

25 REFERENCES

- Able KP (1989) Skylight polarization patterns and the orientation of migratory birds. *J Exp Biol* 141:241-256
- Able KP (1993) Orientation cues used by migratory birds: a review of cue-conflict experiments. *Trends Ecol Evol* 8:367-371
- Able KP, Able MA (1990c) Ontogeny of migratory orientation in the Savannah sparrow, *Passerculus sandwichensis*: mechanisms at sunset. *Anim Behav* 39:1189-1198
- Able KP, Able MA (1993) Daytime calibration of magnetic orientation in a migratory bird requires a view of skylight polarization. *Nature* 364:523-525
- Adams CN, Kattawar GW (1993) Effect of volume-scattering function on the errors induced when polarization is neglected in radiance calculations in an atmosphere-ocean system. *Appl Opt* 32:4610-4617
- Adams JT, Kattawar GW (1997) Neutral points in an atmosphere-ocean system. 1. Upwelling light field. *Appl Opt* 36:1976-1986
- Akersten WA, Shaw CA, Jefferson GT (1983) Rancho La Brea: status and future. *Paleobiol* 9:211-217
- Andrikovics S (1991) On the long-term changes of the invertebrate macrofauna in the creeks of the Pilis-Visegrádi mountains (Hungary). *Verhandl Internat Vereins Limnol* 24:1969-1972
- Andrikovics S, Kéri A (1991) Winter macroinvertebrate investigations along the Bükkös stream (Visegrádi Mountains, Hungary). *Opuscula Zoologica Budapest* 24:57-67
- Angus PB (1973) Pleistocene *Helophorus* (Coleoptera, Hydrophilidae) from Borislav and Starunia in the Western Ukraine, with a reinterpretation of M. Somnicki's species, description of a new Siberian species and comparison with British Weichselian faunas. *Phil Trans Roy Soc Lond* 265:299-326
- Arikawa K, Inokuma K, Eguchi E (1987) Pentachromatic visual system in a butterfly. *Naturwissenschaften* 74:297-298
- Autrum H, Stumpf H (1950) Das Bienenauge als Analysator für polarisiertes Licht. *Z Naturforsch* 5b:116-122
- Azzam RMA, Bashara NM (1992) Ellipsometry and polarized light. North-Holland, Amsterdam, New York
- Babinet J (1840) Sur un nouveau point neutre dans l'atmosphère. *Compt Rend* 11:618-620
- Bandai K, Arikawa K, Eguchi E (1992) Localization of spectral receptors in the ommatidium of butterfly compound eye determined by polarization sensitivity. *J Comp Physiol A* 171:289-297
- Barfoed JHP (1967) Navigation. *Kulturhistoriskt Lexikon Nordisk Medeltid* 12:261
- Barral MJA (1858) Oeuvres de Francois Arago I-V., Gide - Paris, Weigel - Leipzig
- Barta A, Horváth G (2004) Why is it advantageous for animals to detect celestial polarization in the ultraviolet? Skylight polarization under clouds and canopies is strongest in the UV. *J Theor Biol* 226: 429-437
- Barta A, Horváth G, Bernáth B, Meyer-Rochow VB (2003) Imaging polarimetry of the rainbow. *Appl Opt* 42:399-405

- Bartsch K (1991) Die funktionelle und strukturelle Regionalisierung des Auges der Wasserläufer. PhD thesis, Univ Tübingen, Germany
- Bartsch K (1995) Polarization-sensitive photoreceptors of different spectral types in the compound eye of waterstriders. *Naturwissenschaften* 82:292-293
- Bary E de, Bullrich K, Lorenz D (1961) Messungen der Himmelsstrahlung und deren Polarisationsgrad während der Sonnenfinsternis am 15.2.1961 in Viareggio (Italien). *Geofisica Pura et Applicata* 48:193-198
- Baylor ER, Smith FE (1958) Extra-ocular polarization analysis in the honeybee. *Anat Rec* 132:411-412
- Beach DA, Bustamante C, Wells KS, Fougar KM (1987) Theory confirmation. Patterns of polymerization of hemoglobin S in red blood sickle cells. *Biophys J* 52:947-954
- Beaglehole D, Carter GG (1992) Antarctic skies. 2. Characterization of the intensity and polarization of skylight in a high albedo environment. *J Geophys Res D* 97:2597-2600
- Beason RC, Semm P (1991) Neuroethological aspects of avian orientation. In: Berthold P (ed) Orientation in birds. Birkhäuser, Basel Boston Berlin, pp 106-127
- Beaudet L, Bowman HI, Hawryshyn CW (1993) Optic nerve response and retinal structure in rainbow trout of different sizes. *Vis Res* 33:1739-1746
- Beaudet L, Novales Flamarique I, Hawryshyn CW (1997) Cone-photoreceptor topography in the retina of sexually mature Pacific salmonid fishes. *J Comp Neurol* 383:49-59
- Beckers JM, Wagner WJ (1970) A photographic polarimeter for solar observations. *Appl Opt* 9:1933-1934
- Bellver C (1987) Influence of particulate pollution on the positions of neutral points in the sky at Seville (Spain). *Atmos Environ* 21:699-702
- Bennett ATD, Cuthill IC, Partridge JC, Maier EJ (1996) Ultraviolet vision and mate choice in zebra finches. *Nature* 380:433-435
- Bernard GD, Wehner R (1977) Functional similarities between polarization vision and color vision. *Vis Res* 17:1019-1028
- Bernáth B, Horváth G (1999) Visual deception of a Great White Egret by shiny plastic sheets. *Ornis Hungarica* 8/9:57-61
- Bernáth B, Szedenics G, Molnár G, Kriska G, Horváth G (2001a) Visual ecological impact of a peculiar waste oil lake on the avifauna: dual-choice field experiments with water-seeking birds using huge shiny black and white plastic sheets. *Arch Nat Conserv Landsc Res* 40(1):1-28
- Bernáth B, Szedenics G, Molnár G, Kriska G, Horváth G (2001b) Visual ecological impact of "shiny black anthropogenic products" on aquatic insects: oil reservoirs and plastic sheets as polarized traps for insects associated with water. *Arch Nat Conserv Landsc Res* 40(2):89-109
- Bernáth B, Szedenics G, Wildermuth H, Horváth G (2002) How can dragonflies discern bright and dark waters from a distance? The degree of polarization of reflected light as a possible cue for dragonfly habitat selection. *Freshwater Biol* 47:1707-1719
- Bernáth B, Gál J, Horváth G (2004) Why is it worth flying at dusk for aquatic insects? Polarotactic water detection is easiest at low solar elevations. *J Exp Biol* 207: 755-765
- Bisch SM (1999) Orientierungsleistungen des nachtaktiven Wüstenkäfers *Parastizopus armaticeps* Peringuéy (Coleoptera: Tenebrionidae). PhD thesis, Univ Bonn, Germany
- Blanke H (1996) Visuelle Detektion von Eigenbewegung beim Rückenschwimmer *Notonecta glauca*. PhD thesis, Univ Tübingen, Germany, p. 79
- Blanke H, Varjú D (1995) In: Elsner N, Menzel R (eds) Proc 23rd Göttingen Neurobiol Conf, Thieme G, Stuttgart, vol II, p 427
- Boerner WM, Brand H, Cram LA, Holm WA, Stein DE, Wiesbeck W, Keydel W, Giuli D, Gjessing DT, Molinet FA (eds) (1992) Direct and inverse methods in radar polarimetry. Dordrecht, Kluwer

- Bohn H, Täuber U (1971) Beziehungen zwischen der Wirkung polarisierten Lichtes auf das Elektroretinogramm und der Ultrastruktur des Auges von *Gerris lacustris* L. Z vergl Physiol 72:32-53
- Bohren C (1987) Multiple scattering of light and some of its observable consequences. Am J Phys 55:524-533
- Born M, Wolf E (1999) Principles of optics. 7th ed, Cambridge Univ Press, Cambridge, UK
- Brewster D (1842) On the existence of a new neutral point and two secondary neutral points. Rept British Assoc Adv Sci 2:13
- Brewster D (1847) On the polarisation of the atmosphere. Phil Magaz J Sci 31:444-454
- Brewster D (1864) Additional observations on the polarisation of the atmosphere, made at St. Andrews in 1841-1845. Trans Roy Soc Edinburgh 24:247-286
- Bréon FM, Deuzé JL, Tanré D, Herman M (1997) Validation of spaceborne estimates of aerosol loading from Sun photometer measurements with emphasis on polarization. J Geophys Res D 102:17187-17195
- Bréon FM, Tanré D, Lecomte P, Herman M (1995) Polarized reflectance of bare soils and vegetation: measurements and models. IEEE Trans Geosci Rem Sens 33:487-499
- Brines ML (1980) Dynamic patterns of skylight polarization as clock and compass. J Theor Biol 86:507-512
- Brines ML, Gould JL (1979) Bees have rules. Science 206:571-573
- Brines ML, Gould JL (1982) Skylight polarization patterns and animal orientation. J Exp Biol 96:69-91
- Britton W (1972) The Britton Viking sun-stone expedition. Nutr Today 7(3):14-22
- Brodskiy AK (1973) The swarming behavior of mayflies (Ephemeroptera). Entomol Rev 52:33-39
- Browman HI, Novales Flamarique I, Hawryshyn CW (1994) Ultraviolet photoreception contributes to prey search behaviour in two species of zooplanktivorous fishes. J Exp Biol 186:187-198
- Brown T (1994) Stereoscopic phenomena of light and sight. London, 1903, a facsimile of the 1903 edition, Reel 3-D Enterprises Historical 3-D Reprint Series, USA, 1994
- Brunner D, Labhart T (1987) Behavioural evidence for polarization vision in crickets. Physiol Entomol 12:1-10
- Buchwald R (1989) Die Bedeutung der Vegetation für die Habitatbindung einiger Libellenarten der Quellmoore und Fliessgewässer. Phytocoenol 17:307-448
- Budó Á, Mátrai T (1980) Experimental physics III. Optics and atomphysics. Tankönyvkiadó, Budapest (in Hungarian)
- Bueno JM (2000a) Polarimetry using liquid-crystal variable retarders: theory and calibration. J Opt A (Pure Appl Opt) 2:216-222
- Bueno JM (2000b) Measurement of parameters of polarization in the living human eye using imaging polarimetry. Vis Res 40:3791-3799
- Bueno JM (2001) Depolarization effects in the human eye. Vis Res 41:2687-2696
- Bueno JM, Artal P (1999) Double-pass imaging polarimetry in the human eye. Opt Lett 24:64-66
- Bueno JM, Artal P (2001) Polarization and retinal image quality estimates in the human eye. J Opt Soc Am A 18:489-496
- Bueno JM, Jaronski J (2001) Spatially resolved polarization properties for in vitro corneas. Ophthalm Physiol Opt 21:384-392
- Bullrich K (1964) Scattered radiation in the atmosphere and the natural aerosol. In: Advances in geophysics. Academic Press, New York, vol 10, pp 99-260
- Burchak-Abramovich NI (1975) Die pleistozäne Vogelfauna der UdSSR. Quartär Paläon 1:87-105
- Burder D, Whitehouse P (1992) Photographing in 3-D. Stereoscopic Society, England
- Burghause FMHR (1981) The structure of the double-eyes of Baetis and the uniform eyes of Ecdyonurus (Ephemeroptera). Zoomorphol 98:17-34

- Buschmann C (1993) Fernerkundung von Pflanzen – Ausbreitung, Gesundheitszustand und Produktivität. *Naturwissenschaften* 80:439-453
- Cameron DA, Pugh EN Jr (1991) Double cones as a basis for a new type of polarization vision in vertebrates. *Nature* 353:161-164
- Cariou J, Jeune BL, Lotrian J, Guern Y (1990) Polarization effects of seawater and underwater targets. *Appl Opt* 29:1689-1695
- Chamberlain JW (1978) Theory of planetary atmospheres. (vol 22 of International Geophysics Series) Academic Press, New York
- Chandrasekhar S (1950) Radiative transfer. Clarendon Press, Oxford
- Chittka L (1996) Does bee color vision predate the evolution of flower color? *Naturwissenschaften* 83:136-138
- Clarke D, Grainger JF (1971) Polarized light and optical measurement. Pergamon Press, Oxford
- Coemans MAJM, Vos HJJ (1989) On the perception of polarized light by the homing pigeon, *Columba livia* L. In: Kulikowski JJ, Dickenson CM, Murray IJ (eds) Seeing contour and colour. Pergamon Press, Oxford, pp 632-638
- Coemans MAJM, Vos HJJ, Nuboer JFW (1990) No evidence for polarization sensitivity in the pigeon. *Naturwissenschaften* 77:138-142
- Coemans MAJM, Vos HJJ, Nuboer JFW (1994a) The orientation of the E-vector of linearly polarized light does not affect the behaviour of the pigeon *Columba livia*. *J Exp Biol* 191:107-123
- Coemans MAJM, Vos HJJ, Nuboer JFW (1994b) The relation between celestial colour gradients and the position of the sun, with regard to the sun compass. *Vis Res* 34:1461-1470
- Collett E (1994) Polarized light: fundamentals and applications. Marcel Dekker Inc, New York
- Coombe PE, Srinivasan MV, Guy RG (1989) Are the large monopolar cells of the insect lamina on the optomotor pathway? *J Comp Physiol A* 166:23-35
- Corbet PS (1999) Dragonflies: behaviour and ecology of Odonata. Harley Books, Martins, Great Horkesley, Colchester, Essex
- Cornu MA (1884) Observations relatives à la couronne visible actuellement autour du Soleil. *Compt Rend* 99:488-493
- Coughlin DJ, Hawryshyn CW (1995) A cellular basis for polarized-light vision in rainbow trout. *J Comp Physiol A* 176:261-272
- Coulson KL (1974) The polarization of light in the environment: polarization by reflection from natural surfaces. In: Gehrels T (ed) Planets, stars and nebulae studied with photopolarimetry. Univ Arizona Press, Tucson, Arizona, pp 444-471
- Coulson KL (1980) Characteristics of skylight at the zenith during twilight as indicators of atmospheric turbidity. I. Degree of polarization. *Appl Opt* 19:3469-3480
- Coulson KL (1988) Polarization and intensity of light in the atmosphere. A Deepak Publishing, Hampton, Virginia, USA
- Coulson KL, Dave JV, Sekera Z (1960) Tables related to radiation emerging from a planetary atmosphere with Rayleigh scattering. Univ California Press, Berkeley Los Angeles
- Coulson KL, Whitehead VS, Campbell C (1986) Polarized views of the earth from orbital altitude. *Proc Soc Photo-Optical Instrumentation Engin (SPIE)* vol 637 (Ocean Optics VIII):35-41
- Craig PC (1971) An analysis of the concept of lunar orientation in *Orchoptoidea corniculata* (Amphipoda). *Anim Behav* 19:368-374
- Cronin TW, Marshall J (2001) Parallel processing and image analysis in the eyes of mantis shrimps. *Biol Bull* 200:177-183
- Cronin TW, Shashar N (2001) The linearly polarized light field in clear, tropical marine waters: spatial and temporal variation of light intensity, degree of polarization and e-vector angle. *J Exp Biol* 204:2461-2467

- Cronin TW, Shashar N, Wolff L (1994) Portable imaging polarimeters. Proc 12th IAPR Int Conf Pattern Recogn. Jerusalem, Israel, October 9-13, 1994, pp 606-609
- Curran PJ (1978) A photographic method for the recording of polarized visible light for soil surface moisture indications. *Rem Sens Environ* 7:305-322
- Curran PJ (1979) The use of polarized panchromatic and false-color infrared film for the monitoring of soil surface moisture. *Rem Sens Environ* 8:249-266
- Curran PJ (1982) Polarized visible light as an aid to vegetation classification. *Rem Sens Environ* 12:491-499
- Czelhai R (1979) Introduction to meteorology I. Tankönyvkiadó, Budapest (in Hungarian)
- Czihak G, Langer H, Ziegler H (1990) Biologie. Springer, Berlin, Heidelberg, New York
- Dacke M, Nilsson DE, Warrant EJ, Blest AD, Land MF, O'Carroll DC (1999) Built-in polarizers form part of a compass organ in spiders. *Nature* 401:470-473
- Dacke M, Nordström P, Scholtz CH, Warrant EJ (2002) A specialized dorsal rim area for polarized light detection in the compound eye of the scarab beetle *Pachysoma striatum*. *J Comp Physiol A* 188:211-216
- Dahmen HJ (1991) Eye specialisation in waterstriders: an adaptation to life in a flat world. *J Comp Physiol A* 169:623-632
- Dandekar BS, Turtle JP (1971) Day sky brightness and polarization during the total solar eclipse of 7 March 1970. *Appl Opt* 10:1220-1224
- Danilevskii AS (1965) Photoperiodism and seasonal development of insects. Oliver and Boyd, Edinburgh London
- Danthanarayana W (ed) (1986) Insect flight: dispersal and migration. Springer, Berlin Heidelberg New York
- Daumer K (1963) Kontrastempfindlichkeit der Bienen für Weiss verschiedenen UV-Gehalts. *Z vergl Physiol* 46:336-350
- Dave JV (1969) Scattering of visible light by large water spheres. *Appl Opt* 8:155-164
- Delius JD, Perchard RJ, Emmerton J (1976) Polarized light discrimination by pigeons and an electroretinographic correlate. *J Comp Physiol Psychol* 90:560-571
- Denton EJ, Rowe DM (1994) Reflective communication between fish, with special reference to the greater sand eel, *Hyperoplus lanceolatus*. *Phil Tran Roy Soc Lond B* 334:221-237
- Derrien M, Farki B, Harang L, LeGléau H, Noyalet A, Pochic D, Sairouni A (1993) Automatic cloud detection applied to NOAA-11/AVHRR imagery. *Rem Sens Environ* 46:246-267
- Deschamps PY, Bréon FM, Leroy M, Podaire A, Bricaud A, Buriez JC, Séze G (1994) The POLDER mission: instrument characteristics and scientific objectives. *IEEE Trans Geosci Rem Sens* 32:598-615
- Desclorites J, Parol F, Buriez JC (1995) On the validity of the plane-parallel approximation for cloud reflectances as measured from POLDER during ASTEX. *Ann Geophys* 13:108-110
- Deuzé JL, Bréon FM, Deschamps PY, Devaux C, Herman M (1993) Analysis of the POLDER (Polarization and Directionality of Earth's Reflectances) airbone instrument observations over land surfaces. *Rem Sens Environ* 45:137-154
- Deuzé JL, Devaux C, Herman M, Santer R, Balois JY, Gonzalez L, Lecomte P, Verwaerde C (1989) Photopolarimetric observations of aerosols and clouds from balloon. *Rem Sens Environ* 29:93-109
- Dollfus A (1961) Polarization studies of planets. In: The solar system. 3. Chap 9, Univ Chicago Press, Chicago
- Dreher AW, Reiter K, Weinreb RN (1992) Spatially resolved birefringence of the retinal nerve fiber layer assessed with a retinal laser ellipsometer. *Appl Opt* 31:3730-3735

- Drouin F (1995) The stereoscope and stereoscopic photography. London, 1894, a facsimile of the 1894 second edition, Reel 3-D Enterprises Historical 3-D Reprint Series, USA
- Duelli P (1975) A fovea for e-vector orientation in the eye of *Cataglyphis bicolor* (Formicidae, Hymenoptera). *J Comp Physiol* 102:43-56
- Duelli P, Wehner R (1973) The spectral sensitivity of polarized light orientation in *Cataglyphis bicolor* (Formicidae, Hymenoptera). *J Comp Physiol* 86:37-53
- Dürst J (1982) Two colour photometry and polarimetry of the solar corona of 16 February 1980. *Astronom Astrophys* 112:241-250
- Edmunds GF, Edmunds CH (1980) Predation, climate and mating of mayflies. In: Flannagan JF, Marshall KE (eds) *Advances of ephemera biology*. New York, pp 277-285
- Edrich W, Helversen O von (1987) Polarized light orientation in honey bees: is time a component in sampling? *Biol Cybern* 56:89-96
- Edrich W, Neumeyer C, Helversen O von (1979) "Anti-sun orientation" of bees with regard to a field of ultraviolet light. *J Comp Physiol* 134:151-157
- Egan WG (1986) Proposed design of an imaging spectropolarimeter/photometer for remote sensing of earth resources. *Opt Engin* 25:1155-1159
- Egan WG, Sidran M (1994) Polarimetric detection of land sediment runoff into the ocean using Space Shuttle imagery. *Engineering and Laboratory Notes (Opt Soc Am)* 17(3): S17-S19
- Eggers A, Gewecke M (1993) The dorsal rim area of the compound eye and polarization vision in the desert locust (*Schistocerca gregaria*). In: Wiese K, Gribakin FG, Popov AV, Renninger G (eds) *Sensory systems of arthropods*. Birkhäuser, Basel, pp 101-109
- Enright JT (1961) Lunar orientation of *Orchoptoidea corniculata* Stout (Amphipoda). *Biol Bull* 120:148-156
- Enright JT (1972) When the beachhopper looks at the moon: the moon-compass hypothesis. In: Galler SR, Schmidt-Koenig K, Jacobs GJ, Belleville RE (eds) *Animal orientation and navigation*. NASA SP-262, US Government Printing Office, Washington DC, pp 523-555
- Fernando CH (1958) The colonization of small freshwater habitats by aquatic insects. 1. General discussion, methods and colonization in the aquatic Coleoptera. *Ceylon J Sci (Biol Sci)* 1(2):116-154
- Fernando CH, Galbraith D (1973) Seasonality and dynamics of aquatic insects colonizing small habitats. *Verhandl Internat Verein Limnol* 18:1564-1575
- Finzi L, Bustamante C, Garab G, Juang CB (1989) Direct observation of large chiral domains in chloroplast thylacoid membranes by differential polarization microscopy. *Proc Natl Acad Sci USA* 86:8748-8752
- Fischer C (1992) Evolution des Schwarmfluges und Flugverhalten der Ephemeropteren. PhD thesis, 1992/3291, Friedrich Alexander Univ Erlangen-Nürnberg, p 171
- Fitch BW, Walraven RL, Bradley DE (1984) Polarization of light reflected from grain crops during the heading growth stage. *Rem Sens Environ* 15:263-268
- Fleishman LJ, Loew ER, Leal M (1993) Ultraviolet vision in lizards. *Nature* 365:397
- Foote PG (1956) Icelandic Sólársteinn and the medieval background. *Arv* 12:26-40
- Frantsevich L, Govardovski V, Gribakin F, Nikolajev G, Pichka V, Polanovsky A, Shevchenko V, Zolotov V (1977) Astroorientation in *Lethrus* (Coleoptera, Scarabaeidae). *J Comp Physiol A* 121:253-271
- Fraser FC (1936) The fauna of British India. Odonata vol 3, London, Taylor and Francis
- Fraser RS (1968) Atmospheric neutral points over water. *J Opt Soc Am* 58:1029-1031
- Fraser RS (1981) Atmospheric neutral points outside of the principal plane. *Contrib Atmos Phys* 54:286-297

- Fratzer C, Dörr S, Neumeyer C (1994) Wavelength discrimination of the goldfish in the ultraviolet spectral range. *Vis Res* 34:1515-1520
- Fränzel U (1985) Öko-ethologische Untersuchungen an *Cordulegaster bidentatus* Selys, 1843 (Insecta: Odonata) im Bonner Raum. Diploma thesis, Univ Bonn
- Freake MJ (1999) Evidence for orientation using the e-vector direction of polarised light in the sleepy lizard *Tiliqua rugosa*. *J Exp Biol* 202:1159-1166
- Frisch K von (1949) Die Polarisation des Himmelslichtes als orientierender Faktor bei den Tänzen der Bienen. *Experientia* 5:142-148
- Frisch K von (1953) Aus dem Leben der Bienen (5th ed) Springer, Berlin Göttingen Heidelberg
- Frisch K von (1965) Tanzsprache und Orientierung der Bienen. Springer, Berlin Heidelberg New York
- Frisch K von (1967) The dance language and orientation of bees. Harvard Univ Press, Cambridge, Massachusetts (USA)
- Frisch K von (1993) The dance language and orientation of bees (2nd ed, foreword by Seeley TD) Harvard Univ Press, Cambridge, Massachusetts (USA)
- Frisch K von, Lindauer M (1954) Himmel und Erde in Konkurrenz bei der Orientierung der Bienen. *Naturwissenschaften* 41:245-253
- Frisch K von, Lindauer M (1993) Aus dem Leben der Bienen (10th ed by Lindauer M) Springer, Berlin, Göttingen, Heidelberg
- Gabryl JR, Cugnon P, Clette F (1998) Polarization observations and results of the 1998 February 26th solar corona. *Contrib Astron Obs Skalnaté Pleso* 28:216-223
- Garab G, Pomozi I, Jávorfi T, Menczel L, Weiss G, Jürgens R (2003) Differential polarization laser scanning microscope. (submitted)
- Gates DM (1980) Biophysical ecology. Springer, Berlin Heidelberg New York
- Gál J, Horváth G, Barta A, Wehner R (2001a) Polarization of the moonlit clear night sky measured by full-sky imaging polarimetry at full moon: comparison of the polarization of moonlit and sunlit skies. *J Geophys Res D* 106:22647-22653
- Gál J, Horváth G, Meyer-Rochow WB (2001b) Measurement of the reflection-polarization pattern of the flat water surface under a clear sky at sunset. *Rem Sens Environ* 76:103-111
- Gál J, Horváth G, Meyer-Rochow VB, Wehner R (2001c) Polarization patterns of the summer sky and its neutral points measured by full-sky imaging polarimetry in Finnish Lapland north of the Arctic Circle. *Proc Roy Soc Lond A* 457:1385-1399
- Gedzelman SD (1982) Rainbow brightness. *Appl Opt* 21:3032-3037
- Gehrels T (ed) (1974) Planets, stars and nebulae studied with photopolarimetry. Univ Arizona Press, Tucson, Arizona
- Gerharz R (1975) Self-polarization in refractive systems. *Optik* 43:471-485
- Gerharz R (1976) Appearance of the atmospheric scatter field during a solar eclipse. *J Geophys* 42:163-167
- Gerharz R (1977) Polarization of scattered horizon light in inclement weather. *Arch Meteorol Geophys Bioklimatologie Ser A* 26:265-273
- Glas HW van der (1975) Polarization induced colour patterns: a model of the perception of the polarized skylight by insects. I. Tests in choice experiments with running honey bees, *Apis mellifera*. *Netherlands J Zool* 25:476-505
- Glas HW van der (1976) Polarization induced colour patterns: a model of the perception of the polarized skylight by insects. II. Experiments with direction trained dancing bees, *Apis mellifera*. *Netherlands J Zool* 26:383-413
- Glas HW van der (1977) Models for unambiguous E-vector navigation in the bee. *J Comp Physiol A* 113:129-159

- Glas HW van der (1980) Orientation of bees, *Apis mellifera*, to unpolarized colour patterns, simulating the polarized zenith skylight pattern. *J Comp Physiol A* 139:225-241
- Goldsmith TH (1972) The natural history of invertebrate visual pigments. In: Dartnall HJA (ed) *Handbook of sensory physiology. VII/1*, Springer, Berlin Heidelberg New York, pp 685-719
- Goldsmith TH (1994) Ultraviolet receptors and color vision: evolutionary implications and a dissonance of paradigms. *Vis Res* 34:1479-1487
- Goloub P, Deuzé JL, Herman M, Fouquart Y (1994) Analysis of the POLDER polarization measurements performed over cloud covers. *IEEE Trans Geosci Rem Sens* 32:78-88
- Gordon HR (1978) Removal of atmospheric effects from satellite imagery of the oceans. *Appl Opt* 17:1631-1636
- Gordon HR, Wang M (1992) Surface-roughness considerations for atmospheric correction of ocean color sensors. I. The Rayleigh scattering component. *Appl Opt* 31:4247-4260
- Grant L, (1987) Diffuse and specular characteristics of leaf reflectance. *Rem Sens Environ* 22:309-322
- Grant L, Daughtry CST, Vanderbilt VC (1987a) Polarized and non-polarized leaf reflectances of *Coleus blumei*. *Environ Exp Bot* 27:139-145
- Grant L, Daughtry CST, Vanderbilt VC (1987b) Variations in the polarized leaf reflectance of *Sorghum bicolor*. *Rem Sens Environ* 21:333-339
- Grant L, Daughtry CST, Vanderbilt VC (1993) Polarized and specular reflectance variation with leaf surface features. *Physiol Plantarum* 88:1-9
- Greenler RG (1980) Rainbows, halos and glories. Cambridge Univ Press, Cambridge, London
- Grzimeks (1974) Tierleben. Sonderband: Verhaltensforschung. Kindler-Verlag, Zürich
- Guenther RD (1990) Modern optics. Duke Univ, John Wiley and Sons, Inc
- Gupta VA, Kornfield V (1994) Controlling molecular order in "Hairy-rod" Langmuir Blodgett films: polarization modulation microscopy study. *Science* 265:940-942
- Hamann B, Langer H (1980) Sehfarbstoffe im Auge des Wasserläufers *Gerris lacustris* L. *Verhandl Dtsch Zool Ges*, p 337
- Hanlon RT, Maxwell MR, Shashar N, Loew ER, Boyle KL (1999) An ethogram of body patterning behavior in the biomedically and commercially valuable squid *Loligo pealei* off Cape Cod, Massachusetts. *Biol Bull* 197:49-62
- Hanlon RT, Messenger JB (1996) Cephalopod behaviour. Cambridge Univ Press, Cambridge
- Hannemann D, Raschke E (1974) Measurements of the elliptical polarization of sky radiation: preliminary results. In: Gehrels T (ed) *Planets, stars and nebulae studied with photopolarimetry*. Univ Arizona Press, Tucson, Arizona, pp 510-513
- Hardie RC (1984) Properties of photoreceptors R7 and R8 in dorsal marginal ommatidia in the compound eyes of *Musca* and *Calliphora*. *J Comp Physiol A* 154:157-165
- Hardie RC (1985) Functional organization of the fly retina. In: Autrum H et al (eds) *Progress in sensory physiology*. Springer, Berlin Heidelberg New York, vol 5, pp 2-79
- Hardie RC, Franceschini N, McIntyre PD (1979) Electrophysiological analysis of fly retina. II. Spectral and polarisation sensitivity in R7 and R8. *J Comp Physiol A* 133:23-39
- Harker JE (1992) Swarm behaviour and mate competition in mayflies (Ephemeroptera). *J Zool Lond* 228:571-587
- Harkness R, Wehner R (1977) Cataglyphis. *Endeavour (New Series)* 1(3/4):115-121
- Harris JM, Jefferson GI (eds) (1985) Rancho La Brea: treasures of the tar pits. Nat Hist Mus Los Angeles County, Los Angeles
- Hassenstein B (1959) Optokinetiche Wirksamkeit bewegter periodischer Muster nach Messungen am Rüsselkäfer *Chlorophanus viridis*. *Z Naturforsch* 14b:659-674

- Hassenstein B, Reichardt W (1956) Systemtheoretische Analyse der Zeit-, Reihenfolgen- und Vorzeichenauswertung bei der Bewegungsperzeption des Rüsselkäfers Chlorophanus. *Z Naturforsch* 11b:513-524
- Hawryshyn CW (1992) Polarization vision in fish. *Am Sci* 80:164-175
- Hawryshyn CW, Arnold M. G., Bowering E. and Cole R. L. (1990) Spatial orientation of rainbow trout to plane-polarized light: the ontogeny of E-vector discrimination and spectral sensitivity characteristics. *J Comp Physiol A* 166:565-574
- Hawryshyn CW, Bolger AE (1990) Spatial orientation of trout to partially polarized light. *J Comp Physiol A* 167:691-697
- Hawryshyn CW, McFarland WN (1987) Cone photoreceptor mechanisms and the detection of polarized light in fish. *J Comp Physiol A* 160:459-465
- Heisenberg M (1972) Comparative behavioral studies on two visual mutants of Drosophila. *J Comp Physiol* 80:119-136
- Helbig AJ (1990) Depolarization of natural skylight disrupts orientation of an avian nocturnal migrant. *Experientia* 46:755-758
- Helbig AJ (1991) Experimental and analytical techniques used in bird orientation research. In: Berthold P (ed) Orientation in birds. Birkhäuser, Basel Boston Berlin, pp 270-306
- Helbig AJ, Wiltschko W (1989) The skylight polarization patterns at dusk affect the orientation behaviour of blackcaps, *Sylvia atricapilla*. *Naturwissenschaften* 76:227-229
- Helversen O von, Edrich W (1974) Der Polarisationsempfänger im Bienenauge: ein Ultraviolettrezeptor. *J Comp Physiol* 94:33-47
- Henderson ST (1970) Daylight and its spectrum. American Elsevier, New York
- Herman M, Balois JY, Gonzalez L, Lecomte P, Lenoble J, Santer R, Verwaerde C (1986) Stratospheric aerosol observations from a balloon-borne polarimetric experiment. *Appl Opt* 25:3573-3584
- Herman M, Deuzé JL, Devaux C, Goloub P, Bréon FM, Tanré D (1997) Remote sensing of aerosols over land surfaces including polarization measurements and application to POLDER measurements. *J Geophys Res D* 102:17039-17049
- Herzmann D, Labhart T (1989) Spectral sensitivity and absolute threshold of polarization vision in crickets: a behavioral study. *J Comp Physiol A* 165:315-319
- Hess P (1939) Die spektrale Energieverteilung der Himmelsstrahlung. *Gerlands Beitr Geophys* 55:204-220
- Holzworth GC, Rao CR (1965) Studies of skylight polarization. *J Opt Soc Am* 55:403-408
- Horridge GA (1976) The ommatidium of the dorsal eye of Cloeon as a specialization for photoreoisomerization. *Proc Roy Soc Lond B* 193:17-29
- Horridge GA, Marcelja L, Jahnke R, Matic T (1983) Single electrode studies on the retina of the butterfly Papilio. *J Comp Physiol A* 150:270-294
- Horridge GA, McLean M (1978) The dorsal eye of the mayfly Atalophlebia (Ephemeroptera). *Proc Roy Soc Lond B* 200:137-150
- Horváth G (1993) Computational Visual Optics. Theoretical Physiologic Optical Study of the Optical Environment and Visual System of Animals. Postdoctoral dissertation to take the degree "candidate for biophysical science" awarded by the Hungarian Academy of Sciences, Budapest, pp 1-256
- Horváth G (1995a) Reflection-polarization patterns at flat water surfaces and their relevance for insect polarization vision. *J Theor Biol* 175:27-37
- Horváth G (1995b) How do water insects find their aquatic habitat? World of Nature (Természet Világa special issue) 125:44-49
- Horváth G, Barta A, Gál J, Suhai B, Haiman O (2002a) Ground-based full-sky imaging polarimetry of rapidly changing skies and its use for polarimetric cloud detection. *Appl Opt* 41:543-559

- Horváth G, Bernáth B, Molnár G (1998a) Dragonflies find crude oil visually more attractive than water: multiple-choice experiments on dragonfly polarotaxis. *Naturwissenschaften* 85:292-297
- Horváth G, Bernáth B, Suhai B, Barta A, Wehner R (2002b) First observation of the fourth neutral polarization point in the atmosphere. *J Opt Soc Am A* 19:2085-2099
- Horváth G, Gál J, Labhart T, Wehner R (2002c) Does reflection polarization by plants influence colour perception in insects? Polarimetric measurements applied to a polarization-sensitive model retina of *Papilio* butterflies. *J Exp Biol* 205:3281-3298
- Horváth G, Gál J, Pomozi I, Kriska G, Wehner R (2001) Polarized glance at the sky during a total solar eclipse: the peculiar polarization patterns of the sky-dome and the solar corona on 11 August 1999. *Fizikai Szemle (Physical Review)* 51:229-238 (in Hungarian)
- Horváth G, Gál J, Pomozi I, Wehner R (1998b) Polarization portrait of the Arago point: video-polarimetric imaging of the neutral points of skylight polarization. *Naturwissenschaften* 85:333-339
- Horváth G, Gál J, Wehner R (1997) Why are water-seeking insects not attracted by mirages? The polarization pattern of mirages. *Naturwissenschaften* 84:300-303 [Erratum 85:90 (1998)]
- Horváth G, Pomozi I (1997) How celestial polarization changes due to reflection from the deflector panels used in deflector loft and mirror experiments studying avian navigation. *J Theor Biol* 184:291-300
- Horváth G, Pomozi I, Gál J (2003) Neutral points of skylight polarization observed during the total eclipse on 11 August 1999. *Appl Opt* 42:465-475
- Horváth G, Varjú D (1991) On the structure of the aerial visual field of aquatic animals distorted by refraction. *Bull Math Biol* 53:425-441
- Horváth G, Varjú D (1995) Underwater refraction-polarization patterns of skylight perceived by aquatic animals through Snell's window of the flat water surface. *Vis Res* 35:1651-1666
- Horváth G, Varjú D (1997) Polarization pattern of freshwater habitats recorded by video polarimetry in red, green and blue spectral ranges and its relevance for water detection by aquatic insects. *J Exp Biol* 200:1155-1163
- Horváth G, Varjú D (2003) Polarized light in animal vision - polarization patterns in nature. Springer, Berlin Heidelberg New York
- Horváth G, Wehner R (1999) Skylight polarization as perceived by desert ants and measured by video polarimetry. *J Comp Physiol A* 184:1-7 [Erratum 184:347-349 (1999)]
- Horváth G, Zeil J (1996) Kuwait oil lakes as insect traps. *Nature* 379:303-304
- Hulst HC van de (1952) Scattering in atmospheres. In: Kniper GP (ed) *The atmosphere of the earth and planets*. Univ Chicago Press, Chicago
- Hulst HC van de (1981) Light scattering by small particles. John Wiley and Sons, Dover, New York
- Ivanoff A (1974) Polarization measurements in the sea. In: Jerlov NG, Steemann-Nielsen E (eds) *Optical aspects of oceanography*. Academic Press, London, pp 151-175
- Ivanoff A, Waterman TH (1958a) Elliptical polarization of submarine illumination. *J Mar Res* 16:255-282
- Ivanoff A, Waterman TH (1958b) Factors, mainly depth and wavelength, affecting underwater polarized light. *J Mar Res* 16:283-307
- Jelley JV (1989) Sea waves: their nature, behaviour, and practical importance. *Endeavour (New Series)* 13:148-156
- Jerlov NG (1963) Optical oceanography. *Ocean Mar Biol Ann Rev* 1:89-114
- Jerlov NG (1976) Marine optics. Elsevier, Amsterdam
- Johnson GC (1969) Migration and dispersal of insects by flight. Methuen and Co, London
- Jones BF, Fairney PT (1989) Recognition of shiny dielectric objects by analysing the polarization of reflected light. *Image Vis Comp* 7:253-258

- Junger W (1991) Waterstriders (*Gerris paludum* F.) compensate for drift with a discontinuously working visual position servo. *J Comp Physiol A* 169:633-639
- Junger W, Dahmen HJ (1991) Response to self-motion in waterstriders: visual discrimination between rotation and translation. *J Comp Physiol A* 169:641-646
- Junger W, Varjú D (1990) Drift compensation and its sensory basis in waterstriders (*Gerris paludum* F.). *J Comp Physiol A* 167:441-446
- Kaiser W (1974) The spectral sensitivity of the honeybees's optomotor walking response. *J Comp Physiol* 90:405-408
- Kaiser W (1975) The relationship between movement detection and colour vision in insects. In: Horridge GA (ed) *The compound eye and vision of insects*. Clarendon Press, Oxford, pp 359-377
- Kaiser W, Liske E (1974) Die optomotorischen Reaktionen von fixiert fliegenden Bienen bei Reizung mit Spektrallichtern. *J Comp Physiol* 89:391-408
- Kalayjian ZK, Andreou AG, Wolff LB, Sheppard N (1996) A polarization contrast retina that uses patterned iodine-doped PVA film. In: Proc ESSCIRC '96, Neuchatel, September 1996, pp 1181-1184
- Kalmus H (1958) Responses of insects to polarized light in the presence of dark reflecting surfaces. *Nature* 182:1526-1527
- Kalmus H (1959) Orientation of animals to polarized light. *Nature* 184:228-230
- Kattawar GW (1994) Polarization of light in the ocean. In: Spinrad RW, Carder KL, Perry MJ (eds) *Ocean optics*. Oxford Univ Press, Oxford, pp 203-225
- Kattawar GW, Adams CN (1989) Stokes vector calculations of the submarine light field in an atmosphere-ocean with scattering according to a Rayleigh phase matrix: effect of interface refractive index on radiance and polarization. *Limnol Oceanogr* 34:1453-1472
- Kattawar GW, Plass GN, Quinn JA Jr (1973) Monte Carlo calculations of the polarization of radiation in the earth's atmosphere-ocean system. *J Phys Oceanog* 3:353-372
- Kay QON, Daoud HS, Stirton CH (1981). Pigment distribution, light reflection and cell structure in petals. *Bot J Linnean Soc* 83:57-84
- Kelber A (1999) Why 'false' colours are seen by butterflies. *Nature* 402:251
- Kelber A, Thunell C, Arikawa K (2001) Polarisation-dependent colour vision in *Papilio* butterflies. *J Exp Biol* 204:2469-2480
- Kennedy CH (1917) Notes on the life history and ecology of the dragonflies (Odonata) of central California and Nevada. *Proc US Nat Mus* 52:483
- Kennedy CH (1938) The present status of work on the ecology of aquatic insects as shown by the work on the Odonata. *Ohio J Sci* 38:267
- Kerfoot WB (1967) The lunar periodicity of *Sphecodogastra texana*, a nocturnal bee (Hymenoptera: Halictidae). *Anim Behav* 15:479-486
- Khare V, Nussenbaum HM (1974) Theory of the rainbow. *Phys Rev Lett* 33:976-980
- Kien J, Menzel R (1977) Chromatic properties in the optic lobes of the bee. *J Comp Physiol* 121:35-53
- Kim M, Keller D, Bustamante C (1987) Differential polarization imaging. I. Theory. *Biophys J* 52:911-927
- Kimball HH (1913) The effect of the atmospheric turbidity of 1912 on solar radiation intensities and skylight polarization. *Bull Mt. Weather Observ* 5:295-312
- King RS, Wrubleski DA (1998) Spatial and diel availability of flying insects as potential duckling food in prairie wetlands. *Wetlands* 18:100-114
- Kirschfeld K (1971) Aufnahme und Verarbeitung optischer Daten im Komplexauge von Insekten. *Naturwissenschaften* 58:201-209
- Kirschfeld K (1973a) Optomotorische Reaktionen der Biene auf bewegte "Polarisations-Muster". *Z Naturforsch* 28c:329-338

- Kirschfeld K (1973b) Vision of polarised light. In: Symp papers 4th int biophys cong, int union pure appl biophys, Acad Sci USSR, Pushchino, 19 zak 181, pp 289-296
- Kirschfeld K (1973c) Das neurale Superpositionsauge. Fortschr Zool 21:229-257
- Kirschfeld K, Reichardt W (1970) Optomotorische Versuche an Musca mit linear polarisiertem Licht. Z Naturforsch 25b:228
- Kliger DS, Lewis JW, Randall CE (1990) Polarized light in optics and spectroscopy. Academic Press, San Diego, USA
- Kocsis K, Hyttinen M, Helminen HJ, Aydelotte MB, Módis L (1998) Combination of digital image analysis and polarization microscopy: theoretical considerations and experimental data. Microscop Res Technh 43:511-517
- Kondratyev KY, Buznikov AA, Pozdnyakov DV, Ivanyan GA, Lakhtanov GA, Orlov VM, Mikhailova SM (1974) Application of spectrometric and polarization techniques for remote sensing of oil on sea waters. Proc 9th Int Symp Rem Sens Environ, 15-19 April 1974, Ann Arbor, MI, USA, vol 3, pp 1793-1802
- Kopal Z (1969) The moon. Dordrecht, Reidel, Holland
- Korte R (1965) Durch polarisiertes Licht hervorgerufene Optomotorik bei Uca tangeri. Experientia 21:98
- Koshikawa K, Shirai Y (1987) A model-based recognition of glossy objects using their polarimetric properties. Advances in Robotics vol 2, No 2
- Kowalski K (1999) Il Pleistocene di Starunia. In: Pina G (ed) Storia naturale d'Europa - Lagerstaetten of Europe. Jaca Book SpA Servizio Lettori, Milano
- Können GP (1985) Polarized light in nature. Cambridge Univ Press, Cambridge
- Können GP (1986) Viewing our world with polarizing glasses. Endeavour (new series) 10(3):121-124
- Können GP (1987) Skylight polarization during a total solar eclipse: a quantitative model. J Opt Soc Am A 4:601-608
- Können GP (1992) Polarization in nature. In: Boerner WM, Brand H, Cram LA, Holm WA, Stein DE, Wiesbeck W, Keydel W, Giuli D, Gjessing DT, Molinet FA (eds) Direct and inverse methods in radar polarimetry. Dordrecht, Kluwer Acad Publ, The Netherlands, Part I, pp 33-44
- Können GP, de Boer JH (1979) Polarized rainbow. Appl Opt 18:1961-1965
- Kramer G (1950a) Orientierte Zugaktivität gekäfigter Singvögel. Naturwissenschaften 37:188
- Kramer G (1950b) Weitere Analyse der Faktoren, welche die Zugaktivität des gekäfigten Vogels orientieren. Naturwissenschaften 37:377-378
- Kramer G (1951) Eine neue Methode zur Erforschung der Zugorientierung und die bisher damit erzielten Ergebnisse. Proc 10th Ornithol Cong, Uppsala, pp 269-280
- Kramer G, St Paul U von (1950) Stare (*Sturnus vulgaris* L.) lassen sich auf Himmelsrichtung dressieren. Naturwissenschaften 37:526-527
- Kreithen ML, Keeton WT (1974) Detection of polarized light by the homing pigeon, *Columba livia*. J Comp Physiol 89:83-92
- Kriska G, Horváth G, Andrikovics S (1998) Why do mayflies lay their eggs en masse on dry asphalt roads? Water-imitating polarized light reflected from asphalt attracts Ephemeroptera. J Exp Biol 201:2273-2286
- Labhart T (1980) Specialized photoreceptors at the dorsal rim of the honeybee's compound eye: polarizational and angular sensitivity. J Comp Physiol A 141:19-30
- Labhart T (1986) The electrophysiology of photoreceptors in different eye regions of the desert ant, *Cataglyphis bicolor*. J Comp Physiol A 158:1-7
- Labhart T (1988) Polarization-opponent interneurons in the insect visual system. Nature 331:435-437
- Labhart T (1996) How polarization-sensitive interneurons of crickets perform at low degrees of polarization. J Exp Biol 199:1467-1475

- Labhart T (1999) How polarization-sensitive interneurons of crickets see the polarization pattern of the sky: a field study with an optoelectronic model neurone. *J Exp Biol* 202:757-770
- Labhart T, Hodel B, Valenzuela I (1984) The physiology of the cricket's compound eye with particular reference to the anatomically specialized dorsal rim area. *J Comp Physiol A* 155:289-296
- Labhart T, Meyer EP (1999) Detectors for polarized skylight in insects: a survey of ommatidial specializations in the dorsal rim area of the compound eye. *Microsc Res Techn* 47:368-379
- Labhart T, Meyer EP, Schenker L (1992) Specialized ommatidia for polarization vision in the compound eye of cockchafers, *Melolontha melolontha* (Coleoptera, Scarabaeidae). *Cell Tissue Res* 268:419-429
- LaFay H (1970) The Vikings. *Natl Geogr* 137:528-530
- Lambrinos D, Maris M, Kobayashi H, Labhart T, Pfeifer R, Wehner R (1997) An autonomous agent navigating with a polarized light compass. *Adapt Behav* 6:131-161
- Land MF (1993) Old twist in a new tale. *Nature* 363:581-582
- Landin J (1968) Weather and diurnal periodicity of flight by *Helophorus brevipalpis* Bedel (Col. Hydrophilidae). *Opusc Entomol* 33:28-36
- Landin J, Stark E (1973) On flight thresholds for temperature and wind velocity, 24-hour flight periodicity and migration of the water beetle *Helophorus brevipalpis*. *ZOON Suppl* 1:105-114
- Lau D (1976) Reaktionen von Honigbienen (*Apis mellifica*) auf Polarisationsmuster an der Futterquelle. *Zool Garten NF* (Jena) 1:34-38
- Lee RL Jr (1991) What are 'all the colors of the rainbow'? *Appl Opt* 30:3401-3407
- Lee RL Jr (1998a) Digital imaging of clear-sky polarization. *Appl Opt* 37:1465-1476
- Lee RL Jr (1998b) Mie theory, Airy theory, and the natural rainbow. *Appl Opt* 37:1506-1519
- Lee RL Jr, Fraser AB (2001) The rainbow bridge: rainbows in art, myth, and science. Pennsylvania State Univ Press
- Lehrer M, Srinivasan MV, Zhang SW (1990) Visual edge detection in the honeybee and its chromatic properties. *Proc Roy Soc Lond B* 238:321-330
- Leroy M, Deuzé JL, Bréon FM, Hautecœur O, Herman M, Buriez JC, Tanré D, Bouffis S, Chazette P, Roujean JL (1997) Retrieval of atmospheric properties and surface bidirectional reflectances over land from POLDER/ADEOS. *J Geophys Res D* 102:17023-17037
- Levorsen AI (1967) Geology of petroleum. (2nd ed, FAF Berry) Freeman, San Francisco, London
- Lieke E (1984) Farbensehen bei Bienen: Wahrnehmung der Farbsättigung. PhD thesis, Freie Univ Berlin, Berlin
- Liou KN (1980) An introduction to atmospheric radiation. Academic Press, San Diego, California
- Liu Y, Voss KJ (1997) Polarized radiance distribution measurements of skylight. II. Experiment and data. *Appl Opt* 36:8753-8764
- Loesel R, Homberg U (2001) Anatomy and physiology of neurons with processes in the accessory medulla of the cockroach *Leucophaea maderae*. *J Comp Neurol* 439:193-207
- Loew ER, McFarland WN (1990) The visual environment. In: Douglas RH, Djamgoz MBA (eds) The visual system of fish. Chapman and Hall, London, pp 1-43
- Loew ER, McFarland WN, Mills EL, Hunter D (1993) A chromatic action spectrum for planktonic predation by juvenile yellow perch, *Perca flavescens*. *Can J Zool* 71:384-386
- Lock JA (ed) (1991) Light and color in the open air. *Appl Opt* (feature issue) 30:3381-3552
- Lunau K, Maier EJ (1995) Innate colour preferences of flower visitors. *J Comp Physiol A* 177:1-19
- Luria SM, Kinney JAS (1974) Linear polarising filters and underwater vision. *Undersea Biomed Res* 1:371-378
- Lynch DK, Schwartz P (1991) Rainbows and fogbows. *Appl Opt* 30:3415-3420
- Lythgoe JN (1979) The ecology of vision. Clarendon Press, Oxford
- Lythgoe JN, Hemmings CC (1967) Polarized light and underwater vision. *Nature* 213:893-894

- Malus ÉL (1809) Sur une propriété de la lumière réfléchie par les corps diaphanes. *Nouveau Bull d Sci, par la Soc Philomathique (Paris)* 1:266-269; *Mém de la Soc d'Arcueil*, vol 2
- Marshall NJ (1988) A unique colour and polarization vision system in mantis shrimps. *Nature* 333:557-560
- Marshall NJ, Land MF, King CA, Cronin TW (1991a) The compound eyes of mantis shrimps (Crustacea, Hoplocarida, Stomatopoda). I. Compound eye structure: the detection of polarized light. *Phil Trans Roy Soc Lond B* 334:33-56
- Marshall NJ, Land MF, King CA, Cronin TW (1991b) The compound eyes of mantis shrimps (Crustacea, Hoplocarida, Stomatopoda). II. Coloured pigments in the eyes of stomatopod crustaceans: polychromatic vision by serial and lateral filtering. *Phil Trans Roy Soc Lond B* 334:57-84
- Martens A (1996) Die Federlibellen Europas. Westarp Wissenschaften, Magedeburg
- Mazokhin-Porshnyakov GA (1969) Insect Vision. Plenum Press, New York
- McCann GD, Arnett DW (1972) Spectral and polarization sensitivity of the dipteran visual system. *J Gen Physiol* 59:534-558
- McFarland WN, Munz FW (1975) Part III: the evolution of photopic visual pigments in fishes. *Vis Res* 15:1071-1080
- McGrath WH (1991) The stars look down. *Navig News* 3:15
- Meyer HW (1970) Reizwechselfrequenz und Auslösung des Beutefangs beim Bachwasserläufer (*Velia caprai*). *Naturwissenschaften* 57:313
- Meyer HW (1971) Visuelle Schlüsselreize für die Auslösung der Beutefanghandlung beim Bachwasserläufer *Velia caprai* (Hemiptera, Heteroptera). I. Untersuchung der räumlichen und zeitlichen Reizparameter mit formverschiedenen Attrappen. *Z vergl Physiol* 72:260-297
- Miller L (1925) The birds of Rancho La Brea. Carnegie Inst Washington, Wash DC, USA
- Miller RE, Fastie WG (1972) Skylight intensity, polarization and airglow measurements during the total solar eclipse of 30 May 1965. *J Atmos Terrest Phys* 34:1541-1546
- Minnaert M (1940) Light and colour in the open air. G Bell and Sons, London
- Mischke U (1984) The stimulus efficiency of intensity contrast, spectral contrast and polarization contrast in the optomotorics of *Pachnoda marginata* (Coleoptera: cetoniinae). In: Varjú D, Schnitzler HU (eds) Localization and orientation in biology and engineering. Springer, Berlin Heidelberg, pp 156-159
- Mizera F, Bernáth B, Kriska G, Horváth G (2001) Stereo videopolarimetry: measuring and visualizing polarization patterns in three dimensions. *J Imag Sci Technol* 45:393-399
- Mobbs SD (1979) Theory of the rainbow. *J Opt Soc Am* 69:089-1092
- Mobley CD (1994) Light and water. Academic Press, San Diego, USA
- Moore FR (1982) Sunset and the orientation of a nocturnal bird migrant: a mirror experiment. *Behav Ecol Sociobiol* 10:153-155
- Moore FR (1985) Integration of environmental stimuli in the migratory orientation of the Savannah sparrow (*Passerculus sandwichensis*). *Anim Behav* 33:657-663
- Moore FR, Phillips JB (1988) Sunset, skylight polarization and the migratory orientation of yellow-rumped warblers, *Dendroica coronata*. *Anim Behav* 36:1770-1778
- Moore JG, Rao CRN (1966) Polarization of the daytime sky during the total solar eclipse of 30 May 1965. *Annal Geophys* 22:147-150
- Módis L (1991) Organization of the extracellular matrix: polarization microscopic approach. Boca Raton, FL, CRC Press
- Muller HRA (1937) Een wonderlijke vergissing van Copera marginipes. *De Tropische Natuur* 26:95
- Munk O (1970) On the occurrence and significance of horizontal band-shaped retinal areas in teleosts. *Vidensk Medd Dan Naturhist Foren* 133:85-120

- Nagel MR, Quenzel H, Kweta W, Wendling R (1978) Daylight illumination: color-contrast tables for full-form objects. Academic Press, New York
- Neuberger H (1950) Arago's neutral point: a neglected tool in meteorological research. Bull Am Meteorol Soc 31:119-125
- Neumeyer C (1985) An ultraviolet receptor as a fourth receptor type in goldfish colour vision. Naturwissenschaften 72:162-163
- Neville AC (1960) A list of Odonata from Ghana, with notes on their mating, flight, and resting sites. Proc Roy Entomol Soc Lond A 35:124
- Newall HF (1906) Polarization phenomena in the solar corona 1905, Aug. 30. Month Not Roy Astronom Soc 66:475-481
- Noordwijk MV (1980) Dragonfly behaviour over shining surfaces. Notul Odonatol 1:105
- North JA, Duggin MJ (1997) Stokes vector imaging of the polarized sky-dome. Appl Opt 36:723-730
- Novales Flamarique I, Browman HI (2000) Wavelength-dependent polarization orientation in *Daphnia*. J Comp Physiol A 186:1073-1087
- Novales Flamarique I, Hawryshyn CW (1996) Retinal development and visual sensitivity of young Pacific sockeye salmon (*Oncorhynchus nerka*). J Exp Biol 199:869-882
- Novales Flamarique I, Hawryshyn CW (1997a) Is the use of underwater polarized light by fish restricted to crepuscular time periods? Vis Res 37:975-989
- Novales Flamarique I, Hawryshyn CW (1997b) No evidence of polarization sensitivity in freshwater sunfish from multi-unit optic nerve recordings. Vis Res 37:967-973
- Novales Flamarique I, Hawryshyn CW, Hárosi FI (1998) Double-cone internal reflection as a basis for polarization detection in fish. J Opt Soc Am A 15:349-358
- Novales Flamarique I, Hendry A, Hawryshyn CW (1992) The photic environment of a salmonid nursery lake. J Exp Biol 169:121-141
- Nussenzveig HM (1979) Complex angular momentum theory of the rainbow and the glory. J Opt Soc Am 69:1068-1079
- Papi F (1960) Orientation by night: the moon. Cold Spring Harbor Symp Quantit Biol 25:475-480
- Papi F (1991) Olfactory navigation. In: Berthold P (ed) Orientation in birds. Birkhäuser, Basel Boston Berlin, pp 52-85
- Papi F, Pardi L (1963) On the lunar orientation of sandhoppers (Amphipoda, Talitridae). Biol Bull 124:97-105
- Parkyn DC, Hawryshyn CW (1993) Polarized-light sensitivity in rainbow trout (*Oncorhynchus mykiss*): characterization from multi-unit responses in the optic nerve. J Comp Physiol A 172:493-500
- Parkyn DC, Hawryshyn CW (2000) Spectral and ultraviolet-polarisation sensitivity in juvenile salmonids: a comparative analysis using electrophysiology. J Exp Biol 203:1173-1191
- Pearce F (1995) Devastation in the desert. New Scientist 146 (No 1971):40-43
- Pearce F (1998) Sunny side up. New Scientist 159 (No 2142):45-48
- Pellicori SF (1971) Polarizing properties of pulverized materials with special reference to the lunar surface. Appl Opt 10:270-285
- Pezzaniti JL, Chipman RA (1995) Mueller matrix imaging polarimetry. Opt Engin 34:1558-1568
- Philipsborn A von, Labhart T (1990) A behavioural study of polarization vision in the fly, *Musca domestica*. J Comp Physiol A 167:737-743
- Phillips JB, Waldvogel JA (1982) Reflected light cues generate the short-term deflector-loft effect. In: Papi F, Wallraff HG (eds) Avian navigation. Springer, Berlin Heidelberg, pp 190-202
- Phillips JB, Waldvogel JA (1988) Celestial polarized light patterns as a calibration reference for sun compass of homing pigeons. J Theor Biol 131:55-67

- Pilcher CWT, Sexton DB (1993) Effects of the Gulf War oil spills and well-head fires on the avifauna and environment of Kuwait. *Sandgrouse* 15:6-17
- Piltschikoff N (1906) Sur la polarisation du ciel pendant les éclipses du soleil. *C. R. Acad. Sci. Paris* 142:1449
- Plass GN, Kattawar GW (1970) Polarization of the radiation reflected and transmitted by the earth's atmosphere. *Appl Opt* 9:1122-1130
- Pomozi I (2002) Polarization patterns measured by wide and narrow field-of-view imaging polarimetry with atmospheric optical and biological applications. PhD thesis, Eötvös Univ, Dept Biol Phys, Biooptics Lab, Budapest, p 103 (supervisor: Horváth G) (in Hungarian)
- Pomozi I, Gál J, Horváth G, Wehner R (2001a) Fine structure of the celestial polarization pattern and its temporal change during the total solar eclipse of 11 August 1999. *Rem Sens Environ* 76:181-201
- Pomozi I, Horváth G, Wehner R (2001b) How the clear-sky angle of polarization pattern continues underneath clouds: full-sky measurements and implications for animal orientation. *J Exp Biol* 204:2933-2942
- Pomozi I, Jávorfi T, Menczel L, Garab G (2003) Birefringence mapping of magnetically oriented chloroplasts, determined by a differential polarization laser scanning microscope. *Biophys J* (submitted)
- Popham EJ (1964) The migration of aquatic bugs with special reference to the Corixidae (Hemiptera Heteroptera). *Arch Hydrobiol* 60:450-496
- Povel H (1995) Imaging Stokes polarimetry with modulators and charge coupled-device image sensors. *Opt Engin* 34:1870-1878
- Priestly EB, Wojtowicz PJ, Sheng P (1975) Introduction to liquid crystals. Plenum Press, New York
- Prosch T, Hennings D, Raschke E (1983) Video polarimetry: a new imaging technique in atmospheric science. *Appl Opt* 22:1360-1363
- Przyrembel C, Keller B, Neumeyer C (1995) Trichromatic colour vision in the salamander (*Salamandra salamandra*). *J Comp Physiol A* 176:575-586
- Puschnig R (1926) Albanische Libellen. *Konowia* 5:33, 113, 208, 313
- Ramskou T (1967) Solstesen. *Skalk* 2:16-17
- Ramskou T (1969) Solstesen. Primitiv Navigation I Norden for Kompasset. Kobenhavn, Rhodos, pp 1-96
- Rao NCR (1969) Balloon measurements of the polarization of the light diffusely reflected by the earth's atmosphere. *Planet Space Sci* 17:1307-1309
- Rao CRN, Takashima T, Moore JG (1972) Polarimetry of the daytime sky during solar eclipses. *J Atmos Terrest Phys* 34:573-576
- Robinson PC, Bradbury S (1992) Qualitative polarized-light microscopy. Oxford Sci Publ
- Roslund C (1989) Sun tables of Star-Oddi in the Icelandic sagas. In: Aveni AF (ed) World archaeoastronomy. Cambridge Univ Press, Cambridge
- Roslund C, Beckman C (1994) Disputing Viking navigation by polarized skylight. *Appl Opt* 33:4754-4755
- Rossel S, Wehner R (1984) Celestial orientation in bees: the use of spectral cues. *J Comp Physiol A* 155:605-613
- Rowe MP, Pugh EN Jr, Tyo JS, Engheta N (1995) Polarization difference imaging: a biologically inspired technique for observation through scattering media. *Opt Lett* 20:608-610
- Rozenberg GV (1966) Twilight: a study in atmospheric optics. Plenum Press, New York
- Sandberg R (1991) Sunset orientation of robins, *Erithacus rubecula*, with different fields of sky vision. *Behav Ecol Sociobiol* 28:77-83

- Santschi F (1911) Observations et remarques critiques sur le mécanisme de l'orientation chez les fourmis. *Rev Suisse Zool* 19:303-338
- Santschi F (1923) L'orientation sidérale des fourmis, et quelques considérations sur leurs différentes possibilités d'orientation. I. Classification des diverses possibilités d'orientation chez les fourmis. *Mém Soc Vaudoise Sci Nat* 4:137-175
- Sarto AW, Woldemar CM, Vanderbilt VC (1989) Polarized light angle reflectance instrument. I. Polarized incidence. *SPIE* 1166:220-230
- Sassen K (1979) Angular scattering and rainbow formation in pendant drops. *J Opt Soc Am* 69:1083-1089
- Saunders DS (1981) Insect photoperiodism. In: *Handbook of behavioral neurobiology* (J Aschoff, ed) Plenum, New York
- Saunders RW (1986) An automated scheme for the removal of cloud contamination from AVHRR radiances over Western Europe. *Int J Rem Sens* 7:867-886
- Saunders RW, Kriebel KT (1988) An improved method for detecting clear sky and cloudy radiances from AVHRR data. *Int J Rem Sens* 9:123-150
- Savolainen E (1978) Swarming in Ephemeroptera: the mechanism of swarming and the effects of illumination and weather. *Ann Zool Fennici* 15:17-52
- Schaerer S, Neumeyer C (1994) Motion perception in goldfish is "color blind". In: Elsner N, Breer H (eds) *Proc 22nd Göttingen Neurobiol Conf*. G Thieme-Verlag, Stuttgart, vol II, p 484
- Schenck H (1957) On the focusing of sunlight by ocean waves. *J Opt Soc Am* 47:653-657
- Schmidt-Koenig K (1979) Avian orientation and navigation. Academic Press, London
- Schmidt-Koenig K, Ganzhorn JU, Ranavaud R (1991) The sun compass. In: Berthold P (ed) *Orientation in birds*. Birkhäuser, Basel Boston Berlin, pp 1-15
- Schnall U (1975) Navigation der Wikinger. *Schr Dtsch Schiffahrtsmuseums* 6:92-115
- Schneider L, Langer H (1969) Die Struktur des Rhabdoms im "Doppelauge" des Wasserläufers Gerris lacustris. *Z Zellforsch* 99:538-559
- Schwind R (1978) Visual system of *Notonecta glauca*: a neuron sensitive to movement in the binocular visual field. *J Comp Physiol A* 123:315-328
- Schwind R (1980) Geometrical optics of the *Notonecta* eye: adaptations to optical environment and way of life. *J Comp Physiol A* 140:59-68
- Schwind R (1983a) A polarization-sensitive response of the flying water bug *Notonecta glauca* to UV light. *J Comp Physiol* 150:87-91
- Schwind R (1983b) Zonation of the optical environment and zonation in the rhabdom structure within the eye of the backswimmer, *Notonecta glauca*. *Cell Tissue Res* 232:53-63
- Schwind R (1984a) Evidence for true polarization vision based on a two-channel analyser system in the eye of the water bug, *Notonecta glauca*. *J Comp Physiol A* 154:53-57
- Schwind R (1984b) The plunge reaction of the backswimmer *Notonecta glauca*. *J Comp Physiol A* 155:319-321
- Schwind R (1985a) A further proof of polarization vision of *Notonecta glauca* and a note on threshold intensity for eliciting the plunge reaction. *Experientia* 41:466-467
- Schwind R (1985b) Sehen unter und über Wasser, Sehen von Wasser. *Naturwissenschaften* 72:343-352
- Schwind R (1991) Polarization vision in water insects and insects living on a moist substrate. *J Comp Physiol A* 169:531-540
- Schwind R (1995) Spectral regions in which aquatic insects see reflected polarized light. *J Comp Physiol A* 177:439-448
- Schwind R (1999) *Daphnia pulex* swims towards the most strongly polarized light - a response that leads to 'shore flight'. *J Exp Biol* 202:3631-3635

- Schwind R, Horváth G (1993) Reflection-polarization pattern at water surfaces and correction of a common representation of the polarization pattern of the sky. *Naturwissenschaften* 80:82-83
- Seitz G (1969) Polarisationsoptische Untersuchungen am Auge von *Calliphora erythrocephala* Meig. *Z Zellforsch* 93:525-529
- Sekera Z (1956) Recent developments in the study of the polarization of skylight. In: Landsberg HE (ed) *Advances in geophysics*. Academic Press, New York, vol 3, pp 43-104
- Sekera Z (1957a) Light scattering in the atmosphere and the polarization of skylight. *J Opt Soc Am* 47:484-490
- Sekera Z (1957b) Polarization of skylight. In: Flügge S (ed) *Handbuch der Physik/Encyclopedia of Physics*. Springer, Berlin Göttingen Heidelberg, vol 48, pp 288-328
- Seliger HH, Lall AB, Biggley WH (1994) Blue through UV polarization sensitivities in insects: optimizations for the range of atmospheric polarization conditions. *J Comp Physiol A* 175:475-486
- Sharp WE, Silverman SM, Lloyd JWF (1971) Summary of sky brightness measurements during eclipses of the sun. *Appl Opt* 10:1207-1210
- Shashar N (1995) UV vision by marine animals: mainly questions. In: *Ultraviolet Radiation and Coral Reefs* (D Gulkov, PL Jokiel, eds.) HIMP Techn Rep 41:201-206
- Shashar N, Borst DT, Ament SA, Saidel WM, Smolowitz RM, Hanlon RT (2001) Polarization reflecting iridophores in the arms of the squid *Loligo pealeii*. *Biol Bull* 201:267-268
- Shashar N, Cronin TW, Johnson G, Wolff LB (1995a) Portable imaging polarized light analyzer. Proc Soc Photo-Optical Instrumentation Engineers (SPIE) (9th Meet Opt Engin Israel) 2426:28-35
- Shashar N, Cronin TW, Johnson G, Wolff LB (1995b) Designs for submersible imaging polarimeters. In: Gulkov D, Jokiel PL (eds) *Ultraviolet radiation and coral reefs*. HIMP Techn Rep 41:213-218
- Shashar N, Cronin TW, Wolff LB, Condon MA (1998) The polarization of light in a tropical rain forest. *Biotropica* 30:275-285
- Shashar N, Rutledge PS, Cronin TW (1996) Polarization vision in cuttlefish. A concealed communication channel? *J Exp Biol* 199:2077-2084
- Shaw GE (1975) Sky brightness and polarization during the 1973 African eclipse. *Appl Opt* 14:388-394
- Shaw JA (1999) Degree of linear polarization in spectral radiances from water-viewing infrared polarimeters. *Appl Opt* 38:3157-3165
- Shaw SR (1967) Simultaneous recording from two cells in the locust retina. *Z vergl Physiol* 55:183-194
- Shul'gin IA, Moldau KA (1964) On coefficients of brightness of leaves in nature and polarized light. Dokl Akad Nauk SSR Bot Sci Sect (English translation) 162:99-101
- Shurcliff WA (1962) Polarized light: production and use. Harvard Univ Press, Cambridge, Massachusetts, USA
- Sivak JG, Mandelman T (1982) Chromatic dispersion of the ocular media. *Vis Res* 22:997-1003
- Sivaraman KR, Jayachandran M, Scaria KK, Babu GSD, Bagare SP, Jayarajan AP (1984) Brightness, polarization and electron density of the solar corona of 1980 February 16. *J Astrophys Astron* 5:149-158
- Skrzipek KH, Skrzipek H (1974) Die spektrale Transmission und die optische Aktivität des dioptrischen Apparates der Honigbiene (*Apis mellifera*). *Experientia* 30:314-315
- Smola U, Meffert P (1978) A single UV-receptor in the eye of *Calliphora erythrocephala*. *J Comp Physiol* 103:353-357
- Soret MJL (1888) Influence des surfaces d'eau sur la polarisation atmosphérique et observation de deux points neutres à droite et à gauche de Soleil. *Compt Rend* 107:867-870
- Southwood TRE (1966) Ecological methods. Chapman and Hall, London

- Speck M, Labhart T (2001) Carotinoid deprivation and rhodopsin alignment in R1-6 photoreceptors of *Drosophila melanogaster*. In: Elsner N, Kreutzberg GW (eds) Proc 28th Göttingen Neurobiol Conf. Thieme, Stuttgart, p 514
- Srinivasan MV, Guy RG (1990) Spectral properties of movement perception in the dronefly *Eristalis*. J Comp Physiol A 166:287-295
- Steiner H (1948) Die Bindung der Hochmoorlibelle *Leucorrhinia dubia* Vand. an ihren Biotop. Zool Jhrb, Systematik 78:65-96
- Sternberg K (1990) Autökologie von sechs Libellenarten der Moore und Hochmoore des Schwarzwaldes und Ursachen ihrer Moorbindung. PhD thesis, Univ Freiburg, Freiburg, Germany
- Stevani CV, de Faria DLA, Porto JS, Trindade DJ, Bechara EJH (2000a) Mechanism of automotive clearcoat damage by dragonfly eggs investigated by surface enhanced Raman scattering. Polym Degrad Stabil 68:61-66
- Stevani CV, Liria CW, Miranda MTM, Bechara EJH (2001) Cysteic acid is the chemical mediator of automotive clearcoat damage promoted by dragonfly eggs. J Appl Polym Sci 81:1549-1554
- Stevani CV, Porto JS, Trindade DJ, Bechara EJH (2000b) Automotive clearcoat damage due to oviposition of dragonflies. J Appl Polym Sci 75:1632-1639
- Stockhammer K (1956) Zur Wahrnehmung der Schwingungsrichtung linear polarisierten Lichtes bei Insekten. Z vergl Physiol 38:30-83
- Stockhammer K (1959) Die Orientierung nach der Schwingungsrichtung linear polarisierten Lichtes und ihre sinnesphysiologischen Grundlagen. Ergebni Biol 21:23-56
- Stokes GG (1852) On the composition and resolution of streams of polarized light from different sources. Trans Cambr Phil Soc 9:233-258
- Strutt JW (Lord Rayleigh) (1871) On the light from the sky, its polarisation and colour. Phil Magaz 41:107-120, 274-279
- Timofeeva VA (1961) On the problem of polarization of light in turbid media. Izvestiya Akad Nauk SSSR, Geophysics 5:766-774
- Timofeeva VA (1962) Spatial distribution of the degree of polarization of natural light in the sea. Izvestiya Akad Nauk SSSR, Geophysics 6:1843-1851
- Timofeeva VA (1969) Plane of vibrations of polarized light in turbid media. Izvestiya Akad Nauk SSSR, Atmospheric and Oceanic Physics 5:603-607
- Timofeeva VA (1974) Optics of turbid waters - results of laboratory studies. In: Jerlov N, Steeman-Nielsen E (eds) Optical aspects of oceanography. Academic Press, New York, pp 177-218
- Tinbergen J, Abeln RG (1983) Spectral sensitivity of the landing blowfly. J Comp Physiol A 150:319-328
- Tovée MJ (1995) Ultra-violet photoreceptors in the animal kingdom: their distribution and function. Trends Ecol Evol 10:455-460
- Tricker RAR (1970) Introduction to meteorological optics. Elsevier Publ Co, New York
- Tyler JE (1963) Estimation of per cent polarization in deep oceanic water. J Mar Res 21:102-109
- Ugolini A, Melis C, Innocenti R (1999a) Moon orientation in adult and young sandhoppers. J Comp Physiol A 184:9-12
- Ugolini A, Melis C, Innocenti R, Tiribilli B, Castellini C (1999b) Moon and sun compasses in sandhoppers rely on two separate chronometric mechanisms. Proc Roy Soc Lond B 266:749-752
- Vanderbilt VC, Grant L (1985a) Polarization photometer to measure bidirection reflectance factor $R(55^\circ, 0^\circ, 55^\circ, 180^\circ)$ of leaves. Opt Engin 25:566-571
- Vanderbilt VC, Grant L (1985b) Plant canopy specular reflectance model. IEEE Trans Geosci Rem Sens 23:722-730
- Vanderbilt VC, Grant L, Daughtry CST (1985a) Polarization of light scattered by vegetation. Proc IEEE 73:1012-1024

- Vanderbilt VC, Grant L, Biehl LL, Robinson BF (1985b) Specular, diffuse and polarized light scattered by wheat canopies. *Appl Opt* 24:2408-2418
- Varjú D (1959) Optomotorische Reaktionen auf die Bewegung periodischer Helligkeitsmuster: anwendung der Systemtheorie auf Experimente am Rüsselkäfer *Chlorophanus viridis*. *Z Naturforsch* 14b:724-735
- Varjú D, Horváth G (1989) Looking into the water with a facet eye. *Biol Cybern* 62:157-165
- Vebaek CL, Thirslund S (1992) The Viking compass. Humlebaek, Denmark
- Verbelen JP, Kerstens S (2000) Polarization confocal microscopy and Congo Red fluorescence: a simple and rapid method to determine the mean cellulose fibril orientation in plants. *J Microscopy* 198:101-107
- Vos HJJ, Coemans MAJM, Nuboer JFW (1995) No evidence for polarization sensitivity in the pigeon electroretinogram. *J Exp Biol* 198:325-335
- Voss KJ, Liu Y (1997) Polarized radiance distribution measurements of skylight. I. System description and characterization. *Appl Opt* 36:6083-6094
- Vries HL de, Kuiper JW (1958) Optics of the insect eye. *Ann NY Acad Sci* 74:196-303
- Waack FG (1985) Stereo photography. Germany
- Walcott C, Michener M (1971) Sun navigation in homing pigeons: attempts to shift sun coordinates. *J Exp Biol* 54:291-316
- Waldvogel JA (1990) The bird's eye view. *Am Scient* 78:342-353
- Walraven R (1977) Polarization imagery. In: Azzam RMA, Coffeen DL (eds) Optical polarimetry: instrumentation and applications. *Proc Soc Photo-Opt Instrum Eng* 112:164-167
- Walraven RL (1981) Polarization imagery. *Opt Engin* 20:14-18
- Wang M, Gordon HR (1993) Retrieval of the columnar aerosol phase function and single-scattering albedo from sky radiance over the ocean: simulations. *Appl Opt* 32:4598-4609
- Wang RT, Hulst HC van de (1991) Rainbows: Mie computations and the Airy approximation. *Appl Opt* 30:106-117
- Waterman TH (1954a) Polarization patterns in submarine illumination. *Science* 120:927-932
- Waterman TH (1955) Polarization of scattered sunlight in deep water. *Deep Sea Res* 3: 426-434
- Waterman TH (1981) Polarization sensitivity. In: Autrum H (ed) *Handbook of sensory physiology*. VII/6B Vision in invertebrates. Comparative physiology and evolution of vision in invertebrates B: invertebrate visual centers and behavior I, Springer, Berlin Heidelberg New York, pp 281-469
- Waterman TH, Westell WE (1956) Quantitative effect of the sun's position on submarine light polarization. *J Mar Res* 15:149-169
- Watson JAL (1992) Oviposition by exophytic dragonflies on vehicles. *Notul Odonatol* 3:137
- Wehner R (1976) Polarized-light navigation by insects. *Sci Am* 235(7):106-115
- Wehner R (1981) Spatial Vision in Arthropods. In: Autrum H (ed) *Handbook of sensory physiology* VII/6C Comparative physiology and evolution of vision in invertebrates C: Invertebrate visual centers and behavior II, Springer, Berlin Heidelberg New York, pp 287-616
- Wehner R (1982) Himmelsnavigation bei Insekten. *Neurophysiologie und Verhalten*. *Neujahrsbl Naturforsch Ges Zürich* 184:1-132
- Wehner R (1983) The perception of polarised light. In: Cosens DJ, Vince-Price D (eds) *The biology of photoreception*. Soc Exp Biol Symp 36, Cambridge Univ Press, Cambridge, London, pp 331-369
- Wehner R (1984) Astronavigation in insects. *Ann Rev Entomol* 29:277-298
- Wehner R (1989a) Neurobiology of polarization vision. *Trends Neurosci* 12:353-359
- Wehner R (1989b) The hymenopteran skylight compass: matched filtering and parallel coding. *J Exp Biol* 146:63-85
- Wehner R (1991) Visuelle Navigation: Kleinstgehirn-Strategien. *Verhandlungen Deutschen Zool Gesellschaft* 84:89-104

- Wehner R (1992) Arthropods. In: Papi F (ed) Animal homing. Chapman and Hall, London, pp 45-144
- Wehner R (1994a) The polarization-vision project: championing organismic biology. In: Schildberger K, Elsner N (eds) Neural basis of behavioural adaptations. Gustav Fischer Verlag, Stuttgart Jena New York, *Fortschr Zool* 39:103-143
- Wehner R (1994b) Himmelsbild und Kompaßauge - Neurobiologie eines Navigationssystems. *Verhandlungen der Deutschen Zoologischen Gesellschaft* 87(2):9-37
- Wehner R (1997) The ant's celestial compass system: spectral and polarization channels. In: Lehrer M (ed) Orientation and communication in arthropods. Birkhäuser, Basel, pp 145-185
- Wehner R (1998) Der Himmelskompaß der Wüstenameisen. *Spektrum Wissenschaft* 1998 November:56-67
- Wehner R (1999) Large-scale navigation: the insect case. In: Freksa C, Mark DM (eds) Spatial information theory: cognitive and computational foundations of geographic information science. Springer, Berlin Heidelberg, *Lect Notes Computer Sci* 1661:1-20
- Wehner R (2001) Polarization vision - a uniform sensory capacity? *J Exp Biol* 204:2589-2596
- Wehner R, Bernard GD (1993) Photoreceptor twist: a solution to the false-color problem. *Proc Natl Acad Sci USA* 90:4132-4135
- Wehner R, Bernard GD, Geiger E (1975) Twisted and non-twisted rhabdoms and their significance for polarization detection in the bee. *J Comp Physiol* 104:225-245
- Wehner R, Rossel S (1985) The bee's celestial compass - a case study in behavioural neurobiology. In: Hölldobler B, Lindauer M (eds) Experimental behavioral ecology and sociobiology. Gustav Fischer Verlag, Stuttgart, New York, *Fortschr Zool* 31:11-53
- Wehner R, Strasser S (1985) The POL area of the honey bee's eye: behavioural evidence. *Physiol Entomol* 10:337-349
- Wetzel RG (1975) Limnology. WB Saunders and Co, Philadelphia, USA
- Whitehouse FC (1941) A guide to the study of dragonflies of Jamaica. *Bull Inst Jamaica Sci Ser No 3*, pp 1-69
- Wildermuth H (1980) Die Libellen der Drumlinlandschaft im Zürcher Oberland. *Vierteljahrsschr Naturf Ges Zürich* 125:201-237
- Wildermuth H (1992a) Habitate und Habitatwahl der Grossen Moosjungfer (*Leucorrhinia pectoralis*) Chap. 1825 (Odonata, Libellulidae). *Z Ökol Natursch* 1:3-22
- Wildermuth H (1992b) Visual and tactile stimuli in choice of the oviposition substrates by the dragonfly *Perithemis mooma* Kirby, 1899 (Anisoptera: Libellulidae). *Odonatologica* 21:309-321
- Wildermuth H (1993) Habitat selection and oviposition site recognition by the dragonfly *Aeshna juncea* (L.): an experimental approach in natural habitats (Anisoptera: Aeshnidae). *Odonatologica* 22:27-44
- Wildermuth H (1994) Habitatselektion bei Libellen. *Adv Odonatol* 6:223-257
- Wildermuth H (1998) Dragonflies recognize the water of rendezvous and oviposition sites by horizontally polarized light: a behavioural field test. *Naturwissenschaften* 85:297-302
- Wildermuth H, Krebs A (1983) Sekundäre Kleingewässer als Libellenbiotope. *Vierteljhrschr Naturforsch Ges Zürich* 128:21-42
- Wildermuth H, Krebs A (1987) Die Libellen der Region Winterthur. *Mitteil Naturwiss Ges Winterthur* 38:89-107
- Wildermuth H, Spinner W (1991) Visual cues in oviposition site selection by *Somatochlora arctica* Zetterstedt (Anisoptera: Corduliidae). *Odonatologica* 20:357-367
- Wilson EO (1971) Insect Societies. Harvard Univ Press, Cambridge, Massachusetts, USA
- Wolf R, Gebhardt B, Gademann R, Heisenberg M (1980) Polarization sensitivity of course control in *Drosophila melanogaster*. *J Comp Physiol A* 139:177-191

- Wolff LB (1990) Polarization-based material classification from specular reflection. IEEE Trans Pattern Anal Machine Intell 12:1059-1071
- Wolff LB (1993) Polarization camera technology. Proc DARPA Image Understanding Works, April 1993, Washington DC, USA, pp 1031-1036
- Wolff LB (1994) Polarization camera for computer vision with a beam splitter. J Opt Soc Am A 11:2935-2945
- Wolff LB, Andreou AG (1995) Polarization camera sensors. Image Vision Comp 13:497-510
- Wolff LB, Boult TE (1991) Constraining object features using a polarization reflectance model. IEEE Trans Pattern Analys Machine Intellig 13:635-657
- Wolken JJ (1995) Light detectors, photoreceptors, and imaging systems in nature. Chap 13, Polarized light in nature: detection by animals. Oxford Univ Press, Oxford, New York
- Wolstencroft RD, Brandt JC (1974) Multicolor polarimetry of the night sky. In: Gehrels T (ed) Planets, stars and nebulae studied with photopolarimetry. Univ Arizona Press, Tucson, Arizona, pp 768-780
- Wyniger R (1955) Beobachtungen über die Eiablage von *Libellula depressa* (L.) (Odonata, Libellulidae). Mitt entomol Ges Basel NF5:62
- YES (2001) Description of the TSI-990 Total Sky Imager, Yankee Environmental Systems, Inc., Airport Industrial Park, 101 Industrial Blvd., Turners Falls, MA 01376, USA, <http://www.yesinc.com>, e-mail: info@yesinc.com
- Young AT (1982) Rayleigh scattering. Phys Today 35(1):42-48
- Zalom FG, Grigarick AA, Way MO (1979) Seasonal and diel flight periodicities of rice field Hydrophilidae. Environm Entomol 8:938-943
- Zalom FG, Grigarick AA, Way MO (1980) Diel flight periodicities of some Dytiscidae (Coleoptera) associated with California rice paddies. Ecol Entomol 5:183-187
- Zufall F, Schmitt M, Menzel R (1989) Spectral and polarized light sensitivity of photoreceptors in the compound eye of the cricket (*Gryllus bimaculatus*). J Comp Physiol A 164:597-608
- Zwick P (1990) Emergence, maturation and upstream oviposition flights of Plecoptera from Breitenbach, with notes on the adult phase as a possible control of stream insect populations. Hydrobiol 194:207-223