REFERENCES

Adorjan, A.S., and G.B. Kolenosky. 1969. *A manual for the identification of hairs of selected Ontario mammals.* Res. Report (Wildlife) No. 90. Dept. Lands and Forests: Ontario.

Appleyard, H.M. 1960. *Guide to the identification of animal fibres.* Wool Industries Research Association: Leeds.

Barker, D.J.P. 1973. *Practical Epidemiology.* Churchill Livingstone: Edinburgh. 168 pp.

Bartholomew, G.A., and F. Wilke. 1956. Body temperature in the northern fur seal, *Callorhinus ursinus. J. Mammal.* 37(3): 327-37.

Benedict, F.A. 1957. Hair structure as a generic character in bats. *Univ. Calif. Pubs. Zool.* 59: 285-548.

Bonsma, J.C., and A.J. Pretorius. 1943. The influence of colour and coat cover on adaptability of cattle. *Fmg. S. Afr.* 18: 101-104.

Bonsma, J.C. 1949. Breeding cattle for increased adaptability to tropical and sub-tropical environments. *J. Agric. Sci.* Camb. 39: 204-221.

Bonsma, J.C., and G.N. Louw. 1963. Heat as a limiting factor in animal production. *Biometeorology* 2: 371-382.

Brunner, H., and B.J. Coman. 1974. *The identification of mammalian hair.* Inkata Press: Hong Kong. 176 pp.

Cena, K., and J.A. Clark. 1973. Thermographic measurements of the surface temperature of animals. *J. Mammal.* 54: 1003-1007.

Cena, K., and J.L. Monteith. 1975. Transfer processes in Animal coats I, II, and III. *Proc. R. Soc. Lond. B.* 188: 377-392, 395-411, 413-423.

Clark, J.A. 1976. Energy transfer and surface temperature over plants and animals. *In: Light as an ecological factor: II.* 16th Symposium of the British Ecological Society. Eds. G.C. Evans, R. Bainbride and O. Racham. Blackwell Scientific Publications: Oxford.

Cooper, R.L., and J.D. Skinner. 1979. Importance of termites in the diet of aardwolf (*Proteles cristatus*) in South Africa. *S. Afr. J. Zool.* (in press).

Crompton, A.W., C.R. Taylor and J.A. Jagger. 1978. Evolution of Homeothermy in mammals. *Nature* Lond. 272: 333-336.

Danforth, C. 1925. Hair in its relation to questions of Homology and Phylogeny. *Am. J. Anat.* 36: 47-68.

Danforth, C.H. 1939. Physiology of human hair. *Physiol. Rev.* 19: 94-111.

Davis, D.H.S. 1962. Distribution patterns of Southern African Muridae with notes on some of their fossil antecedents. *Ann. Cape Prov. Mus. II. South Africa:* 56-76.

Dawson, T.J. 1972. Thermoregulation in Australian desert Kangaroos. *Symp. zool. Soc. Lond.* 31: 133-146.

Day, M.G. 1966. Identification of hair and feather remains in the gut and faeces of stoats and weasels. *J. Zool.* Lond. 148: 201-217.

Dearborn, N. 1939. Sections aid in identifying hair. *J. Mammal.* 20: 346-348.

De Boom, H.P.A., and J.H. Dreyer. 1953. Identifying hair from South African game for forensic purposes. *S. Afr. J. Sci.* 49(F): 233-234.

De Meijere, J.C.H. 1894. Uber die Haare der Saugetiere besonders ueber ihre Anordnung. *Gegenbaur's Morphol. Jahrb.* 21: 312-424.

Dorst, J., and P. Dandelot. 1970. *A field guide to the larger Mammals of Africa.* Collins: London. 287 pp.

Dowling, D.F. 1959. The medullation characteristic of the hair coat as a factor in heat tolerance of cattle. *Aust. J. agric. Res.* 10: 736-743.

Dreyer, J.H. 1966. A study of hair morphology in the family Bovidae. *Onderstepoort J. vet. Res.* 1966: 379-472.

Elton, C. 1927. *Animal Ecology.* Methuen: London.

Ewer, R.F. 1974. *The Carnivores.* Weidenfeld and Nicholson: London.

Finch, V.A. 1972. Energy exchanges with the environment of two East African antelopes, the eland and the hartebeest. *Symp. zool. soc. Lond.* 31: 315-326.

Finch, V.A., and D. Western. 1977. Cattle colors in pastoral herds: Natural selection or social preference? *Ecology* 58: 1384-1392.

Ford, J.E., and S.C. Simmens. 1959. Fibre section cutting by the plate method. *J. Text. Inst. Proc.* 50: 496-526.

Fourie, K. 1938. The endemic focus of plague. *S. Afr. med. J.* 12: 352-358.

Gentry, R.L. 1972. *Thermoregulatory Behaviour of Eared Seals.* University

Green, C.A., D.H. Gordon and N.F. Lyons. 1978. Biological species in *Praomys* (*Mastomys*) *natalensis* (Smith), a rodent carrier of Lassa virus and Bubonic plague in Africa. *Am. J. Trop. Med. Hyg.* 27: 627-629.

Guiler, E.R. 1953. Distribution of the brush possom in Tasmania. *Nature* Lond. 172: 1091-1093.

Guiler, E.R., and D.M. Banks. 1958. A further examination of the distribution of the brush possum, *Trichosurus vulpecula*, in Tasmania. *Ecology* 39: No.1, 89-97.

Hallet, J.M. 1977. Cytological and Cytogenetical studies on the multimammate mouse *Praomys* (*Mastomys*) *natalensis*. M.Sc. Thesis, University of the Witwatersrand, South Africa.

Hammel, H.T. 1956. Infrared emissivities of some arctic fauna. *J. Mammal.* 37: 375-378.

Hashimoto, K., and S. Shibazaki. 1975. Ultrastructural study on differentiation and function of hair. *In: Biology and Disease of the Hair.* Eds. K. Toda, Y. Ishibashi, Y. Hori and F. Morikawa. University Park Press: Tokyo. 667 pp.

Harris, C.J. 1968. *Otters.* Weidenfeld and Nicholson: London.

Hausman, L.A. 1920. Structural characteristics of the hair of mammals. *Am. Nat.* 54: 496-523.

Hausman, L.A. 1920c. The microscopic identification of commercial fur hairs. *Sci. Monthly* 10: 70-78.

Hausman, L.A. 1924. Further studies of the structural characters of Mammalian hair. *Am. Nat. N.Y.* 58: 544-557.

Hausman, L.A. 1930. Recent studies of hair structure relationships. *Sci. Monthly* 30: 258-277.

Hutchinson, J.C.D., and G.D. Brown. 1969. Penetrance of cattle coats by radiation. *J. appl. Physiol.* 26 No. 4: 454-464.

Hutchinson, J.C.D., G.D. Brown and T.E. Allen. 1973. Effect of the coat on the heat dissipation of cattle in a radiant environment. 1st Aust. Conf. Heat and Mass Transfer. Sect. 3: 15-24 pp. Unpublished mimeograph.

Irving, L., and J.S. Hart. 1957. The metabolism and insulation of seals as bare-skinned mammals in cold water. *Can. J. Zool.* 35: 497-511.

Irving, L., L.J. Peyton, C.H. Bahn and R.S. Peterson. 1962. Regulation of temperature in fur seals. *Physiol. Zool.* 35: 275-284.

Johansen, K. 1962. Buoyancy and insulation in the muskrat. *J. Mammal.* 43: 64-67.

Keay, R.W.J. (ed). 1959. Vegetation map of Africa south of the tropic of Cancer. Oxford University press: London.

Keogh, H.J. 1975. A study of hair characteristics of forty-two species of South African Muridae and the taxonomic application of these characteristics as definitive criteria. M. Sc. thesis, University of Cape Town.

Khemelevskaya, N.V. 1965. Structure of the rodent hair cuticle, its variability and significance for taxonomy. *Zool. Zhur.* 40: 1064-1074.

Kovarik, M. 1964. Flow of heat in an irradiated protective cover. *Nature* Lond. 201: 1085-1087.

Ling, J.K. 1965a. Hair growth and moulting in the southern elephant seal, *Mirounga leonina* (Linn.). *In: Biology of the Skin and Hair Growth*, eds. A.G. Lyne and B.F. Short. Angus and Robertson: Sydney. 525-544 pp.

Ling, J.K. 1965b. Functional significance of sweat glands and sebaceous glands in seals. *Nature* Lond. 208: 560.

Ling, J.K., and C.D.B. Thomas. 1967. The skin and hair of the southern elephant seal, *Mirounga leonina* (Linn.). II. Pre-natal and early post-natal development and moulting. *Aust. J. Zool.* 15: 349-365.

Ling, J.K. 1968. The skin and hair of the southern elephant seal, *Mirounga leonina* (Linn.). III. Morphology of the adult integument. *Aust. J. Zool.* 16: 629-645.

Ling, J.K. 1969. A review of ecological factors affecting the annual cycle in island populations of seals. *Pac. Sci.* 23: 399-413.

Ling, J.K. 1970. Pelage and moulting in wild animals with special reference to acquatic forms. *Quar. Rev. Biol.* 45: 16-54.

Ling, J.K. 1972. Adaptive functions of vertebrate moulting cycles. *Am. Zoologist* 12: 77-93.

Lochte, T.H. 1938. *Atlas der Menschlichen und Tierichen Haare.* Paul Schops: Leipzig.

Lodmuller, L. 1924. Reconnaissance des poiles d'un certain nombres des mammifères. *Bull. Sci. Pharmac.* 10: 497-506, 567-581.

Lyne, A.G., and T.S.McMahon. 1951. Observations on the surface structure of the hairs of Tasmanian Monotremes and Marsupials. *Pap. and Proc. Roy. Soc. Tasmania 1950* (5th Dec. 1951): 71-84.

Lyne, A.G. 1959. The systematic and adaptive significance of the vibrissae in the Marsupiala. *Proc. Zool. Soc. Lond.* 133: 79-133.

Lyne, A.G., and B.F. Short. Ed. 1965. *Biology of the skin and hair growth.* Angus and Robertson: Sydney.

Lyne, A.G. 1966. The development of hair follicles. *Aust. J. Sci.* 28: 370-376.

Lyons, N.F., C.A. Green, D.H. Gordon and C.R. Walters. 1977(a) G-banding chromosome analysis of *Praomys natalensis* (Smith) (Rodentia : Muridae) from Rhodesia. 1. 36 chromosome population. *Heredity* 38: 197-200.

Lyons, N.F., C.A. Green, D.H. Gordon and C.R. Walters. 1979(b) G-banding chromosome analysis of *Praomys natalensis* (Smith) (Rodentia : Muridae) from Rhodesia. 2. 32 chromosome population. *Heredity* (in press).

Mathiak, H.A. 1938a. A rapid method of cross-sectioning hairs. *J. Wildl. Mgmt.* 2: 162-164.

Mathiak, H.A. 1938b. Key to mammalian hairs found in faeces. *J. Wildl. Mgmt.* 2: 251-268.

Matoltsy, A.G. 1953. A study of the medullary cells of the hair. *Exp. Cell Res.* 5: 98-110.

Maxwell, G. 1961. The lives and times of Mij and Edal. *Nat. Hist. N.Y.* 70 No.3: 50-61.

Mayer, W.V. 1952. The hair of Californian mammals with keys to the dorsal guard hairs of Californian mammals. *Am. Midl. Nat.* 48: 480-512.

Meester, J., D.H.S. Davis and C.G. Coetzee. 1964. An Interim Classification of South African Mammals. Zool. soc. sth. Afr. & C.S.I.R. Pretoria. Mimeograph.

Meester, J., and H. Setzer (Ed.). 1971. *The Mammals of Africa: an identification manual.* The Smithsonian Institution: Washington DC.

Mitchell, D. 1974. Physical basis of thermoregulation. International review of Science. Physiology series, vol. 7. *Environmental Physiology.* Ed. D. Robertshaw. Butterworths: London.

Mitchell, D. 1977. Physical basis of thermoregulation. International review of physiology. *Environmental Physiology II,* vol. 15. Ed. Robertshaw. University Park Press: Baltimore.

Montagna, W. 1962. *The structure and function of skin.* 2nd Ed. Academic Press: New York.

Montagna, W., and R.A. Ellis (Ed.). 1958. *The Biology of Hair Growth.* Academic Press: New York.

Montagna, W., and R.L. Dobson. 1969. *Advances in Biology of Skin.* Vol. IX Hair Growth. Pergamon Press: Oxford.

Moreau, R.E. 1952. Africa since the mesozoic: with particular reference to certain biological problems. *Proc. zool. Soc. Lond.* 121: 869-913.

Mortimer, M.A.E. 1963. Notes on the biology and behaviour of the spotted-necked otter *(Lutra maculicollis). Puku* 1: 192-206.

Mutchler, J.P., J. Menkart and A.M. Schwartz. 1969. Rapid estimation of critical surface tension of fibres. *Advan. Chem. Ser.* 86: 7-14

Nel, J.A.J., and I.L. Rautenbach. 1977. Body temperature of some Kalahari rodents (Mammalia : Muridae, Cricetidae). *Anns. Tvl. Museum* 17: 206-210.

Noback, C.R. 1951. Morphology & phylogeny of hair. *Ann. N.Y. Acad. Sci*, 53: 476-492.

Ohata, C.A., and L.K. Miller. 1977. Some temperature responses of northern fur seal (*Callorhinus ursinus*) Pups. *J. Mammal.* 48: 438-440.

Oritsland, N.A. 1971. Wavelength-dependent solar heating of harp seals (*Pagophilus groenlandicus*). *Comp. Biochem. Physiol.* 40A: 359-361.

Palmer, E., and G. Weddel. 1964. Biochemical and histological investigation of the skin of the dolphin (*Turciops*). *Proc. Zool. Soc. Lond.* 143: 553-567.

Portman, A. 1967. *A study of appearance of animals.* Translated by Hella Czech. Faber and Faber: London. 246 pp.

Pringle, J.A. 1977. The Distribution of Mammals in Natal. Part 2. Carnivora. *Ann. Natal Mus.* 23(1): 93-115.

Quay, W.B. 1965. Integumentary Modifications of North American Desert Rodents. *In: Biology of skin and hair growth.* Eds. A.G. Lyne and B.F. Short. Angus and Robertson: Sydney.

Ray, C., and F.H. Fay. 1968. Influence of climate on the distribution of walruses *Odobenus rosmarus* (Linnaeus). II. Evidence from

Rautenbach, I.L., and J.A.J. Nel. 1978. Co-existence in Transvaal Carnivora. *Bull. Carnegie Mus. Nat. Hist.* 6: 138-145.

Rautenbach, I.L. 1978. (See end of references).

Rhodin, J.A.G. 1974. *Histology : a text and atlas.* Oxford University Press: New York. 803 pp.

Riemerschmid, G. 1943a. The amount of solar radiation and its absorption on the hairy coat of cattle under South African and European conditions. *J. S. Afr. vet. med. Ass.* 14 No.4: 121-141.

Riemerschmid, G. 1943b. Some aspects of solar radiation in relation to cattle in South Africa and Europe. *Onderstepoort vet. J.* 18 (1 and 2): 327-353.

Riemerschmid, G., and J.S. Elder. 1945. The absorptivity for solar radiation of different coloured hairy coats of cattle. *Onderstepoort J. vet. Res.* 20: 223-23.

Roberts, A. 1951. *The Mammals of South Africa.* Central News Agency: Johannesburg. 700 pp.

Robinson, T.J. 1975. A comparative study of three sub-species of springbok *Antidorcas marsupialis marsupialis* Zimmerman (1780) *A.m. hofmeyri* Thomas (1926) and *A.m. angolensis* Blane 1922. M.Sc. Thesis, University of Pretoria, South Africa.

Rosevear, D.R. 1974. *The Carnivores of West Africa.* Trustees of the British Museum (Natural History): London.

Ryder, M.L. 1973. *Hair.* Institute of Biology. Camelot Press Ltd.: London and Southampton. 55 pp.

Scheffer, V.B., and A.M. Johnson. 1963. Molt in the Northern Fur Seal. United States Fish and Wildlife Service Special Scientific Report - Fisheries No. 450, Washington, D.C.

Schleger, A.V. 1962. Physiological attributes of coat colour in beef cattle. *Aust. J. agric. Res.* 13: 943-959.

Schmidt-Nielson, K. 1964. *Desert Animals. Physiological problems of heat and water.* Oxford University Press: New York. 277 pp.

Shortridge, G.C. 1934. *Mammals of South West Africa.* William Heineman: London, vol. I and II, 779 pp.

Skinner, J.D. 1976. Ecology of the Brown Hyaena *Hyaena brunnea* in the Transvaal with a distribution map for southern Africa. *S. Afr. J. Sci.* 72: 262-268.

Skinner, J.D. 1978. The striped hyaena *Hyaena hyaena* of the Judean and Negev deserts and a comparison with the brown hyaena *Hyaena brunnea.* *Israel J. Zool.* (in press).

Smith, H.M. 1958. The Phylogeny of hair and epidermal scales. *Turtox News* 36: 82-84.

Smith, H.M. 1960. *Evolution of chordate structure.* Holt, Richart and Winston: New York.

Smithers, R.H.N. 1971. *The Mammals of Botswana.* Museum Memoir No. 4 Trustees of National Museums of Rhodesia: Salisbury. 340 pp.

Smithers, R.H.N. 1978. The regal caracal. *Fauna and Flora* Pretoria 33: 6-7.

Smithers, R.H.N. 1978. The serval *Felis serval* Schreber, 1776. *S. Afr. J. Wildl. Res.* 8: 29-37.

Smithers, R.H.N. 1979. *The Carnovores of southern Africa.* (in press).

Soholov, W. 1960. The skin structure in Pinnipedia of the U.S.S.R. fauna. *J. Morphol.* 107: 285-296.

Soholov, W. 1962. Adaptations of the mammalian skin to the aquatic mode of life. *Nature* Lond. 195: 464-466.

Spearman, R.I.C. 1964. The evolution of mammalian keratinised structures. *Symp. Zool. Soc. Lond.* 12: 67-81.

Spence, L.E. Jr. 1963. Study of identifying characters of mammal hair. Wyoming game and fish job completion report No. FW-3-5-10. Unpublished mimeograph.

Stains, H.J. 1958. Field guide to guard hairs of Middle-Western Fur-bearers. *J. Wildl. Mgmt.* 2: 251-268.

Stoves, J.L. 1957. *Fibre microscopy.* National Trade Press: London.

Stutterheim, J.C. 1975. 'n Aftas elektronmikroskopiese ondersoek van die oppervlakstruktuur van die hare van die springbok *(Antidorcas marsupialis* Zimmerman). M.Sc. Thesis, Potchefstroom University, South Africa.

Toldt, von T. 1935. *Aufbau und natürliche Farbung des Haarkleides Wildsaugtiere.* D. Ges. Kleint: Berlin.

Trevor-Deutch, B. 1970. Hair morphology and its use in the identification of taxonomic groups. M.Sc. Thesis, McGill University: Canada.

Vogel, P., and F. Besancon. 1978. Hair structures and their taxonomic value *Chimarrogale* and *Nectogale* (Insectivora). Proceedings 2nd Congressus theriologicus internationalis. Brno. Czechoslovakia : 61.

Walker, D.R.G. 1972. Observations on a collection of weasels *(Mustela nivalis)* from estates in south-west Hertfordshire. *J. Zool. Lond.* 166: 474-480.

Wildman, A.B. 1954. *The microscopy of animal textile fibres.* Wool Industries Research Association: Leeds.

Williams, C.S. 1938. Aids to identification of mole and shrew hairs with general comments on hair structure and hair determination. *J. Wildl. Mgmt.* 2: 239-250.

Wrogemann, N. 1975. *Cheetah under the sun.* McGraw-Hill Book Company: Johannesburg. 159 pp.

Young, J.Z. 1962. *The Life of the Vertebrates.* 2nd Ed. Clarendon Press: Oxford. 820 pp.

Rautenbach, I.L. 1978. The Mammals of the Transvaal. Ph.D. Thesis, University of Natal.

APPENDIX

Some tests on textile properties of wild animal fibres

The results of tests carried out at the South African Wool and Textile Research Institute have been included, although after careful analysis they appear inconclusive.

The techniques used are outlined in the Material and Methods section of this work. Samples were selected from species which exhibited different hair shapes, and differences in the relative size of the cortex to the medulla, as well as exhibiting examples of various scale patterns.

Fibre breaking strength, fibre tenacity and breaking extension of hairs from thirteen species of Carnivores were tested

The results are listed in Table III.

There appears to be no relation between these physical properties and the size and shape of the hairs submitted. The relatively large cortex found in the hair of *Hyaena brunnea* may be a contributory factor to the high breaking strength and breaking extension of hairs of this species, as shown in Table III. Other parameters used for analysis all produced inconclusive results. The Table however is included in support of this, and for possible future interest to other workers.

Critical surface tension

The methods for this test are outlined in the Material and Methods section, and the results are refered to in the Discussion. Table IV is included to demonstrate that the tests used produced results showing

Table III. Textile properties of guard hairs of thirteen species of Carnivores

	FIBRE BREAKING STRENGTH (cN)	CV(%)	FIBRE TENACITY (cN/tex)	CV(%)	INITIAL MODULUS (cN/tex)	CV(%)	BREAKING EXTENSION (%)	CV(%)	DIAMETER OF FIBRE (µm)	DIAMETER OF MEDULLA (µm)	NO. OF FIBRES TESTED
Proteles cristatus	65,1	35,5	6,87	66,7	81	54,6	33,9	28,3	167	131	10
Hyaena brunnea	153,8	25,6	12,0	39,3	93	31,2	54,7	19,9	132	66	10
Crocuta crocuta	65,3	35,2	14,5	17,0	226	14,2	42,6	7,8	71	27,6	10
Acinonyx jubatus	34,3	46,3	13,9	34,4	240	25,7	38,5	12,9	62	38	10
Felis lybica	14,4	36,8	11,55	40.0	176	33,3	45,1	8,4	43	18,6	9
Lycaon pictus	45,7	20,8	13,7	15,8	210	17,6	42,1	11,2	60,7	21,7	10
Vulpes chama	22,0	36,4	13,8	33,9	209	42,7	47,4	8,1	53	32	10
Canis mesomelas	57,4	6,8	14,0	19,4	157	36,1	47,2	8,0	-	-	5
Aonyx capensis	21,2	14,2	7,1	29,0	130	51,7	45,5	9,2	62	29	10
*Lutra maculicollis**	-	-	-	-	-	-	-	-	-	-	0
Viverra civetta	38,5	26,0	6,05	47,0	79	49,1	43,4	11,2	135	107	10
Paracynictis selousi	46,9	24,1	8,38	46,1	132	39,2	37,4	15,7	105	89	10
Atilax paludinosis	134,9	17,9	23,4	39,1	267	36,2	44,8	13,5	111	79	10

Gauge length: 10 mm
Rate of extension: 10/min
Time of break: 25s
Pretension: 1% of breaking strength

*Fibres too short

very little difference in the critical surface tension of the hairs investigated, although there appears to be a large range in critical surface tension values. Variations in hair diameter within and between hairs from a particular species could account for this. The critical surface tension is generally dependent upon the solvent in which it is measured. In this particular case only non-polar solvents were used. Some preliminary tests on fibres, probably located closer to the skin of the animal, had a lower critical surface tension than the coarser fibres which had probably had a greater exposure to weathering. For wool it is known that the critical surface tension near the fibre tips is slightly higher than that measured near to the fibre root.

Table IV. Critical surface tension of guard hairs from thirteen species of Carnivores

Sample	Critical Surface Tension
Lutra maculicollis	28-36
Aonyx capensis	25-36
Atilax paludinosis	24-33
Crocuta crocuta	28-36
Hyaena brunnea	28-36
Proteles cristatus	28-36
Canis mesomelas	25-36
Vulpes chama	28-33
Paracynictis selousi	28-36
Viverra civetta	24-33
Acinonyx jubatus	28-36
Felis lybica	25-36
Lycaon pictus	28-36

ADDENDUM

The statement on page 157 that when transmission (or absorbtion) depends on wave-length, the energy transmitted can be represented graphically as a function of penetration by a curved line, can most easily be seen by taking the example of radiation consisting of two approximately equal components which are absorbed at a different extent. The curve drawn on the co-ordinates shown in Fig. 17 (page 159) will always have a slope which becomes less negative with penetration, i.e. the curve will be convex downwards. All furs reported by Cena and Monteith in the paper under reference show this trend. In no cases are the points representing their measurements a satisfactory fit to a straight line. Those on the Clun Forest sheep appear to lie on a well defined curve which is a clear departure from a straight line. This has been chosen by way of example only for comparison with the results of a calculation based on the assumption that the incident radiation on a coat has a wavelength distribution $F_1(\lambda)$ and that the properties of the coat are such that the absorbtion of radiation is a function of wavelength $F_2(\lambda)$.

Whilst the distribution of energy in the incident radiation can be assumed with reasonable confidence to follow some such curve as indicated in Fig. 15 (page 153) (that is, the customary distribution curve for a full radiator) there is at present no evidence as to the way in which absorbtion depends on wavelength. There is, in fact, great difficulty in making such measurements in the range of long wavelengths with which we are particularly

concerned here. It is therefore necessary to make an assumption as to the wavelength dependence of absorbtion.

The assumption made here for reasons which will have become obvious on reading the relevant portions of this work, is that longwave radiation is trapped and therefore abstracted as heat from the incident beam by the structure of the hair, and in particular the medullary cavities of some other repetitive pattern such as cuticular scales on the hair. [In the case of wool hairs on the sheep the spacing of the cuticular scales is regular and spreads over a relatively small range similar to that covered by the medullary spacings of the hairs of many mammals.] There is only scant data on the frequency distribution of medullary spacings, and this is related to a survey of many different mammals. A few examples of hairs from a single animal serves to show that medullary spacings vary to some degree within the coat. It can be assumed that if radiation absorbtion by single hairs depends on wavelength in some such manner then the passage of radiation through a coat will be selective and the quality of the radiation will be altered.

For the purpose of comparison with the measurements by Cena and Monteith (1975) of the Clun Forest sheep, the coarse assumption was made that radiation within a narrow band of wavelengths 10 μ wide is totally absorbed by a hair standing in its way and which has a medulla (or other structural spacing within the same wave-band). The frequency distribution of medullary spacing illustrated in Fig. 16 (page 156) was used for this purpose. A combination of energy distribution in the radiation and frequency distribution of the absorbing elements in the fur permits the construction of a

curve showing the way in which the energy of the total radiation beam decreases with the depth of penetration. The distribution of energy bands in the incident radiation gives the starting points of the components of the radiation transmission curves, each of which will be a straight line equivalent to that representing the interception function which would be calculated by Cena and Monteith (1975) using monochromatic radiation. The population density of the relevant absorbing element in the fur dictates the slope of the line representing the decrease in energy transmitted with penetration. The total beam decreases in energy with penetration in accordance with a curve which is obtained by the summation of the numerous straight lines. There is no formula which can readily be derived to describe this curve, which is derived graphically. The shape of the curve is affected by the total population density of the hairs (just as the slope of the single straight line used by Cena and Monteith (1975) is dependant on the density of hairs in the coat). The density of the notional coat represented by the curve in Fig. 17 (page 159) has been chosen in order to demonstrate the strong possibility that absorbtion in fur is selective, rather than independent of wavelength.

There is no formula which fits this curve because although energy distribution in the incident radiation $F_1(\lambda)$ may approximate to Planck's radiation law, there is no such formula which can at present be expected to fit the frequency distribution of hair structural patterns in fur, and F_2 must be based upon the best available data.