements of Physics* (4th Ed.), Longman, London.
7. Thompson, N. S. (1912), *Mechanical Equipment of Federal Buildings*, David Williams, New York.
8. ASHVE: Guide 1922.
9. ASHAE: Guide 1956.
10. ASHAE: Guide 1962.
11. Babbitt, H. E. (1928) *Plumbing*, McGraw-Hill.
12. Bagenal, H. and Wood, A. (1931) *Planning for Good Acoustics*, Methuen.
13. Banham, R. (1969) *The Architecture of the Well-tempered Environment*, Arch. Press.
14. Barker, A. H. (1912) *Heating*, Caxton Press, London.
15. Barker, A. H. (1920) *Domestic Fuel Consumption*, Constable, London.
16. Bedford, T. (1948) *Basic Principles of Heating and Ventilation*, Lewis, London.
17. Bedford, T. (1936) Warmth factor in comfort at work, IHRB Report 76, HMSO, London.
18. Bedford, F. and Warner, C. G. (1939) Subjective impressions of freshness in relation to environmental conditions, *J.Hyg., Camb.* 39, 498.
19. Bell, - (1908) Physiological basis of illumination, *Illum. Engr. Lond.* 1, 329, 414, 507.
20. Bennett, S. B. (1910) *Manual of technical plumbing and sanitary science*, Batsford.
21. Billings, J. S. (1884) *Principles of Heating and Ventilating*, Kegan Paul, New York.
22. Blazier, W. E. (1967) A field measurement study of the sound level produced by residential air conditioning equipment, *J.ASHRAE* 9, 5.
23. Box, T. (1868) *Practical treatise on heat*, Spon, London.
24. Brundrett, G. (1975) Ventilation requirements for smokers: ECRC Report M870, Electricity Council.
25. Carnelly, T., Haldane, J. S. and Anderson, A. M. (1887) Carbonic acid, organic matter and micro-organisms in air, *Phil.Trans. B*, 178, 61.
26. Casney, W. H. (1908/9) Warming and ventilating, *Proc.IHVE* 9, p. 31.
27. Chadwick, E. (1842) *Report on the sanitary conditions of the labouring population of Great Britain*, Reprinted Edinburgh U.P., 1965.

28. Chrenko, F. A. (1953) Heated ceilings and comfort, *JIHVE* 20, 375.
29. Clark, J. (1924) *Lighting in Relation to Public Health*, Williams and Wilkins, Baltimore.
30. Constantine, J. (1881) *Practical Ventilation and Warming*, Churchill, London.
31. Croome, D. (1977) *Noise, Buildings and People*, Pergamon.
32. Croome, D. and Roberts, B. M. (1975) *Air Conditioning and Ventilation of Buildings*, Pergamon.
33. Debesson, G. (1908) *Le chauffage des habitations*, Dunod, Paris.
34. Dufton, A. F. (1932) Radiant heat, *Proc. IHVE* 31, 228.
35. Dufton, A. F. (1932) Equivalent temperature, *Building Research Tech. Paper* 13, HMSO.
36. Dufton, A. F. (1937) The air we breathe, *JIHVE* 5 (53), 200.
37. Dufton, A. F. and Fishenden, M. (1929/30) Heating research at Watford, *Proc. IHVE* 28, 98.
38. Edwards, T. (1890) *Ventilation and Heating*, Longman.
39. Egerton Committee (1945) *Heating and ventilation of dwellings*; Post-War Building Studies No. 19, HMSO, London.
40. Fanger, P. O. (1970) *Thermal Comfort*, Danish Technical Press, Copenhagen.
41. Fanger, P. O. (1977) Can colour and noise influence man's thermal comfort? *Ergonomics*, 20 (1), 11.
42. Fishenden, M. and Willgress -. (1925) Heating of rooms, *Fuel Res. Tech. Paper* 12, HMSO.
43. Fletcher, B. F. and Fletcher, H. P. (1911) *Architectural Hygiene*, Whittaker.
44. General Board of Health (1857) *Report by Commissioners appointed to enquire into the warming and ventilation of dwellings*, HMSO, London.
45. Guhl. E. and Koner, W. (1881) *The life of the Greeks and Romans*, Chatto and Windus.
46. Haldane, J. S. (1905) The influence of high air temperatures, *J.Hyg.Camb.* 5, 495.
47. v d Held, E. F. M. (1942) Burnt fingers and cold feet, *Schweiz. Bl. f.Heiz. Lüft.* 9 (1), 18.
48. Hickish, D. (1955) Thermal sensations of workers in light industries in summer, *J.Hyg.Camb.* 53, 112.
49. Hill, L. (1919) Science of ventilation and open air treatment, Part I, *MRC Spec.Rep.* 32. HMSO.
50. Hill, L. (1920) *ibid.*, Part II, *MRC Spec.Rep.* 52. HMSO.
51. Hill, L. (1914) Report on ventilation and the effect of open air and wind on respiratory metabolism, *Local Govt. Bd. Publ. Health, Rep.* 100.
52. Hopkinson, R. G. (1975) Lighting - art. in *Encycl. Britt.*
53. Hopkinson, R. G. (1975) Paper to PSA Conference, 1975.
54. Hopkinson, R. G. and Collins, J. (1970) *Ergonomics of Lighting*, Macdonald.
55. Houghton, F. C. and Yagloglou, C. P. (1923) Determining lines of equal comfort, *Trans.ASHVE* 21, 163,
56. Humphreys, M. (1978) Outdoor temperatures and comfort indoors, *BRE Current Paper CP53/78*, HMSO.
57. Klauss, A. K., Roots, L. M., Tull, R. H. and Pfafflin, J. R. (1970) History of the changing concepts in ventilation requirements, *J.ASHRAE* 12, 6.
58. Lawrence, J. C. and Bull, J. P. (1976) *Thermal conditions which cause skin burns*, Symposium, I. Mech.Eng., March.
59. Luckeish, M. (1926) A half-century of artificial lighting, *Ind.Eng Chem.* 18 (9), 920.
60. Lythgoe, R. J. (1932) Measurement of visual acuity, *MRC Sp.Rep.* 173.
61. Macpherson, R. K. (compiler) (1960) *Physiological responses to hot environment*, *MRC Sp.Rep.* 298, HMSO, London.
62. Missenard, F. (1933) *Etude physiologique et technique de la ventilation*, Paris.
63. Munro, A. F. and Chrenko, F. A. (1949) Effect of radiation from surroundings on subjective impressions of freshness, *J.Hyg.,Camb.* 47, 288.

64. Parkin, P. H. and Humphreys, H. R. (1958) *Acoustics Noise and Buildings*, Faber & Faber.
65. Pavlukhin, L. V. (1969) Economic and social effectiveness of air conditioning, *Vodnosnabzhenie i Sanitarnaya Tekhnika*, 8, 12.
66. Pécllet, E. (1861). *Traité de la chaleur*, (3rd Ed.), Masson, Paris.
67. Picard, Ph. (1897) *Chauffage et ventilation*, Baudry, Paris.
68. Raynes, F. W. (1913) *Heating Systems*, Longman Green, London.
69. Reid, D. B. (1844) *Illustrations of Ventilation*, Longman Green, London.
70. Reinders, H. (1964) *Beitrag zur Klärung der Einflüsse elektrische Gleichstromfelder auf die Gestaltung der Raumluft* (privately published).
71. Rietschel, H. (1911) *Traité théorique et pratique de chauffage et de ventilation*, Béranger, Paris.
72. Rothlisberger, J. F. (1942) *The Hawthorne Experiment*, Harvard U.P.
73. Rydberg, J. and Nörback, P. (1949) Air distribution and draft, *Trans.ASHVE* 55, 225.
74. Sabine, W. C. (1927) *Collected Papers on Acoustics*, Harvard U.P.
75. Scott, -. (1908) Sacrifice of the eyes of school children, *Illum.Engr., Lond.* 1, 64.
76. Strock, C. and Koral, R. L. (1965) *Handbook of Air Conditioning Heating and Ventilating*, Industrial Press, New York.
77. Sturtevant, B. F. and Co. (1906) *Ventilation and Heating* (catalogue) (6th Ed.), The company, Boston.
78. Thomas, J. W. (1903) *Ventilation, Heating etc. of Churches and Public Buildings*, Longman Green, London.
79. Thomas, J. W. (1906) *Ventilation, Heating and Lighting of Dwellings*, Longman Green, London.
80. Tomlinson, C. (1850) *Rudimentary Treatise on Warming and Ventilation*, Weale, London.
81. Tredgold, T. (1824) *Principles of Warming and Ventilating*, Archway Lib, London.
82. Trotter, A. (1921) *Elements of Illuminating Engineering*, Pitman, London.
83. Vernon, H. M. (1928) Methods of heating and ventilation in schools and their influence on health, *Proc.IHVE* 27, 146.
84. Vernon, H. M. (1932) Measurement, in relation to human comfort, of radiation produced by various heating systems, *Proc.IHVE* 31, 160.
85. Vernon, H. M., Bedford, T. and Warner, C. G. (1926) Physiological study of ventilation and heating in certain factories, IFRB Rep.35.HMSO.
86. Vernon, H. M., Bedford, T. and Warner, C. G. (1927) Relation of atmospheric conditions to working capacity and accident rates of miners, IFRB Rep.39.HMSO.
87. Vernon, H. M., Bedford, T. and Warner, C. G. (1926) Influence of cooling power on sensation of air movement, MRC. Sp.Rep.100.HMSO.
88. Vernon, H. M., Vernon, M. D. and Lorraine-Smith, J. (1928) A physiological study of radiant heating in various buildings, IFRB Rep.46.HMSO.
89. Vernon, H. M. and Warner, C. G. (1932) Influence of humidity of air on capacity for work at high temperatures, *J.Hyg.Camb.* 32, 431.
90. Waldram, J. (1972) A review of lighting progress, *Ltg.Res.Tech.* 4 (3), 129.
91. Weston, H. C. (1949) *Sight, Light and Efficiency*, Lewis, London.
92. Yates, W. (1902) Mechanical ventilation, *Proc.IHVE* 3, 6.
93. Yaglou, C. P., Riley, E. C. and Coggins, D. I. (1936) Ventilation requirements, *Trans.ASHVE* 42, 133.
94. Bell, L. (1903), *The Art of Illumination*, Constable.
95. Albrechtsen, O. (1979), *The Effect of Electric Fields on Mental Work*, Danish Building Research Institute.
96. Langkilde, G. (1979), *Influence of thermal environment on office work*, Danish Building Research Institute.
97. Madsen, T. L. and Saxhof, B. (1979), Proc. XVth International Congress of Refrigeration.