

Synthesis of a 4-methylene-6-phosphabicyclo[1.1.0]hex-2-ene: A 1,4-dipole as a building block for novel phosphorus compounds containing the cyclopentadienyl skeleton

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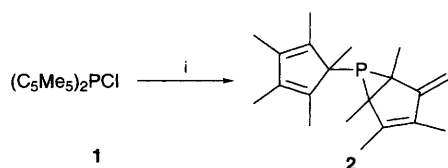
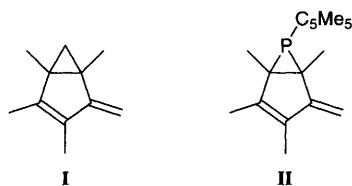
The reaction of bis(pentamethylcyclopentadienyl)chlorophosphane with $\text{LiN}(\text{SiMe}_3)_2$ affords the novel 4-methylene-6-phosphabicyclo[1.1.0]hex-2-ene, acting as a 1,4-dipole in addition (cycloaddition) reactions; the X-ray structure of a 3*a*,4-dihydro-7*H*-phosphinine is reported.

During the last decades, the pentamethylcyclopentadienyl group has attracted increased interest in phosphorus chemistry.¹ The C_5Me_5 group provides sufficient steric bulk for the stabilization of multiply-bonded phosphorus centres and the flexibility of the P–C bond permits synthetically valuable functionalisation by main-group and transition metal elements.² Furthermore, its capability in multihapto bonding results in versatility of structure and bonding.³

In the context of our investigations on the synthesis and reactivity of bis(pentamethylcyclopentadienyl)phosphanes⁴ we have investigated the reactivity of the chloroderivative⁵ with sterically hindered nucleophiles.

Here we report the synthesis of the 4-methylene-6-phosphabicyclo[1.1.0]hex-2-ene **II**, a phosphorus analogue of the well known 'homofulvene',⁶ **I** as well as its informative 1,4-addition and cycloaddition reactions.

Treatment of bis(pentamethylcyclopentadienyl)chlorophosphane, $(\text{C}_5\text{Me}_5)_2\text{PCl}$,⁵ **1** with 1 equiv. $\text{LiN}(\text{SiMe}_3)_2$ in hexane at 69 °C resulted in quantitative formation of **2** via elimination of LiCl and $\text{HN}(\text{SiMe}_3)_2$. Product **2** was isolated as pale yellow crystals in good yield (70%). The mass spectrum† exhibits the molecular ion at m/z 300 (3.4%). The base peak corresponds to the mass for the $[\text{C}_5\text{Me}_5\text{P}]$ fragment (m/z 166). The ³¹P NMR spectrum shows a strongly shielded phosphorus atom (δ –87) indicating the formation of a phosphirane. Final evidence for the constitution of **2** as a 4-methylene-6-phosphabicyclo[1.1.0]hex-2-ene derivative was derived from the ¹H and ¹³C NMR spectra.† The ¹³C NMR spectrum exhibits resonances typical for a rigid C_5Me_5 -moiety linked to a phosphorus(III) centre. The three-membered ring is evidenced by the presence



Scheme 1 Reagents and conditions: i, hexane, 20 h, reflux, 41%

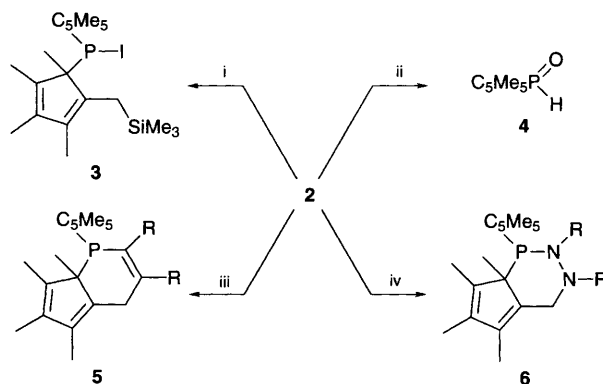
of two deshielded carbon atoms, which show direct coupling with the phosphorus nuclei (δ 49.9, J 51.1 Hz; δ 42.3, J 49.2 Hz). Eight characteristic resonances in the alkenic region of the ¹³C NMR spectrum indicate the proposed ring components as a cyclopentadienyl and a buta-1,3-diene fragment. Furthermore, the presence of the exocyclic methylene group is evidenced by two deshielded hydrogen atoms in the ¹H NMR spectrum (δ 5.01, 4.93; ² J_{HH} 3.0 Hz).

Single crystals were obtained by crystallization from pentane, but their poor quality did not allow an accurate structural solution.‡ Nonetheless, the available data confirmed the presence of an annelated ring system. Furthermore, the P-substituent (C_5Me_5) adopts the 'anti-flagpole' position to relieve steric congestion.

Considering the formation of **2** via a 1,4-elimination reaction, we allowed **2** to react with Me_3SiI or H_2O , which resulted in the formation of the iodophosphane† **3** or phosphane oxide **4**, respectively, concurrently regenerating the cyclopentadienyl ring system. Compound **4** had already been obtained by reacting **1** with H_2O .⁴

These findings clearly indicate the reactive sites in **2** to be the phosphorus and the exocyclic methylene carbon atom. In other words, **2** represents a 1,4-dipolar system (shown by the resonance formula **B** in Fig. 1) with the methylene carbon atom as the nucleophilic centre. This finding stimulated us to widen the synthetic scope of **2** to cycloaddition reactions.

Treatment of an ethereal solution of **2** at –60 °C with an equimolar amount of acetylenic ester $[\text{N}_2(\text{CO}_2\text{Et})_2]$ afforded upon warming up to room temperature pale yellow solutions, from which the dihydrophosphinine **5** and the diazaphosphinine **6**



Scheme 2 Reagents and conditions: i, SiMe_3I , Et_2O , –76 °C, 3 h, 39%; ii, H_2O , Et_2O , 20 °C, 8 h; iii, $\text{C}_2(\text{CO}_2\text{Me})_2$, Et_2O , –76 °C, 2 h, 20%; iv, $\text{N}_2(\text{CO}_2\text{Et})_2$, Et_2O , –76 °C, 7 h, 86%

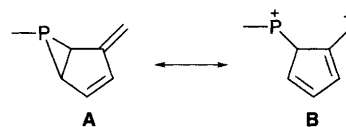


Fig. 1 Resonance formula of **2**

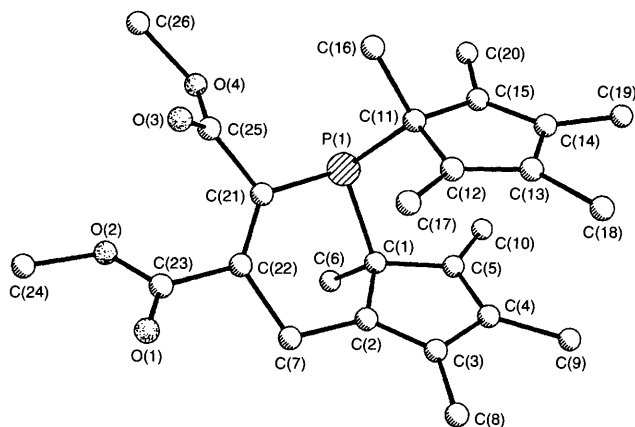


Fig. 2 Molecular structure of **5**. Hydrogen atoms are omitted for clarity. Selected bond lengths (pm) and angles ($^{\circ}$): P(1)–C(1) 188.8(3), P(1)–C(21) 183.2(3), P(1)–C(11) 189.7(3), C(1)–C(2) 150.8(4), C(7)–C(22) 150.6(4), C(21)–C(22) 135.2(5), C(2)–C(7) 148.0(4), C(1)–P(1)–C(11) 110.6(1), C(11)–P(1)–C(21) 104.0(1), P(1)–C(1)–C(5) 113.9(2), P(1)–C(1)–C(6) 105.4(2), P(1)–C(21)–C(22) 126.1(2), C(1)–P(1)–C(21) 99.6(1), P(1)–C(1)–C(2) 109.6(2), P(1)–C(11)–C(15) 107.7(2), P(1)–C(11)–C(16) 106.2(2), P(1)–C(21)–C(25) 117.8(2), C(7)–C(22)–C(21) 125.0(2), C(12)–C(11)–C(16) 110.8(2) and C(2)–C(1)–C(6) 112.5(3).

6 separated as yellow crystals **5** or yellow oil **6** which were studied by mass and NMR spectroscopies.† For **5**, the presence of a ethylenedicarbonyl ester moiety was proved by observation of the expected additional resonances in the alkenic region of the ^{13}C NMR spectrum. The exocyclic methylene carbon atom in **2** is shifted to high field because of its integration (change of hybridisation) into the ring ($\Delta\delta$ 68 ppm). The formal replacement of the ethylene group in **5** by a diaza moiety results in a significant deshielding of both the phosphorus and the ring methylene group.

The constitution of **5** was further corroborated by an X-ray structure analysis,‡ for which suitable single crystals were obtained from ether at -30°C . The molecular structure (Fig. 2) shows the connection of a dihydrophosphine ring with a cyclopentadienyl skeleton in an α,β -position. The atoms, P(1)–C(21)–C(22)–C(7), are located nearly in one plane [dihedral angle $13.0(8)^{\circ}$], with a slight twist (10°) of the C–C double bond. The cyclopentadienyl rings are nearly parallel and the distance between the centres of the rings (337 pm) lies in the range of van der Waals contacts. Other bond lengths and angles show no peculiarities.

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Footnotes

† *Spectroscopic data for 2*: ^{31}P NMR (C_6D_6): $-\delta$ 86.4; ^1H NMR (300 MHz, C_6D_6): δ 5.01 (d, J 3.0 Hz, 1 H, CH_2), 4.93 (d, J 3.0 Hz, 1 H, CH_2), 2.00 (m, 6 H, Me), 1.96 (m, 6 H, Me), 1.78 (dd, J 13.4 and 5.9 Hz, 3 H, Me), 1.64 (d, J 2.0 Hz, 3 H, Me), 1.62 (d, J 0.9 Hz, 3 H, Me), 1.51 (d, J 2.7 Hz, 3 H, Me) and 1.28 (d, J 14.1 Hz, 3 H, Me); ^{13}C NMR (75.47 MHz, C_6D_6): δ 163.3 (d, J 8.0 Hz, $\text{C}=\text{CH}_2$), 147.1 (d, J 10.3 Hz, $\text{C}=\text{}$), 140.2 (d, J 4.2 Hz, $\text{C}=\text{}$), 139.5 (d, J 3.4 Hz, $\text{C}=\text{}$), 135.2 (d, J 3.0 Hz, $\text{C}=\text{}$), 135.2 (d, J 2.4 Hz, $\text{C}=\text{}$), 132.1 (d, J 11.0 Hz, $\text{C}=\text{}$), 97.1 (d, J 1.1 Hz, CH_2), 60.1 (d, J 65.2 Hz, P–C), 49.9 (d, J 51.1 Hz, P–C), 42.3 (d, J 49.2 Hz, P–C), 21.0 (d, J 30.1 Hz, Me), 12.5 (d, J 1.1 Hz, Me), 12.1 (d, J 3.8 Hz, Me), 11.9 (d, J 1.5 Hz, Me), 11.8 (d, J 4.57 Hz, Me), 11.5 (d, J 1.5 Hz, Me), 11.1 (d, J 1.5 Hz, Me) and 10.4 (d, J 2.2 Hz, Me). The CH_2 group is confirmed by a DEPT 135 experiment; MS (40 eV, EI) m/z (%) 300(3) [M^+], 166(100) [$\text{M}^+ - \text{C}_{10}\text{H}_{14}$], 165(8) [$\text{C}_{10}\text{H}_{14}\text{P}^+$],

151(9) [$\text{C}_9\text{H}_{12}\text{P}^+$], 135(8) [$\text{C}_{10}\text{H}_{15}^+$], 134(38) [$\text{C}_{10}\text{H}_{14}^+$] and 119(82) [$\text{C}_9\text{H}_{11}^+$]; found: m/z 300. 1994, calc. for $\text{C}_{20}\text{H}_{29}\text{P}$: M , 300.2006; mp $100-102^{\circ}\text{C}$.

For **3**: ^{31}P NMR (C_6D_6): δ 140.9; ^1H NMR (C_6D_6): δ 3.38 (m, 2 H, CH_2), 1.88 (m, 6 H, Me), 1.82 (m, 12 H, Me), 1.72 (d, J 3.2 Hz, 3 H), 1.07 (d, J 7.6 Hz, 6 H), 0.19 (s, 9 H, SiMe_3). For **5**: ^{31}P NMR (CDCl_3): δ 5.5; ^{13}C NMR (CDCl_3): δ 171.1 (d, J 24.4 Hz, CO), 168.7 (s, CO), 144.9 (d, J 1.0 Hz, $\text{C}=\text{}$), 138.3 (d, J 13.9 Hz, $\text{C}=\text{}$), 138.0 (d, J 2.6 Hz, $\text{C}=\text{}$), 136.4 (d, J 4.4 Hz, $\text{C}=\text{}$), 135.3 (d, J 4.5 Hz, $\text{C}=\text{}$), 134.8 (d, J 6.2 Hz, $\text{C}=\text{}$), 134.6 (d, J 43.6 Hz, P–C=), 134.3 (s, $\text{C}=\text{}$), 133.6 (d, J 1.6 Hz, $\text{C}=\text{}$), 133.5 (d, J 0.5 Hz, $\text{C}=\text{}$), 58.5 (d, J 32.2 Hz, P–C), 52.7 (s, OMe), 52.3 (d, J 22.5 Hz, P–C), 28.7 (d, J 2.5 Hz, CH_2), 2.07 (d, J 31.6 Hz, Me), 19.8 (d, J 13.8 Hz, Me), 11.7 (d, J 13.3 Hz, 11.6 (d, J 7.5 Hz, Me), 11.3 (d, J 10.2 Hz, Me), 11.1 (d, J 2.5 Hz, Me) and 10.7 (d, J 1.3 Hz, Me). The CH_2 group is confirmed by a DEPT 135 experiment; MS (35 eV, EI) m/z (%) 442(17) [M^+], 307(100) [$\text{M}^+ - \text{C}_{10}\text{H}_{15}$], 279(85), 275(50), 247(80), 135(25) [$\text{C}_{10}\text{H}_{15}^+$], 119(50), 105(25) and 91(18); found: m/z 442.2267. Calc. for $\text{C}_{26}\text{H}_{35}\text{O}_4\text{P}$: M , 442.2272. mp $80-83^{\circ}\text{C}$. For **6**: ^{31}P NMR (C_6D_6): δ 100.1; ^{13}C NMR (C_6D_6): δ 158.5 (d, J 18.9 Hz, CO), 157.8 (d, J 8.3 Hz, CO), 138.5 (d, J 2.2 Hz, $\text{C}=\text{}$), 138.0 (d, J 2.2 Hz, $\text{C}=\text{}$), 137.2 (d, J 8.6 Hz, $\text{C}=\text{}$), 136.2 (d, J 0.5 Hz, $\text{C}=\text{}$), 136.0 (d, J 3.8 Hz, $\text{C}=\text{}$), 135.3 (d, J 1.1 Hz, $\text{C}=\text{}$), 134.6 (s, $\text{C}=\text{}$), 63.3 (s, OCH_2 62.3 (s, OCH_2), 61.3 (d, J 38.0 Hz, P–C), 55.2 (d, J 27.5 Hz, P–C), 41.1 (s, CH_2), 21.7 (d, J 31.3 Hz, Me), 18.8 (d, J 12.3 Hz, Me), 15.0 (d, J 10.2 Hz, Me), 13.1 (s, Me), 12.5 (d, J 12.7 Hz, Me), 12.0 (d, J 12.9 Hz, Me), 11.4 (d, J 8.8 Hz, Me), 10.9 (d, J 1.9 Hz, Me), 11.5 (s, Me) and 11.2 (s, Me). The CH_2 group is confirmed by a DEPT 135 experiment; MS (20 eV, EI) m/z (%) 474 (< 1 [M^+], 339 (< 1) [$\text{M}^+ - \text{C}_{10}\text{H}_{15}$], 205 (100) [$\text{M}^+ - \text{C}_{20}\text{H}_{29}$], 135(30) [$\text{C}_{10}\text{H}_{15}^+$] and 134(70) [$\text{C}_{10}\text{H}_{14}^+$].

‡ *Crystal data for 2*: Owing to the twinning of the crystal, only the conformation could be determined [space group $P2_1/n$, $a = 10.879(10)$, $b = 11.106(3)$, $c = 15.129(9)$ Å, $\beta = 90.10(8)^{\circ}$, $U = 1828$ Å 3 , $Z = 4$; twin matrix: $-1\ 0\ 0, 0\ -1\ 0, 0\ 0\ 1$, fractional contribution of the two twin components 0.50(1): 0.50(1), $wR1(F2) = 0.314$], program used: SHELXL-93.7 For **5**: $\text{C}_{26}\text{H}_{35}\text{O}_4\text{P}$, $M = 442.5$, monoclinic, space group $P2_1/n$ (no. 14), colourless crystals, dimensions $0.20 \times 0.30 \times 0.40$ mm 3 , $a = 9.014(3)$, $b = 33.466(4)$, $c = 9.045(3)$ Å, $\beta = 116.02(2)^{\circ}$, $U = 2452(1)$ Å 3 , $D_c = 1.20$ mg m $^{-3}$, $Z = 4$, μ (Cu-K α) = 1.20 mm $^{-1}$, $T = 193$ K, 3626 symmetry independent reflections were collected of which 3354 with $F > 4.0\sigma(F)$ were used for the structure solution (direct methods) and refinement (full-matrix least-squares refinement on F , 281 parameters) non-hydrogen atoms were refined anisotropically, H atoms localized by difference electron density and refined using a 'riding' model. $R = 0.058$ ($R_w = 0.064$). An empirical absorption correction and an extinction correction 8 were applied. Atomic coordinates, bond lengths and angles, and thermal parameters have been deposited at the Cambridge Crystallographic Data Centre (CCDC). See Information for Authors, Issue No 1. Any request to the CCDC for this material should quote the full literature citation and the reference number 182/136.

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Conference Diary*

July 1996

International Conference on Science and Technology of Synthetic Materials

Snowbird, USA July 28-August 2
Contact: Professor Z V Vardeny, Secretary General, ICSM '96, Physics Dept., 214 JFB, University of Utah, Salt Lake City, Utah 84112, Tel +1 (801) 581 8372. Fax +1 (801) 581 4801. E-mail icsm96@mail.physics.utah.edu

Recent Advances in Polymer Synthesis

York, UK July 29-August 2
Contact: Professor P Hodge, Department of Chemistry, University of Manchester, Oxford Road, Manchester, UK M13 9PL. Tel +44 (0) 161 275 4706. Fax +44 (0) 161 275 4598. E-mail Philip.Hodge@man.ac.uk

August 1996

36th International Symposium on Macromolecules

Seoul, Korea August 4-9
Contact: Dr Kwang Ung Kim, Secretariat of IUPACMACRO SEOUL 96, Division of Polymers, Korea Institute of Science and Technology, PO Box 131, Cheongryang, Seoul 130-650, Korea. Tel +82 (2) 957 6104. Fax +82 (2) 957 6105. E-mail iupac@kistmail.kist.re.kr

10th American Conference on Crystal Growth

Vail, Colorado August 4-9
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3rd European Conference on Bio-inorganic Chemistry (EUROBIC III)

Noordwijkerhout, The Netherlands August 4-11
Contact: Professor Cees Veeger, Department of Biochemistry, Agricultural University, Dreyenlaan 3, 6703 HA Wageningen, The Netherlands.

10th International Symposium on Homogeneous Catalysis

Princeton, USA August 11-16
Contact: Dr I T Horváth, Exxon Research and Engineering Co., Annandale, NJ 08801, USA. Tel +1 (908) 7302154. Fax +1 (908) 7303042. E-mail ithorva@erenj.com

2nd International Conference on Excitonic Processes in Condensed Matter (EXCON '96)

Bad Schandau, Germany August 14-17
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31st International Conference on Coordination Chemistry

Vancouver, Canada August 18-23
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International Symposium on Macromolecular Condensed State

Beijing, China August 20-25
Contact: Professor X Jin, Institute of Chemistry, Chinese Academy of Sciences, PO Box 2709, Beijing 100080, China. Tel +86 1 256 4829. Fax +86 1 256 9564. E-mail huangsl@rose.cnc.ac.cn

6th International Meeting CD Spectroscopy

Exeter, UK August 24-29
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Autumn ACS National Meeting

Orlando, USA August 25-30
Contact: American Chemical Society, Meetings, PO Box 18598, 20th St Station, Washington, DC 20036 8598, USA.

13th IUPAC International Conference on Physical Organic Chemistry

Seoul, Korea August 25-29
Contact: Professor J Suh, Department of Chemistry, Seoul National University, Seoul 151-742, Republic of Korea. Tel +82 2 8805456. Fax +82 2 8891568.

10th International Biotechnology Symposium

Sydney, Australia August 25-30
Contact: 10th IBS '96 Symposium Secretariat, PO Box 128, Sydney, NSW 2001, Australia. Tel +61 (2) 2622277. Fax +61 (2) 2622323. E-mail veckels@tourhosts.com.au

14th IUPAC Conference on Chemical Thermodynamics

Osaka, Japan August 25-30
Contact: Professor M Sorai, Executive Secretary of ICCT-96. Microcalorimetry Research Center, Faculty of Science, Osaka University, Toyonaka, Osaka 560, Japan. Tel +81 (6) 8505523. Fax +81 (6) 850 5526 or 5288. E-mail icct96@chem.sci.osaka-u.ac.jp

10th Conference of the European Society of Biomechanics

Leuven, Belgium August 28-31
Contact: Dr J Vander Sloten, Executive Secretary, 10th Conference of the European Society of Biomechanics, Katholieke Universiteit Leuven, Division of Biomechanics and Engineering Design, Celestijnenlaan 200A, B-3001 Heverlee, Belgium. Tel +32 16 32 70 96. Fax +32 16 29 27 16. E-mail jos.vandersloten@mech.kuleuven.ac.be

Supramolecular Chemistry: Molecular Recognition and Drug-Receptor Interactions

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September 1996

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8th FECHM Conference on Heterocycles in Bio-organic Chemistry

Villa Olmo, Como, Italy September 1-4
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Palmerston North, New Zealand September 1-4
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1st H S Taylor Conference on Catalysis

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ECME 96, Third European Conference on Molecular Electronics

Leuven, Belgium September 1-6
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XIth International Symposium on Organosilicon Chemistry

Montpellier, France September 1-6
Contact: Professor R J P Corriu, Laboratoire des Précurseurs Organométalliques de Matériaux, UMR CNRS 44, Université de Montpellier II, Place E. Bataillon, CC 007, F34095 Montpellier Cedex 5, France. Fax +33 67 14 38 88.

11th European Symposium on Quantitative Structure-Activity Relationships: Computer-assisted Lead Finding and Optimization

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5th International Conference on Chemical Synthesis of Antibiotics and Related Microbial Products

Debrecen, Hungary September 1-6
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Odense, Denmark September 6-11
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9th International Symposium on Molecular Recognition and Inclusion (ISMRI9)

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XIVth International Symposium on Medicinal Chemistry

Maastricht, The Netherlands September 8-12
Contact: H Timmerman, Leiden/Amsterdam Centre for Drug Research (LACDR), Department of Pharmacochemistry, Vrije University, De Boelelaan 1083, NL-1081-HV Amsterdam, The Netherlands. Tel +31 (0) 20 44 47580. Fax +31 (0) 20 44 47610. E-mail bijloo@chem.vu.nl

4th International Symposium on Heterogeneous Catalysis and Fine Chemicals

Basel, Switzerland September 8-12
Contact: 4th International Symposium on HCFC '96, c/o AKM Congress Service, PO Box, CH-4005 Basel, Switzerland. Tel +41 61 691 51 11. Fax +41 61 691 81 89.

XIIIth International Symposium on the Reactivity of Solids

Hamburg, Germany September 8-12
Contact: Secretary XIIIth ISRS, Institute of Inorganic and Applied Chemistry, University of Hamburg, Martin-Luther-King-Platz 6, 20146 Hamburg, Germany. Tel +49 40 41 23 60 86. Fax +49 40 41 23 63 48.

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Molecular Modelling of Chemicals and Materials

Amsterdam, The Netherlands September 9-10
Contact: Dr A M Brouwer, Laboratory of Organic Chemistry, Amsterdam Institute of Molecular Studies (AIMS), Nieuwe Achtergracht 129, 1018 WS Amsterdam, The Netherlands. Fax +31 (0) 20 5255670. E-mail mgms@chem.uva.nl WWW <http://krop.chem.uva.nl/mgms/>

Advances in Chemistry of Crop Protection

Cambridge, UK September 9-11
Contact: Conference Secretariat, SCI, 14/15 Belgrave Square, London, UK SW1X 8PS. Tel +44 (0) 171 235 3681. Fax +44 (0) 171 823 1698.

14th International Symposium on Gas Kinetics

Leeds, UK September 9-12
Contact: RSC†

RSC Autumn Meeting

Uxbridge, UK September 10-13
Contact: RSC†

Reactivity in Organised Microstructures: Chemical Reactions and Physical Processes in Compartmentalized Systems

Santiago de Compostela, Spain September 10-15
Contact: Dr J Hendekovic, European Science Foundation, 1 quai Lezay-Mamésia, 67080 Strasbourg Cedex, France. Tel +33 88 76 71 35. Fax +33 88 36 69 87. E-mail euresco@esf.org WWW <http://www.esf.org/euresco>

†*Contact:* Dr J F Gibson, The Royal Society of Chemistry, Burlington House, London, UK W1V 0BN. Tel +44 (0) 171 437 8656. Fax +44 (0) 171 734 1227. E-mail Conferences@rsc.org

COPS-IV 4th International Symposium on the Characterisation of Porous Solids

Bath, UK September 15-18
Contact: Elaine Wellingham, Conference Secretariat, Field End House, Bude Close, Nailsea, Bristol, UK BS19 2FQ.
Tel & Fax +44 (0) 1275 853311.

20th IUPAC Symposium on the Chemistry of Natural Products

Chicago, USA September 15-20
Contact: IUPAC Symposium Headquarters, 5999 Butterfield Road, Hillside, IL 60162, USA. E-mail IUPAC@searle.monsanto.com
www <http://www.a2z.com/iupac20/index.html>

Faraday Discussion 104, Complex Fluids and Interfaces

Cambridge, UK September 18-20
Contact: RSC†

3rd International Medicinal Chemistry Symposium

Bath, UK September 22-24
Contact: Elaine Wellingham, Conference Secretariat, Field End House, Nailsea, Bristol, UK BS19 2FQ.
Tel & Fax +44 (0) 1275 853311.
E-mail i.s.blagbrough@bath.ac.uk and m.d.threadgill@bath.ac.uk

The Scale-up of Chemical Processes

Eastbourne, UK September 23-26
Contact: Dr T Laird, Scientific Update, Wyvern Cottage, High Street, Mayfield, East Sussex, UK TN20 6AE.
Tel +44 (0) 1435 873062. Fax +1 (0) 1432 872734

Polycondensation '96, International Symposium on Polycondensation

Paris, France September 23-26
Contact: Alain Fradet, Université Pierre et Marie Curie, Synthèse Macromoléculaire - Case 184, 4 Place Jussieu, F-75252 Paris Cedex 05, France. Tel +33 1 44 27 37 38. Fax +33 1 44 27 70 54.
E-mail sym@ccr.jussieu.fr

23rd Annual Conference of the Federation of Analytical Chemistry and Spectroscopic Societies, FACSS XXIII

Kansas City, USA September 29-October 4
Contact: FACSS National Office, 201-B Broadway St., Frederick, MD 21701-6501 USA.
Tel +1 301 846 4797. Fax +1 301 694 6860.

Innovative Research in Organic Chemistry

Ischia Porto, Italy September 29-October 4
Contact: Dr S Pedatella, Department of Organic and Biological Chemistry, Università di Napoli 'Federico II', Via Mezzocannone, 16, I-80134 Napoli, Italy. Tel & Fax +39 81 7041283.
E-mail iasoc@ds.unina.it

7th International Conference on Multiphoton Processes

Garmisch Partenkirchen, Germany September 30-October 4
Contact: Professor P Lambropoulos, Max-Planck-Institut für Quantenoptik, Hans-Kopfermann-Str. 1, D-85748 Garching, Germany

October 1996

5th International Symposium on the Chemistry and Pharmacology of Pyridazines

Sopron, Hungary October 2-5
Contact: Dr Péter Mátyus, Institute for Drug Research, PO Box 82, H-1325, Hungary. Tel +36 1 1690011. Fax +36 1 1693229.

XVIIth European Colloquium of Heterocyclic Chemistry

Regensburg, Germany October 6-9
Contact: Professor G Märkl, Institut für Organische Chemie, Universität Regensburg, D-93040 Regensburg, Germany.
Tel +49 941 943 4631. Fax +49 941 943 4505.

Chiral Europe '96

Strasbourg, France October 14-15
Contact: Spring Innovations Ltd, 185A Moss Lane, Bramhall, Stockport, UK SK7 1BA.
Tel +44 (0) 161 440 0082. Fax +44 (0) 161 440 9127.

Joint RSC Fine Chemicals and Medicinals Group-SCI Cardiovascular Meeting

Edinburgh, UK October 20-22
Contact: RSC†

Recent Advances in Drugs for the Treatment of Cardiovascular Disease

Edinburgh, UK October 20-22
Contact: Elaine Wellingham, Conference Secretariat, Field End House, Bude Close, Nailsea, Bristol, UK BS19 2FQ.
Tel & Fax +44 (0) 1275 853311.

November 1966

IRaP 96 2nd International Symposium on Ionizing Radiation and Polymers

Saint-François, Guadeloupe November 3-8
Contact: Dr N Betz, Chairwoman of IRaP 96 Organizing Committee, DRECAM/SRSIM/LPI, CEA/Saclay, F-91191 Gif sur Yvette Cedex, France. Tel +33 1 69 08 48 34.
Fax +33 1 69 08 96 00.
E-mail betz@drecam.cea.fr or irap@drecam.cea.fr

International Symposium on the Industrial Application of the Mössbauer Effect

Johannesburg, South Africa November 4-8
Contact: Professor H Pollak, Mössbauer Laboratory, University of the Witwatersrand, Private Bag 3, Johannesburg, WITS 2050, South Africa. Tel +27 (11) 7164051. Fax +27 (11) 3398262.
E-mail isiam@physnet.phys.wits.ac.za

Heterocycles in Synthesis

London, UK November 11
Contact: Dr D M Hollinshead, Zeneca Pharmaceuticals, Mereside, Alderly Park, Macclesfield, UK SK10 4TG.
Tel +44 (0) 1625 514791. Fax +44 (0) 1625 586707.

XV Chemistry Conference

Santiago de Cuba, Cuba November 27-29
Contact: Dr L Ballester Gonzalez, Executive Secretary, XV Conference de Quimica, Universidad de Orite, Santiago de Cuba 90500, Cuba. E-mail xvconf@cnm.uo.edu.cu

December 1996

Asymmetric Catalysis

London, UK December 2
Contact: Dr D Craig, Department of Chemistry, Imperial College of Science, Technology & Medicine, London, UK SW7 2AY.
Tel +44 (0) 171 594 5771. Fax +1 (0) 171 594 5804.
E-mail d.craig@ic.ac.uk

Fifth Eurasia Conference on Chemical Sciences

Guangzhou, China December 10-14
Contact: Professor Liang-Nian Ji, Biotechnology Research Center, Zhongshan (Sun Yatsen) University, Guangzhou, Canton 510275, China. Tel +86 (20) 418 5461. Fax +86 (20) 418 9173.
E-mail leiy@bepc2.ihep.ac.cn

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E-mail Conferences@rsc.org

Faraday Discussion 105, Catalysis and Surface Science at High Resolution

Reading, UK December 16-18
Contact: Professor M Bowker, Department of Chemistry, University of Reading, Whiteknights Park, Reading, UK RG6 6AD.

January 1997

International Symposium on Chemical and Biological Thermodynamics

Amritsar, India January 5-8
Contact: Professor D V S Jain, Department of Chemistry, Panjab University, Chandigarh 160014, India. Tel +91 (172) 541435. Fax +91 (172) 541409. E-mail dvs-jain@imtech.ernet.in

April 1997

Spring ACS National Meeting

San Francisco, USA April 13-17
Contact: American Chemical Society, Meetings, PO Box 18598, 20th St Station, Washington, DC 20036-8598, USA.

6th International Symposium, Chemistry in the Oil Industry

Ambleside, UK April 14-17
Contact: P Ogden, Laporte Absorbents, PO Box 2, Moorfield Road, Widnes, Cheshire, UK WA8 0JU.

May 1997

11th Noordwijkerhout-Camerino Symposium, Trends in Drug Research

Noordwijkerhout, The Netherlands May 11-16
Contact: Secretariat 11th Noordwijkerhout-Camerino Symposium, c/o Professor H Timmerman, LACDR/Dept. of Pharmacology, VU, De Boelelaan 1083, 1081 HV Amsterdam, The Netherlands.

EPDIC-5 5th European Powder Diffraction Conference

Parma, Italy May 26-28
Contact: Professor G Artoli, Dipartimento di Scienze della Terra, Università di Milano, Via Botticelli, I-20133 Milano, Italy. Tel +39 2 23698320. Fax +39 2 70638681. E-mail epdic@lummix.terra.unimi.it

June 1997

80th Canadian Society for Chemistry Conference and Exhibition

Windsor, Canada June 1-5
Contact: Diane Goltz, The Chemical Institute of Canada, 130 Slater Street, Suite 550, Ottawa, ON, K1P 6E2. Tel +1 613 232 6252. Fax +1 613 232 5862.

4th International Symposium on Bio-organic Chemistry

Biarritz, France June 1-6
Contact: Professor A Marquet, Université Paris, URA CNRS 493, Laboratoire de Chimie Organique Biologique, Tour 44/45-4 Pl. Jussieu, 75252 Paris Cedex 05, France.

16th Conference on Coordination Chemistry

Smolenice, Slovakia June 9-13
Contact: Professor G Ondrejovič, Department of Inorganic Chemistry, Slovak Technical University, Radlinského 9, 812 37 Bratislava, Slovakia. Tel +42 7 495257. Fax +42 7 493198. E-mail sirota@cvstu.cvt.stuba.sk

35th National Organic Symposium

San Antonio, USA June 22-26
Contact: Dr James Rigby, Department of Chemistry, Wayne State University, Detroit, MI 48202, USA. Tel +1 313 577 3472. Fax +1 313 577 2099. E-mail jhr@che.wayne.edu

10th European Symposium on Organic Chemistry (ESOC 10)

Basel, Switzerland June 22-27
Contact: ESOC 10, Convention Center Basel, PO Box/Messeplatz 21, CH-4021 Basel, Switzerland. Tel +41 61 686 28 28. Fax +41 61 686 21 85.

Faraday Discussion 106, Solid State Chemistry: New Opportunities from Computer Simulations

London, UK June 30-July 2
Contact: Dr W C Mackrodt, School of Chemistry, University of St Andrews, Fife, UK KY16 9ST.

July 1997

13th International Meeting: NMR Spectroscopy

Exeter, UK July 6-11
Contact: RSC†

3rd International Symposium: Supported Reagents and Catalysis in Chemistry

Limerick, Ireland July 8-11
Contact: RSC†

3rd International Conference on Materials Chemistry

Exeter, UK July 21-25
Contact: RSC†

15th International Symposium. Synthesis in Organic Chemistry

Oxford, UK July 22-24
Contact: RSC†

8th International Conference on Bioinorganic Chemistry

Yokohama, Japan July 27-August 1
Contact: Professor Masanobu Hidai, Department of Chemistry and Biotechnology, Faculty of Engineering, University of Tokyo, Hongo 7-3-1, Bunkyo-ku, Tokyo 113, Japan. Tel +81 (3) 3812 2111. Fax +81 (3) 5800 6945.

August 1997

Inorganic Rings International Symposium, IRIS VIII

Loughborough, UK August 10-15
Contact: Professor J D Woollins, Department of Chemistry, Loughborough University, Loughborough, Leicestershire, UK LE11 3TU. Tel +44 (0) 1509 222565. Fax +44 (0) 1509 233163. E-mail j.d.woollins@lut.ac.uk

International Society of Heterocyclic Chemistry, 16th ISHC Congress

Bozeman, USA August 10-15
Contact: Professor T Livinghouse, Department of Chemistry, Montana State University, Bozeman, Montana, 59717, USA. Tel +1 (406) 994 4801. Fax +1 (406) 994 5407. E-mail uchtl@earth.oscs.montana.edu www http://euch6f.chem.emory.edu/bozeman.html

IUPAC Congress

Geneva, Switzerland August 18-22
Contact: Professor J Weber, Department of Physical Chemistry, University of Geneva, 30 quai Ernest-Andermet, 1211 Geneva 4, Switzerland. Tel +41 22 702 6111. Fax +41 22 702 6518. E-mail weber@sc2a.unige.ch

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