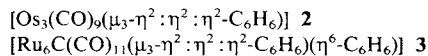


ing longer and shorter bonds (mean values 1.39(2) and 1.48(2) Å), corresponding to a cyclohexatriene, are present in the μ_3 -bridging ligand of **3**.^[12]



On metal single crystals benzene and other aromatic hydrocarbons are adsorbed molecularly parallel to the close-packed surfaces (e.g. Ni(111) or Rh(111)).^[9] However, there is some uncertainty about the orientation relative to the surface metal atoms (C_6 centroid above a metal atom, a 2-fold (M_4) or 3-fold (M_3) metal site).^[9,10] According to LEED investigations (LEED = low energy electron diffraction) of coadsorbates $\text{C}_6\text{H}_6/\text{CO}$ and $\text{C}_6\text{H}_6/2\text{CO}$ on Rh(111) (planar benzene fixed in 3-fold coordination sites) benzene has, at least in these cases, the Kekulé structure with strongly alternating bond lengths.^[11] In contrast, a planar arene with virtually equal bonding fixed in a 3-fold metal coordination site is present in **1**—a remarkable finding in view of the postulated analogy between metal surfaces and clusters.^[12]

The unsaturated side chain on the benzene ring appears to be the prerequisite for the formation of **1**. We assume initial attack of a CpCo fragment at this site. Assembly of the metal cluster could then proceed (if necessary after shifting of the double bond into the α -position to the arene) via an intermediate with methylstyrene as a doubly η^4 -coordinating diene (3-6- η , 1-2:7-8- η). Related structures, albeit with metal atoms coordinating the bridging ligands from opposite sides, were derived from NMR spectroscopic data for $[\{\text{Fe}(\text{CO})_3\}_2]$ -complexes of substituted styrenes^[13] and $[\{\text{C}_5\text{Me}_5\text{Co}\}_3(\eta^4\text{:}\eta^4\text{:}\eta^4\text{-biphenyl})]$.^[14] Reaction of the intermediate with a further CpCo fragment and rearomatization of the arene could then lead to **1**.

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- [1] E. L. Muetterties, J. R. Bleeke, E. J. Wucherer, T. A. Albright, *Chem. Rev.* 82 (1982) 499. For more recent studies on compounds with doubly bridging arene ligands see: K. Jonas, *Angew. Chem.* 97 (1985) 292; *Angew. Chem. Int. Ed. Engl.* 24 (1985) 295, and references cited therein.
- [2] M. P. Gomez-Sal, B. F. G. Johnson, J. Lewis, P. R. Raithby, A. H. Wright, *J. Chem. Soc. Chem. Commun.* 1985, 1682.
- [3] K. Jonas, C. Krüger, *Angew. Chem.* 92 (1980) 513; *Angew. Chem. Int. Ed. Engl.* 19 (1980) 520; K. Jonas, E. Deffense, D. Habermann, *Angew. Chem.* 95 (1983) 729; *Angew. Chem. Int. Ed. Engl.* 22 (1983) 716; *Angew. Chem. Suppl.* 1983, 1005.
- [4] *Procedure*: *trans*- β -methylstyrene (6.31 g, 53.4 mmol) was added dropwise at room temperature to a solution of $[\text{CpCo}(\text{C}_2\text{H}_4)_2]$ (4.81 g, 26.7 mmol) in petroleum ether (100 mL, b.p. 40–60°C). After 1 h the mixture was heated for a further 3 h at 60°C, then cooled to room temperature again and all volatile components removed in a vacuum. The residue was dissolved in toluene/petroleum ether (1:1) and chromatographed on $\text{Al}_2\text{O}_3/5\%$ H_2O . Dark brown needles of **1** (3.49 g, 7.12 mmol, 80% based on Co) were obtained from the eluate at 5°C; m.p. 182°C; correct C,H analyses).
- [5] ¹H-NMR (200.1 MHz, $[\text{D}_8]$ toluene, 25°C): δ = 5.76 (dq, $J_{\text{HH}} = 15.6$, 1.5 Hz, 1H; H-6), 5.44 (dq, $J_{\text{HH}} = 15.6$, 6.5 Hz, 1H; H-7), 4.58 (s, 15H; Cp), 4.4 (m, 2H; arene-H), 4.2 (m, 3H; arene-H), 1.57 (dd, $J_{\text{HH}} = 6.5$, 1.5 Hz, 3H; CH_3). ¹³C-NMR (50.3 MHz, $[\text{D}_6]$ benzene, 25°C): δ = 140.1 (d; olefin-C), 116.4 (d; olefin-C), 82.7 (d; Cp), 56.1 (s; C-1), 41.8 (d; arene-C), 40.9 (d; arene-C), 39.2 (d; arene-C), 18.4 (q; CH_3). MS (direct chemical ionization) m/z 490 (43% rel. int., M^+), 370 (100, $[(\text{CpCo})_3 - 2\text{H}]^+$), 247 (20, $[(\text{CpCo})_2 - \text{H}]^+$), 207 (22), 189 (87, $[\text{Cp}_2\text{Co}]^+$), 124 (28, $[\text{CpCo}]^+$), 118 (15, $[\text{PhC}_3\text{H}_3]^+$), 117 (19, $[\text{PhC}_3\text{H}_4]^+$), 91 (8, $[\text{C}_7\text{H}_7]^+$), 59 (15, Co^+), 44 (19).
- [6] Two ¹³C-NMR signals in the intensity ratio 1:2 are observed for the C_5H_5 carbon atoms at 220 K.
- [7] B. E. Mann, B. F. Taylor: *¹³C NMR Data for Organometallic Compounds*. Academic Press, London 1981, p. 247.
- [8] Crystal structure analysis of **1**: Space group $P2_1$, $a = 8.725(5)$, $b = 7.542(5)$, $c = 15.151(6)$ Å, $\beta = 103.17(4)^\circ$, $V = 970.7$ Å³, $Z = 2$; 3030 reflections measured (Weissenberg diffractometer, $\text{MoK}\alpha$, ω scan), 2893 observed ($I \geq \sigma(I)$), numerical absorption correction; 337 parameters refined (Co, C anisotropically, H isotropically, CH_3 as rigid group), $R = 0.026$, $R_w = 0.027$. Further details of the crystal structure investigation are available on request from the Fachinformationszentrum Energie, Physik, Mathematik GmbH, D-7514 Eggenstein-Leopoldshyfen 2 (FRG), on quoting the depository number CSD-52636, the names of the authors, and the journal citation.

[9] E. L. Muetterties, *Pure Appl. Chem.* 54 (1982) 83.

[10] R. F. Lin, R. J. Koestner, M. A. Van Hove, G. A. Somorjai, *Surf. Sci.* 134 (1983) 161.

[11] M. A. Van Hove, R. Lin, G. A. Somorjai, *Phys. Rev. Lett.* 51 (1983) 778; *J. Am. Chem. Soc.* 108 (1986) 2532.

[12] E. L. Muetterties, *Bull. Soc. Chim. Belg.* 84 (1975) 959; 85 (1976) 451; *Science* 196 (1977) 839; *Chem. Rev.* 79 (1979) 91, and references cited therein.

[13] R. Victor, R. Ben-Shoshan, S. Sarel, *Chem. Commun.* 1970, 1680; *J. Org. Chem.* 37 (1972) 1930.

[14] H. Lehmkuhl, H. Nehl, R. Benn, R. Mynott, *Angew. Chem.* 98 (1986) 628; *Angew. Chem. Int. Ed. Engl.* 25 (1986) 646.

- [9] E. L. Muetterties, *Pure Appl. Chem.* 54 (1982) 83.
- [10] R. F. Lin, R. J. Koestner, M. A. Van Hove, G. A. Somorjai, *Surf. Sci.* 134 (1983) 161.
- [11] M. A. Van Hove, R. Lin, G. A. Somorjai, *Phys. Rev. Lett.* 51 (1983) 778; *J. Am. Chem. Soc.* 108 (1986) 2532.
- [12] E. L. Muetterties, *Bull. Soc. Chim. Belg.* 84 (1975) 959; 85 (1976) 451; *Science* 196 (1977) 839; *Chem. Rev.* 79 (1979) 91, and references cited therein.
- [13] R. Victor, R. Ben-Shoshan, S. Sarel, *Chem. Commun.* 1970, 1680; *J. Org. Chem.* 37 (1972) 1930.
- [14] H. Lehmkuhl, H. Nehl, R. Benn, R. Mynott, *Angew. Chem.* 98 (1986) 628; *Angew. Chem. Int. Ed. Engl.* 25 (1986) 646.

Reactions of 2,2,4,4-Tetramethyl-3-methylenecyclobutylidene; Thermal Rearrangements of a 2-Methylenebicyclo[2.1.0]pentane**

By Udo H. Brinker* and Wolfgang Erdle

Dedicated to Professor Emanuel Vogel on the occasion of his 60th birthday

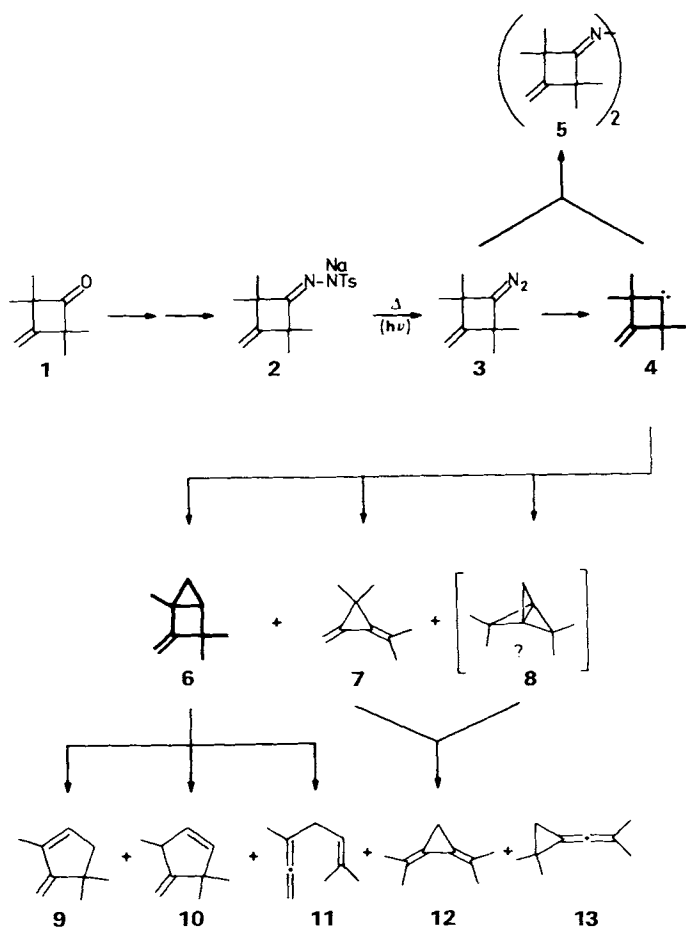
Small ring carbenes are important reactive building blocks for the synthesis of highly strained, polycyclic compounds.^[1] Cyclobutylidenes preferentially undergo ring contractions to give methylene cyclopropanes.^[2] We have examined the extent to which possible interactions between carbene center and an *exo*-methylene group in the 2-^[3] or 3-position influence the rearrangement behavior of 2,2,4,4-tetramethyl-3-methylenecyclobutylidene **4**. Besides ring contraction to give **7** there are further intramolecular reactions open to **4**, e.g. insertion into a C–H bond of the neighboring CH_3 groups with formation of the strained 2-methylenebicyclo[2.1.0]pentane **6**. A spectacular addition of the carbene **4** or of the diazo group in **3** to the *exo* double bond could result in formation of the tetramethyl-substituted [1.1.1]propellane **8** or the corresponding 4,5-dihydro-3H-pyrazole. That is, the highly-strained propellane skeleton^[4] would either have to be formed directly via the structurally integrated allylcarbene^[5] in **4** with concomitant formation of *three* cyclopropane rings or only after cleavage of N_2 from the dihydropyrazole.

The 3-methylenecyclobutanone **1**^[6] required for the formation of the tosylhydrazone-sodium salt **2** was synthesized from commercially available 2,2,4,4-tetramethyl-1,3-cyclobutanedione.^[6] The reaction of **1** with *p*-toluenesulfonylhydrazide afforded the corresponding tosylhydrazone in 92% yield, which on reaction with sodium hydride furnished the sodium salt **2** in almost quantitative yield (97%).

Upon flash pyrolysis^[4] of **2** at 240–290°C (10^{-4} – 10^{-5} torr) a pink-colored pyrolyzate was obtained whose IR spectrum (CCl_4) showed a strong band at 2020 cm^{-1} ($\text{R}_2\text{C}=\text{N}=\text{N}$ valence vibration). The diazo compound **3**

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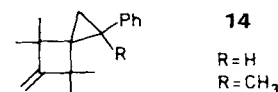
[**] Carbene Rearrangements, Part 23. This work was supported by the Deutsche Forschungsgemeinschaft (Br 667/6) and the Fonds der Chemischen Industrie. W. E. thanks the Land Nordrhein-Westfalen for a graduate fellowship. We thank Dr. W. Dietrich for the ¹H- and ¹³C-NMR spectra of **6** and Prof. W. R. Roth for valuable discussions.—Part 22: I. Fleischhauer, U. H. Brinker, *Chem. Ber.* 120 (1987) 501.



thyl groups are moved to the terminal carbon of the double bond via methylenecyclopropane rearrangement.^[11] In the flow pyrolysis^[12, 13] of **7** at 550°C (0.1 torr, quartz tube filled with quartz chips)^[12] **12** is formed in 61% yield. This result suggests that 2–3% of **7** is also converted into **12**^[14] under the conditions of the flash pyrolysis.^[13, 12]

In addition, 1,1-dimethyl-2-(2-methyl-1-propenyli-dene)cyclopropane **13**^[13b, 14] could be identified as a further product (<1%) of the pyrolysis. In the carbene **4** the 1,3-C–H insertion to give **6** (+ **9** + **10** + **11**) dominates over the ring contraction to **7** (+ **12**) in the ratio of ca. 1.2 : 1.

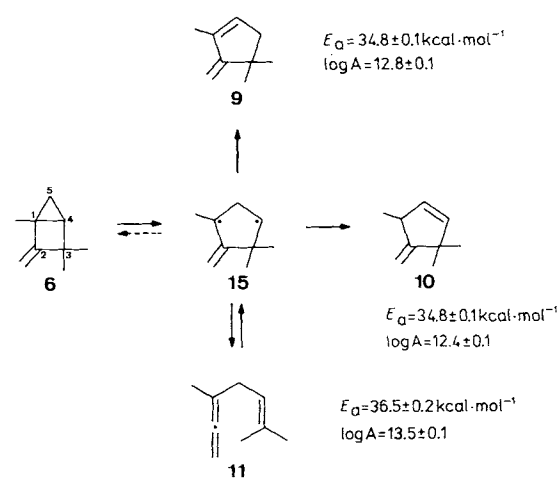
The photolysis (Pyrex, Philips HPK, 125W) of an etheral suspension of **2** between 0 and 20°C afforded the hydrocarbons **7** and **6** in 40 and 35% yield, respectively. In addition, ca. 5–10% azine **5**, 0.8% **12** and ca. 1% ketone **1** were isolated. **2** was decomposed thermally and photochemically also in the presence of styrene and α -methylstyrene. In the photolysis the spiro[2.3]hexanes **14** are formed in yields of 28–35%. The long lifetime of the diazo compound **3** suggests that spirohexane formation takes place by 1,3-dipolar cycloaddition of **3** via intermediary dihydropyrazoles.^[15]



The thermolysis of **6** in the gas phase at 140–190°C leads to formation of **9**, **10**, and **11**; their formation follows a first order rate law with the given activation parameters (see formula). This suggests formulating the forma-

could be enriched if the decomposition of **2** took place between 120 and 130°C (<10⁻⁴ torr). The half-life of ca. 6700 s at 31.5°C shows that **3** is kinetically highly stabilized in comparison to the diazocyclobutane, which is unstable at room temperature.^[7] The “longevity” of **3** at 240–290°C is also reflected in the relatively high yield of azine **5** (20–30%). At these temperatures in addition to some toluene (ca. 3%) seven hydrocarbons are formed in a total yield of 72% (isolated by preparative gas chromatography). 1-Isopropylidene-2,2-dimethyl-3-methylenecyclopropane **7**,^[8] which could be formed by a cyclobutylidene-methylenecyclopropane rearrangement of **4**, is isolated in 35% (42% relative) yield. A 1,3-insertion of the carbene carbon into one of the C–H bonds of the four methyl groups results in formation of the strained 1,3,3-trimethyl-2-methylenebicyclo[2.1.0]pentane **6**^[8] (27% relative, 15% isolated). As will be shown below, the methylenecyclopentenes **9** (10%, 8%)^[8] and **10** (6%, 3%)^[8] as well as the allene **11** (11%, 7%)^[8] are secondary products of **6**. In addition, diisopropylidenecyclopropane **12**,^[9] which could not be formed directly from the carbene **4**, was isolated in 2–3% (4% relative) yield.

Two possible routes come into consideration for the formation of **12** from **4**: 1. The intermediary tetramethyl[1.1.1]propellane **8** resulting from the intramolecular carbene addition (or a 1,3-dipolar cycloaddition of **3** via 4,5-dihydro-3H-pyrazole and subsequent N₂ cleavage) rearranges directly to **12**. The parent compound [1.1.1]propellane^[5] yields exclusively dimethylenecyclopropane at 430°C under flow pyrolysis conditions^[10] **2**. An isomerization of **7** takes place, and the geminal cyclopropane me-



tion of **9**, **10**, and **11**—as in the case of the unsubstituted bicyclo[2.1.0]pentane^[16]—via a diradical **15**. Consistent with this interpretation the flow pyrolysis^[13a] of the allene **11** affords, besides *p*-xylene, the isomers **9** and **10** (**9** : **10** : **11** = 7 : 4 : 89). The assumption of an intermediary diradical also makes the markedly lower activation energies compared to the parent system understandable. For the formation of **9** and **10** these are ca. 11 kcal mol⁻¹ lower compared to the cyclopentene formation ($E_a = 45.6 \text{ kcal mol}^{-1}$),^[16] whereby the resonance stabilization of the allyl radical should make the greatest contribution.

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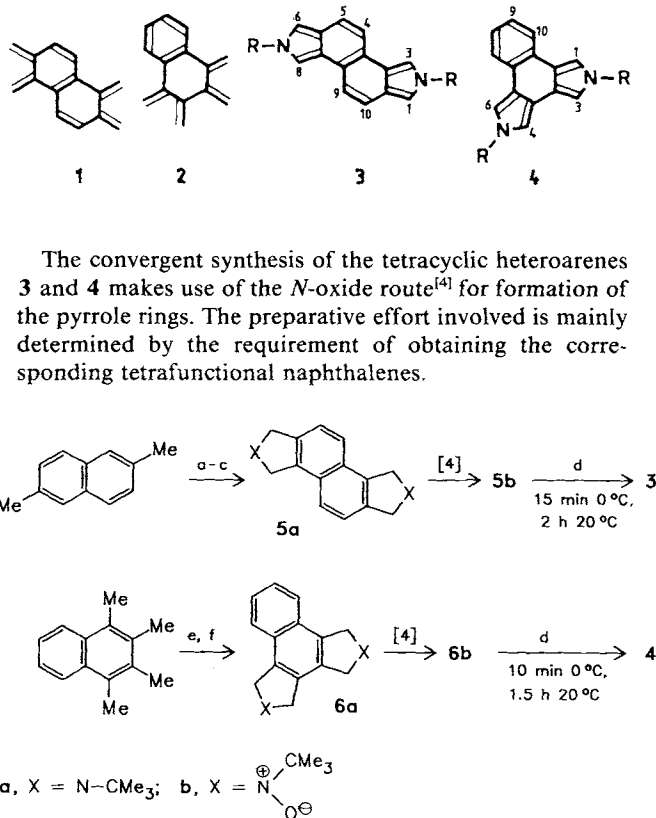
- [1] A. Greenberg, J. F. Liebman: *Strained Organic Molecules*, Academic Press, New York 1978; A. P. Krapcho, *Synthesis* 1978, 77.
- [2] W. Kirmse: *Carbene Chemistry*, 2nd Edit., Academic Press, New York 1971, p. 473; L. Friedman, H. Shechter, *J. Am. Chem. Soc.* 82 (1960) 1002; U. H. Brinker, G. Schenker, *J. Chem. Soc. Chem. Commun.* 1982, 679; W. W. Schoeller, *J. Am. Chem. Soc.* 101 (1979) 4811.
- [3] U. H. Brinker, L. König, *Chem. Ber.* 116 (1983) 882.
- [4] K. B. Wiberg, F. H. Walker, *J. Am. Chem. Soc.* 104 (1982) 5239.
- [5] Z. Majerski, M. Zuanic, *J. Am. Chem. Soc.* 109 (1987) 3496, and references cited therein.
- [6] E. Lee-Ruff, *Can. J. Chem.* 50 (1972) 952; D. R. Morton, N. J. Turro, *J. Am. Chem. Soc.* 95 (1973) 3947.
- [7] D. E. Applequist, D. E. McGreer, *J. Am. Chem. Soc.* 82 (1960) 1965.
- [8] The new compounds are characterized by their spectra ($^1\text{H-NMR}$, $^{13}\text{C-NMR}$, IR, MS) and elemental analyses (**5**, **6**, **7**, **11**, **14**). **6**: $^1\text{H-NMR}$ (400 MHz, CDCl_3): δ = 0.79 (dd, A part of the ABX system, $J_{5a,5b}$ = -4.5 Hz, $J_{4,5a}$ = 5.5 Hz, 1H; H5a), 0.85 (s, 3H; CH_3), 1.12 (dd, B part, $J_{4,5b}$ = 1.5 Hz, 1H), 1.22 (s, 3H; CH_3), 1.35 (s, 3H; CH_3), 1.70 (dd, X part, 1H), 4.48 (s, 1H; H7), 4.52 (s, 1H; H7); $^{13}\text{C-NMR}$ (100.6 MHz, CDCl_3): δ = 16.1 (q), 20.0 (q), 22.9 (t, $J(^{13}\text{C}-^1\text{H})$ = 159 Hz; C5), 28.0 (s; C1), 29.0 (q), 31.9 (d; C4), 41.8 (s; C3), 96.1 (t; C7), 162.7 (s; C2); UV (*n*-hexane): λ_{max} = 204 nm (ϵ = 24 500). — **7**: $^1\text{H-NMR}$ (400 MHz, CDCl_3): δ = 1.20 (s, 6H; aliphatic CH_3), 1.86 (q, J = 0.7 Hz; CH_3), 1.89 (q, J = 0.65 Hz; CH_3), 5.06 ("s", 1H, olefin. H), 5.18 ("s", 1H, olefin. H); $^{13}\text{C-NMR}$ (100.6 MHz, CDCl_3): δ = 21.7 (s), 21.9 (q), 22.9 (q, 2 CH_3), 23.5 (q), 96.0 (t), 123.2 (s), 124.4 (s), 138.5 (s). — **9**: $^1\text{H-NMR}$ (400 MHz, CDCl_3): δ = 1.09 (s, 6H; aliphatic CH_3), 1.74–1.77 (m, 3H, CH_3), 2.20–2.24 (m, 2H; H5), 4.62 ("s", 1H; H7), 4.74 ("s", 1H; H7), 5.67–5.71 (m, 1H; H1); $^{13}\text{C-NMR}$ (100.6 MHz, CDCl_3): δ = 13.0 (q), 30.0 (q, 2 CH_3), 41.2 (s), 47.2 (t), 98.6 (t), 131.4 (d), 138.6 (s), 165.3 (s). — **10**: $^1\text{H-NMR}$ (400 MHz, CDCl_3): δ = 1.09 (s, 3H; CH_3), 1.12 (s, 3H; CH_3), 1.12 (d, J = 7 Hz, 3H; CH_3), 3.29 (q, each signal exhibits additional fine splitting, 1H; H5), 4.89 ("d", J = 2.5 Hz; H8), 4.93 (d, J = 2.5 Hz, 1H; H8), 5.03 ("s", 2H; H1, H2); $^{13}\text{C-NMR}$ (100.6 MHz, CDCl_3): δ = 21.4 (q), 29.2 (q), 30.0 (q), 44.3 (d), 48.1 (s), 103.6 (t), 132.0 (d), 139.4 (d), 165.1 (s). — **11**: IR (film): ν = 1960 cm^{-1} (C=C=C); $^1\text{H-NMR}$ (400 MHz, CDCl_3): δ = 1.60 (s, 3H; CH_3), 1.65 (t, J = 3 Hz, 3H; CH_3), 1.70 (d, J = 1.5 Hz, 3H; CH_3), 2.58–2.65 (m, 2H; H4), 4.56 (sext., J = 3 Hz, 2H; H1), 5.18 (t sept., $J_{4,5}$ = 7 Hz, J = 1.5 Hz, 1H; H5).
- [9] R. F. Bleiholder, H. Shechter, *J. Am. Chem. Soc.* 86 (1964) 5032.
- [10] J. Belzner, G. Szeimies, *Tetrahedron Lett.* 27 (1986) 5839.
- [11] R. J. Crawford, H. Tokunaga, *Can. J. Chem.* 52 (1974) 4033; J. J. Gajewski: *Hydrocarbon Thermal Isomerizations*, Academic Press, New York 1981, p. 51 ff.
- [12] The results of the flow and the flash pyrolyses [3] cannot be compared with each other directly. Thus, the dry sodium salt of the tosylhydrazone is transferred in solid form into the reaction flask, where it decomposes on the hot glass surface. In contrast, the liquid hydrocarbons must be passed in the gas phase through a furnace-heated quartz tube.
- [13] a) Under flow pyrolysis conditions (0.1 torr, quartz tube, l = 30 cm, \varnothing = 1 cm, packed with quartz chips) **12** first begins to convert into **7** above 400°C (575°C; **12** : **7** = 43 : 57); b) **3** rearranges completely to **12** at 300°C.
- [14] G. Leandri, C. Santelli-Rouvier, *Bull. Chem. Soc. Fr.* 1970, 1515.
- [15] U. H. Brinker, M. Boxberger, *Angew. Chem.* 96 (1984) 971; *Angew. Chem. Int. Ed. Engl.* 23 (1984) 974.
- [16] C. Steel, R. Zand, P. Hurwitz, S. G. Cohen, *J. Am. Chem. Soc.* 86 (1964) 679.

Annulated Isoindoles with an 18 π -Electron System**

By Richard P. Kreher* and Thomas Hildebrand
Dedicated to Professor Klaus Hafner
on the occasion of his 60th birthday

The radialenes **1** and **2** of naphthalene^[2] have been postulated as reactive intermediates and have been suggested as precursors for tetrahydrodicyclobuta[*a,f*] and tetrahydrodicyclobuta[*a,c*]naphthalenes, respectively. By bridging with two alkylimino groups, it is possible to establish the labile radialene structure. The corresponding tetracyclic

heteroarenes **3** and **4** are stabilized by cyclic conjugated 18 π -electron systems. Noteworthy in the heteroarene **3** are the annulated 2*H*-isoindole moieties and the central triene system; the isoelectronic heteroarene **4**, on the other hand, is characterized by a "nonperturbed" peripheral benzenoid ring system.^[3]



Scheme 1. Synthesis of **3** and **4**, R = CMe₃. a) HBr/formaldehyde in acetic acid/phosphoric acid, 6.5 h reflux. b) *N*-Bromosuccinimide in CCl₄, 45 min reflux. c) *tert*-Butylamine in benzene added over 3 d under reflux, 16 h room temperature. d) Acetic anhydride/triethylamine in CHCl₃; 15 min 0°C, 2 h room temperature. e) *N*-Bromosuccinimide in CCl₄, 1 h reflux. f) *tert*-Butylamine in CHCl₃ added over 3 d under reflux, 2 h reflux. **5b**: 98% yield, m.p. 163–164°C; **6b**: 71% yield, m.p. = 151°C.

The synthesis of the heteroarene **3**, R = CMe₃, starts from commercially available 2,6-dimethylnaphthalene (Scheme 1). An acceptable yield is obtained by halomethylation^[5] of the reactive 1,5 positions. Radical bromination of the methyl groups in the 2,6 positions is followed by facile cyclization with *tert*-butylamine leading to **5a**. Acetylation of the *N,N*-dioxide **5b**, which is likewise easily carried out, results in aromatization to form **3**.

In order to synthesize the heteroarene **4**, R = CMe₃, synthetically accessible 1,2,3,4-tetramethylnaphthalene^[6] is substituted via radical bromination (Scheme 1). The subsequent ring closure occurs in spite of competing reactions with a satisfactory yield of **6a**. Compound **6a** is converted into the *N,N*-dioxide **6b**, which, in turn, is caused to undergo aromatization.

The structural differences in the isoelectronic heteroarenes **3** and **4** are manifested in their chemical behavior. Cycloaddition reactions, which are expected for **3**, are indeed observed. Treatment with *N*-methylmaleimide results, via addition to a pyrrole ring, in the formation of a 1:1 cycloadduct having the topology of 2*H*-benz[*e*]isoindole; the reactivity of this 14 π -electron system is decreased by

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