$\rho_{calcd} = 3.040\ g\,cm^{-3}$, $\mu = 11.85\ mm^{-1}$. Crystal size $0.08 \times 0.08 \times 0.2\ mm^3$. The SMART software was used for data acquisition and the SAINT software for data extraction.[17a] Unit cell parameters based on 25 reflections ($12^\circ < 2\theta < 30^\circ$). Absorption correction by SADABS,[17a] structure solved and refined by using the SHELXS-86[17b] and SHELXTL program systems,[17c] 1003 independent reflections, 913 with $F > 4\sigma(F_o)$, $R = 0.032/wR2$ (all data) $= 0.061$; max./min. residual electron density 2.2/ – 1.3 e Å^{-3} in the vicinity of the U atoms. Further details on the crystal structure investigation may be obtained from the Fachinformationszentrum Karlsruhe, 76344 Eggenstein-Leopoldshafen, Germany (fax: (+49) 7247-808-666; e-mail: crysdata @fiz-karlsruhe.de), on quoting the depository number CSD-411668.

[17] a) SMART, SAINT V-4, SADABS Programs, Bruker Analytical X-ray Systems Inc., Madison, WI, **1996**; b) G. M. Sheldrick, SHELXS-86: Program for crystal structure solution, University of Göttingen, **1986**; c) G. M. Sheldrick, SHELXL-97: Program for crystal structure refinement, University of Göttingen, **1997**.

[18] O. Ermer, A. Eling, *Angew. Chem.* **1988**, *100*, 856 – 859; *Angew. Chem. Int. Ed. Engl.* **1988**, *27*, 829 – 833.

[19] R. Riedel, A. Greiner, G. Miehe, W. Dressler, H. Fuess, J. Bill, F. Aldinger, *Angew. Chem.* **1997**, *109*, 657 – 660; *Angew. Chem. Int. Ed. Engl.* **1997**, *36*, 603 – 606.

[20] a) K. A. Hirsch, D. Venkataraman, S. R. Wilson, J. S. Moore, S. Lee, *J. Chem. Soc. Chem. Commun.* **1995**, 2199 – 2200; b) K. A. Hirsch, S. C. Wilson, J. S. Moore, *Chem. Eur. J.* **1997**, *3*, 765 – 771.

[21] H. Lueken, *Magnetochemie*, Teubner, Stuttgart, **1999**.

[22] a) R. L. Carlin, A. J. van Duyneveldt, *Magnetic Properties of Transition Metal Compounds*, Springer, New York, **1977**; b) "Magnetic Molecular Materials": *NATO ASI Ser. Ser. E* **1991**, *198*.

[23] a) V. I. Srdanov, G. D. Stucky, E. Lippmaa, G. Engelhardt, *Phys. Rev. Lett.* **1996**, *80*, 2449; b) G. K. H. Madsen, C. Gatti, B. B. Iversen, Lj. Damjanovic, G. D. Stucky, V. I. Srdanov, *Phys. Rev. B* **1999**, *59*, 12 359 – 12 369.

[24] P. Allemand, *Science* **1991**, *253*, 301 – 304.

[25] a) H. Noel, J. Padiou, J. Prigent, *C. R. Seances Acad. Sci. Ser. C* **1975**, *280*, 123 – 126; b) H. Noel, *C. R. Seances Acad. Sci. Ser. C* **1973**, *277*, 463 – 464; c) H. Noel, *C. R. Seances Acad. Sci. Ser. C* **1979**, *279*, 513 – 515; d) T. Vovan, N. Rodier, *C. R. Seances Acad. Sci. Ser. C* **1979**, *289*, 17 – 20; e) R. Brochu, J. Padiou, J. Prigent, *C. R. Seances Acad. Sci. Ser. C* **1972**, *274*, 959 – 961; f) H. Noel, J. Daoudi, *J. Solid State Chem.* **1985**, *60*, 131 – 134; g) H. Noel, M. Potel, *J. Less-Common Met.* **1985**, *113*, 11 – 15; h) H. Noel, *J. Less-Common Met.* **1980**, *72*, 45 – 49.

[26] H. Noel, R. Troc, *J. Solid State Chem.* **1979**, *27*, 123 – 135.

[27] a) X. Cieren, J. Angenault, J.-C. Courtier, S. Jaulmes, M. Quarton, F. Robert, *J. Solid State Chem.* **1996**, *121*, 230 – 235; b) V. Derstroff, G. Regelsky, H. Eckert, W. Tremel, *J. Mater. Chem.* **2001**, submitted.

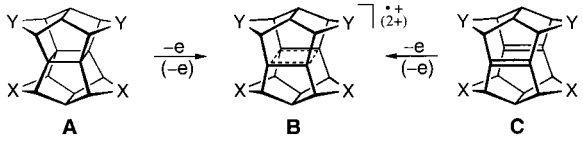
[28] P. Fragnaud, M. Evain, E. Prouzet, R. Brec, *J. Solid State Chem.* **1993**, *102*, 390 – 399.

[29] F. Hiltmann, P. zum Hebel, A. Hammerschmidt, B. Krebs, *Z. Anorg. Allg. Chem.* **1993**, *619*, 293 – 302.

σ-Bishomoconjugation (σ-Bishomoaromaticity) in 4C/3(2)e Cations—Scope and Limitations**

Horst Prinzbach,* Jens Reinbold, Martin Bertau, Torsten Voss, Hans-Dieter Martin, Bernhard Mayer, Jürgen Heinze, Dmytro Neschchadin, Georg Gescheidt, G. K. Surya Prakash, and George A. Olah

The experimental verification of σ-bishomoconjugation (σ-bishomoaromaticity) in the 4C/3e radical cation and the 4C/2e dication **B**, generated by one- and two-electron oxidation of the [1.1.1.1]pagodane **A** (X = Y = CH_2) and of the respective [1.1.1.1]pagodadiene **C** ("bisseco-dodecahedradiene"), respectively, was a prominent spin-off from our search for versatile synthetic routes to pentagonal dodecahedranes.[1] In order to



assess the geometrical prerequisites of these novel bonding motifs,[2] modification of the cage structures has been pursued in three directions: a) by formal rotation of a molecular "half" (→"isopagodanes"),[3] b) by homologation at the X- and/or Y-positions (→[2.2.1.1]/[2.2.2.2](iso)pagodanes),[3] and c) by bridging the X,Y positions (→(homo)dodecahedradienes).[4] A particularly attractive triad of this latter series consists of the parent bisseco-(**1**), seco-(**2**), and 1,16-dodecahedradienes (**3**) (Scheme 1).[5]

[*] Prof. Dr. H. Prinzbach, Dr. J. Reinbold, Dr. M. Bertau, Dr. T. Voss
Institut für Organische Chemie und Biochemie der Universität Freiburg
Albertstrasse 21, 79104 Freiburg (Germany)
Fax: (+49) 761-203-6051
E-mail: horst.prinzbach@orgmail.chemie.uni-freiburg.de

Prof. Dr. H.-D. Martin, Dr. B. Mayer
Institut für Organische Chemie und Makromolekulare Chemie der Universität Düsseldorf
Universitätsstrasse 1, 40225 Düsseldorf (Germany)

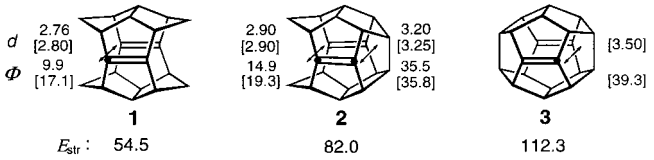
Prof. Dr. J. Heinze
Institut für Physikalische Chemie der Universität Freiburg
Albertstrasse 21, 79104 Freiburg (Germany)

Dipl.-Chem. D. Neschchadin, Doz. Dr. G. Gescheidt
Institut für Physikalische Chemie der Universität Basel
Klingelbergstrasse 80, 4056 Basel (Switzerland)

Prof. Dr. G. K. S. Prakash, Prof. Dr. G. A. Olah
Donald P. and Katherine B. Loker Hydrocarbon Research Institute and Department of Chemistry
University of Southern California
Los Angeles, CA 90089-1661 (USA)

Supporting information for this article is available on the WWW under http://www.angewandte.com or from the author.

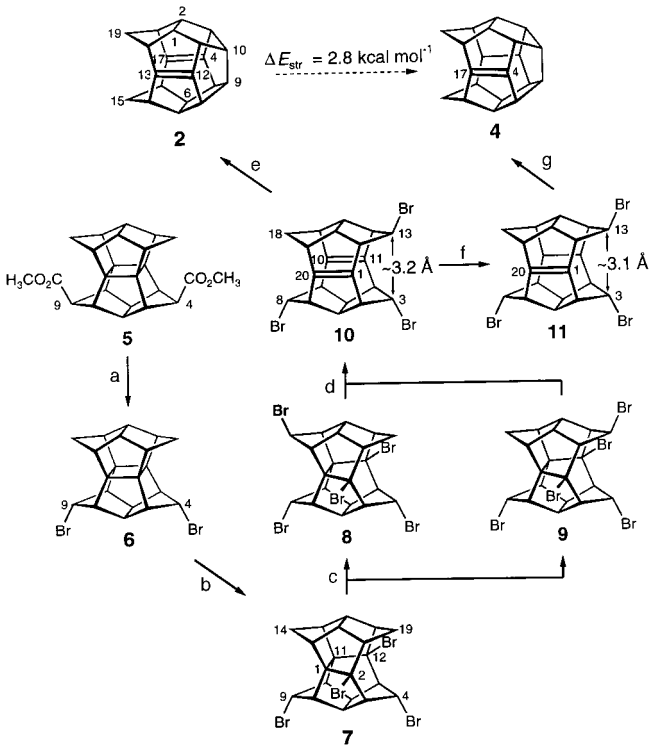
[**] This project has been supported by the Deutsche Forschungsgemeinschaft, the Fonds der Chemischen Industrie, and BASF AG. We thank A. Kurscheidt and M. Lutterbeck for technical assistance, Dr. D. Hunkler and Dr. J. Wörth for NMR and MS measurements, and Prof. Dr. T. Bally for access to his ^{60}Co-γ-irradiation equipment.



Scheme 1. Experimental and calculated (B3LYP/6-31G*, in square brackets) π,π-distances d [Å], pyramidalization angles Φ [°], and strain energies E_{str} (MM3, [kcal mol^{-1}]).

For very "proximate" **1**, it had been established that radical cation $\mathbf{1}^{\bullet+}$ and dication $\mathbf{1}^{2+}$ are persistent even at room temperature, whilst for "distant" **3** the radical cation $\mathbf{3}^{\bullet+}$ does exist only in a low temperature matrix and dication $\mathbf{3}^{2+}$ is not observable at all.[6] The synthesis of the missing compound **2**—the "hybrid" of **1** and **3** with regard to its π,π-distances d and pyramidalization Φ on the olefinic carbon atoms[7]—and of monoene **4** as a reference, as well as their response to one-/two-electron oxidation are subject of this Communication.

Prior attempts to prepare parent **2** through defunctionalization of available derivatives[7, 8] have consistently failed due to the incompatibility of the severely bent C–C double bonds with the respective reaction and separation conditions. Success came with the reaction sequence shown in Scheme 2 (total yield of **2** > 30% with only 5–6% of **1** as impurity),[9, 10] when a satisfying protocol for the problematic step **10** → **2**—internal competition between reductive C3–C13 bond formation and hydrogenolytic C–Br cleavage—had become



Scheme 2. a) 1) KOH, $HOCH_2CH_2OH$, 180 °C, 16 h; 2) H_2O, conc. HCl; 3) 2-mercaptopyridine-1-oxide (Na salt), DMAP, $BrCCl_3$, 120 °C, 30 min; 76%. b) Br_2/CH_2Cl_2 (10/1), RT, $h\nu$ (300 W daylight lamp), 5 min; > 95%. c) Br_2/CH_2Cl_2 (4/1), RT, $h\nu$ (300 W daylight lamp), 5 h; 95%. d) KI, DMF, 180 °C; 70%. e) 1) Li/Hg, THF, −78 °C → RT, 2 h; 2) MeOH, 1 h; 80–85%. f) N_2H_2, 0 °C, 12 h; 95%. g) 1) Li/Hg, THF, −78 °C → RT, 2 h; 2) MeOH/1 h; 80–85%. DMAP = 4-dimethylaminopyridine.

available after intensive experimentation with various metals and electron-transfer agents.

For the hydrogenation of diene **2** to monoene **4**, only a small increase in strain was calculated (+2.8 kcal mol^{-1}); correspondingly, the selective preparation of **4** through hydrogenation of **2** was found to be not possible. Alternatively, **4** was expeditiously obtained by hydrogenation of tribromobisseco-diene **10** to give "hyperstable"[11] **11** followed by cyclization.

The longest wavelength UV/Vis absorption of **2** at 254 nm ($\varepsilon \approx 600$, *n*-hexane), as evidence for transannular π,π-interaction (charge transfer), hardly differs from that of **3** (252 nm, $\varepsilon \approx 350$) but significantly from that of **1** (270 nm, $\varepsilon = 180$). In the ^{13}C NMR spectra, the olefinic shifts of 151.8 and 171.4 ppm reflect the degree of pyramidalization, while $\Delta\delta = 1.47$ for the geminal methylene protons reflects the steric constraint inside the half-cage.[7]

In the photoelectron (PE) spectrum of **2**, the mean value (8.06 eV) of the two π-ionization bands (7.48 and 8.64 eV) turns out to be higher by 0.15 eV than the π-band of **4** (7.91 eV). The π,π-split ($\Delta_{\pi\pi}$) of 1.16 eV is well reproduced by calculations (B3LYP/6-31G*: 1.14 eV; AM1: 1.03 eV). According to Heilbronner–Schmelzer analysis, 87% of the split is caused by through-space (TS) interaction (compare **1**: $\Delta_{\pi\pi} = 1.91$ eV, 100% TS and **3**: $\Delta_{\pi\pi} = 0.68$ eV, 59% TS).[12]

Cyclovoltammetry (CH_2Cl_2, nBu$_4$NPF$_6$, −20 °C, 0.2 V s^{-1}) recorded two irreversible oxidation waves with $E_p = 1.00$ and 1.50 V for **2** and one irreversible wave with $E_p = 1.60$ V for **4** (**1**: $E_{1/2} = 0.66$ V, $E_p = 1.20$ V; **3**: $E_p \approx 1.0$ V). The difference of the peak potential for $\mathbf{2}^{\bullet+}$ relative to $\mathbf{4}^{\bullet+}$ ($\Delta E_p = 0.60$ V) as a measure for the homoconjugational stabilization of $\mathbf{2}^{\bullet+}$ has to be compared with $\Delta E_p = 0.91$ V for $\mathbf{1}^{\bullet+}$ and $\Delta E_p \approx 0.4$ V for $\mathbf{3}^{\bullet+}$ relative to the respective monoenes.[13]

The radical cation $\mathbf{2}^{\bullet+}$ could not be observed after oxidation of **2** in fluid solution as established for **1** ($AlCl_3$, tris(*p*-bromophenyl)ammoniumyl hexachloroantimonate, Tl(O$_2$C-CF$_3$)$_3$, electrolysis).[5] However, as for **3**,[6] γ-irradiation of **2** and **4** in a $CFCl_3$ matrix allowed the observation of ESP spectra (Figure 1). The pattern of the ESP spectrum attributed to $\mathbf{2}^{\bullet+}$ is dominated by a nonet spaced by about 1.5 mT (eight nearly equivalent protons, no differentiation between the β/β' protons). Additional information follows from the polarization pattern of the CIDNP experiment, in which $\mathbf{2}^{\bullet+}$ was generated by photoinduced electron transfer to chloranil (tetrachloro-*p*-benzoquinone, in CD_2Cl_2). From the intensities of the two emissions lines at 3.28 and 3.48 mT, ^1H hyperfine coupling constants (hfcs) of 1.18 and 1.55 mT for the β and β' protons were derived.[14] These values are in very good agreement with the calculated (B3LYP/6-31G*[15]) ^1H hfcs of 1.49 (β) and 1.59 mT (β'); the very small hfcs for the remaining protons (< 0.1 mT) are not resolved in experimental spectra.

In the case of $\mathbf{4}^{\bullet+}$, the ESP spectrum reveals a pattern due to two pairs of equivalent protons with ^1H hfcs of 4.3 and 2.9 mT (Figure 1). According to the calculated values of 3.98 and 2.71 mT, these hfcs are attributed to the β and β' protons.

In line with the cyclically delocalized 4C/3e configuration of $\mathbf{2}^{\bullet+}$—within the ESP time scale—these hfcs are about one half those of $\mathbf{4}^{\bullet+}$. According to calculations, in the trapezoidal 4C/3e structure of $\mathbf{2}^{\bullet+}$ the C_{2v} symmetry of parent

  1433-7851/01/4005-0912 $ 17.50+.50/0

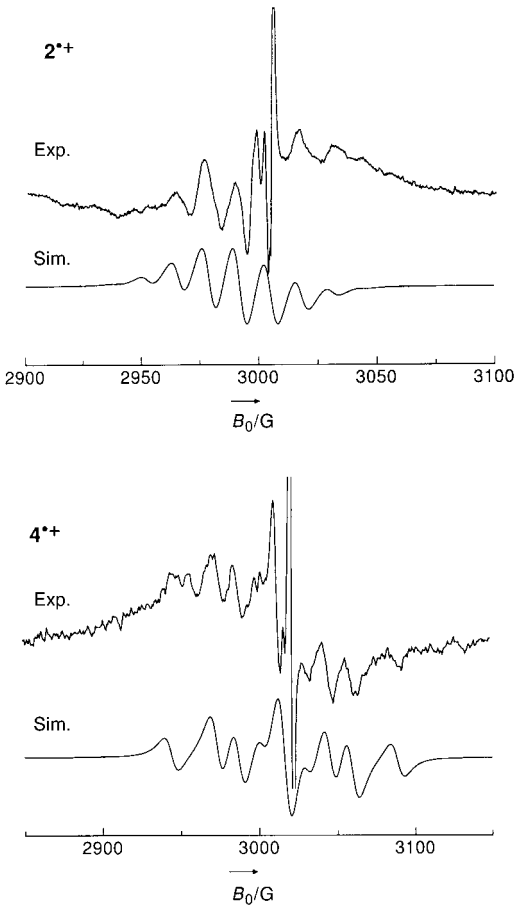
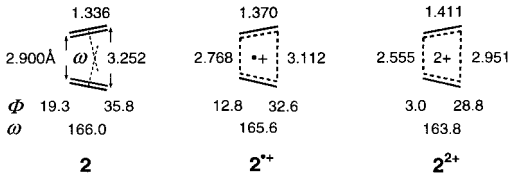


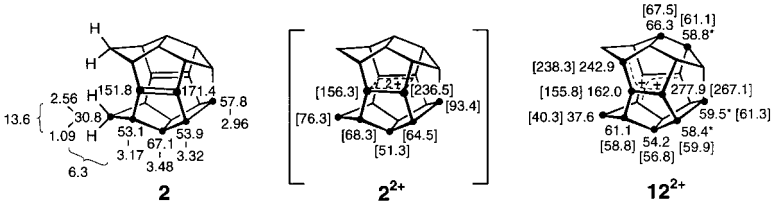
Figure 1. ESR spectra of **2** and **4** ($CFCl_3$, 100 K, modulation 0.5 mT).

2 is retained, the C–C double bonds are lengthened by 0.034 Å, and the π,π-distances are shortened by 0.132/0.140 Å (Scheme 3).



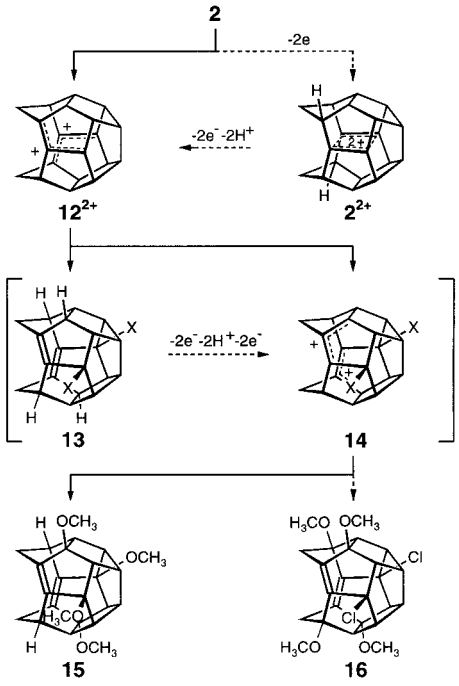
Scheme 3. Calculated structures of diene **2**, in-plane homoconjugated radical cation $\mathbf{2}^{\bullet+}$, and σ-bishomoaromatic dication $\mathbf{2}^{2+}$ (B3LYP/6-31G*; distances d [Å], pyramidalization angles Φ [°], and angles ω [°].)

For its two-electron oxidation, **2** was mixed (as a slurry in SO_2ClF at −70 °C) with a six-fold excess of SbF_5 in SO_2ClF at −70 °C. After very slow dissolution (vortex stirrer, −70 °C), a dark yellowish-brown solution developed. At this temperature, the NMR signals were quite broad and indicate some paramagnetic species. Upon warming to −20 °C, however, the peaks sharpened. Whilst the ^{1}H NMR spectrum was too complex to allow an interpretation, the ^{13}C NMR spectrum clearly revealed the presence of one prominent species (>80%, ten intense signals and several weaker ones). The assignment to C_2 symmetrical bisallylic dication $\mathbf{12}^{2+}$, rather than to the C_{2v} symmetrical 4C/2e dication $\mathbf{2}^{2+}$, is based on the number of ^{13}C NMR signals (ten rather than seven), the allylic nature of the three olefinic signals (δ = 277.9, 242.9, and 162.0; Scheme 4), and the good agreement with the GIAO-B3LYP/6-31G* calculations.[16] Additional support comes from



Scheme 4. Experimental and calculated (GIAO-B3LYP/6-31G*, in square brackets) ^{13}C NMR shifts δ for dications $\mathbf{2}^{2+}$ and $\mathbf{12}^{2+}$. For comparison, ^{1}H and ^{13}C shifts and J(H,H) coupling [Hz] for diene **2** (C_6D_6) are given.

quenching the superacid solution with CH_3OH/Na_2CO_3. Two main products could be chromatographically separated from a complex mixture of mostly higher methoxylated dienes (MS, ≈25%), unequivocally identified as C_2-symmetrical tetramethoxydiene **15** (≈30%) and C_2-symmetrical dichlorotetramethoxydiene **16** (≈25%). The intermediacy of dienes **13** (X = OCH_3, Cl) and bisallylic dications **14** (X = OCH_3, Cl) is



plausible. Correspondingly from DFT calculations, the parent diene structure **13** (X = H), and not **2**, had surfaced as "stabilomer" of the seco-dodecahedradiene family (−3.5 kcal mol^{-1} versus **2**). An intriguing cascade of oxidation/deprotonation/OCH_3-addition steps during the quenching procedure is held responsible for the $C_{20}H_4(OCH_3)_{14}$ ion in the MS spectrum (m/z = 678, low intensity) and suggests the total substitution of all tertiary hydrogens by CH_3O groups.

The radical cation generated from diene **2** in low temperature matrices (or with very short lifetime in solution, CIDNP), is firmly established as in-plane cyclically delocal-

  1433-7851/01/4005-0913 $ 17.50+.50/0

ized 4C/3e species. Both, the total π,π split (PE) as well as its through-space/through-bond partition, the degree of homoconjugational stabilization (cyclovoltammetry), and the structural details (DFT) place $\mathbf{2}^{\bullet+}$ between $\mathbf{1}^{\bullet+}$ and $\mathbf{3}^{\bullet+}$. A limitation of the observability of σ-bishomoaromatic 4C/2e dications is manifested: If $\mathbf{2}^{2+}$ is an intermediate at all on the way from **2** to $\mathbf{12}^{2+}$, minimization of Coulomb repulsion through "hydride" elimination[17]—prohibited by the skeleton in $\mathbf{1}^{2+}$ ("*anti*-Bredt protection")[18]—wins over σ-bishomoaromaticity.

Received: September 11, 2000 [Z15785]

[1] G. K. S. Prakash, V. V. Krishnamurthy, R. Herges, R. Bau, H. Yuan, G. A. Olah, W.-D. Fessner, H. Prinzbach, *J. Am. Chem. Soc.* **1988**, *110*, 7764 – 7772.

[2] In the meantime, 4N/5(6)e anions are also established: a) K. Exner, D. Hunkler, G. Gescheidt, H. Prinzbach, *Angew. Chem.* **1998**, *110*, 2013 – 2016; *Angew. Chem. Int. Ed.* **1998**, *37*, 1910 – 1913; b) K. Exner, H. Prinzbach, G. Gescheidt, B. Großmann, J. Heinze, *J. Am. Chem. Soc.* **1999**, *121*, 1964 – 1965; c) K. Exner, M. Vögtle, H. Prinzbach, B. Grossmann, J. Heinze, L. Liesum, R. Bachmann, A. Schweiger, G. Gescheidt, *J. Am. Chem. Soc.* **2000**, *112*, 10650 – 10660.

[3] a) G. K. S. Prakash, K. Weber, G. A. Olah, H. Prinzbach, M. Wollenweber, M. Etzkorn, T. Voss, R. Herges, *Chem. Commun.* **1999**, 1029 – 1030; b) M. Wollenweber, M. Etzkorn, J. Reinbold, F. Wahl, T. Voss, J.-P. Melder, C. Grund, R. Pinkos, D. Hunkler, M. Keller, J. Wörth, L. Knothe, H. Prinzbach, *Eur. J. Org. Chem.* **2000**, 3855 – 3886.

[4] A. Weiler, E. Quennet, M. Keller, K. Exner, H. Prinzbach, *Tetrahedron Lett.* **2000**, *41*, 4763 – 4767, and references therein.

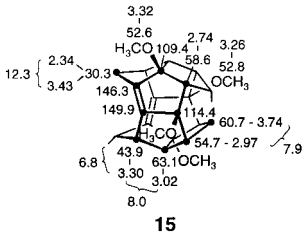
[5] H. Prinzbach, G. Gescheidt, H.-D. Martin, R. Herges, J. Heinze, G. K. S. Prakash, G. A. Olah, *Pure Appl. Chem.* **1995**, *67*, 673 – 682.

[6] K. Weber, H. Prinzbach, R. Schmidlin, F. Gerson, G. Gescheidt, *Angew. Chem.* **1993**, *105*, 907 – 910; *Angew. Chem. Int. Ed. Engl.* **1993**, *32*, 875 – 877.

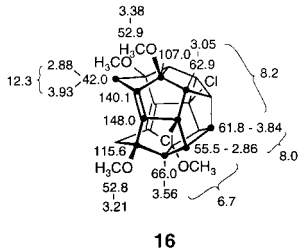
[7] H. Irngartinger, U. Reifenstahl, H. Prinzbach, R. Pinkos, K. Weber, *Tetrahedron Lett.* **1990**, *31*, 5459 – 5462.

[8] M. Bertau, J. Leonhardt, A. Weiler, K. Weber, H. Prinzbach, *Chem. Eur. J.* **1996**, *2*, 570 – 579.

[9] All operations with **2** and **4** have to be performed under exclusion of air (storage possible at $-40\,^{\circ}C$ for weeks). The new compounds are fully characterized by elemental analysis and their spectra (MS, IR, ^1H and ^{13}C NMR; ^1H-^1H COSY, HMRC, NOESY); see below, for example, the NMR data for **15** and **16** ($CDCl_3$; ^{13}C and ^1H shifts, *J*(H,H) coupling constants [Hz]).



15



16

[10] D. H. R. Barton, *Aldrichimica Acta* **1990**, *23*, 3.

[11] a) B. A. R. C. Murty, R. Pinkos, P. R. Spurr, W.-D. Fessner, G. Lutz, H. Fritz, D. Hunkler, H. Prinzbach, *Chem. Ber.* **1992**, *125*, 1719 – 1739; b) W. F. Maier, P. von R. Schleyer, *J. Am. Chem. Soc.* **1981**, *103*, 1891 – 1900.

[12] H.-D. Martin, B. Mayer, K. Weber, F. Wahl, H. Prinzbach, *Liebigs Ann.* **1995**, 2019 – 2025, and references therein.

[13] K. Weber, G. Lutz, L. Knothe, J. Mortensen, J. Heinze, H. Prinzbach, *J. Chem. Soc. Perkin Trans. 2* **1995**, 1991 – 1997.

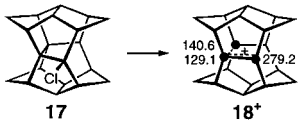
[14] The hfcs are given by the formula $hfc = CIT_1$. The constant *C* was determined relating hfcs (ESP) of pagodane-type radicals to polarization intensities (G. Gescheidt, unpublished results); *I* is the intensity of the polarization. The longitudinal relaxation times T_1 were measured by an inversion – recovery experiment.

[15] Gaussian 94, Revision E.2, Gaussian, Inc., Pittsburgh, PA, **1995**.

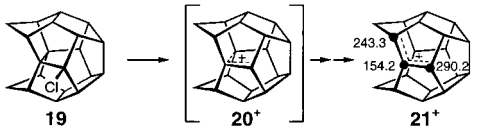
[16] GIAO: R. Ditchfield, *Mol. Phys.* **1974**, *27*, 789 – 807.

[17] G. A. Olah, G. K. S. Prakash, W.-D. Fessner, T. Kobayashi, L. A. Paquette, *J. Am. Chem. Soc.* **1988**, *110*, 8599 – 8605.

[18] The same difference has been established for the behavior of the chlorides **17** and **19** in the superacid medium. Of the σ-homoallylic cations $\mathbf{18}^{+}$ and $\mathbf{20}^{+}$, the former is highly persistent,[19] the latter at $-20\,^{\circ}C$ undergoes rapid hydride shifts to give isomeric $\mathbf{21}^{\bullet+}$.



17 **18**$^+$



19 **20**$^+$ **21**$^+$

[19] G. K. S. Prakash, W.-D. Fessner, G. A. Olah, G. Lutz, H. Prinzbach, *J. Am. Chem. Soc.* **1989**, *111*, 746 – 748.

A Versatile and High-Yield Route to Active and Well-Defined Catalysts [Ru(bisphosphane)(H)(solvent)$_3$](BF$_4$)**

Jason A. Wiles, Steven H. Bergens,* Koenraad P. M. Vanhessche, Daniel A. Dobbs, and Valentin Rautenstrauch*

The well-known and well-defined Rh systems $[Rh(\widehat{P\,P})(sol)_2]^+$ ($\widehat{P\,P}$ = chiral bisphosphane ligand, sol = weakly O-bound solvent, for example acetone, THF, MeOH)[1] catalyze a wide variety of reactions, the most prominent of which is the asymmetric hydrogenation of functionalized

[*] Prof. Dr. S. H. Bergens, Dr. J. A. Wiles
Department of Chemistry, University of Alberta
Edmonton, AB, T6G 2G2 (Canada)
Fax: (+1) 780-492-82-31
E-mail: steve.bergens@ualberta.ca
Dr. V. Rautenstrauch, Dr. K. P. M. Vanhessche, Dr. D. A. Dobbs
Firmenich SA, Corporate R&D Division
1211 Geneva 8 (Switzerland)
Fax: (+41) 22-780-33-34
E-mail: valentin.rautenstrauch@firmenich.com

[**] We are much indebted to Dr. J.-Y. Lenoir and Prof. J.-P. Genêt (Ecole Nationale Supérieure de Chimie de Paris), who made the initial breakthrough in this project, to Prof. G. Whitesides (Harvard University), who much helped to initiate it, to R. Challand and Y. Kirschmann (Firmenich) for skillful and exacting experimental work throughout, and to Dr. V. G. Young, Jr. (University of Minnesota) for the X-ray structure determination of **1**. We thank W. Thommen, R. Brauchli, F. Delavenay, and C. Hottelier (Firmenich), and G. Bigam, G. Aarts, and Dr. T. Nakashima (University of Alberta) for the NMR investigations, and M. Abric and Dr. J. Youssefi (Firmenich) for measuring the mass spectra.

  1433-7851/01/4005-0914 $ 17.50+.50/0