

**Julian Francis Vincent VINCENT**  
**Professor of Biomimetics**  
**Dept of Mechanical Engineering**  
**University of Bath**  
**d.o.b. Jan 19th 1943**

**Education**

- 1953** Perse School for Boys, Cambridge  
- **1961** O-level - nine subjects; A-level - three subjects (distinction in Chemistry)  
**1962** University of Cambridge (Clare College) **BA (Hons) (2i)**  
-**1965** Natural Sciences Tripos  
Part I - Zoology, Botany, Geology, Experimental Psychology  
Part II - Zoology  
**1965** University of Sheffield, Dept of Zoology **PhD**  
- **1968** *Bursicon, the Hardening and Darkening Hormone in  
Locusta migratoria migratorioides and other Orthoptera*  
**1968** Lecturer in Zoology, University of Reading  
**1970** Elected Fellow of the Royal Entomological Society **FRES**  
**1971** University of Cambridge **MA**  
**1982** University of Sheffield **DSc**  
*The Mechanical, Ultrastructural, Chemical, Physiological and Biological  
Properties of the extensible intersegmental membranes of the African Migratory  
Locust, Locusta migratoria migratorioides*  
**1987** The Institute of Materials **MIM**  
**1991** Established Centre for Biomimetics (with G Jeronimidis)  
**1993** Promoted to Senior Lecturer  
**1997** Elected Fellow of the Royal Society of the Arts **FRSA**  
**1999** Promoted to Professor of Biomimetics  
**2000** Appointed Professor in Dept of Mechanical Engineering, Bath U.  
**2004** Honorary Professor of the University of Jilin, China

**In The University of Reading**

**Departmental Seminars** --- assembling programme of internal and external speakers, organising times and rooms, advertising.

**Post-Graduate Programme** --- establishing times and types of monitoring, suggesting and monitoring extra activities (lectures, directed reading), monitoring establishment and meetings of advisory groups, monitoring general progress of students, organising their research talks.

**Research Grant Applications** --- advice and encouragement in making applications to research councils, charities and industry.

**Director of the Centre for Biomimetics** --- This involved running a 14-strong research group, and maintaining a high profile outside the University (public lectures, interviews for radio and TV, articles for magazines and newspapers), responding to enquiries from industry for contracts and advice, etc.

**Area Safety Officer** --- Since the CfB was so interdisciplinary, the safety officer needed to be aware of biological, chemical and engineering hazards.

**In the University of Bath**

**Director of the Centre for Biomimetic and Natural Technologies** --- This involved running a 10 – 20 -strong research group, and maintaining a high profile outside the University (public lectures, interviews for radio and TV, articles for magazines and newspapers), responding to enquiries from industry for contracts and advice, etc.

## Membership of External Committees, etc

### Research Councils

#### 1998

- EPSRC - Discussion Retreat on *Engineering Challenges for the 21st Century*

#### 1997

- EPSRC - Expert Meeting on *Smart Structures and Materials*

#### 1996

- BBSRC - Plant Cell Wall Group (--> 1998)
- BBSRC - Engineering and Physical Sciences Committee
- BBSRC - Assessment Panel for Institute Performance

#### 1992-5

- AFRC - Engineering Research Board

### Learned Societies

1991 Initiator and Member of the Working Party on Smart Materials, Institute of Materials

1989 - 1996 Biomaterials Group Committee, Institute of Materials

1988 - 1994 Fellowship Committee, Royal Entomological Society of London

1984 - 1989 Materials Science Committee, Institute of Metals

1979 - 1981 Council, Royal Entomological Society of London

1976 - 1979 Meetings Committee, Royal Entomological Society of London

### Editorial Boards (Journals and Series)

2004 *Journal of Bionics Engineering* (Associate Chief Editor)

2001 *Journal of Texture Studies* (Food & Nutrition Press, Inc)

2000 *International Series in Design and Nature* (WITPress)

1999 *Arthropod Structure and Development* (Elsevier)

1993 *Materials Science & Engineering C - Biomimetic Materials, Sensors & Systems* (Elsevier)

1991 *Journal of Smart Materials & Systems* (Inst. of Physics)

1989 *Journal of Intelligent Materials, Systems and Structures* (Technomic); *Journal of Biomedico-Mechanical Behaviour, Materials & Engineering* (IOS Press)

## Publications by Julian FV Vincent

### Refereed Papers in Learned Journals

1. JFV Vincent (1971). Effects of Bursicon on cuticular properties in *Locusta migratoria migratorioides*. *J. Insect Physiol.*, **17**, 625-630.
2. JFV Vincent (1972). Dynamics of release and the possible identity of Bursicon in *Locusta migratoria migratorioides*. *J. Insect Physiol.*, **8**, 757-780.
3. JFV Vincent & SDE Wood (1972). Mechanism of abdominal extension during oviposition in *Locusta*. *Nature, Lond.*, **235**, 167-168.
4. JFV Vincent & JH Prentice (1973). Rheological properties of the extensible membrane of the adult female locust. *J. Mater. Sci.*, **8**, 624-630.
5. JFV Vincent (1973). A novel relationship between two types of elastic cuticle in the locust. *Ent. Exp. Appl.* **16**, 135-136.
6. E Hunter & JFV Vincent (1974). The effects of a novel insecticide on insect cuticle. *Experientia*, **30**, 1432.
7. JFV Vincent (1975). Locust oviposition – stress-softening of the extensible intersegmental membranes. *Proc. R. Soc. Lond. B*, **188**, 189-201.
8. JFV Vincent (1975). How does the female locust dig her oviposition hole? *J. Ent. A*, **50**, 175-181.
9. JFV Vincent (1975). The mechanism of extension of the pleural pleat in adult *Rhodnius prolixus*. *J. Ent. A*, **50**, 183-185.

10. PH Tychsen & JFV Vincent (1976). Correlated changes in mechanical properties of the intersegmental membrane and bonding between the proteins in the female adult locust. *J. Insect Physiol.*, **22**, 115-125.
11. RM Stephens & JFV Vincent (1976). Infrared spectroscopy of locust intersegmental membrane cuticle and its components. *J. Insect Physiol.*, **22**, 601-605.
12. L Clarke, GMH Temple & JFV Vincent (1977). The effects of a chitin inhibitor – Dimilin – on the production of peritrophic membrane in the locust, *Locusta migratoria*. *J. Insect Physiol.*, **23**, 241-246.
13. PP Purslow & JFV Vincent (1978). The mechanical properties of primary feathers from the pigeon. *J. Exp. Biol.*, **72**, 251-260.
14. JFV Vincent & NAF Shawky (1978). The proteins of the urea-soluble fraction of locust intersegmental membrane. *Insect Biochem.*, **8**, 255-261.
15. AE Glaser & JFV Vincent (1979). The autonomous inflation of insect wings. *J. Insect Physiol.*, **25**, 315-318.
16. JE Smeathers & JFV Vincent (1979). Mechanical properties of mussel byssus threads. *J. mollusc. Stud.*, **45**, 219-230.
17. JE Hillerton & JFV Vincent (1979). The stabilisation of insect cuticles. *J. Insect Physiol.*, **25**, 957-963.
18. JFV Vincent (1979). The hardness of the tooth of *Patella vulgata* radula: a reappraisal. *J. mollusc. Stud.*, **46**, 129-133.
19. JFV Vincent & JE Hillerton (1979). The tanning of insect cuticle - a critical review and a revised mechanism. *J. Insect Physiol.*, **25**, 653-658.
20. JFV Vincent (1981). The morphology and ultrastructure of the intersegmental membrane of the female locust. *Tissue & Cell*, **13**, 831-852.
21. JFV Vincent (1982). The mechanical design of grass. *J. Mater. Sci.*, **17**, 856-860.
22. JE Hillerton, SE Reynolds & JFV Vincent (1982). On the indentation hardness of insect cuticle. *J. Exp. Biol.*, **96**, 45-52.
23. JE Hillerton & JFV Vincent (1982). The specific location of zinc in insect mandibles. *J. Exp. Biol.*, **101**, 333-336.
24. JFV Vincent (1983). The influence of water content on the stiffness and fracture properties of grass leaves. *Grass For. Sci.*, **38**, 107-114.
25. JE Hillerton & JFV Vincent (1983). Consideration of the importance of hydrophobic interactions in stabilising insect cuticle. *Int. J. Biol. Macromol.*, **5**, 163-166.
26. AG Atkins & JFV Vincent (1984). An instrumented microtome for improved histological sections and the measurement of fracture toughness. *J. Mater. Sci. Letters*, **3**, 310-312.
27. B Robertson, JE Hillerton & JFV Vincent (1984). The presence of zinc or manganese as the predominant metal in the mandibles of adult stored product beetles. *J. Stored Prod. Res.*, **20**, 133-137.
28. JFV Vincent & L Clarke (1985). Effects of Diflubenzuron on the stabilisation of protein within the cuticular matrix of the locust (Ensifera: Locustidae). *Entomol. General.*, **11**, 15-24.
29. JE Hillerton & JFV Vincent (1985). In vitro aggregation of proteins from insect cuticle. *Entomol. General.*, **11**, 1-9.
30. JFV Vincent & K Gravell (1986). The mechanical design of kelp, *Laminaria digitata*. *J. Mater. Sci. Letters*, **5**, 353-354.
31. JFV Vincent (1986). Computer modelling of the pattern on the shells of *Conus* and other molluscs. *J. mollusc. Stud.*, **52**, 97-105.
32. JFV Vincent & P Owers (1986). Mechanical design of hedgehog spines and porcupine quills. *J. Zool. Lond. (A)*, **210**, 55-75.
33. AP Jackson, JFV Vincent, D Briggs, RA Crick, SF Davies, MJ Hearn & RM Turner (1986). The application of surface analytical techniques to the study of fracture surfaces of mother-of-pearl. *J. Mater. Sci. Letters*, **5**, 975-978.

34. ML Green, KR Langley, RJ Marshall, BE Brooker, A Willis & JFV Vincent (1986). Mechanical properties of cheese, cheese analogues and protein gels in relation to composition and microstructure. *Food Microstructure*, **5**, 169-180.
35. AC Kitchener & JFV Vincent (1987). Composite theory and the effect of water on the stiffness of horn keratin. *J. Mater. Sci.*, **22**, 1385-9.
36. JFV Vincent & S Ablett (1988). Hydration and tanning in insect cuticle. *J. Insect Physiol.*, **33**, 973-979.
37. AP Jackson, JFV Vincent & RM Turner (1988). The mechanical design of nacre. *Proc. R. Soc. B*, **234**, 415-440.
38. JFV Vincent & AC Kitchener (1988). Field experiments in biomechanics. *J. Biol. Educ.*, **22**, 220-224.
39. JFV Vincent (1989). The relation between density and stiffness of apple flesh. *J. Sci. Food Agric.*, **47**, 443-462.
40. AP Jackson, JFV Vincent & RM Turner (1989). A physical model of nacre. *Compos. Sci. Tech.*, **36**, 255-266.
41. AP Jackson, JFV Vincent & RM Turner (1990). Comparison of nacre with other ceramic composites. *J. Mater. Sci.*, **25**, 3173-3178.
42. JFV Vincent & RT Allison (1990). Measuring the forces acting during microtomy by the use of load cells. *J. microsc.*, **159**, 203-210.
43. AA Khan & JFV Vincent (1990). Anisotropy of apple parenchyma. *J. Sci. Food Agric.*, **52**, 455-466.
44. JFV Vincent, P Latham & S Marsden (1990). Strength of bones in chickens. *Vet. Rec.*, **127**, 219.
45. C Lees, JFV Vincent & JE Hillerton (1991). Poisson's ratio in skin. *J. Biomed. / mech. Behav., Mater. Engng.*, **1**, 19-23.
46. JFV Vincent (1991). Strength and fracture of grasses. *J. Mater. Sci.*, **26**, 1947-1950.
47. JFV Vincent, G Jeronimidis, AA Khan & H Luyten (1991). The Wedge Fracture Test – a new method for measurement of food texture. *J. Texture Stud.*, **22**, 45-57.
48. AA Khan & JFV Vincent (1991). Bruising and splitting of apple fruit under uni-axial compression and the role of skin in preventing damage. *J. Texture Stud.*, **22**, 251-263.
49. JFV Vincent & P Wyeth (1991). Characterisation of a hardened biocomposite, zinc-impregnated cuticle. *J. Inorg. Biochem.*, **43**, 675.
50. JFV Vincent & FA Sibbing (1992). How the Grass Carp (*Ctenopharyngodon idella*) chooses and chews its food – some clues. *J. Zool. Lond.*, **226**, 435-444.
51. SA Smith, P Wyeth & JFV Vincent (1992). SEM-EDXA characterisation of metal-impregnated cuticle. *Micron Microscop. Acta*, **3**, 387-388.
52. JFV Vincent, G Jeronimidis, BHV Topping & A Khan (1992). Biomimetics of flexible composites: towards the development of new materials. *Biomimetics*, **4**, 251-263.
53. AA Khan & JFV Vincent (1993). Anisotropy in the fracture properties of apple flesh as investigated by crack-opening tests. *J. Mater. Sci.*, **28**, 45-51.
54. AA Khan & JFV Vincent (1993). Compressive stiffness and fracture properties of apple and potato parenchyma. *J. Texture Stud.*, **24**, 423-435.
55. AC Kitchener, GE Bacon & JFV Vincent (1994). Orientation in antler bone and the expected stress distribution, studied by neutron diffraction. *Biomimetics*, **2**, 297-307.
56. Hepworth DG, Gathercole LJ, Knight DP, Feng D & Vincent JFV (1994). Correlation of ultrastructure and tensile properties of a collagenous composite material, the egg capsule of the dogfish, *Scyliorhinus* spp., a sophisticated collagenous material. *J. Struct. Biol.*, **112**, 231-240.
57. A Willis & JFV Vincent (1995). Monitoring cutting forces with an instrumented histological microtome. *J. Microsc.*, **178**, 56-65.
58. W Wright & JFV Vincent (1996). The mechanics of fracture in plants and its relevance to herbivory. *Biol. Revs.* **71**, 401-413.
59. H-Ch Spatz, EJ O'Leary & JFV Vincent (1996). Young's moduli and shear moduli in cortical bone. *Proc. R. Soc. B* **263**, 287-294

60. M J King & JFV Vincent (1996). Static and dynamic fracture properties of the leaf of New Zealand flax *Phormium tenax* (Phormiaceae: Monocotyledones). *Proc. R. Soc. B* **263**, 521-527.
61. AA Khan & JFV Vincent (1996). The measurement of mechanical damage induced by controlled freezing in apple and potato. *J. Texture Stud.* **27**, 143-157.
62. JFV Vincent & M J King (1996). The mechanism of drilling by wood wasp ovipositors. *Biomimetics* **3**, 187-201.
63. M J King, JFV Vincent & W Harris (1996). Curling and folding of leaves of monocotyledons – a strategy for structural stiffness. *N. Z. J. Bot.* **34**, 411-416
64. D Gower & JFV Vincent (1996). The mechanical design of the cuttlebone and its bathymetric implications. *Biomimetics*, **4**, 37-57.
65. C Dawson, JFV Vincent & A-M Rocca (1997). How scales open in female pine cones. *Nature, Lond.* **390**, 668.
66. M J King & JFV Vincent (1998). Fracture energy during cleaving of *Pinus radiata*. *Eur. J. Wood Wood Prods.* **56**, 259-265.
67. JFV Vincent (1998). The quantification of crispness. *J. Sci. Food Agric.* **78**, 162-168.
68. H Kobayashi, B Kresling & JFV Vincent (1998). The geometry of unfolding tree leaves. *Proc. R. Soc. Lond. B*, **265**, 147-154.
69. H Kobayashi, M Daimaruya & JFV Vincent (1998). Unfolding manner of corrugated plant leaves. *Trans. Jpn. Soc. Mech. Eng.* **64**, 3089-3094 (in Japanese).
70. DG Hepworth, JFV Vincent & W Schuch (1998). Using the viscoelastic properties of the woody tissue from tobacco plants (*Nicotiana tabacum*) to comment on the molecular structure of the cell walls. *Ann. Bot.*, **81**, 729-734.
71. DG Hepworth & JFV Vincent (1998). The mechanical properties of xylem tissue from tobacco plants (*Nicotiana tabacum* cv. samsun). *Ann. Bot.*, **81**, 751-759.
72. DG Hepworth & JFV Vincent (1998). Modelling the mechanical properties of xylem tissue from tobacco plants (*Nicotiana tabacum* cv. samsun) by considering the importance of micro and molecular mechanisms. *Ann. Bot.*, **81**, 761-770.
73. SG Strait & JFV Vincent (1998) Primate faunivores: physical properties of prey items. *Int. J. Primatol.* **19**, 867-878.
74. DG Hepworth & JFV Vincent (1999). The growth response of the stems of genetically modified tobacco plants (*Nicotiana tabacum* ‘samsun’) to flexural stimulation. *Ann. Bot.*, **83**, 39-43.
75. D Quicke, P Wyeth, J Fawke, H Basibuyuk & JFV Vincent (1999). Manganese and zinc in the ovipositors and mandibles of hymenopterous insects. *Zool. J. Linn Soc.*, **124**, 387-396.
76. C Dawson, JFV Vincent, G Jeronimidis, G Rice & P Forshaw (1999). Heat transfer through penguin feathers. *J. Theor. Biol.* **199**: 291-5.
77. H Kobayashi, M Daimaruya & JFV Vincent (1999). Effect of crease interval on unfolding manner of corrugated tree leaves. *JSME Int. J. C*, **42**, 759-767.
78. DG Hepworth, DM Bruce, JFV Vincent & G Jeronimidis (2000). The manufacture and mechanical testing of thermosetting natural fibre composites. *J. Mater. Sci.* **35**, 293-298.
79. K Norris, A Freeman & JFV Vincent (2000). The economics of getting high: decisions made by common gulls dropping cockles to open them. *Behaviour*, **137**, 783-807.
80. MD Alvarez, DEJ Saunders & JFV Vincent (2000). Effect of turgor pressure on the cutting energy of stored potato tissue. *Eur. Food Res. Technol.*, **210**, 331-339.
81. MD Alvarez, DEJ Saunders & JFV Vincent (2000). Fracture properties of stored fresh and osmotically manipulated apple tissue. *Eur. Food Res. Technol.*, **211**, 284-290.
82. DG Hepworth, JFV Vincent, G Jeronimidis & DM Bruce (2000). The penetration of epoxy resin into plant fibre cell walls increases the stiffness of plant fibre composites. *Compos. Part A – Applied Sci.*, **31**, 599-601.
83. T Rama, KS Burton & JFV Vincent (2000). Relationship between sporophore morphology and mushroom quality. *Mushroom Sci.* **15**, 725-731.

84. MD Alvarez, DEJ Saunders, JFV Vincent & G Jeronimidis (2000) An engineering method to evaluate the crisp texture of fruit and vegetables. *J. Textural Stud.* **31**,457-473.
85. M Miessner, M Peter & JFV Vincent (2001) Preparation of Insect-cuticle-like biomimetic materials *Biomacromolecules* **2**, 369-372.
86. DG Hepworth, A Steven-Fountain, DM Bruce & JFV Vincent (2001). Affine versus non-affine deformation in soft biological tissues, measured by reorientation and stretching of collagen fibres through the thickness of compressed porcine skin. *J. Biomechanics* **34**, 341-346.
87. H Kobayashi, M Daimaruya & JFV Vincent (2001). Folding and unfolding of tree leaves with corrugation creases. *Theor. Appl. Mech.* **50**, 81-89.
88. BJ Dobraszczyk, MB Whitworth, JFV Vincent & AA Khan (2002). Single kernel wheat hardness and fracture properties in relation to density and the modelling of fracture in wheat endosperm. *J. Cereal Sci.* **35**, 245-263.
89. JFV Vincent & DL Mann (2002) Systematic technology transfer from biology to engineering. *Phil. Trans. R. Soc. A* **360**, 159-174.
90. A Skordos, C Chan, G Jeronimidis & JFV Vincent (2002) A novel strain sensor based on the campaniform sensillum of insects. *Phil. Trans. R. Soc. A* **360**, 239-254.
91. DG Hepworth, JFV Vincent, G. Stringer & G Jeronimidis (2002) Variations in the morphology of wood structure can explain why hardwood species of similar density have very different resistances to impact and compressive loading. *Phil. Trans. R. Soc. A*, **360**, 255-272.
92. JFV Vincent, DEJ Saunders & P Beyts (2002). The use of stress intensity factor to quantify “Hardness” and “Crunchiness” objectively. *J. Texture Stud.* **33**, 149-159.
93. A. J. Steven-Fountain, A. G. Atkins, G. Jeronimidis, J. F. V. Vincent, D. F. Farrar and R. A. Chivers (2002). The effect of flexible substrates on pressure-sensitive adhesive performance. *Int. J. Adhes. Adhesives*, **22**423-430.
94. JFV Vincent (2003). Arthropod Cuticle: a natural composite shell system. *Composites A*
95. MJ Brennan, SJ Elliott, P Bonello & JFV Vincent (2003) The “click” mechanism in dipteran flight: if it exists, then what effect does it have? *J. Theor. Biol.* **224**, 205-213.
96. JFV Vincent (2003). Biomimetic modelling. *Phil. Trans R. Soc. Lond. B*, **358**, 1597-1603.
97. JFV Vincent (2004). Application of fracture mechanics to the texture of food. *Engineering Failure Analysis*, **11**, 695-704.
98. JFV Vincent (2004). Dynamics of drying in phenolically tanned materials *J. Bionics Engng.*, **1**, 4-8.
99. JFV Vincent et al (2004). Taking biology into TRIZ

#### **Refereed Reviews**

100. JFV Vincent (1990). Fracture properties of plants. *Adv. Bot. Res.*, **17**, 235-287.
101. JFV Vincent (1990). The design of natural materials and structures. *J. Int. Mats. Structs. Systs.*, **1**, 141-146.
102. JFV Vincent (1994). Biomechanics in botany: A general introduction. *Biomimetics*, **2**, 77-85.
103. JFV Vincent (1998). Wood as a material. *Current Opinion Solid State Mater. Sci.*, **3**, 228-231.
104. JFV Vincent (1999). Ideas from Skins. *Interdisciplinary Science Reviews*, **24**, 52-57.
105. JFV Vincent (1999). From cellulose to cell. *J. Exp. Biol.* **202**, 3263-3268.
106. JFV Vincent (2000). Smart by name, smart by nature. *J. Smart Mater. Struct.*, **9**, 255-259.
107. JFV Vincent (2000). Deployable structures in nature: Potential for biomimicking. *Proc. I. MechE*, **214C**, 1-10.
108. JFV Vincent (2000). A unified nomenclature for plant fibres for industrial use. *Appl. Comp. Mater.* **7**, 269-271.
109. JFV Vincent (2002). Survival of the cheapest. *Materials Today* (December), 28-41.
110. JFV Vincent & UGK Wegst (2004). Insect cuticle. *Arthropod structure . . .*

#### **Refereed Conference Proceedings**

111. JFV Vincent (1986). Natural Structural Materials. *The World Biotech Report, 1, Applied Biotechnology*.

112. SP Hopkin, MJ Gaywood, JFV Vincent & ELV Mayes-Harris (1987). Defensive secretion of proteinaceous glues by *Henia* (= *Chaetechelyne*) *vesuviana* (Chilopoda, Geophilomorpha). *Proc. 7th Int. Congr. Myriapodology*
113. JFV Vincent (1988). Plants: designing for fracture. *Proc. Sonderforschungsbereich 230, 'Naturliche Konstruktionen'*, 49-56.
114. JFV Vincent (1989). Toughness in Biological Materials. *Proc. International Workshop on Intelligent Materials*, Tsukuba, Japan, 131-138.
115. JFV Vincent (1990). The mechanical design of insect cuticle. In *US/Japan Workshop on Smart / Intelligent Materials and Systems*, ed I Ahmad, A Crowson, CA Rogers & M Aizawa, pp 187-196. Technomic Publishing Co, Inc.
116. JFV Vincent (1990). Parallel fibres control fracture in biological materials *Mater. Res. Soc. Symp. Proc.*
117. JFV Vincent (1990). Anisotropy and simple mechanics of the flesh of apples *Mater. Res. Soc. Symp. Proc.* **207**, 61-63.
118. AA Khan & JFV Vincent (1990). Fracture properties of an anisotropic biological cellular material apple flesh *Mater. Res. Soc. Symp. Proc.* **207**, 65-68.
119. JFV Vincent, G Jeronimidis, BHV Topping & A Khan (1991). Mechanical Design of Skin. *Proc. Sonderforschungsbereich 230, 'Naturliche Konstruktionen'*.
120. JFV Vincent (1993). Nuts. in MRS Symposium Proceedings **292 Biomolecular Materials**, Materials Research Society, Pittsburgh, Pennsylvania, pp 35-43.
121. Tanouja Rama, Kerry S Burton & Julian FV Vincent (1995). Changes of the surface texture of mushrooms during postharvest storage. *Science and Cultivation of Edible Fungi*, ed. TJ Elliott, Proc 14th Int. Congr. on The Science and Cultivation of Edible Fungi, 729-732.
122. JFV Vincent, AA Khan & J-H Liu (1995). The shape of the wheat kernel and its influence on fracture. In *Wheat Structure, Biochemistry and Functionality* ed JD Schofield, 25-30.
123. JFV Vincent & MJ King (1996). Static and dynamic fracture properties of leaves of New Zealand flax *Phormium tenax* (Phormiaceae: Monocotyledones). *J. Exp Bot.* **47**, suppl., 91.
124. H Kobayashi, M Daimaruya & JFV Vincent (1997). Folding / unfolding manner of simple leaves of several plants as deployable structures. *Int. Conf. on New Frontiers in Biomech. Engng. Japan Soc. Mech. Engrs.*, Tokyo.
125. B Kresling & JFV Vincent (1997). Adaptive growth mechanisms in unfolding tree leaves. *Proc. Plant Biomech. Symp.*, 369-376, Reading.
126. DG Hepworth, W Schuch & JFV Vincent (1997). The viscoelastic properties of the woody tissue from tobacco plants, *Nicotiana tabaccum*. *Proc. Plant Biomech. Symp.*, 65-72, Reading.
127. T Rama, KS Burton & JFV Vincent (1997). Review of mechanical properties and morphology related to mushroom quality. *Proc. Plant Biomech. Symp.*, 295-300, Reading.
128. AA Khan, BJ Dobraszczyk & JFV Vincent (1997). Characterisation of vitreous and mealy wheat endosperm in relation to their mechanical properties and density. *Proc. Plant Biomech. Symp.*, 301-308, Reading.
129. JFV Vincent (1998). The application of materials science to the measurement of fish texture. in *Methods to determine the freshness of fish in research and industry*, ed. Olafsdottir, G, pp 391-395.
130. JFV Vincent (1998). Smart by name, smart by nature. *Proc. 4th Int. Conf. Smart Mater.*, 1-7.
131. UN Hansen, G Jeronimidis & JFV Vincent (1998). An alternative function of cancellous bone. *Proc. 3rd World Congr. Biomechanics WCB '98*, Sapporo, Japan, p 253
132. UN Hansen, JFV Vincent & G Jeronimidis (1998). Impact resistant design of bone. *Proc. PASS '98* Colchester, UK, pp 157-166.
133. JFV Vincent (2000). Choice and chance in the fracture of plants. *Proc 3<sup>rd</sup> Int. Conf. Plant Biomechanics, Freiburg.*, pp 497-505.
134. X Huang, G Jeronimidis & JFV Vincent (2000). The instrumented microtome cutting tests on wood from transgenic tobacco plants with modified lignification. *Proc 3<sup>rd</sup> Int. Conf. Plant Biomechanics, Freiburg.* pp 475-482.

135. L Wang, G Jeronimidis & JFV Vincent (2000). Fracture mechanics of wheat grain endosperm. *Proc 3<sup>rd</sup> Int. Conf. Plant Biomechanics, Freiburg.*, p.506.
136. JFV Vincent (2000). Holes in biological structures – a neglected resource. *Comp. Biochem. Physiol.* **126B**, Suppl. 1, S98.
137. JFV Vincent (2001). Deployable structures for robotics. *Proc. Int. Workshop on MorphoFunctional Machines, Tokyo.*
138. JJ Evans, G Jeronimidis & JFV Vincent (2001). Structural design in insect exoskeletons. *Proc. S.E.M.*
139. JFV Vincent (2001). Arthropod Cuticle – a natural composite shell system. *Proc IPCM, Arcachon.*
140. JFV Vincent (2001). Introduction to, and scope of, Biomimetics. *Proc. Biomimetics in Post-Genome Period, Tokyo*, pp 3-17.
141. JFV Vincent & DL Mann (2001). Systematic technology transfer from biology to engineering, *TRIZ Future 2001, ETRIA, Bath*, 165-276.
142. JFV Vincent (2002). Biomimetics modelling. *Comp. Biochem. Physiol.* **132A Suppl. 1** S86.
143. JFV Vincent & DL Mann (2002). Naturally smart TRIZ. *TRIZcon 2002*
144. A-K Pahl & JFV Vincent (2002). Using TRIZ-based evolution trends to integrate biology with engineering design. *TRIZcon 2002*
145. JFV Vincent (2002). Smart Biomimetic TRIZ. *TRIZ Future, 2002: Proc. ETRIA World Conf. Strasbourg.* 61-68.
146. O Bogatyreva, A-K Pahl & JFV Vincent (2002). Enriching TRIZ with biology. *TRIZ Future, 2002: Proc. ETRIA World Conf. Strasbourg.* 301-308.
147. JJ Evans, G Call G, G Jeronimidis & JFV Vincent (2002) The Morphology of Strain Sensing Features in the Skin of Locusts. *Proceedings of the SEM Annual Conference on Experimental and Applied Mechanics, Milwaukee, Wisconsin, USA*
148. O Bogatyreva & JFV Vincent (2003). Is TRIZ Darwinian? *TRIZcon 2003*, 17-1 – 17-5.
149. O Bogatyreva, A-K Pahl, A Bowyer & JFV Vincent (2003). Data gathering for putting biology in TRIZ. *TRIZcon 2003*, 18-1 – 18-7.
150. JFV Vincent (2003). Application of fracture mechanics to the texture of food. *Anales Mec. Fract. (Proc. 20<sup>th</sup> Encuentro del Grupo Espanol de Fractura)*, 1-7.
151. JFV Vincent (2003). Biomimetic engineering [4763-03]. *European Workshop on Smart Structures in Engineering and Technology, SPIE 4763* pp 16-30.
152. DHB Wicaksono, WA van Duyl, JFV Vincent, & PJ French (2003) Preliminary study on the design of a new micromachined silicon strain sensor based on the campaniform sensillum of insects. *Proc. SAFE Program, Veldhoven, The Netherlands.*
- Chapters in Books and non-refereed Reviews**
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162. JFV Vincent (1993). Mechanical and fracture properties of Fruit and Vegetables. In: *Food Colloids and Polymers: stability and mechanical properties*, ed E Dickinson & P Walstra, Society of Chemistry & Industry, pp 191-203.
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164. JFV Vincent (1994). Texture of plants. In: *Vegetables and Vegetable products, Modern Methods of Plant Analysis* vol 16, ed HF Linskens and JF Jackson, Springer-Verlag, Berlin, pp 57-72.
165. RM Sibly & JFV Vincent (1997). Optimality approaches to resource allocation in woody tissues. In *Plant Resource Allocation* ed FA Bazzaz & J Grace. Academic Press, San Diego.
166. JFV Vincent (1997). Biomimetics. In: *Smart Materials and Systems - Designing with responsive technologies*, ed J Boekbinder. Netherlands Design Institute, pp 7-23.
167. JFV Vincent (1998). The cuticle as an exoskeleton. In: *Microscopic Anatomy of Invertebrates* 11a: Insecta ed FW Harrison & M Locke pp 139-149.
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169. JFV Vincent (1999). Determining the physical properties of skeletal materials. In *Functional morphology of the invertebrate skeleton* ed E Savazzi, J Wiley & Sons Ltd., Chichester, pp 29-36.
170. JFV Vincent & DJ Gower (1999). Structure of the cuttlefish phragmocone. In *Functional morphology of the invertebrate skeleton* ed E Savazzi, J Wiley & Sons Ltd., Chichester, pp 349-354.
171. JFV Vincent (1999). Actuating systems in biology. In *Polymer sensors and actuators* ed. Y Osada & D deRossi, Springer, pp 371-383.
172. BJ Dobrasczyck & JFV Vincent (1999). Mechanical testing of foods. In *Food texture, measurement and perception*, ed A. Rosenthal, pp 99-151.
173. H Kobayashi, M Daimaruya & JFV Vincent (2000). Folding/unfolding manner of tree leaves as a deployable structure. In S Pellegrino & SD Guest (eds), *Deployable Structures: Theory and Applications, Proc. IUTAM Symp. 1998*, Kluwer Academic Publishers, London, pp. 211-220.
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189. M Beaven & JFV Vincent (2004). Architecture and biomimetics: closing the gap.
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199. JFV Vincent (1988). Where biology leads, industry can follow. *Biologist*, **35**, 274-276.
200. JFV Vincent (1988). Why don't we talk any more? *New Scientist*, **120**, 60.
201. JFV Vincent (1989). A leaf from Nature's Book. *The Daily Telegraph*, January 22nd.
202. JFV Vincent (1989). On the benefits of a biological training. *New Scientist*, **122**, 64.
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206. JFV Vincent (1992). Intelligent Materials. *Met. Mat.*, **8**, 13-15.
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208. JFV Vincent (1994). The mute dogs of nature. *Science & Public Affairs, Autumn 1994*, 41-43.
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### Book reviews

217. JFV Vincent (1988). The importance of being cylindrical *New Scientist*, **119**, 74.
218. JFV Vincent (1993). Biomechanics – Structures and Systems. A Practical Approach. Ed A Biewener *Biomimetics*, **1**, 246-247.
219. JFV Vincent (1993). Biomaterials – an Introduction. By JB Park & RS Lakes *Biomimetics*, **1**, 245.
220. JFV Vincent (1993). Plant Biomechanics. An Engineering Approach to Plant Form and Function. By KJ Niklas *Biomimetics*, **1**, 247-248.
221. JFV Vincent (1993). Plant Biomechanics. An Engineering Approach to Plant Form and Function. By KJ Niklas *THES*

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 Proceedings of the 34th Symposium of the Society for Experimental Biology. CUP.  
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 234. JFV Vincent (1990). *Structural Biomaterials* (2nd ed) Princeton University Press, pp xii, 244.  
 235. JFV Vincent & PJ Lillford (eds) (1991). *Feeding and the texture of food*, SEB Seminar Series, CUP,  
 pp x, 247.  
 236. JFV Vincent (ed) (1992). *Biomechanics --- Materials: a Practical Approach*. IRL Press (Oxford  
 University Press), pp xii, 240.  
 237. G Jeronimidis & JFV Vincent (eds) (1997). *Proceedings of the First International Plant  
 Biomechanics Conference I - papers* Centre for Biomimetics, The University of Reading.  
 238. G Jeronimidis & JFV Vincent (eds) (1997). *Proceedings of the First International Plant  
 Biomechanics Conference II - posters* Centre for Biomimetics, The University of Reading.  
 239. JFV Vincent (200?). *Materials of nature - the Nature of materials*. Princeton University Press (in  
 preparation)

### Awards and Prizes

- 1990** Prince of Wales Environmental Innovation Award  
**1983** Leslie Holliday Prize (Materials Science Club / Institute of Materials)  
**1965** Thomas Woodcock Essay Prize (University of Sheffield)

### Consultancies

- 2001** Shell Oil  
**1999** The Green Hat Co.  
**1998** The Technology Partnership  
**1997** Vitacress, Alresford; The Science Museum, London (Materials Gallery)  
**1996-7** Consulting Professor, Scottish Agricultural College, Edinburgh  
**1994** ICI; DERA; Dunlop-Slazenger  
**1992** BlackBox Films, Zurich  
**1989** PA Technology; Compak Systems Ltd; QuoTec; Scientific Generics  
**1986** Celltech  
**1984** Unilever Research

### Research Seminars - UK only

(All were invitations, expenses paid, occasionally with an honorarium)

#### 2004

- University of Sheffield – *Micro Air-Vehicles: the prototypes*
- Royal College of Art – *Stealing ideas from nature*
- Bath Science Society – *Stealing the Best Ideas from Nature*
- FeildenClegg Architects – *Stealing ideas from nature*

#### 2003

- Institute of Physics/British Association – *Biomimetics: Stealing ideas from nature*

- University of Oxford, Dept of Engineering – *Biomimetics: Stealing ideas from nature*
- Rothamsted Sawicki lecture – *Stealing design from nature*
- ARO London – *Jumping robots* (twice!)
- Arup Associates workshop - *Biomimetics*
- Physics Society, Aberystwyth – *Biomimetics: Stealing ideas from nature*
- Newcastle IDS Teachers – *Biomimetics: Stealing ideas from nature*
- Food Texture Club – *The origins of crispness*

## 2002

- The Bartlett, University College, London – *Stealing Ideas from Nature.*
- Dept of Architecture, University of Oxford Brookes – *Stealing ideas from Nature.*
- Dept of Engineering, University of Bath – *Insect cuticle – a natural fibrous composite.*

## 2001

- 2001 The Martin Centre, Cambridge – *Deployable Structures in Nature*
- 2002 University of Bristol Dept of Engineering – *Holes*
- 2003 ICI Research Wilton – *Biomimetics*
- 2004 Foster and Partners, London – *Stealing ideas from nature*
- 2005 Dept of Architecture, Westminster University – *Technical ideas from nature*

## 2000

- 2006 Dept of Materials, UMIST – *Stealing ideas from nature*
- University of Southampton Institute of Sound and Vibration Research – *Mechanical Design of plants.*
- The Bartlett, University College, London – *Stealing Ideas from Nature.*

## 1999

- University of Westminster, Dept of Architecture – *Deployable Structures in Nature*
- Royal College of Art – *Curves and folds*
- Gillette Ltd - *Biomimetics*

## 1998

- University of Exeter Dept of Biology - *Nature as a source of design*
- Henley Management College - *Strategies for success - creativity*
- Chelsea College of Art and Design - *Nature by Design*
- University of Sheffield Dept of Engineering Materials - *A biomimetics approach to materials science*
- Royal College of Art - *From Worms to Wearables*
- Sheffield University Dept of Engineering - *A biologist's perspective of smart systems and structures*
- University of Westminster, Dept of Architecture - *Material lessons from nature*

## 1997

- University of Oxford, Dept of Zoology - *Breaking into Zoology with Fracture Mechanics*
- University of Newcastle, Dept of AES - *Biology and engineering - can you see the join?*
- The Architectural Association - *Material lessons from nature*
- European Intelligent Buildings Group - *Material lessons from nature*
- Unilever - The Colworth Seminar - *Stealing ideas from nature*
- The Welding Institute - *Stealing joints from nature*
- University of Southampton Institute of Sound and Vibration Research - *Biomimetics*
- University of Sheffield Dept of Electronics - *Biological microactuators*
- The Architectural Association - *Stealing ideas from Nature*

## 1996

- Institute of Physics Branch AGM, Oakham - *Texture of Food*
- Institute of Physics Branch Meeting, Univ. of Warwick - *Texture of Food*

- Dept of Physics, Univ. of Loughborough - *Chewing it over - the texture of food*
  - AFQ - LINK meeting - *Measuring the texture of crisp foods*
- 1995**
- Horticulture Research International, Wellesbourne - *Plant Biomechanics*
  - University of Reading Dept of Physics - *Plant Biomechanics*
  - University of Reading Dept of Food Science - *Sensory Evaluation of Food Texture*
  - Newcastle branch of the Institute of Materials - *Biomimetics*
  - SCI Food Section AGM, Reading - *Crispness and Texture of Food*
  - University of Surrey Materials Department - *Biomimetics*
- 1994**
- University of Cambridge, Cavendish Laboratory - *Fracture and the Texture of Food*
  - West of England branch of the Institute of Materials - *Smart Materials*
  - Zeneca plc, Macclesfield - *Mechanical Properties of Bone*
- 1993**
- University of Cambridge Dept of Engineering - *Biomimetics*
  - University of Manchester Dept of Biology - *Mechanical Design of Plants*
- 1992**
- NRI, Chatham - *Mechanical Design of Plants*
  - University of Sussex, Dept of Chemistry - *Mechanical Design of Plants*
  - University of Leicester Dept of Engineering - *Fracture of Biological Ceramics*
  - AFQ-LINK meeting - *Mechanical properties of apple flesh and other parenchymas*
- 1991**
- ICI New Materials Group, Runcorn - *Zinc in Biological Composites*
  - AWE, Aldermaston - *Fracture Toughness of Biological Materials*
  - University of Oxford, Metallurgical Society - *Toughness of Biological Materials*
- 1990**
- ICI Annual Composites Dinner, Runcorn - *Biological Composites*
  - Western England Branch, Institute of Metals - *Parallel-fibred Biological Materials*
  - London Institute of Agricultural Botany - *Mechanical Design of Apples*
- 1989**
- ICI Wilton Advanced Materials - *Recent Advances in Smart Materials*
  - Scientific Generics, Cambridge - *Recent Advances in Smart Materials*
  - University of Oxford, Dept of Zoology - *Parallel-fibred Biological Materials*
  - University of Cambridge, Cavendish Laboratory - *Biological Materials*
- 1988**
- University of Leeds, Dept of Biology - *Parallel-fibred Biological Materials*
- 1987**
- PA Technology, Cambridge - *Biomechanics*
- 1985**
- Brunel University, Dept. of Materials Research - *Biological Composites*
  - East Malling AFRC Inst of Horticulture - *Mechanical Design of Apples*
  - London Zoological Society - *Hedgehog Spines & Porcupine Quills*
- 1984**
- ICI New Materials, Runcorn - *Biomaterials*
  - ICI Paints, Slough - *Zinc in Biological Composites*
  - Open University - *Mechanical Design of Plants*
  - University of Bristol, HH Wills Physics Lab - *Biological Ceramics*
- 1983**

- University of Leeds Rheumatology Research Unit - *Water in Biological Materials*
- John Innes Institute, Norwich - *Mechanical Design of Plant Stems*

**1982**

- Pest Infestation Control Laboratory Slough - *Insect Pesticides Affecting Cuticle*

**1981**

- University of Exeter, Dept of Biology - *Stretchy Cuticle in the Locust*

**1980**

- Grasslands Research Institute, Hurley - *Mechanical Design of Grass*
- ICI Mond Divn., Runcorn - *Biomaterials*

**1978**

- Thames Valley Biology Centre - *Pheromones in Insects*
- Reading Natural History Society - *Biomechanical Approach to Ecology*
- University of Sussex Zoology Dept - *Biomaterials*

**1976**

- University of Manchester Dept of Zoology - *Stretchy Cuticle in the Locust*

**1975**

- University of Strathclyde Bioengineering Dept - *Mechanical Properties of Filled Composites*

**1973**

- University of Cambridge Dept of Zoology - *Morphology & Development of Extensible Insect Cuticle*

**1971**

- University of Oxford, ARC Insect Physiology Unit - *Extensible Insect Cuticle*
- Oxford University Entomological Society - *Hormones and Insect Cuticle*
- Royal Entomological Society monthly meeting - *Extensible Insect Cuticle*

### **Conference Presentations**

(invitation and full expenses paid for those conferences asterisked)

**2004**

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**2003**

- Biomimetics 8 (Reading) – *Biomimetics in Architecture*

**2002**

- 2007 \*Society for Experimental Biology – *Biomimetics as modelling*

**2001**

- \*The Royal Society – Conference on Elastic Proteins (Session Chair)

- 2008 \* Novartis Foundation – Session Chair and presentation – *Biomimetic materials*

- 2009 \*Biomimetics 6, Reading – *Chitin and cellulose in composite materials*

- 2010 First ETRIA TRIZ conference, Bath – *2 papers*

**2000**

- 2011 Gaia Research – Animal Architecture Seminar – *Technology transfer; Biomimetics models*

- 2012 \*SEB Millennium meeting – *Holes, a neglected resource.*

- 2013 \*Biomimetics 5, Reading – *Taking nature to engineering with TRIZ*

**1999**

- \* Designs for Life: The Science of Biomechanics (A symposium to celebrate the work of R McNeill Alexander, FRS) - *From Cellulose to Cells*

**1998**

- \* Leatherhead Food RA, Advances in Texture - *The Measurement of Crispness*

- \* The Architectural Association - *Control of temperature and humidity in natural organisms and their houses*
- \* 4th European Conference on Smart Structures and Materials (Plenary Lecturer; session chairman) - *Smart by name, smart by nature*
- \* Institute of Physics Annual Meeting- *Biomimetics in Smart Systems*
- \* Society for Experimental Biology - *Mechanism of closing of the Venus Fly Trap*
- Deployable Structures: theory and Applications (Cambridge Dept of Engineering) - *Folding / unfolding of tree leaves as deployable structures*

#### **1997**

- \* International Unilever Conference on Crystallisation (Guest lecture) - *Stealing the best from nature*

#### **1996**

- Society for Experimental Biology, Lancaster - *Static and dynamic properties of the leaf of Phormium tenax*
- Society for Experimental Biology, Lancaster - *Young's moduli and shear moduli in cortical bone*
- Royal Entomological Society Hymenoptera Workshop - *How a wasp drills into wood*
- Institute of Materials, Reading - *Biomimetics, an introduction*

#### **1995**

- \* Society for Experimental Biology, St Andrews - *Biomimetics, an Introduction*
- \* Society for Experimental Biology, St Andrews - *Biomimicry of Skin*
- \* SCI Wheat conference, Reading - *Mechanical properties of wheat and the shape of wheat grains*
- \* Institute of Materials, Smart Materials - *Biomimetics as a Route to Smartness*

#### **1994**

- \* Royal Institution - *Display on Biomimetics at Evening Discourse*

#### **1993**

- \* University of Cambridge - *Plants as cellular materials* (Euromech Symposium)

#### **1991**

- Highgrove House - *Participated in Innovation Conference*
- \* Henderson Colloquium on New Structural Materials, International Association for Bridge & Structural Engineering

#### **1989**

- Society for Experimental Biology. Seminar Series on Feeding and the Texture of Food - *Texture of Plants*
- \* Institute of Metals, Natural Technology Seminar - *Insect Cuticle*

#### **1988**

- \* Society for Experimental Biology, Lancaster - *Fracture of Plant Tissues*

#### **1987**

- \* Society for Experimental Biology, Manchester - *Mechanical Design of Fossil Plants*

#### **1986**

- \* OnLine International Conference, Wembley - *Biomechanics*

#### **1985**

- Royal Entomological Society Workshop on Insect Cuticle - *Water Binding in Cuticle*
- \* Institute of Metals - *Adhesion by Animals and Plants in Aqueous Environments*

#### **1983**

- Society for Experimental Biology, Bristol - *Mechanical Design of Plant Stems*

#### **1982**

- \* Materials Science Club, Biomaterials in Industry - *Insect Cuticle*

## **1981**

- \* School Science Teachers Conference, Belfast - *Experiments with Biomaterials*

## **1980**

- Society for Experimental Biology, Oxford - *Water & Tanning in Insect Cuticle*

## **1979**

- School Science Teachers Conference, Reading - *Biomechanics in Schools*
- Society for Experimental Biology Symposium on Mechanical Properties of Biological Materials - *Mechanical Design of Insect Cuticle*

## **1978**

- Royal Entomological Society Cuticle Workshop - *Water Binding in Insect Cuticle*
- 1st European Congress of Entomology, Reading - *Stretchy Insect Cuticle*

## **1976**

- British Rheological Society, Plymouth - *Stretchy Insect Cuticle*

## **1973**

- Society for Experimental Biology, Reading - *Mechanical Properties of Insect Cuticle*

## **1972**

- Joint UK-Dutch Endocrinology meeting, University of Hull - *Hormones and Insect Cuticle*

## **1971**

- Society for Experimental Biology, London - *Stretchy Insect Cuticle*

## **1969**

- European Congress of Comparative Endocrinology, Utrecht - *Hormones and Insect Cuticle*

## **Meetings and Sessions organised at Conferences**

### **2004**

- Conference on biological inspiration for robots

### **1997**

- Session on Animal Architecture, Soc. Exp. Biol. Annual Meeting, Canterbury

### **1989**

- Workshop on Insect Cuticle for Royal Entomological Society
- Seminar Series Symposium on Food and Feeding for Society for Experimental Biology.
- Special Seminar on Natural Technology for the Institute of Metals

### **1988**

- Organiser of Special Interest Group on cuticle for Royal Entomological Society

### **1987**

- Meeting on Fracture Properties of Food for the Institute of Metals

### **1986**

- OnLine International Conference at Wembley Conference Centre - Helped organise a one-day session on Biomaterials

### **1985**

- Royal Entomological Society - one-day meeting on Insect Cuticle
- Institute of Metals - one-day meeting on Adhesion in Aqueous Environments
- British Museum of Natural History - display on the History of British Entomology and of the Royal Entomological Society (displayed for 3 months in the BMNH)

### **1982**

- Royal Entomological Society - one-day meeting on Insect Cuticle
- Materials Science Club - one-day meeting on Biomaterials in Industry

### **1979**

- Society for Experimental Biology - Initiated and organised the 34th International Symposium on The Mechanical Properties of Biological Materials

**1978**

- Royal Entomological Society - one-day meeting on Insect Cuticle

**1973**

- Society for Experimental Biology - one-day session on Biomechanics

## **Membership of External Committees**

### **Conferences**

**2004**

**2014** Organising Committee, Nagoya, Japan – *Biomaterials Materials Processing 4*

**2003**

**2015** Organising Committee, Nagoya, Japan – *Biomaterials Materials Processing 3*

**2016** Arts Council – *Interdisciplinary Arts Taskgroup*

**2002**

- Organising Committee, Nagoya, Japan – *Biomaterials Materials Processing 2*

**2001**

**2017** Scientific Committee, *Smart Technology Demonstrators and Devices*

**1997**

- Organising Committee, *Third International Meeting on Plant Biomechanics, Freiburg*
- Advisory Board, *4th International Conference on Intelligent Materials*

**1996**

- Organising Committee, IoM one-day conference, *Biomimetics - Ideas from nature are SMART*

**1995**

- Organising Committee, *Second International Meeting on Plant Biomechanics, Reading*

**1978**

- Organising Committee of the 1st Symposium of European Comparative Entomology, Reading

## **Public Lectures**

**2003**

- CASE/RIBA - *Zoomorphic architecture*
- V&A – *Zoomorphic architecture*

**2002**

- BA Festival of Science, Leicester – *Listen while you eat*

**2000**

- Science Museum, London - *Smart Plants*

**1997**

- Royal Society of the Arts, The Trueman Wood Lecture - *Stealing Ideas from Nature*
- Second International Conference on Plant Biomechanics - *Smart Plants*

**1996**

- 8th Edinburgh International Science Festival - *Chewing it over*
- Ashmolean Natural History Society Christmas Lecture for Children - *Why Apples go Crunch*

**1995**

- 7th Edinburgh International Science Festival - *Chewing it over*

**1994**

- 6th Edinburgh Science Festival - *Biomimetics*

**1991**

- University of Reading Schools Lecture - *Mechanical Design of Plants*

**1985**

- Thames Valley Biology Centre - *Respiration in Insects*

**1983**

- University of Reading Schools Lecture - *Mechanical Design of Organisms*

**Exposure in Radio, Television and other Media****2002**

- 2018 BBC Archaeology – Making a Roman catapult

**2001**

- 2019 NOW TV - Live studio broadcast on biomimetics

**2000**

- 2020 Wild Ideas (BBC Natural History)

- 2021 Natural Design (Radio 4)

- 2022 Wild Design (New Zealand TV)

- 2023 Animal Design (Austrian TV)

**1999**

- 2024 The Cutting Edge (Radio 4) – Live interview

- 2025 Deadline 2000 (Channel 4) – Filmed “talking head” monologue

- 2026 BBC World Service

**1998**

- The Material World (Radio 4) – Live interview

- Several interviews for BBC World Service

- Prominent feature in the Science Museum *Challenge of Materials* Gallery

- Thames Valley Radio (BBC) - Live interview on *food texture*

- Articles (written by the Science Correspondents) on Biomimetics in *The Guardian, The Independent, The Financial Times, The Times, Sunday Times*

- Tomorrow’s World Plus (interview with Peter Snow) - *Biomimetics*

- Costing The Earth (Radio 4) - *Biomimetics*

**1997**

- Thames Valley Radio (BBC) - 2 live interviews on *biomimetics*

- The Natural History Programme (Radio 4) - *Homes without hands*

- Science Now (Radio 4) - *Smart materials and pine cones*

- The Times - *Article by Defence Correspondent*

**1996**

- Absolutely Animals - Channel 4 series on *animals in technology*

**1995**

- Science Now (Radio 4) - *crisp textures of food*

**1994**

- Science Now (Radio 4) - *apples and other foods*

- Science Now (Radio 4) - *Smart Materials and novel foods*

**1993**

- Horizon programme on Smart Materials - *The New Alchemy*

- Science Now (Radio 4) - nut shells

- Consultant for BBC2 Series *Nature by Design*

**1992**

- Consultant on Horizon programme on intelligent materials

- Appeared in Tomorrow’s World with Water Weed Harvester

**1978**

- Horizon programme - *Nature’s Engineering*

## Lectures for Schools

2003

- Charterhouse

1998

- Bexleyheath School, Kent (School Science Week) - *Chewing it over*
- Maiden Earley School, Reading - *Engineering and biology - the creative interface*

1996

- Oakham School, Rutland - *Texture of Food*

1982

- Cheltenham College, Cheltenham - *Biomaterials*
- Eton College, Eton - *Biomaterials*

1981

- Canford School, Dorset - *Biomaterials*

1980

- Marling School, Stroud - *Biomaterials*

## Higher degrees examined

2004 I Booth, De Montfort University – *Monitoring the progress of retting in bast fibre crops* - PhD

2002 CJ McConnell, University of Liverpool – *Teeth . . .* – PhD (failed)

**Sompit Moi Fusakul, Royal College of Art – *Development of interactive Jewellery* – PhD**

2000 J Sirichaisit, UMIST – *Deformation processes in synthetic and natural polymer fibres* – PhD

1999 SA Maskill, Leeds – *Micro-mechanisms of failure in natural composite materials* - PhD

1998 SJ Amber, UEA, Norwich - *Cell-wall cross links, their importance in plant mechanical properties* - MPhil

1997 Dr MJ O'Dogherty, University of Reading - application for DSc

1996 UGK Wegst, University of Cambridge - *The mechanical performance of natural materials* - PhD

1995 C Smith, University of Leeds - *The mechanical properties of tissues used in tissue banking* - PhD

1985 PhD thesis on fracture of carrots, Silsoe Agricultural College

1984 Hickey PhD Thesis on spine mechanics, University of Manchester

## Patents – granted or applied for

2000

2027 Contractile elastoplast for wound closure (with AW Giles & G Giddins)

1999

- A novel type of strain sensor (with G Jeronimidis)
- Porous Film or Material (With C Dawson)

1997

- Waterproofing paper biodegradably

1989

- Water Weed harvesting machine (with G Jeronimidis)

## Invitations outside the UK

(All invitations, expenses paid, occasionally with an honorarium)

## Fellowships

1998-9

- Institute of Advanced Studies, Berlin (10 months)

#### 1995

- Senior Visiting Research Fellowship, Industrial Research Ltd, Christchurch, New Zealand (4 months)
- Distinguished Visitor, Massey University, New Zealand (1 week)

#### 1987

- Senior Visiting Research Fellowship, The Agricultural University of Wageningen (6 months)

### **Conferences (Session chairs, Organising committee, papers), Research seminars and short courses**

#### 2004

- Nagoya, Japan, BMMP-4 – Scientific Committee, Session chair and paper: *Effects of hydration on the mechanical properties of biological materials*
- MRS Boston
- Bioniks meeting, Hannover – Member of organising committee, Plenary Lecture
- Jilin University, China – *Stealing ideas from nature*

#### 2003

- University of New Mexico, Albuquerque – *Biomimetics: Stealing design from nature*
- University of Washington, Seattle – *Biomimetics: Stealing design from nature*
- TRIZcon2003 – 2 papers on TRIZ
- ARO Workshop on MAVs - *Biomimetics*
- Materials Science Conference, Valencia – *Fracture properties of food*
- Wageningen – *Introduction to the fracture properties of crisp food*
- Nagoya, Japan – *Biomaterials Materials Processing 3 – Biological Prototyping*
- Max-Planck Institute, Potsdam (10-lecture course on Biomimetics and 1 public lecture)
- Swedish Paper Research Institute – *Stealing the best from nature*
- Material Vision, Frankfurt – *Biomimetics in sports clothing*
- WOIS conference – *Biological directions for Innovation*

#### 2002

2028 Workshop at MediaLab Europe, Dublin

- Wageningen Centre for Food Research – *Food Summit on Texture Dynamics*
- TRIZcon2002 – 2 papers on TRIZ
- ASSET – *Biomimetic Engineering*
- TU-Berlin Dept of Architecture – *Stealing ideas from Nature*
- ETRIA, Strasbourg – 3 papers on TRIZ
- STW SeSens, Veldhoven, The Netherlands – *Biomimetic sensors and actuators in robotics*

#### 2001

2003 International Workshop on Morpho-functional Machines (Japan – JSPS) – *The lightweight morphology of deployable structures in biology*

2004 Workshop on Biomimetic Materials Synthesis, Nagoya (Japan – RFTF/JSPS) – *Managing the interface between Biology and Engineering*

2005 Dept of Engineering, Duke University, NC, USA – *Stealing ideas from nature*

2006 Santander Summer School – *Mechanical design of Animals, Mechanical Design of Plants, Technology Transfer.*

2007 Plenary lecture; session chair, IPCM, Arcachon, France - *Insect cuticle for making composite shell structures*

2008 Pisa Gel conference *A biomimetic two-dimensional conveyor system*

**2009** Tokyo, Inaugural meeting of the Japanese Society for Biomimetics – Introductory paper

**2010** Nagaoka University – *Stealing ideas from nature*

**2000**

- Co-organiser, session chairman and plenary lecture, 3rd International Plant Biomechanics Conference, Freiburg - *Fracture mechanics of plants*
- Hierarchical Organization of Polysaccharides and Lignocellulosics. An inspiration for New Materials, Chalmers University, Sweden - *The utility and versatility of polysaccharides*
- Max-Planck Institute, Potsdam – *Stealing ideas from Nature*

**1999**

- Wright-Patterson AFB (USAF) – *Insect cuticle as a multifunctional material*
- Institute of Advanced Studies, Berlin – *Biomimetics*
- Wageningen Centre for Food Research - *Current state of food texture studies*
- Dept of Experimental Morphology, Wageningen – *Biomimetics and smart materials*

**1998**

- DARPA, Washington – *Multifunctional materials in nature*
- Observatoire Français des Techniques Avancées, University of Paris, *Biomimetics for the advancement of Technology*
- Doors of Perception, Netherlands Design Institute – *Biomimetics in architectural design*
- Smart Materials Workshop, Netherlands Design Institute - *Biomimetics*
- TexTech II, “Concepts of Nature”, Sandberg Institute, Gert Reidvelt Academy, The Netherlands - *Skins, from worms to wearables*
- University of Freiburg - *Mechanics and design of leaves*
- Co-organiser, session chairman and author, First International Symposium on the Mechanics of Plants, Animals and their Environment, Santa Barbara - *The right materials for making plants*

**1997**

- EU AIR3 Concerted Action on Fish Freshness - *Measuring “texture” of fish flesh*

**1996**

- Smart Materials Workshop, Netherlands Design Institute - *Biomimetics*
- First Joint UK-Japanese International Symposium on Smart Materials in Tokyo, Japan - *Sensory systems in animals*
- Chaired one session of First Joint UK-Japanese International Symposium on Smart Materials in Tokyo; member of the International Organising Committee
- New Zealand Public Radio - *feature-length interview on Biomimetics*
- First Nordic Meeting on Composites, Materials and Mechanics, Piteå, Sweden. Plenary opening lecture - *Natural composite materials*
- Seventh SIComp conference on Manufacturing and Design of Composites, Piteå, Sweden. Plenary opening lecture - *Adaptive composites*

**1995**

- University of Canterbury, New Zealand - *Fracture properties of wood and related materials*
- Massey University, New Zealand - *Designing the Drip-free drink*
- Massey University, New Zealand - *Strength and fracture of wood and other plant materials*
- University of Otago, New Zealand - *Designing the Drip-free drink*

**1994**

- Montpellier First International Meeting on Plant Biomechanics - Invited Opening Plenary Lecture - *Plant Biomechanics*.
- Chaired a session at the First International Meeting on Plant Biomechanics, Montpellier, and was on the scientific organising committee
- SFB230 Stuttgart - Plenary paper - *Resource Allocation in Plants with respect to Mechanical Design*.
- Chaired a session at the SFB230 Stuttgart and was on the scientific organising committee

### **1993**

- 2nd Smart Polymers Meeting Wollongong, S Australia - Plenary Speaker - *Biomimetic smart structures*
- University of Sydney, Australia, Dept of Mechanical Engineering - *Biomimetics*
- University of Auckland, New Zealand, Dept of Engineering - *Biomimetics*
- University of Auckland, New Zealand, Dept of Zoology - *Mechanical Design of Organisms*
- Industrial Research Ltd, Christchurch, New Zealand - *Biomimetics*
- University of Sydney, Australia, Dept of Mechanical Engineering “Composites Workshop” - *Natural Composites*

### **1992**

- University of Connecticut, Dept. of Materials Science - *Biomaterials*
- United Technologies Research Center, Connecticut - *Insect Cuticle as a Composite Material*
- Zurich, Switzerland, Institute of Polymers, Technische Hochschule - *Biomaterials*
- Tsukuba, Japan, International Workshop on Bionic Design - *Toughness of skin*
- Society for Chemistry in Industry Foods, The Netherlands - *Fracture and design of plants*
- Virginia Polytechnic Institute, Blacksburg, Virginia, USA, Recent Advances in Intelligent Materials & Smart Structures, The Main Keynote speaker - *Toughness of skin*
- US Army Research Office Workshop on Nanotechnology, Jekyll Island, Georgia Invited paper - *Insect Cuticle*
- US Materials Research Society, Fall Meeting, Boston, USA - *Fracture toughness of nut shells*. Also chaired a session.

### **1991**

- San Diego Workshop on Ceramic composites - *Biological Ceramics*
- Seattle International Workshop of Biomimetic Materials - *Natural Composites*
- European Composites Forum, The Netherlands - *Natural composites*
- Sonderforschungsbereich (SFB) 230, Stuttgart - *Toughness of skin*

### **1990**

- Member of the International Committee on Intelligent Materials (based in Japan)
- International Japanese-American Workshop on Intelligent / Smart Materials, Honolulu, Hawaii - *Design of Insect Cuticle*
- US Materials Research Society Fall meeting (Boston, USA) - *Fracture properties of Apple Flesh*
- US Materials Research Society Fall meeting (Boston, USA) - *Mechanical Design of Apples*
- US Materials Research Society Fall meeting (Boston, USA) - *Parallel-fibred Biological Materials*
- Office of Naval Research, Washington - *Biological Materials*
- Office of Naval Research, Washington - *Insect Cuticle as a Composite Material*
- US Army Research, Natick - *Biological Materials*
- USAF Bolling Base, Washington - *Biological Materials*

- USAF Wright Patterson Air Base - *Mechanical Design of Plants and Fracture control in biological materials*

#### **1989**

- Swedish Forest Products Institute, Stockholm - *Insect Cuticle*
- First British-Portuguese Joint Meeting on Rheology, Estoril - *Plasticisers in Biological Ceramics*
- Tsukuba Science City, Japan, Workshop meeting on Intelligent Materials - *Toughness in Biological Materials*

#### **1985**

- University of Dusseldorf Dept of Zoology - *five seminars on all aspects of Biomechanics*
- University of Tübingen Dept of Palaeontology - *Biomechanics*
- University of Stuttgart Lightweight Structures Institute - *Biomechanics*

#### **1984**

- 17th International Congress of Entomology, Hamburg - *Organised a session on Insect Cuticle*
- 17th International Congress of Entomology, Hamburg - *Hydrophobic Proteins in Insect Cuticle*
- 17th International Congress of Entomology, Hamburg - *Effects of DFB on Insect Cuticle*
- 17th International Congress of Entomology, Hamburg - *Mechanical Properties of Insect Cuticle*

#### **1983**

- JW Goethe-University, Frankfurt - *Mechanical Properties of Insect Cuticle*

#### **1982**

- Society for Experimental Biology, Leiden - *Organised a session on Biomechanics*
- Society for Experimental Biology, Leiden - *Mechanical Design of Grass*

#### **1981**

- School Science Teachers Conference, Belfast - *Experiments with Biomaterials*

#### **1978**

- Society for the Comparative Biology of Skin, Copenhagen - *Mechanical Effects of Water in Biological Materials*

#### **1974**

- Duke University Dept of Zoology - *Morphology & Development of Extensible Insect Cuticle*
- Duke University Dept of Zoology - *Mechanical Properties of Filled Composites*
- University of Toronto Dept of Zoology - *Morphology & Development of Extensible Insect Cuticle*
- University of Western Ontario Dept of Zoology - *Morphology & Development of Extensible Insect Cuticle*
- University of Champagne, Illinois, Dept of Zoology - *Morphology & Development of Extensible Insect Cuticle*
- University of Minneapolis, St Paul, Dept of Zoology - *Morphology & Development of Extensible Insect Cuticle*
- US Dept of Agriculture, Fargo - *Morphology & Development of Extensible Insect Cuticle*
- University of British Columbia Dept of Zoology - *Morphology & Development of Extensible Insect Cuticle*
- University of Washington Dept of Zoology - *Morphology & Development of Extensible Insect Cuticle*

- University of Davis, California, Dept of Zoology - *Morphology & Development of Extensible Insect Cuticle*

### **Invited visits**

(Often associated with a seminar listed above; visits are several days long)

**2004**

- Jilin University, China

**2001**

**2029** Duke University, Durham, NC

**2000**

- Max Planck Institut, University of Potsdam

**1995**

- Joint Royal Society / JSPSS to University of Sapporo, Japan

**1992**

- MBB (German Aero-Space), Munich
- USAF Bolling Air Force Base (Washington) and Wright-Patterson Air Force Base Research Labs on *Window on Science* program

**1991**

- US Forces Research Labs in Natick (Army), Washington (Navy) and Wright-Patterson Air Force Base (Dayton, Ohio) on USAF *Window on Science* program

**1989**

- First Unilever Science Policy Development meeting, The Netherlands
- Swedish Forest Products Institute, Stockholm

**1985**

- University of Tübingen (Dept of Palaeontology)
- British Council visitor to University of Dusseldorf

**1983**

- JW-Goethe-University, Frankfurt, Zoology Dept.

### **Theses Examined**

**2001** David Ip, Dept of Horticulture, University of Victoria, Australia – *Mechanical and impact properties of horticultural produce*

**1997** Andrew Leger, St F Xavier University, Canada - *Microfibril-based arterial systems* – MSc (failed)

**1995** A Tseahaye, University of Canterbury - *Within- and Between-tree variation in mechanical properties of clear wood* - PhD

**1988** Chief Examiner at the Promotion of H Luyten, University of Wageningen - PhD

## **Grants, Fellowships, Studentships and Contracts**

n.b. Most of the grants between 1990 and 2000 were awarded jointly to the two Directors of the Centre for Biomimetics at Reading University rather than to myself alone. They were mostly prepared jointly.

### **Research Council Funding**

#### **Research Projects**

**2003 – 5 BBSRC**

Origin and quantification of crispness in snack foods **£119,774**

**2001 – 4 EPSRC**

Mechanical design of hooks in nature **£65,470**

Integration of biology into a method for innovation	<b>£338,006</b>
<b>2000 – 3 EPSRC</b>	
Biomimetic deployable camouflage systems	<b>£43,806</b>
Smart variable stiffness devices for vibration control	<b>£200,509</b>
<b>1997 - 9 EPSRC (ROPA)</b>	
Novel gel actuators based on plant designs	<b>£66,683</b>
<b>1995-7 EPSRC (WCPOP)</b>	
Extraction and use of long plant fibres in structural composites	<b>£136,140</b>
<b>1995-7 EPSRC (ROPA )</b>	
Design of integral sensors in composite laminates based on insect sense organs	<b>£85,000</b>
<b>1993-6 AFRC</b>	
The mechanical and fracture properties of chicken bones	<b>£114,447</b>
<b>1979-81 ARC</b>	
Factors affecting the stabilisation of insect cuticle	<b>£25,393</b>
<b>1975-77 SRC</b>	
The proteins of locust soft cuticle and the control of their interactions	<b>£9,900</b>
<b>1970-72 SRC</b>	
Mechanics and control of extensibility of insect cuticle	<b>£2,800</b>
<b>Other grants</b>	
<b>2002-3 EPSRC</b>	
Equipment for new laboratory	<b>£147,008</b>
<b>Research Fellowship</b>	
<b>1974 SRC</b>	
Senior Visiting Research Fellowship - The growth and development of the extensible membrane of the female locust	<b>£1,900</b>
<b>CASE Studentships</b>	
<b>1997-2000</b> Smith & Nephew Performance of pressure-sensitive adhesives	
<b>1993-96</b> Zeneca plc Mechanical properties of plants with genetically modified lignin	
<b>1988-91</b> Celltech Ltd Novel adhesives from biological systems	
<b>1985-88</b> Unilever Research Ltd Mechanical texture of plant tissues	
<b>1983-86</b> ICI Mond Divn. Towards the development of new composite materials	
<b>1980-83</b> The Wildfowl Trust Mechanics of bird beaks related to feeding and survival	
<b>1974-7</b> ICI Plant Protection Ltd The effects of certain insecticides on the stability of insect cuticle	
<b>MAFF Contracts</b>	
<b>1997-99</b> MAFF	<b>£80,566</b>
<b>Measurement of texture in fruit and vegetables</b>	
<b>Royal Society Grants</b>	
<b>1994-6</b> (In conjunction with JSPS) Visiting expenses to Sapporo, Japan	<b>£9,600</b>
<b>1993</b> Visiting expenses to Sydney, Australia	<b>£1,250</b>
<b>1986</b> Purchase of a tensile test machine	<b>£14,056</b>
<b>EU Funding</b>	
<b>2002 – 5</b> Biomimetic locomotion of robots in humans	<b>£222,000</b>

<b>1997-2000</b>	WIN - Wheat for Industrial Needs (EUREKA!)	<b>£110,000</b>
<b>1997-9</b>	TIMBER - effect of reduced lignification in trees	
	<b>£40,000</b>	
<b>British Council</b>		
<b>1996</b>	Visiting expenses to Japan (2 visits)	<b>£3,400</b>
<b>1985</b>	Visiting expenses to Dusseldorf, Germany	<b>£1,500</b>
<b>Other Universities</b>		
<b>1995</b>	Distinguished Visitor, Massey University, New Zealand	<b>NZ\$ 1,500</b>
<b>1987</b>	Senior Research Fellowship, Agricultural University of Wageningen	<b>£5,800</b>
<b>US Forces</b>		
<b>2003-2004</b>	ERO, London. Jumping Robots	<b>\$37,452</b>
<b>2000-2002</b>	ONR, Washington. Insect cuticle as a multifunctional material	<b>\$360,000</b>
<b>2000</b>	Novel strain sensors based on an insect design	<b>\$50,000</b>
<b>1993-4</b>	US Army Biochemical identity of adhesive proteins of barnacles	<b>£28,960</b>
<b>1990-1</b>	ONR, Washington. Biotechnology of Insect Cuticle	<b>\$68,000</b>
<b>1990</b>	US Army Bibliography of Sensory Systems	<b>\$10,000</b>
(Note - I have had numerous travel grants from the US Forces to attend Workshops and take part in the "Window on Science" programs. I have neglected to keep tally of these, but they probably amount to £20,000 over the last 6 years)		
<b>DTI-LINK Projects</b>		
<b>1995-8</b>	Moulded and recyclable packaging from expanded starch cellular materials	<b>£192,000</b>
<b>1994-7</b>	Mechanical properties of Mushrooms	<b>£15,000</b>
<b>1991-4</b>	Plant Cell Wall Mechanics	<b>£245,235</b>
<b>1991-4</b>	Fracture of Wheat and Milling	<b>£159,000</b>
<b>Industrial Finance</b>		
<b>Defence Research Agency, Farnborough</b>		
<b>1996-7</b>	Impact properties of wood and a wood biomimic	<b>£40,000</b>
<b>1995-5</b>	Properties of Biological Adaptive Fibres	<b>£36,669</b>
<b>1994</b>	"Smart" mechanisms in Biology (Report)	<b>£9,600</b>
<b>Reckitt and Coleman Ltd</b>		
<b>1996</b>	"Smart" devices for domestic use (Report)	<b>£13,500</b>
<b>British Nuclear Fuels Plc</b>		
<b>1995</b>	Application of principles of biomimetics (Report)	<b>£10,200</b>
<b>Defence Clothing &amp; Textile Agency</b>		
<b>1997</b>	A Biomimetic Approach to the design of helmets	<b>£45,000</b>
	Effectiveness of feathers in armour	<b>£18,383</b>
<b>1995-8</b>	A Biomimetic Approach to Clothing Systems	<b>£127,605</b>
<b>Dunlop-Slazenger</b>		
<b>1995</b>	Use of materials in sports equipment	<b>£35,000</b>
<b>1994</b>	Mechanical experiments on Shuttlecock feathers	<b>£4,000</b>
<b>Weetabix Ltd</b>		
<b>1995-8</b>	Mechanical design of Weetabix biscuits	<b>£60,000</b>
<b>Unilever Research</b>		
<b>1996-9</b>	Ice Cream	<b>£55,650</b>
<b>1995-8</b>	Causes of formation of split ends in hair	<b>£55,650</b>
<b>United Biscuits</b>		
<b>1994-6</b>	Origin and control of crispness in crisps	<b>£41,000</b>
<b>CellPath, Hemel Hempstead</b>		
<b>1994-5</b>	Mechanical characterisation of histological waxes	<b>£12,000</b>

<b>Asymptote, Cambridge</b>	
1994 Demonstration of methods for measuring apple texture	<b>£1,000</b>
<b>GPO, Swindon</b>	
1994 Composite materials for blast containment	<b>£10,000</b>
<b>CIBA GEIGY</b>	
1990-94 Travel to Germany for collaborative research	<b>£8,000</b>
<b>Compak Systems Ltd</b>	
1989 Adhesion in straw-board	<b>£2,000</b>
<b>Shandon Southern Instruments</b>	
1985-8 Development of a computer-controlled microtome	<b>£44,689</b>
<b>ICI Plastics</b>	
1982 Surface hardening of plastics	<b>£4,000</b>
<b>Philips Duphar (The Netherlands)</b>	
1978-79 Research on the insecticide, PH 60-40	<b>£4,589</b>