Reaction Intermediates in Organic Chemistry: the "Big Picture"

John Andraos

Department of Chemistry, York University, Toronto, ON M3J 1P3

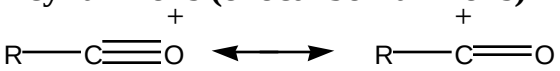
jandraos@yorku.ca

FAX: 416-736-5936

Supplementary Material

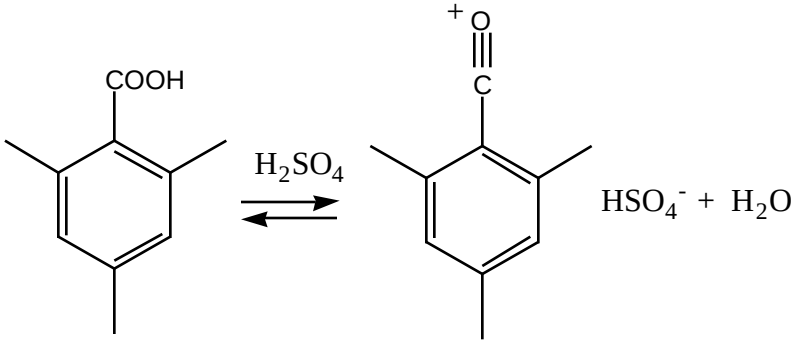
Table S5. Table summarizing reactions that lead to the suggestion, discovery, and identification of various reaction intermediates

Acylium ions (oxocarbonium ions)



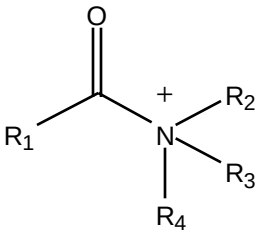
Reviews:

Olah, G.A.; Germain, A.; White, A.M. in *Carbonium Ions* (G.A. Olah; P.v.R. Schleyer, eds.) Wiley-Interscience: New York, 1976, Vol. 5, p. 2049 - 2133



Treffers, H.P.; Hammett, L.P. *J. Am. Chem. Soc.* **1937**, 59, 1708
Burton, H.; Praill, P.F.G. *J. Chem. Soc.* **1955**, 729
Chmiel, C.T.; Long, F.A. *J. Am. Chem. Soc.* **1956**, 78, 3326
Ladenheim, H.; Bender, M.L.. *J. Am. Chem. Soc.* **1960**, 82, 1895
Bender, M.L.; Feng, M.S. *J. Am. Chem. Soc.* **1960**, 82, 6318
Bender, M.L.; Ladenheim, H.; Chen, M.C. *J. Am. Chem. Soc.* **1961**, 83, 123
Yamase, Y. *Bull. Chem. Soc. Jpn.* **1961**, 34, 484
Cook, D. *Can. J. Chem.* **1961**, 40, 445

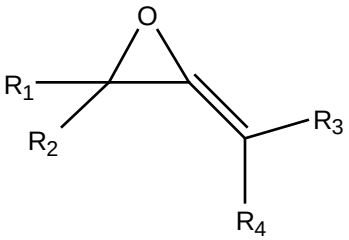
N-Acylonium ions (acylammonium ions)



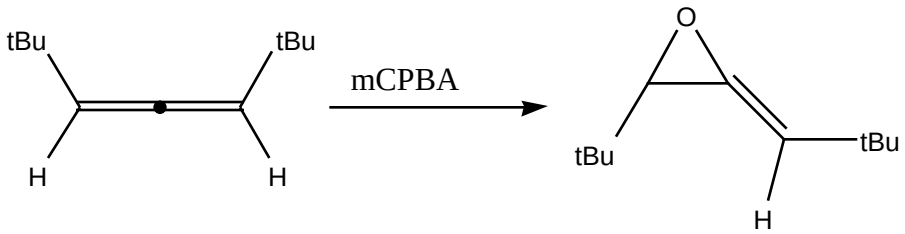
Reviews:
Beckwith, A.L.J. in *The Chemistry of Amides* (Zabicky, J.; ed.) Wiley-Interscience: New York, 1970, Chapter 2, p. 77-81

Kröhnke, F.; Heffe, W. *Chem. Ber.* **1937**, 70B, 1720
Prey, A. *Chem. Ber.* **1942**, 75, 537
Adkins, H.; Thompson, Q.E. *J. Am. Chem. Soc.* **1949**, 71, 2242
Klages, F.; Zange, E. *Ann. Chem.* **1957**, 607, 35
Cook, D. *Can. J. Chem.* **1962**, 40, 2362

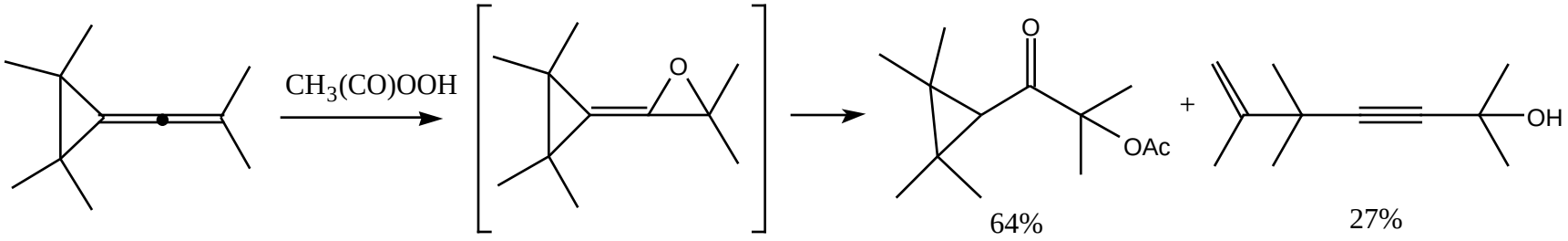
Alleneoxide



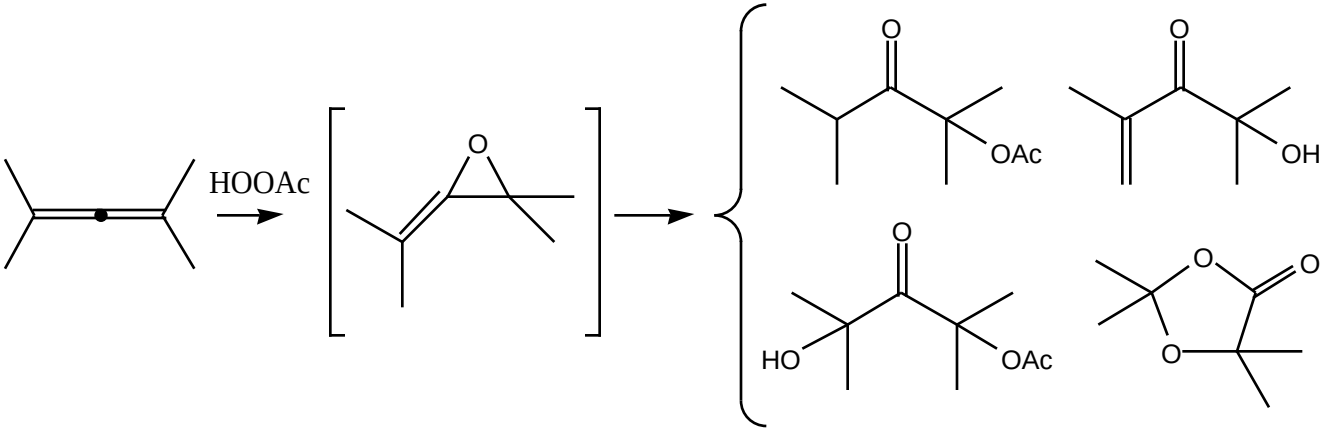
Reviews:
Chan, T.H.; Ong, B.S. *Tetrahedron* **1980**, 36, 2269



Camp, R.L.; Greene, F.D. *J. Am. Chem. Soc.* **1968**, 90, 7349

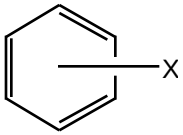


Crandall, J.K.; Paulson, D.R.; Bunnell, C.A. *Tetrahedron Lett.* **1968**, 5063



Crandall, J.K.; Machleder, W.H. *J. Am. Chem. Soc.* **1968**, 90, 7292

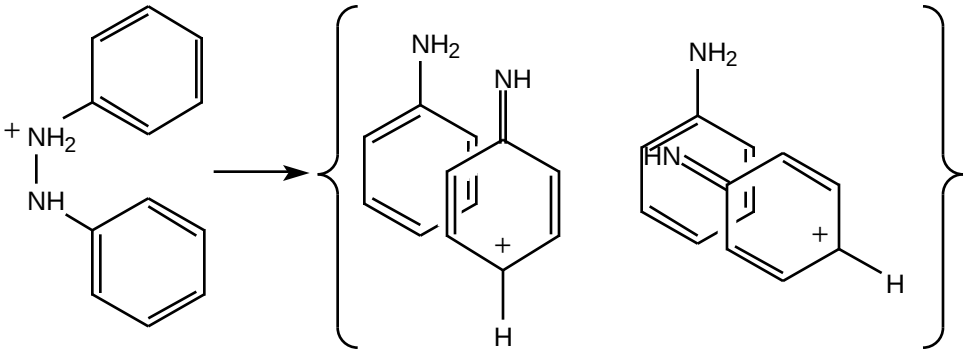
Aromatic π-complexes



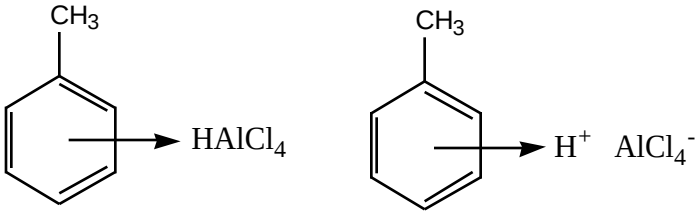
Reviews:
Stock, L.M. *Adv. Phys. Org. Chem.* **1963**, 1, 35
Berliner, E. *Prog. Phys. Org. Chem.* **1964**, 2, 253
Baciocchi, E.; Illuminati, G. *Prog. Phys. Org. Chem.* **1967**, 5, 1
Olah, G.A. *Acc. Chem. Res.* **1971**, 4, 240
Lenoir, D. *Angew. Chem. Int. Ed.* **2003**, 42, 854

(i) Charge transfer complexes

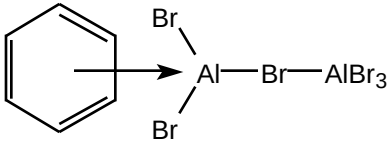
Reviews:
Dewar, M.J.S. *Electronic Theory of Organic Chemistry*, Oxford University Press: New York, 1949
Kosower, E.M. *Prog. Phys. Org. Chem.* **1965**, 3, 81
Blatchly, J.M. *Educ. Chem.* **1970**, 7, 62
Ruasse, F. *Adv. Phys. Org. Chem.* **1993**, 28, 207



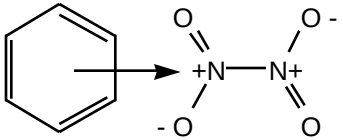
Dewar, M.J.S. *Nature* **1945**, 156, 784 (first suggestion)
Dewar, M.J.S. *J. Chem. Soc.* **1946**, 406; 777



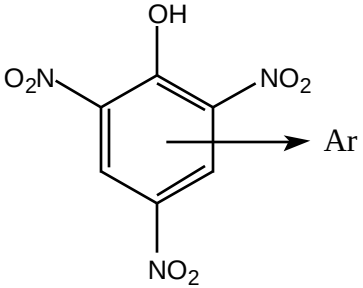
Brown, H.C.; Brady, J.D. *J. Am. Chem. Soc.* **1952**, 74, 3570



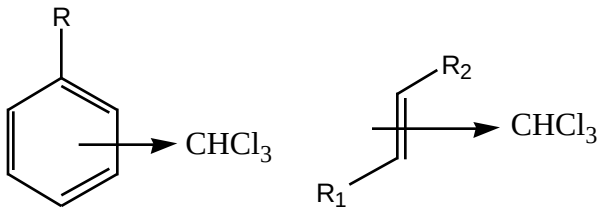
Brown, H.C.; Wallace, W.J. *J. Am. Chem. Soc.* **1953**, 75, 6265



Addison, C.C. *Rec. Trav. Chim. Pays-Bas* **1956**, 75, 626

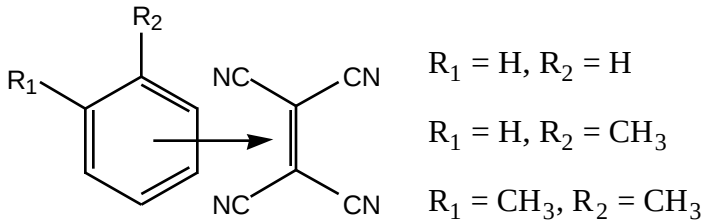


Kross, R.D.; Fassel, V.A. *J. Am. Chem. Soc.* **1957**, 79, 38



Reeves, L.W.; Schneider, W.G. *Can. J. Chem.* **1957**, 35, 251
(proton NMR signal of chloroform as function of concentration of aromatic or olefinic compound)

Brown, H.C.; Stock, L.M. *J. Am. Chem. Soc.* **1957**, 79, 1421

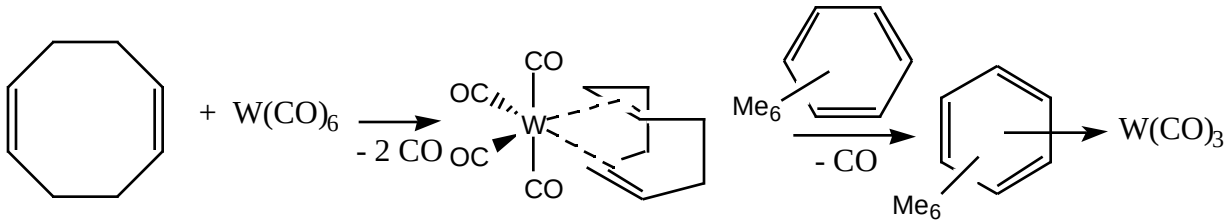


$R_1 = H, R_2 = H$

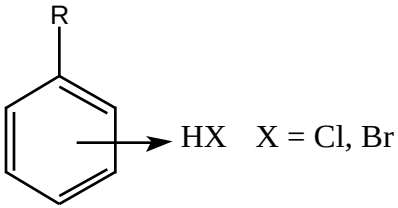
$R_1 = H, R_2 = CH_3$

$R_1 = CH_3, R_2 = CH_3$

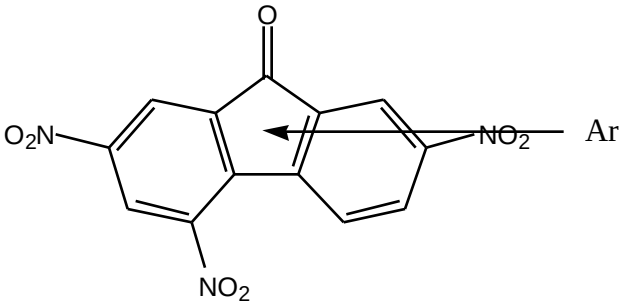
Merrifield, R.E.; Phillips, W.D. *J. Am. Chem. Soc.* **1958**, 80, 2778
Cairns, T.L.; Carboni, R.A.; Coffman, D.D.; Engelhardt, V.A.; Heckert, R.E.; Little, E.L.; McGeer, E.G.; McKusik, B.C.; Middleton, W.J.; Scribner, R.M.; Theobold, C.W.; Windberg, H.E. *J. Am. Chem. Soc.* **1958**, 80, 2775



Manuel, T.A.; Stone, F.G.A. *Chem. Ind.* **1959**, 1349



Brown, H.C.; Melchiore, J.J. *J. Am. Chem. Soc.* **1965**, 87, 5269

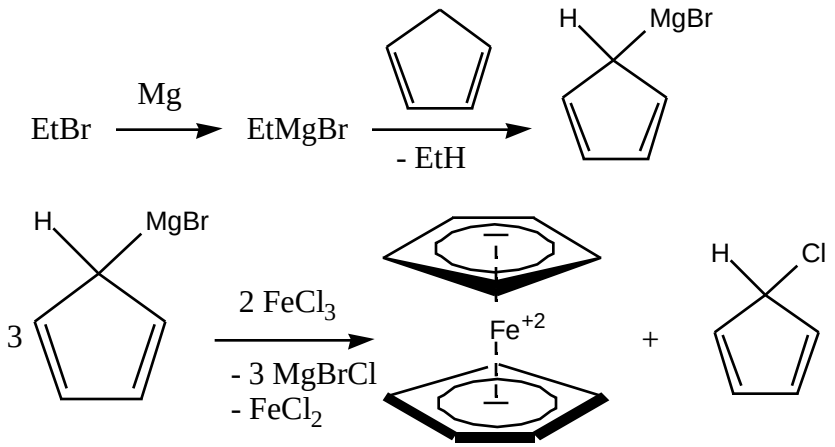


Schenk, G.H.; Vance, P.W.; Pietrandrea, J.; Mojzis, C. *Anal. Chem.* **1965**, 37, 372

(ii) "Sandwich" complexes (metallocenes)

Reviews:
Jutzi, P. *Pure Appl Chem.* **1989**, 61, 1731
Grebenik, P.; Grinter, R.; Perutz, R.N. *Chem. Soc. Rev.* **1988**, 17, 453
Jonas, K. *Pure Appl. Chem.* **1984**, 56, 63
Schloegel, K. *Pure Appl. Chem.* **1970**, 23, 413
Schloegel, K. *Top. Stereochem.* **1967**, 1, 39

Hein, F. *Chem. Ber.* **1919**, 52, 195



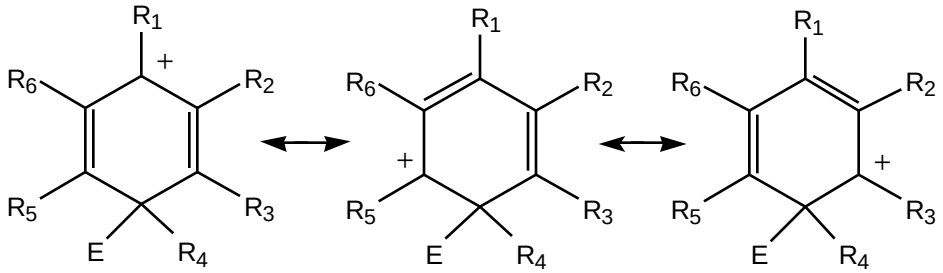
Kealy, T.J.; Pauson, P.L. *Nature* **1951**, 168, 1039
Wilkinson, G.; Rosenblum, M.; Whiting, M.C.; Woodward, R.B. *J. Am. Chem. Soc.* **1952**, 74, 2125
Woodward, R.B.; Rosenblum, M.; Whiting, M.C. *J. Am. Chem. Soc.* **1952**, 74, 3458
Eiland, P.F.; Pepinsky, R. *J. Am. Chem. Soc.* **1952**, 74, 4971
Wilkinson, G. *J. Am. Chem. Soc.* **1954**, 76, 209

$MX_n + n\ AlCl_3 + 2\ Me_6C_6 \longrightarrow [MC_6Me_6]^{+n}\ [AlX_4^-]_n$

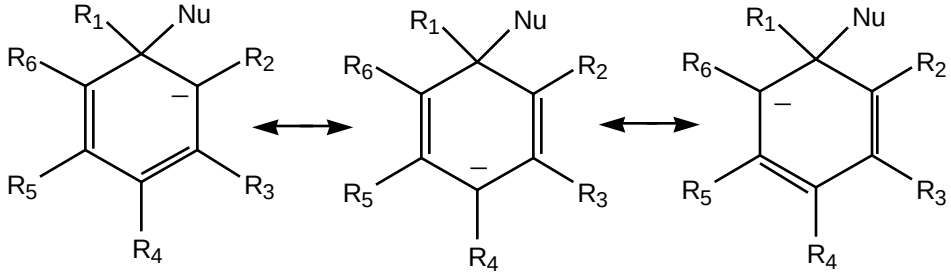
M = Co, Rh; X = Cl, Br

Fischer, E.O.; Lindner, H.H. *J. Organometallic Chem.* **1964**, 1, 307

Aromatic σ-complexes (see Meisenheimer-Jackson complexes and Janovsky complexes for negatively charged complexes; Wheland intermediates for positively charged complexes)

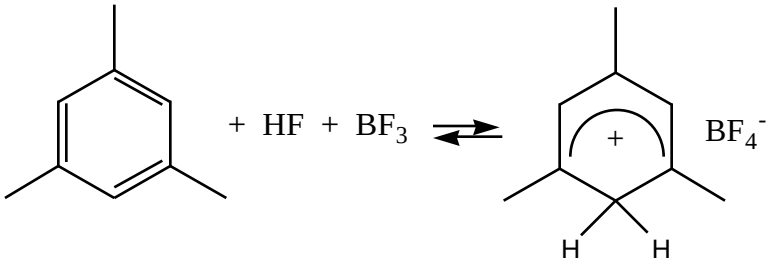


Reaction with electrophiles, E^+



Reaction with nucleophiles, Nu^-

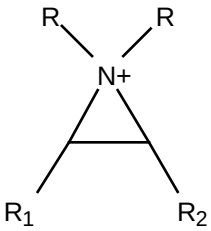
Reviews:
Ross, S.D. *Prog. Phys. Org. Chem.* **1963**, 1, 31
Stock, L.M. *Adv. Phys. Org. Chem.* **1963**, 1, 35
Berliner, E. *Prog. Phys. Org. Chem.* **1964**, 2, 253
Baciocchi, E.; Illuminati, G. *Prog. Phys. Org. Chem.* **1967**, 5, 1
Buncel, E.; Norris, A.R.; Russell, K.E. *Quart. Rev. Chem. Soc.* **1968**, 22, 123
Olah, G.A. *Acc. Chem. Res.* **1971**, 4, 240



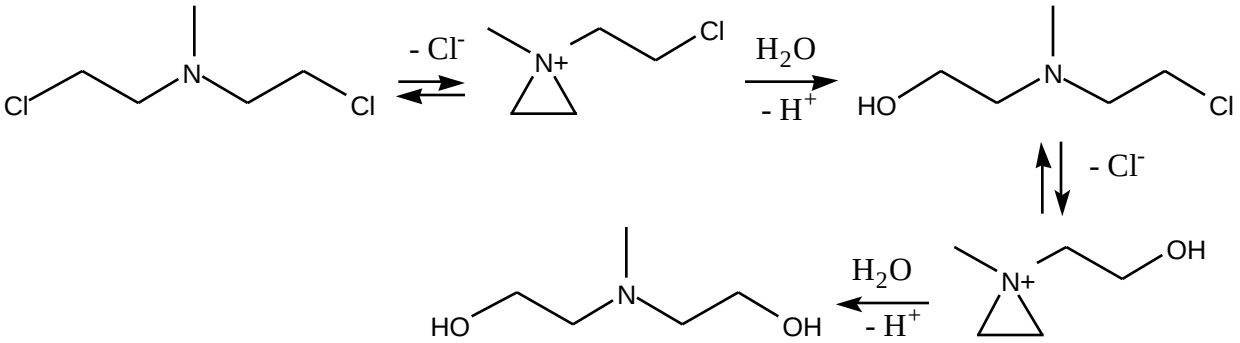
Kilpatrick, M.; Luborsky, F.E. *J. Am. Chem. Soc.* **1953**, 75, 577
Olah, G.A.; Kuhn, S.J.; Pavlath, A. *Nature* **1956**, 178, 693
Olah, G.A.; Kuhn, S.J.; Pavlath, A. *J. Am. Chem. Soc.* **1958**, 80, 6535; 6541
Doering, W.v.E.; Saunders, M.; Boyton, H.G.; Earhart, H.W.; Wadley, E.F.; Edwards, W.R.; Laber, R. *Tetrahedron* **1958**, 4, 178

Arylium ions (see phenyl cation)

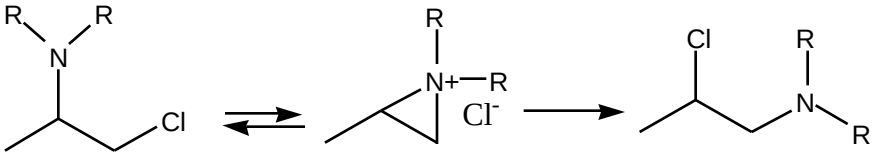
Aziridinium ions



Reviews:
Crist, D.R.; Leonard, N.J. *Angew. Chem. Int. Ed.* **1969**, 8, 962

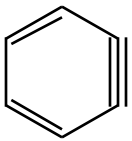


Golumbic, C.; Fruton, J.S.; Bergmann, M. *J. Org. Chem.* **1946**, 11, 518
Fruton, J.S.; Bergmann, M. *J. Org. Chem.* **1946**, 11, 543
Golumbic, C.; Stahlmann, M.A.; Bergmann, M. *J. Org. Chem.* **1946**, 11, 550



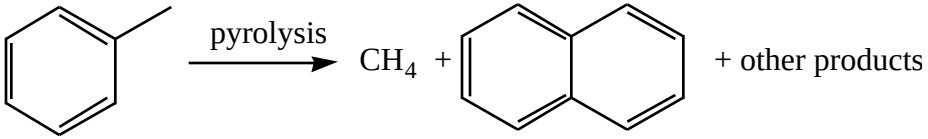
Kerwin, J.F.; Ullyot, G.E.; Fuson, R.C.; Zirkle, C.L. *J. Am. Chem. Soc.* **1947**, 69, 2961
Hanby, W.E.; Hartley, G.S.; Powell, E.O.; Rydon, H.N. *J. Chem. Soc. Abstr.* **1947**, 519
Schultz, E.M.; Sprague, J.M. *J. Am. Chem. Soc.* **1948**, 70, 48
Fuson, R.C.; Zirkle, C.L. *J. Am. Chem. Soc.* **1948**, 70, 2760
Freundlich, H.; Salomon, G. *Z. Physik. Chem.* **1933**, 166A, 161
Bartlett, P.D.; Ross, S.D.; Swain, C.G. *J. Am. Chem. Soc.* **1947**, 69, 2971

Benzyne (arynes)

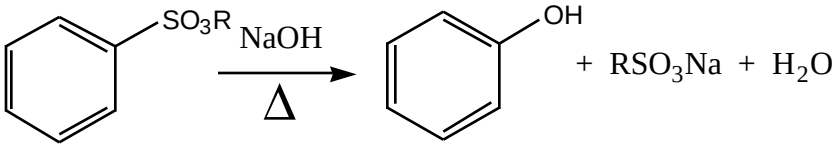


Reviews:
Fields, E.K.; Meyerson, S. *Adv. Phys. Org. Chem.* **1968**, 6, 1

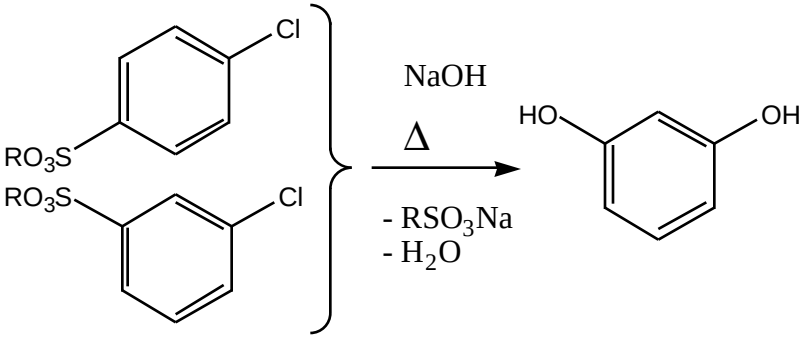
Gilcrist, T.L.; Rees, C.W. *Carbenes, Nitrenes, and Arynes*, Appleton-Century Crofts: New York, 1969
Fields, E.K. in *Organic Reactive Intermediates*, (S.P. McManus, ed.) Academic Press: New York, 1973, p. 449
Brown, R.F.C. *Eur. J. Org. Chem.* **1999**, 3211
Sander, W. *Acc. Chem. Res.* **1999**, 32, 669 (m-benzyne and p-benzyne)
Pellissier, H.; Santelli, M. *Tetrahedron* **2003**, 59, 701 (arynes in syntheses)



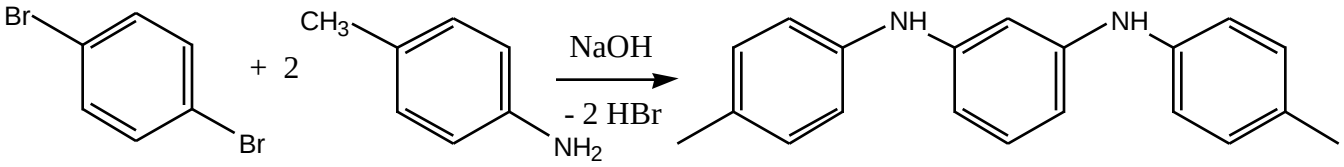
Berthelot, A. *Compt. Rend.* **1866**, 63, 790
Berthelot, A. *Ann. Chem.* **1867**, 142, 254
Berthelot, A. *Bull. Soc. Chim. Fr.* **1867**, 7[2], 218
Badger, G.M.; Spotswood, T.M. *J. Chem. Soc.* **1960**, 4420



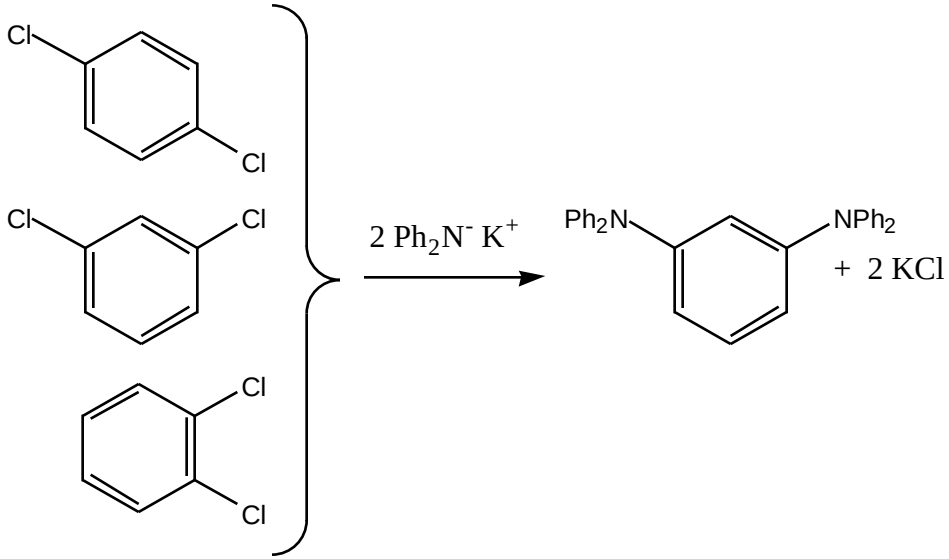
Kekule, A. *Compt. Rend.* **1864**, 64, 753



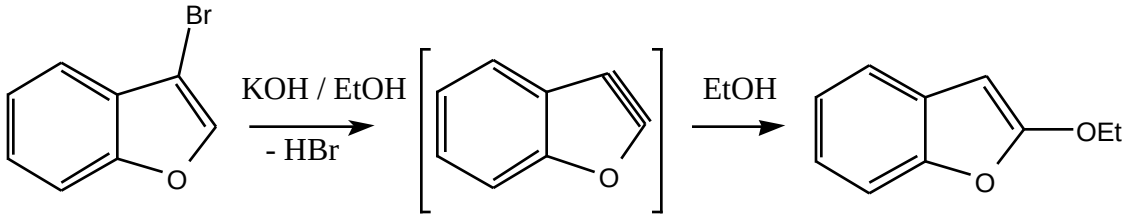
Limpricht, H. *Chem. Ber.* **1874**, 7, 1439



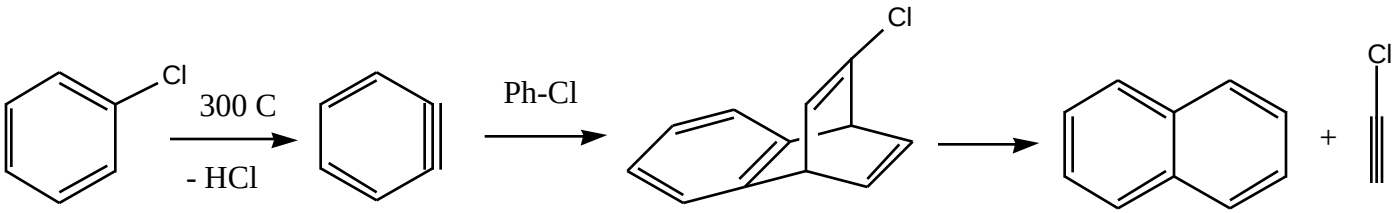
Kym, O. *J. Prakt. Chem.* **1895**, 51[2], 325



Haeussermann, C. *Chem. Ber.* **1900**, 33, 939
Haeussermann, C. *Chem. Ber.* **1901**, 34, 38



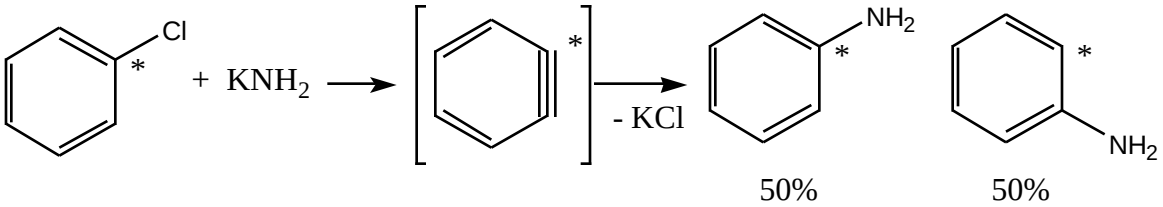
Stoermer, R.; Kahlert, B. *Chem. Ber.* **1902**, 35, 1633 (first suggestion of existence of triple bond in small ring compounds)



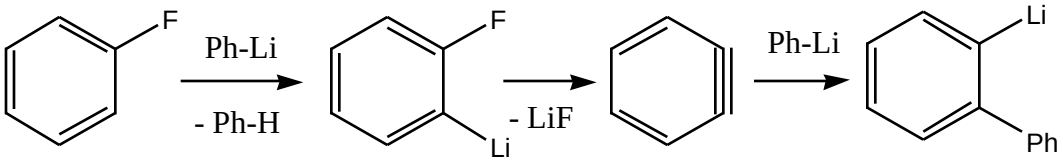
Meyer, K.H.; Bergius, F. *Chem. Ber.* **1914**, 47, 3159

Bachmann, W.E.; Clarke, H.T. *J. Am. Chem. Soc.* **1927**, 49, 2089 (first suggestion of existence of benzyne)

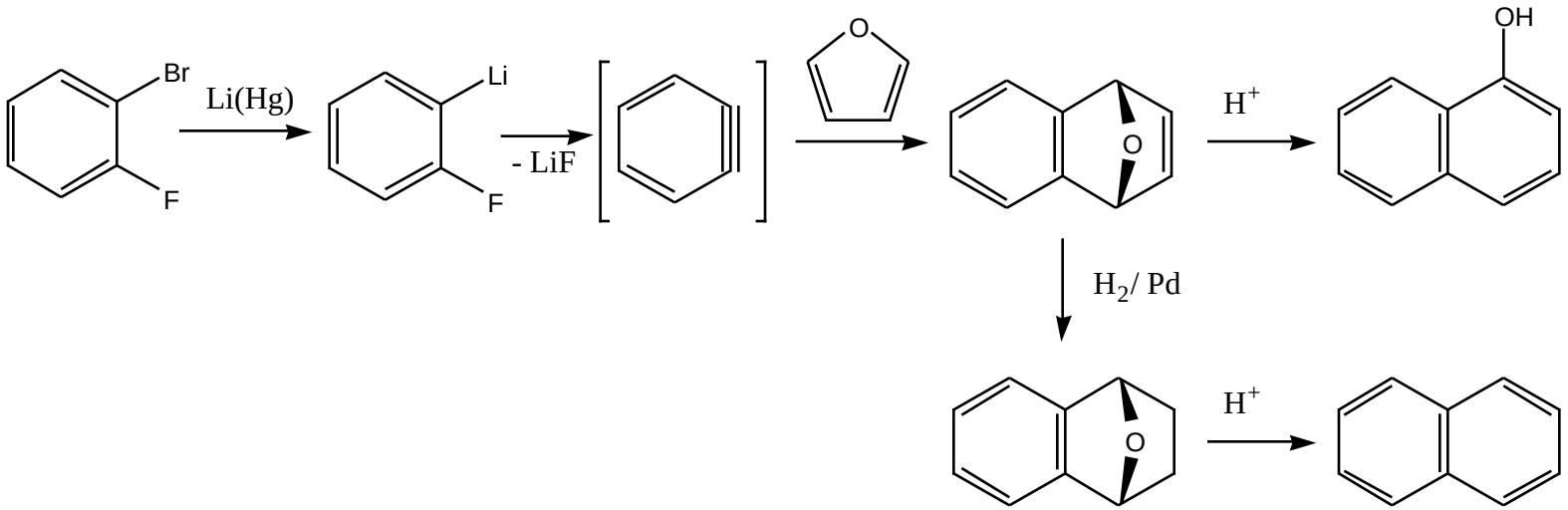
Lüttringhaus, A.; Saaf, G. *Ann. Chem.* **1930**, 542, 250 (aryl-phenol rearrangement)



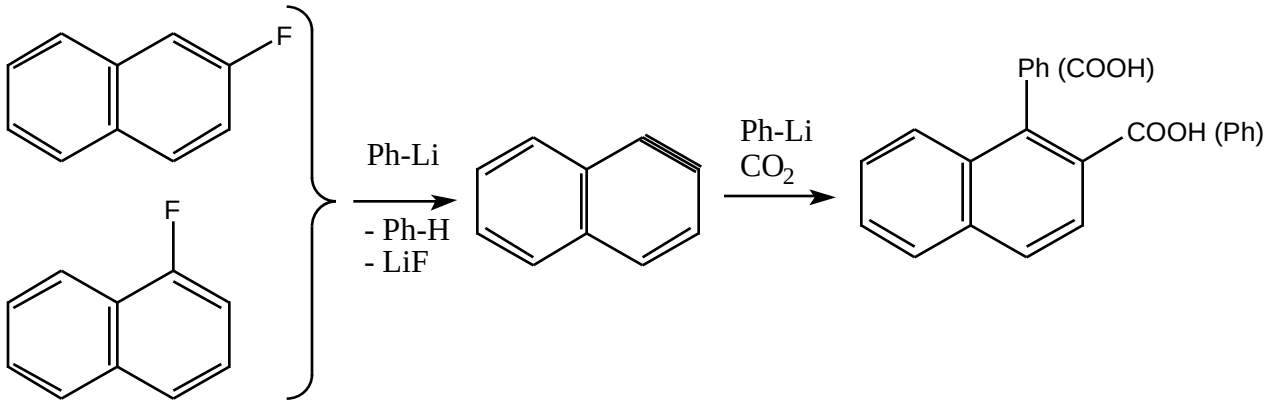
Roberts, J.D.; Simmons, H.E. Jr.; Carlsmith, L.A.; Vaughan, W.C. *J. Am. Chem. Soc.* **1953**, 75, 3290
Roberts, J.D.; Semenov, D.A.; Simmons, H.E. Jr.; Carlsmith, L.A. *J. Am. Chem. Soc.* **1956**, 78, 601
Roberts, J.D.; Vaughan, C.W. Jr.; Carlsmith, L.A.; Semenov, D.A. *J. Am. Chem. Soc.* **1956**, 78, 611
Scardiglia, F.; Roberts, J.D. *Tetrahedron* **1957**, 1, 343
Bottini, A.T.; Roberts, J.D. *J. Am. Chem. Soc.* **1957**, 79, 1458



Wittig, G.; Fuhrmann, G. *Chem. Ber.* **1940**, 73, 1197



Wittig, G. *Naturwiss.* **1942**, 30, 696
Wittig, G.; Harborth, G. *Chem. Ber.* **1944**, 77, 306; 316
Wittig, G.; Pohmer, L. *Angew. Chem.* **1955**, 67, 348
Wittig, G.; Pohmer, L. *Chem. Ber.* **1956**, 89, 1334
Wittig, G. *Pure Appl. Chem.* **1963**, 7, 173

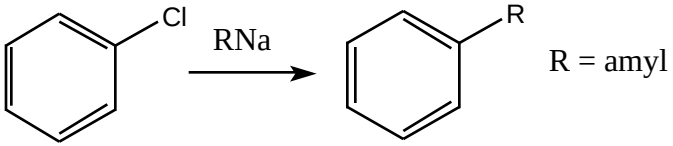


Huisgen, R.; Rist, H. *Naturwiss.* **1954**, 41, 358
Huisgen, R.; Rist, H. *Ann. Chem.* **1955**, 594, 137

Huisgen, R.; Knorr, R. *Tetrahedron Lett.* **1963**, 1017

Levine, R.; Leake, W.W. *Science* **1955**, 121, 780

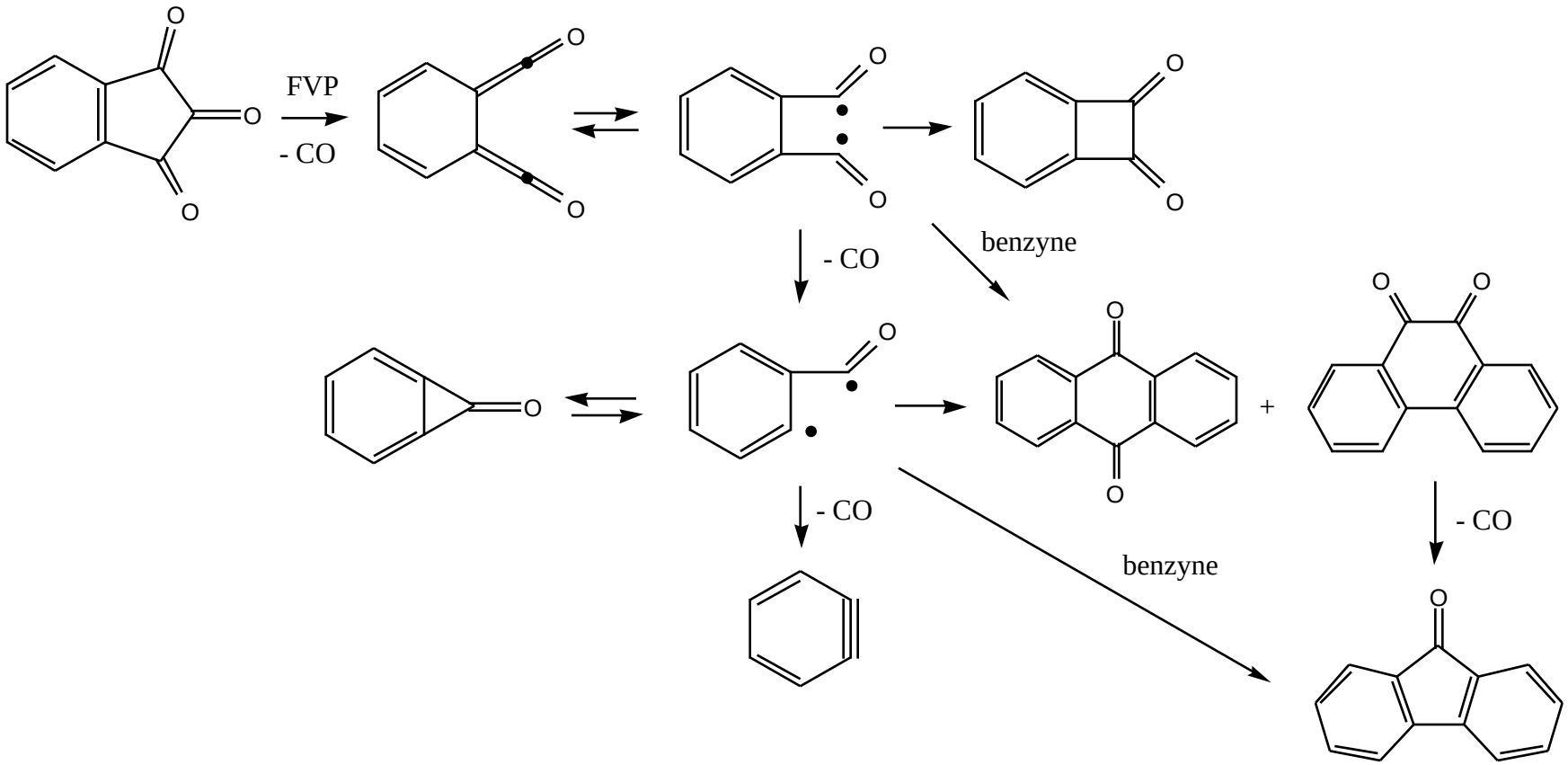
Müller, E.; Roscheisen, G. *Chem. Ztg.* **1956**, 80, 101



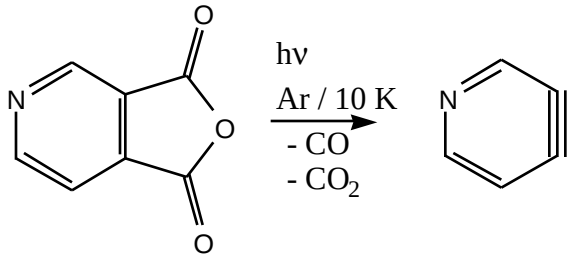
R = amyl

Morton, A.A.; Davidson, J.B.; Hakan, B.L. *J. Am. Chem. Soc.* **1942**, 64, 2242
Morton, A.A. *J. Org. Chem.* **1956**, 21, 593

Heaney, H.; Mann, F.G.; Millar, I.T. *J. Chem. Soc.* **1957**, 3930

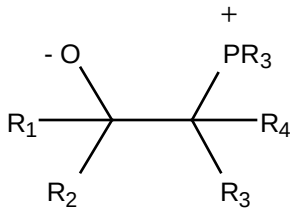


Brown, R.F.C.; Solly, R.K. *Austr. J. Chem.* **1966**, 19, 1045

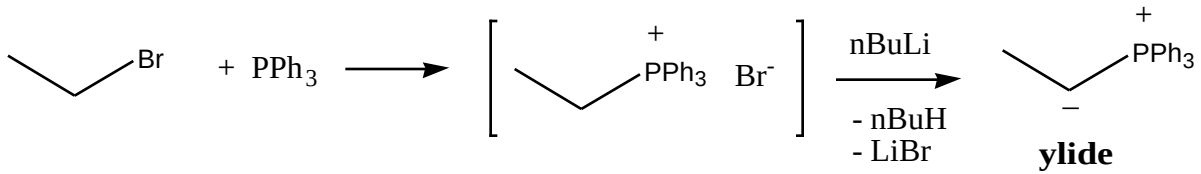


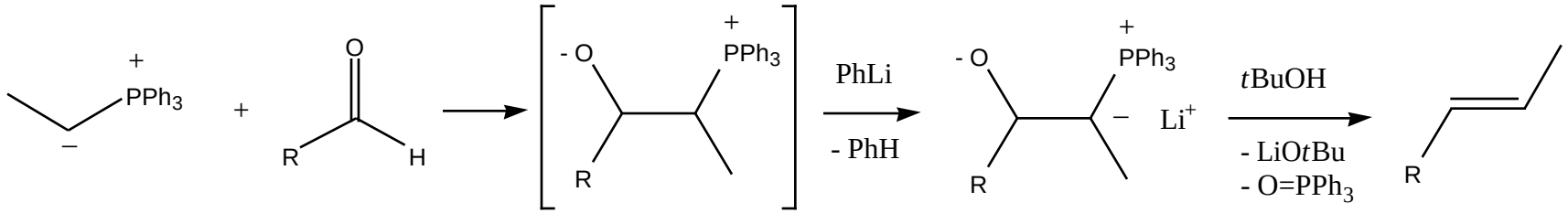
Nam, H.H.; Leroi, G.E. *J. Am. Chem. Soc.* **1988**, 110, 4096 (first observation of 3,4-pyridyne)

Betaines (phosphonium betaines)



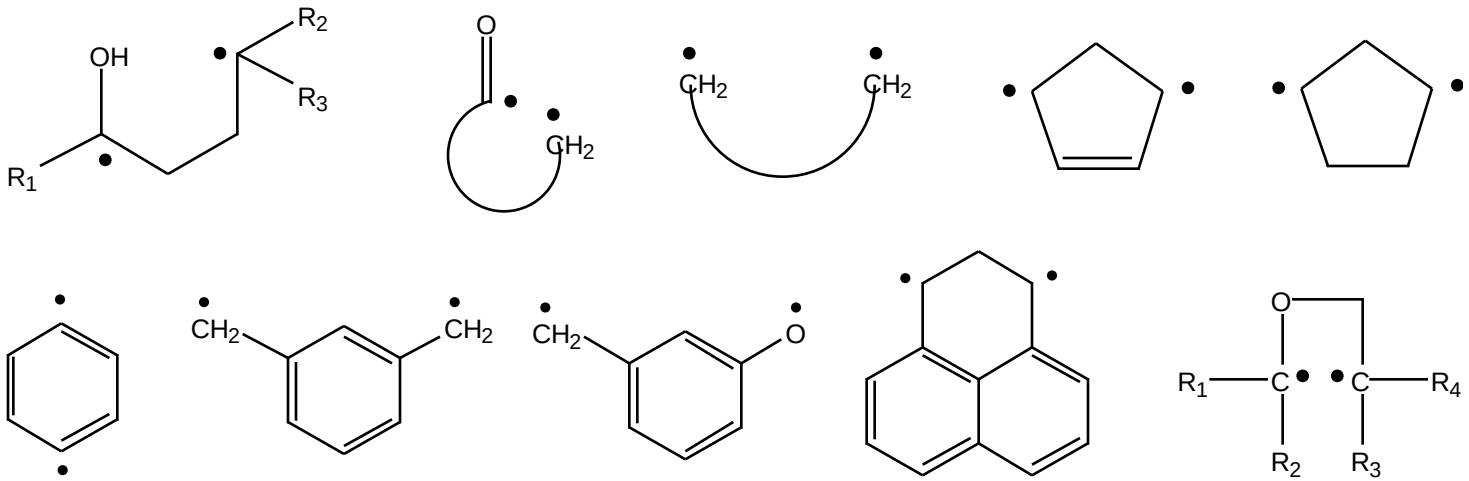
Reviews:
Wittig, G. *Pure Appl. Chem.* **1964**, 9, 245
Vedejs, E. *Science* **1980**, 207, 42
Wittig, G. *Science* **1980**, 210, 600





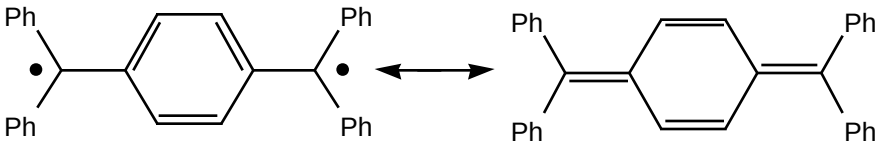
Wittig, G.; Schöllkopf, U., *Chem. Ber.* **1954**, 87, 1318
Wittig, G.; Haag, W. *Chem. Ber.* **1955**, 88, 1654
Wittig, G.; Pommer, H. DE 32741 BASF (1954)

Biradicals



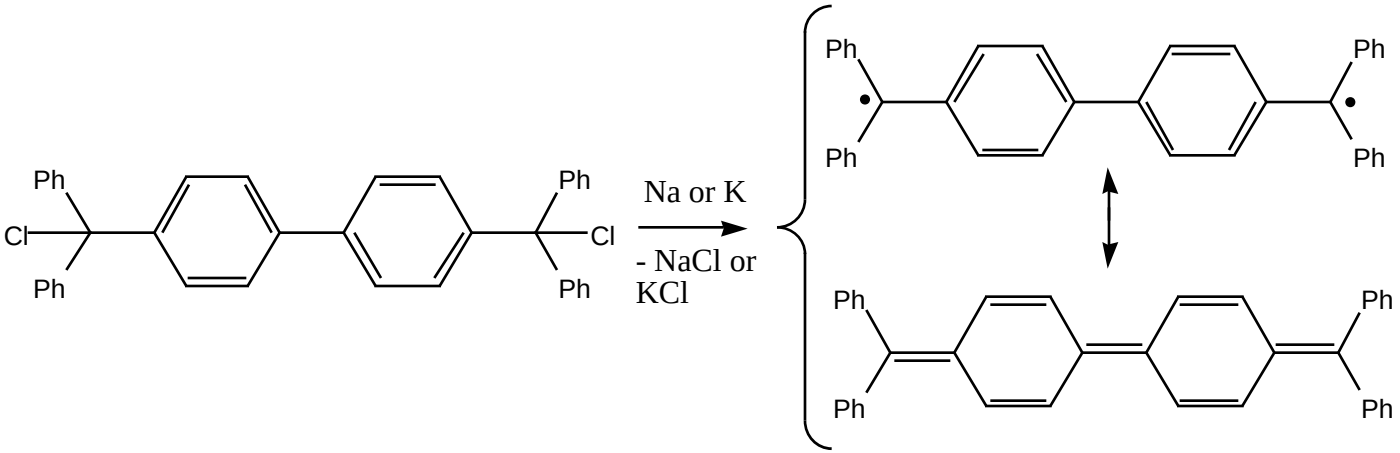
Reviews:
Kuivila, H.G. *Acc. Chem. Res.* **1968**, 1, 299 (organotin hydrides and organic free radicals)
Borden, W.T. (ed.) *Diradicals*, Wiley: New York, 1982
Platz, M.S. (ed.) *Kinetics and Spectroscopy of Carbenes and Biradicals*, Plenum Press: New York, 1990
Cramer, *J. Chem. Soc. Perkin Trans. 2* **1998**, 1007 (biradicals - Paul Dowd)
Arnold, B.R.; Bucher, G.; Netto-Ferreira, J.C.; Platz, M.S.; Scaiano, J.C. *Biradicals, Radicals in Excited States, Carbenes, and Related Species*, Springer-Verlag: Weinheim, 1998
Sander, W. *Acc. Chem. Res.* **1999**, 32, 669 (m-benzyne and p-benzyne)

Thiele hydrocarbon (biradical)



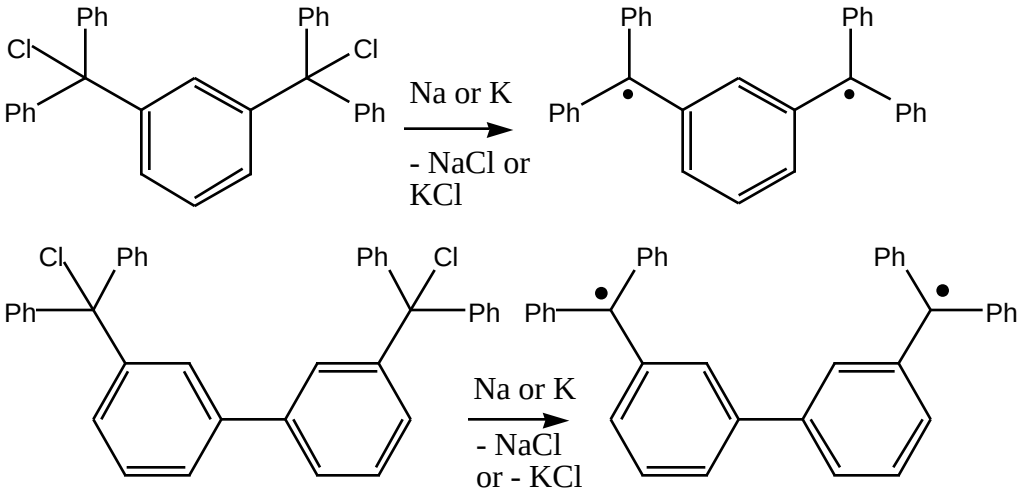
Thiele, J.; Balhorn, H. *Chem. Ber.* **1904**, 37, 1463

Chichibabin hydrocarbon (biradical)



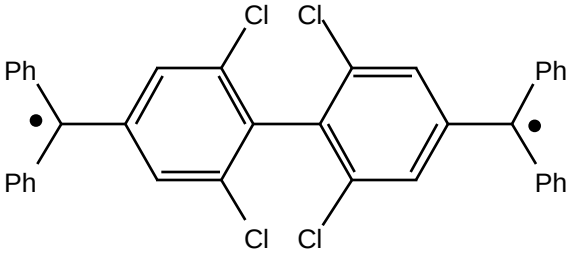
Chichibabin, A.E. *Zh. Russ. Fiz.-Khim., Obshchestva* **1907**, 39, 925
Chichibabin, A.E. *Chem. Ber.* **1907**, 40, 1810

Schlenk-Brauns hydrocarbon (biradical)

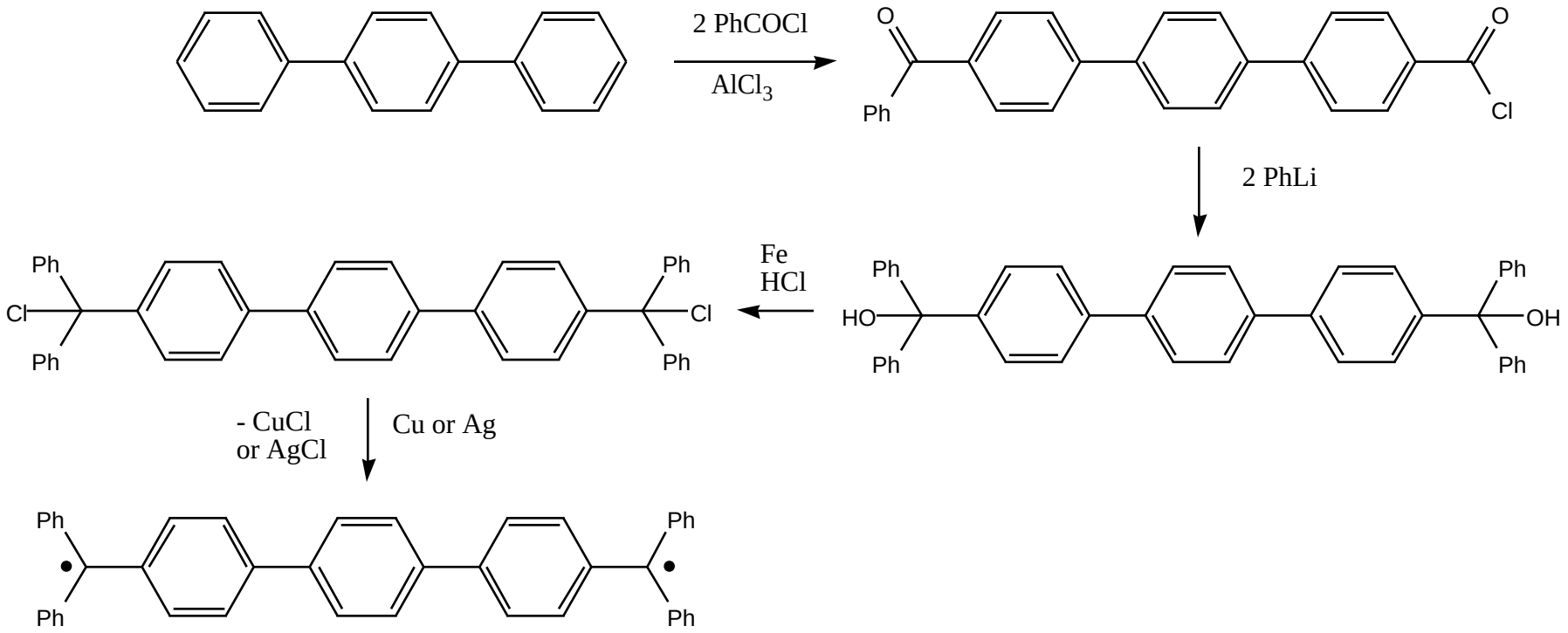


Schlenk, W.; Brauns, M. *Chem. Ber.* **1915**, 48, 661; 716

Müller hydrocarbon (biradical)

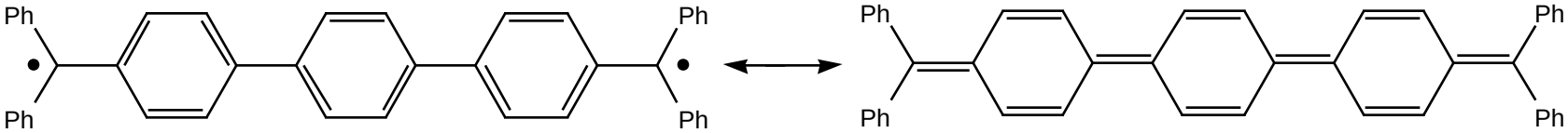


Müller, E.; Neuhoff, H. *Chem. Ber.* **1939**, 72, 2063
Müller, E.; Tietze, E. *Naturwiss.* **1940**, 28, 189
Müller, E.; Tietze, E. *Chem. Ber.* **1941**, 74, 807



Müller, E.; Pfanz, H. *Chem. Ber.* **1941**, 74, 1051

Wittig, G.; von Lupin, F. *Chem. Ber.* **1928**, 61B, 1627
Wittig, G.; Leo, M. *Chem. Ber.* **1929**, 62B, 1405
Schönberg, A.; von Vargha, L. *Chem. Ber.* **1931**, 64B, 1390
Wittig, G.; Leo, M. *Chem. Ber.* **1931**, 64B, 2395
Schönberg, A.; Cernik, D.; Urban, W. *Chem. Ber.* **1931**, 64B, 2577
Schönberg, A. *Chem. Ber.* **1934**, 67B, 1404
Dufraisse, C. *Chem. Ber.* **1934**, 67B, 2018
Schönberg, A. *Chem. Ber.* **1935**, 68B, 162
Schönberg, A. *Ann. Chem.* **1935**, 518, 299

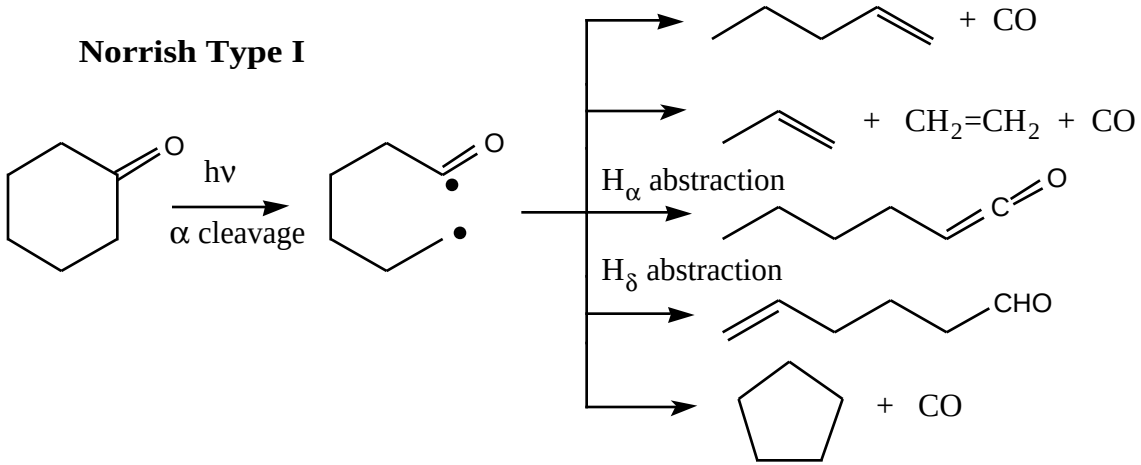


paramagnetism of biradicals:

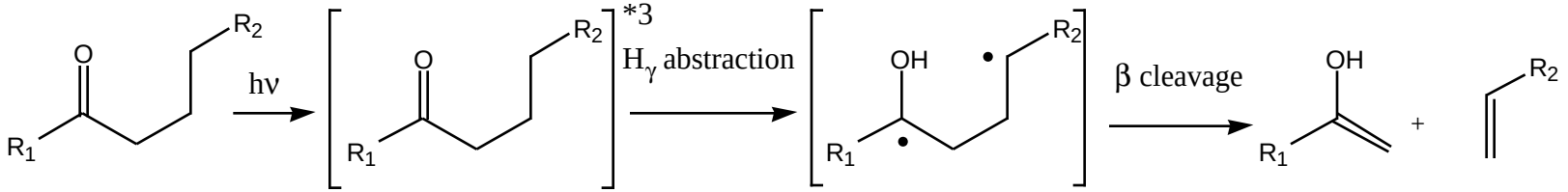
Müller, E. *Z. Elektrochem.* **1934**, 40, 542
Müller, E.; Klemm, W.; Schuth, W. *Naturwiss.* **1934**, 22, 335
Müller, E.; Müller-Rodloff, I. *Ann. Chem.* **1935**, 517, 134
Müller, E.; Müller-Rodloff, I. *Chem. Ber.* **1935**, 68B, 1276
Müller, E.; Müller-Rodloff, I. *Ann. Chem.* **1936**, 521, 81
Müller, E.; Bunge, W. *Chem. Ber.* **1936**, 69, 2164; 2168
Müller, E. *Naturwiss.* **1937**, 25, 545

Müller, E.; Dammerau, I. *Chem. Ber.* **1937**, 70B, 2561
Müller, E.; Sok, G. *Chem. Ber.* **1937**, 70B, 1990
Clar, E. *Chem. Ber.* **1935**, 68B, 2066
Schönberg, A. *Trans. Faraday Soc.* **1936**, 32, 514
Allen, F.L.; Sugden, S. *J. Chem. Soc.* **1936**, 440
Dufraisse, C. *J. Am. Chem. Soc.* **1936**, 58, 858
Hückel, E. *Z. Physik. Chem.* **1936**, B34, 339

Norrish Type I

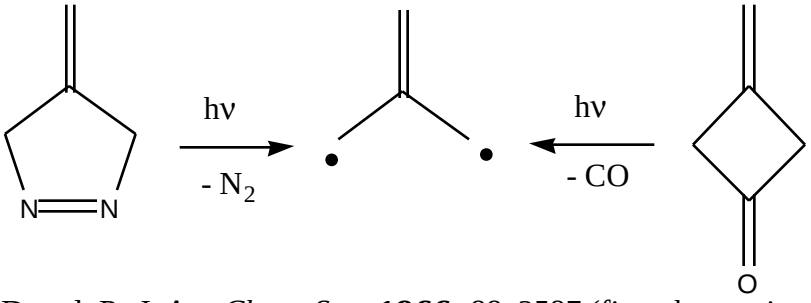


Norrish Type II

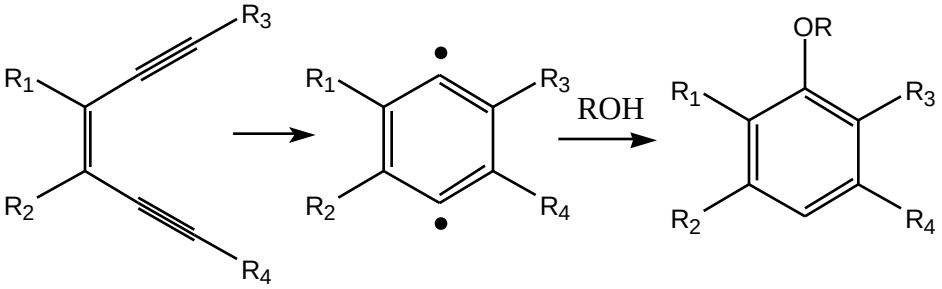


Bamford, C.H.; Norrish, R.G.W. *J. Chem. Soc.* **1935**, 1504
Norrish, R.G.W.; Bamford, C.H. *Nature* **1936**, 138, 1016
Norrish, R.G.W.; Bamford, C.H. *Nature* **1937**, 140, 195
Norrish, R.G.W. *Trans. Faraday Soc*. **1937**, 33, 1521

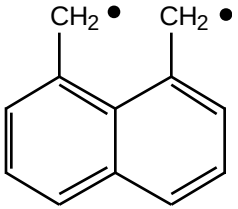
Bawn, C.E.H.; Hunter, R.F. *Trans. Faraday Soc*. **1938**, 34, 608
Fuson, R.C.; Lundquist, W.E. *J. Am. Chem. Soc.* **1938**, 60, 1889
Enderlin, L. *Ann. Chim. Phys.* **1938**, 10, 5
Bawn, C.E.H.; Milsted, J. *Trans. Faraday Soc*. **1939**, 35, 889



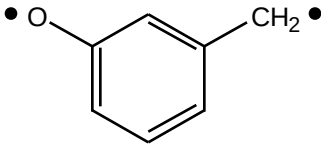
Dowd, P. *J. Am. Chem. Soc.* **1966**, 88, 2587 (first observation of biradicals by ESR)



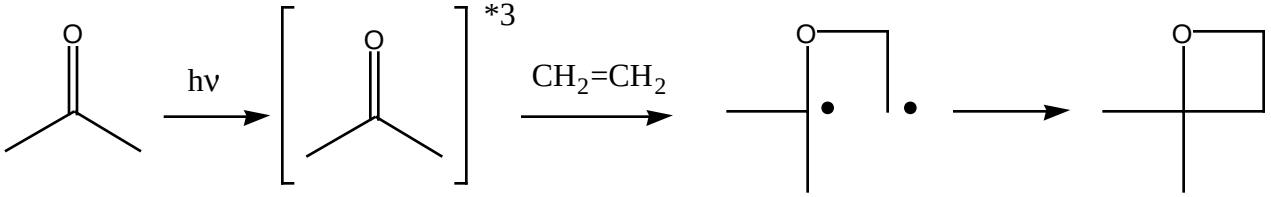
Bergman, R.G.; Jones, R.R., *J. Am. Chem. Soc*. **1972**, 94, 660 (Bergmann cyclization)



Pagni, R.; Burnett, M.N.; Dodd, J.R. *J. Am. Chem. Soc.* **1977**, 99, 1972

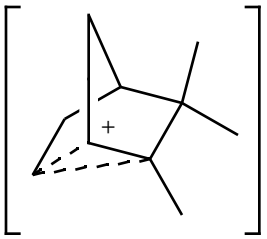


Rule, M.; Matlin, A.R.; Dougherty, D.A.; Hilinski, E.; Berson, J.A. *J. Am. Chem. Soc.* **1979**, 101, 5098



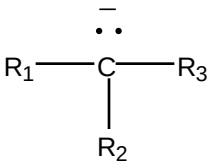
Freilich, S.F.; Peters, K.S. *J. Am. Chem. Soc.* **1981**, 103, 6255; **1985**, 107, 3819 (evidence for biradical in Paterno-Büchi reaction)

Bridged carbocations (see halonium ions, non-classical ions, and phenonium ions)



Nevell, T.P.; de Salas, E.; Wilson, C.L. *J. Chem. Soc.* **1939**, 1188 (first suggestion)

Carbanions



Reviews:
Szwarc, M. (ed.) *Carbanions: living polymers and electron transfer processes*, Wiley: New York, 1968
Kaiser, E.M.; Slocum, D.W. in *Organic Reactive Intermediates*, (S.P. McManus, ed.) Academic Press: New York, 1973, p. 337
Hogen-Esch, T.E. *Adv. Phys. Org. Chem.* **1977**, 15, 154
Stowell, J.C. *Carbanions in Organic Synthesis*, Wiley: New York, 1979
Buncel, E.; Durst, T. (eds.) *Comprehensive Carbanion Chemistry, Part A: structure and reactivity*, Elsevier: Amsterdam, 1980
Gau, G.; Assadourian, L.; Veracini, S. *Prog. Phys. Org. Chem.* **1987**, 16, 237
Nibbering, N.M.M. *Adv. Phys. Org. Chem.* **1988**, 24, 1

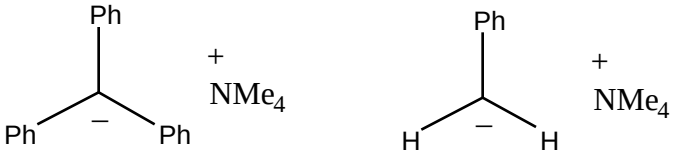
Harder, S. *Chem. Eur. J.* **2002**, 8, 3229

Buncel, E.; Dust, J.M. *Carbanion Chemistry: structures and mechanisms*, Oxford University Press: Oxford, 2003

stabilities of carbanions:
Breslow, R.; Balasubramanian, K. *J. Am. Chem. Soc.* **1969**, 91, 5182 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Breslow, R.; Chu, W. *J. Am. Chem. Soc.* **1970**, 92, 2165 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Breslow, R.; Chu, W. *J. Am. Chem. Soc.* **1973**, 95, 411 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Breslow, R.; Mazur, M. *J. Am. Chem. Soc.* **1973**, 95, 584 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Breslow, R.; Drury, R.F. *J. Am. Chem. Soc.* **1974**, 96, 4702 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Breslow, R. *Pure Appl. Chem.* **1974**, 40, 493 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Wasielewski, M.R.; Breslow, R. *J. Am. Chem. Soc.* **1976**, 98, 4222 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Breslow, R.; Goodin, R. *J. Am. Chem. Soc.* **1976**, 98, 6077 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Bank, S.; Ehrlich, C.L.; Zubieta, J.A. *J. Org. Chem.* **1979**, 44, 1454 (trityl carbanions)
Bank, S.; Ehrlich, C.L.; Mazur, M.; Zubieta, J.A. *J. Org. Chem.* **1981**, 46, 1243 (trityl carbanions)

organomagnesium compounds
Hallwachs, W.; Schafarik, F. *Ann. Chem.* **1859**, 109, 206
Cahours, A. *Ann. Chem.* **1859**, 114, 227
Grignard, V. *Ann. Chim. Phys.* **1901**, 24, 433

Zincke, T.; Suhl, R.S. *Chem. Ber.* **1907**, 39, 4148
Fromberz, K.; Meigen, W. *Chem. Ber.* **1907**, 40, 403
Schiff, H. *Ann. Chem.* **1907**, 352, 73



Schlenk, W. *Ann. Chem.* **1910**, 372, 1

Wren, H. *J. Chem. Soc.* **1910**, 95, 1583
Wren, H. *J. Chem. Soc.* **1910**, 95, 1593
Tarbouriech, P.J. *Compt. Rend.* **1910**, 149, 862
Freylon, G. *Ann. Chim. Phys.* **1910**, 19, 551

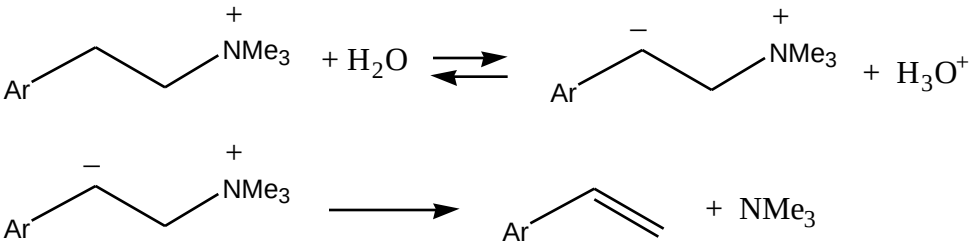
Mitchell, A.D.; Thorpe, J.F. *Proc. Chem. Soc.* **1911**, 26, 248
Mitchell, A.D.; Thorpe, J.F. *Proc. Chem. Soc.* **1911**, 26, 2261
Dieckmann, W. *Chem. Ber.* **1911**, 44, 981
Busch, M.; Limpach, O. *Chem. Ber.* **1911**, 44, 1573
Locquin, R. *Compt. Rend.* **1911**, 153, 284

Curtius, T. *Chem. Ztg.* **1912**, 35, 249
Tarbouriech, P.J. *Compt. Rend.* **1913**, 156, 75
Wislicenus, W.; Elvert, H.R.; Kurtz, P. *Chem. Ber.* **1914**, 46, 3395
Curtius, T. *J. Prakt. Chem.* **1914**, 87, 513
Heiduschka, A.; Langkammerer, H. *J. Prakt. Chem.* **1914**, 88, 425
Hiller, S. *J. Prakt. Chem.* **1914**, 88, 731
Busch, M.; Lotz, H. *J. Prakt. Chem.* **1914**, 90, 257
Brady, O.L.; Dunn, F.P. *J. Chem. Soc.* **1914**, 105, 2409; 2872
Brady, O.L.; Dunn, F.P. *Proc. Chem. Soc.* **1914**, 30, 240; 292
Raffo, M.; Rossi, G. *Gazz. Chim. Ital.* **1915**, 45, 28
von Meyer, F. *J. Prakt. Chem.* **1915**, 92, 255
Chattaway, F.D.; Clemo, G.R. *J. Chem. Soc.* **1916**, 109, 89
Poccianti, P. *Atti Accad. Lincei* **1915**, 24, 1135
Poccianti, P. *Gazz. Chim. Ital.* **1915**, 45, 111
Brady, O.L.; Dunn, F.P. *J. Chem. Soc.* **1916**, 109, 650
Andreasch, R. *Monatsch. Chem.* **1917**, 38, 203

organolithium compounds
Schlenk, W.; Holtz, J. *Chem. Ber.* **1917**, 50, 271
Andreasch, R. *J. Chem. Soc.* **1918**, 114, 80

Conant, J.B.; Wheland, G.W. *J. Am. Chem. Soc.* **1932**, 54, 1212 (stabilities of carbanions from hydrocarbon acidities)

Carbanions via E1cb (elimination unimolecular carbanion) mechanism



Ar = *p*-NO_2-C_6H_4

Hughes, E.D.; Ingold, C.K. *J. Chem. Soc.* **1933**, 523
Hughes, E.D.; Ingold, C.K.; Patel, C.S. *J. Chem. Soc.* **1933**, 526

Carbenes or methylenes (general)

Reviews:
Huisgen, R. *Angew. Chem.* **1955**, 67, 439
Knunyants, I.L.; Gambaryan, N.P.; Rokhin, E.M. *Usp. Khim.* **1958**, 27, 1361
Kirmse, W. *Angew. Chem.* **1959**, 71, 537
Kirmse, W. *Angew. Chem.* **1961**, 73, 161
Zollinger, H. *Azo and Diazo Chemistry: aliphatic and aromatic compounds*, Interscience Publications, Inc.: New York, 1961
Miginiac, P. *Bull. Soc. Chim. Fr.* **1962**, 2000
Chinoporos, E. *Chem. Rev.* **1963**, 63, 235
Parham, W.E.; Schweizer, E.E. *Org. Reactions* **1963**, 13, 55
Hine, J. *Divalent Carbon*, Ronald Press: New York, 1964
Kirmse, W. *Carbene Chemistry*, Academic Press: New York, 1964
DeMore, W.B.; Benson, S.W. *Adv. Photochem.* **1964**, 2, 219
Frey, H.M. *Prog. Reaction Kinetics* **1964**, 2, 131
Bell, J.A. *Prog. Phys. Org. Chem.* **1964**, 2, 1
Closs, G.L. *Top. Stereochem.* **1968**, 3, 193
Gilcrist, T.L.; Rees, C.W. *Carbenes, Nitrenes, and Arynes*, Appleton-Century-Crofts: New York, 1969
Bethell, D. *Adv. Phys. Org. Chem.* **1969**, 7, 153
Jones, M. Jr.; Moss, R.A. *Carbenes*, Wiley-Interscience: New York, Vol. 1 - 2, 1973
Bethell, D. in *Organic Reactive Intermediates*, (S.P. McManus, ed.) Academic Press: New York, 1973, p. 61
Bethell, D. *Org. Reactive Intermed.* **1973**, 61

Connor, J.A. *J. Organometallic Chem.* **1975**, 4, 235 (carbenes and carbynes)
Moss, R.A.; Jones, M. (eds.) *Carbenes*, Vol. 1, 2, Wiley: New York, 1975
Moss, R.A. *Acc. Chem. Res.* **1980**, 13, 58
Griller, D.; Nazran, A.S.; Scaiano, J.C. *Acc. Chem. Res.* **1984**, 17, 283
Platz, M.S. (ed.) *Kinetics and Spectroscopy of Carbenes and Biradicals*, Plenum Press: New York, 1990
Tomioka, H. *Res. Chem. Intermediates* **1994**, 20, 605
Liu, M.T.H. *Acc. Chem. Res.* **1994**, 27, 287
Regitz, M. *Angew. Chem. Int. Ed.* **1996**, 35, 725
Zaragoza, F. *Tetrahedron* **1997**, 53, 3425
Tomioka, H. *Acc. Chem. Res.* **1997**, 30, 315
Tomioka, H. *Bull. Chem. Soc. Jpn* **1998**, 71, 1501
Arnold, B.R.; Bucher, G.; Netto-Ferreira, J.C.; Platz, M.S.; Scaiano, J.C. *Biradicals, Radicals in Excited States, Carbenes, and Related Species*, Springer-Verlag: Weinheim, 1998
Böhm, V.P.W.; Herrmann, W.A. *Angew. Chem. Int. Ed.* **2000**, 39, 4036 (stable carbenes)
Bertrand, G. (ed.) *Carbene Chemistry: from fleeting intermediates to powerful reagents*, Marcel Dekker, Inc.: New York, 2002

$$CH_3OH \xrightarrow{P_2O_5} :CH_2$$

Dumas, J.B.; Peligot, E. *Ann. Chim. Phys.* **1835**, 58, 5 (attempt)
Regnault, H.V. *Ann. Chim. Phys.* **1839**, 71, 427

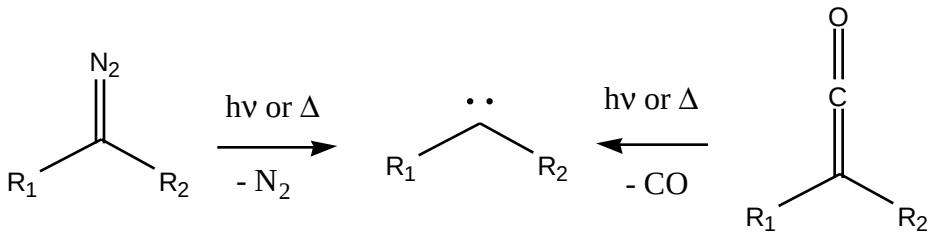
$$CHCl_3 \xrightarrow[-\ HCl]{\text{base}} :CCl_2$$

Geuther, A. *Ann. Chem.* **1862**, 123, 121 (suggestion)

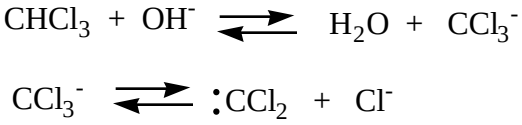
$$CH_2I_2 \xrightarrow[Cu]{\Delta} :CH_2 \xrightarrow{:CH_2} CH_2{=}CH_2$$

Butlerov, A. *Ann. Chem.* **1858**, 107, 110
Butlerov, A. *Ann. Chem.* **1859**, 111, 242

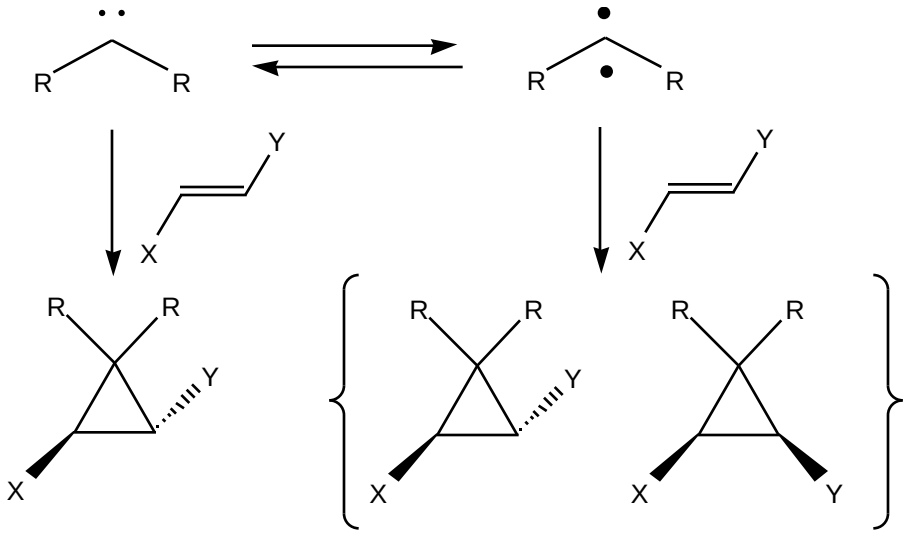
Nef, J.U. *Ann. Chem.* **1897**, 298, 202 (general methylene theory)



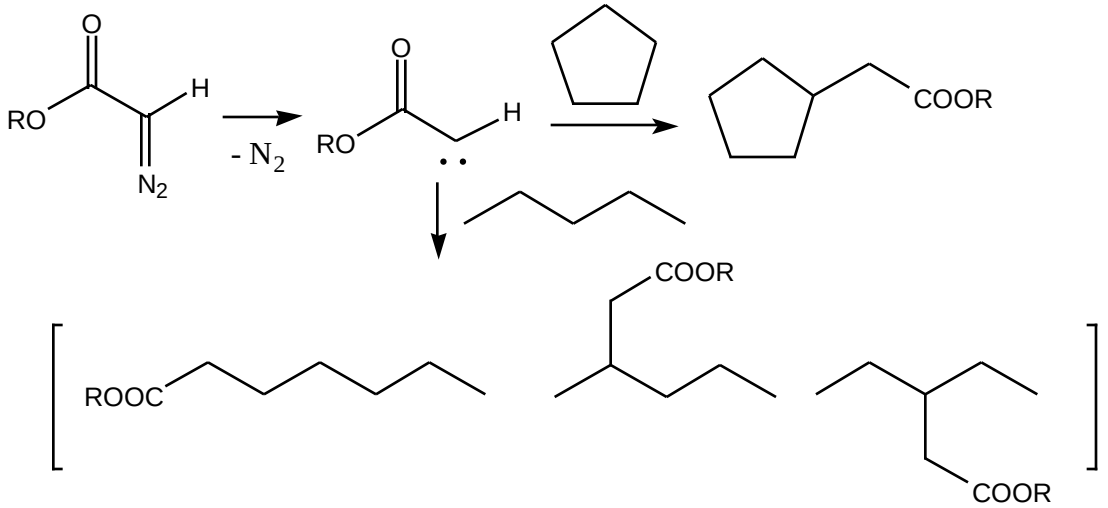
Staudinger, H.; Kupfer, O. *Chem. Ber.* **1911**, 44, 2197
Staudinger, H.; Kupfer, O. *Chem. Ber.* **1912**, 45, 501 (from diazomethanes and diazoketones)
Meerwein, H.; Rathjen, H.; Werner, H. *Chem. Ber.* **1942**, 75, 1610 (discovery of insertion reactions of carbenes in XH bonds)
Doering, W.v.E.; Knox, L.H. *J. Am. Chem. Soc.* **1956**, 78, 4947 (coining of name)



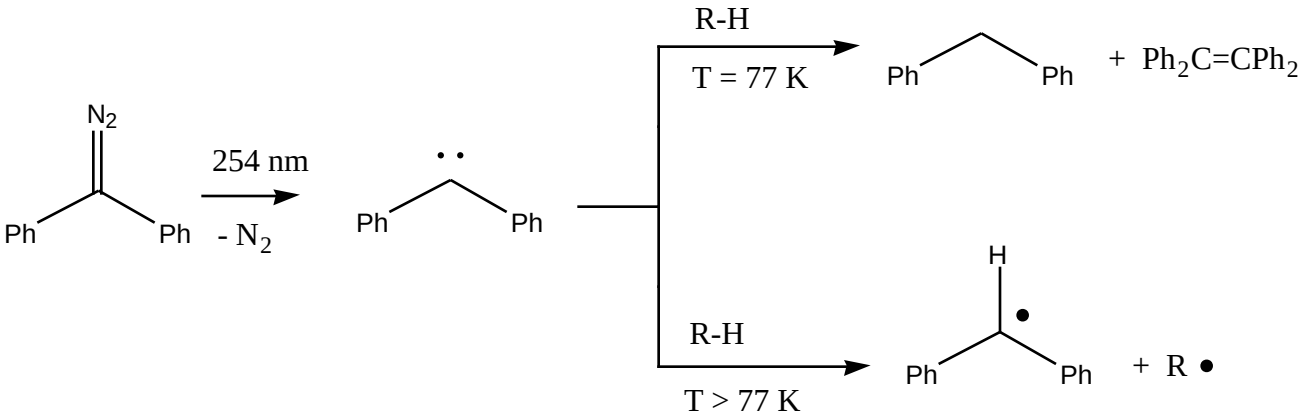
Hine, J. *J. Am. Chem. Soc.* **1950**, 72, 2438 (haloform hydrolysis)
Hine, J.; Dowell, A.M. Jr. *J. Am. Chem. Soc.* **1954**, 76, 2688
Hine, J.; Dowell, A.M. Jr.; Singley, J.E. Jr. *J. Am. Chem. Soc.* **1956**, 78, 479



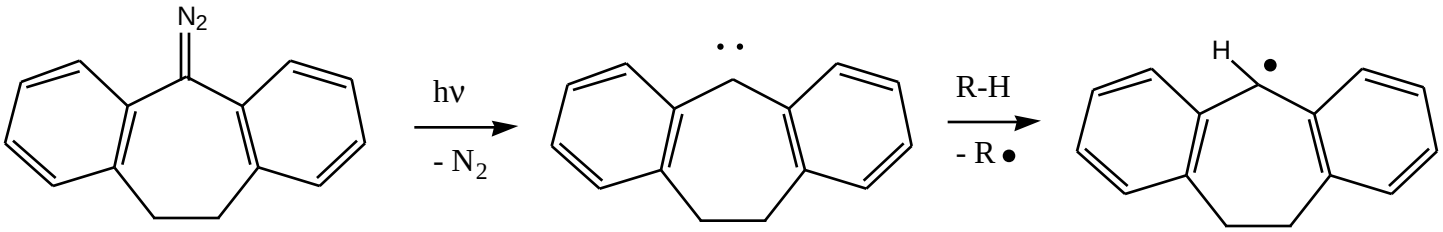
Doering, W.v.E.; Hoffmann, A.K. *J. Am. Chem. Soc.* **1954**, 76, 6162 (trapping of carbenes with olefins)
Skell, P.S.; Garner, A.Y. *J. Am. Chem. Soc.* **1956**, 78, 3409 (connection between multiplicity of carbene and stereochemistry of cyclopropane trapped product)
Skell, P.S.; Garner, A.Y. *J. Am. Chem. Soc.* **1956**, 78, 5430 (connection between multiplicity of carbene and stereochemistry of cyclopropane trapped product)



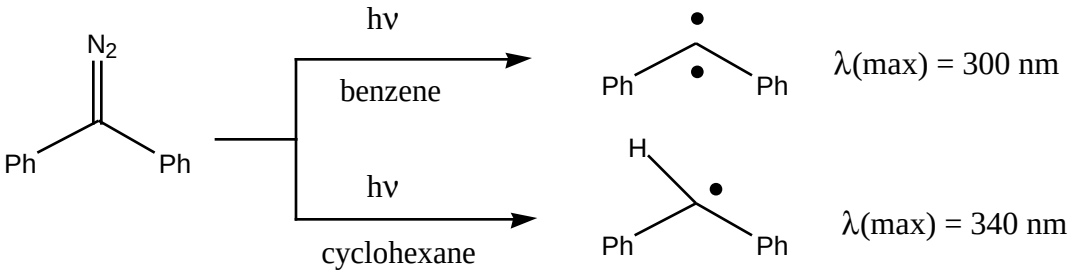
Doering, W.v.E.; Knox, L.H. *J. Am. Chem. Soc.* **1956**, 78, 4947 (coining of "carbene" name)
Doering, W.v.E.; Henderson, W.A. Jr. *J. Am. Chem. Soc.* **1958**, 80, 5274



Gibbons, W.A.; Trozzolo, A.M. *J. Am. Chem. Soc.* **1966**, 88, 172 (matrix isolation EPR)

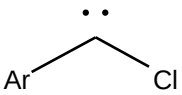


Moritani, I.; Murahashi, S.; Nishino, N.B.; Kimura, K.; Tsubomura, H. *Tetrahedron Lett.* **1966**, 373 (flash photolysis of diazo compounds - no kinetics)

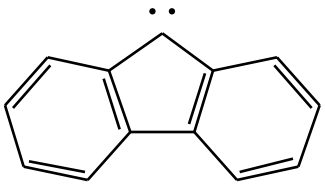


Closs, G.L.; Rabinow, B.E. *J. Am. Chem. Soc.* **1976**, 98, 8190 (first absolute rate constant measurement of carbene reaction by flash photolysis)

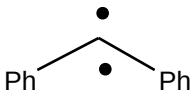
Moss, R.A.; Mallon, C.B. *J. Am. Chem. Soc.* **1975**, 97, 344 (Hammett analysis of carbene + olefin reaction)
Moss, R.A.; Joyce, M.A.; Huselton, J.K. *Tetrahedron Lett.* **1975**, 16, 4621



Turro, N.J.; Butcher, J.A. Jr.; Moss, R.A.; Guo, W.; Munjal, R.C.; Fedorynski, M. *J. Am. Chem. Soc.* **1980**, 102, 7576
Gould, I.R.; Turro, N.J.; Butcher, J. Jr.; Doubleday, C. Jr.; Hacker, N.P.; Lehr, G.F.; Moss, R.A.; Cox, D.P.; Guo, W.; Munjal, R.C.; Perez, L.A.; Fedorynski, M. *Tetrahedron* **1985**, 41, 1587

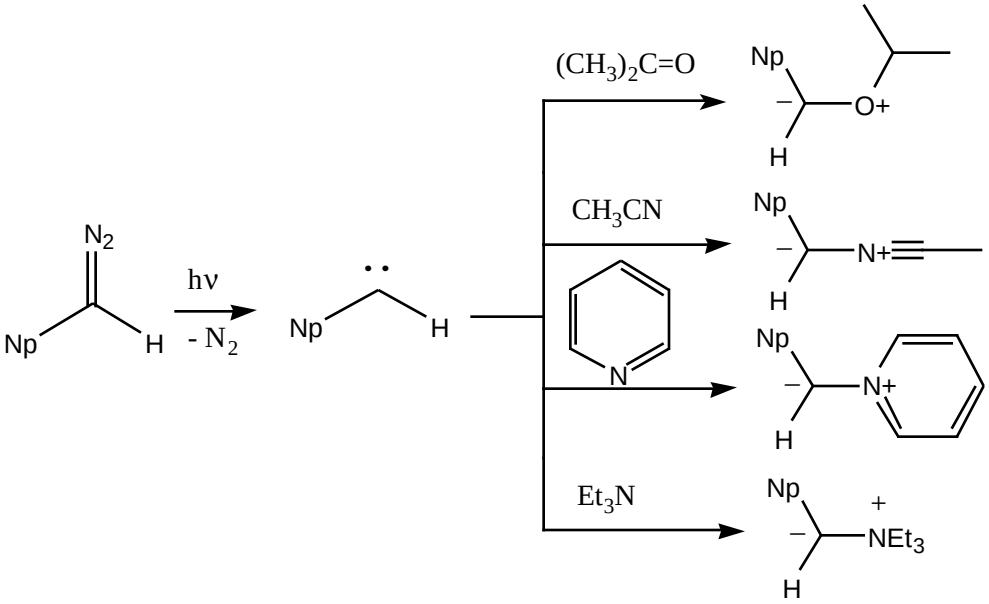


Zupanic, J.J.; Schuster, G.B. *J. Am. Chem. Soc.* **1980**, 102, 5958
Lapin, S.C.; Brauer, B.E.; Schuster, G.B. *J. Am. Chem. Soc.* **1984**, 106, 2092

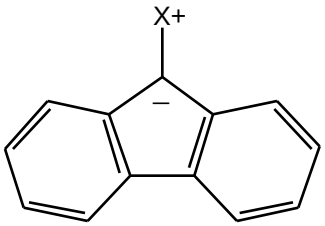


Hadel, L.M.; Platz, M.S.; Scaiano, J.C. *J. Am. Chem. Soc.* **1984**, 106, 283 (quenching of triplet diphenylcarbene)

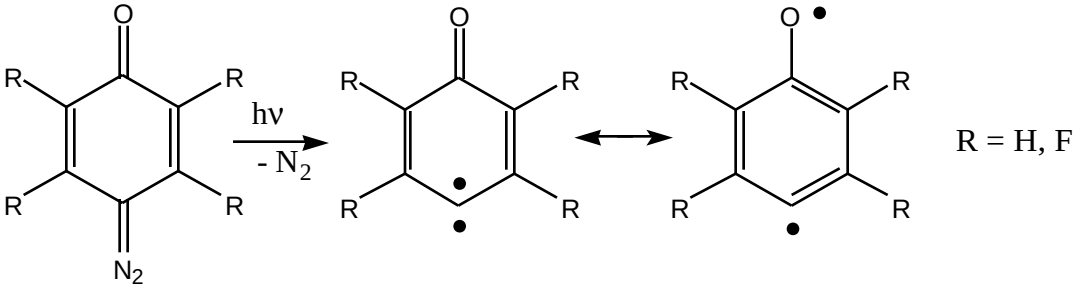
Griller, D.; Nazran, A.S.; Scaiano, J.C. *Tetrahedron* **1985**, 41, 1525



Barcus, R.L.; Hadel, L.M.; Johnston, L.J.; Platz, M.S.; Savino, T.G.; Scaiano, J.C. *J. Am. Chem. Soc.* **1986**, 108, 3928
(trapping of carbenes via ylide formation)



Griller, D.; Hadel, L.M.; Nazran, A.S.; Platz, M.S.; Wong, P.C.; Savino, T.G.; Scaiano, J.C. *J. Am. Chem. Soc.* **1984**, 106, 2227
(trapping of carbenes via ylide formation)



Sander, W.; Bucher, G.; Reichel, F.; Cremer, D. *J. Am. Chem. Soc.* **1991**, 113, 5311
Bucher, G.; Sander, W. *J. Org. Chem.* **1992**, 57, 1346
Wenk, H.H.; Hübert, R.; Sander, W. *J. Org. Chem.* **2001**, 66, 7994
Sander, W.; Hübert, R.; Kraka, E.; Grafenstein, J.; Cremer, D. *Chem. Eur. J.* **2000**, 6, 4567

Carbenes (singlet)

Reviews:

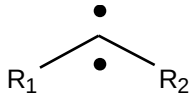
Kirmse, W. *Angew. Chem. Int. Ed.* **2004**, 43, 1767

Herzberg, G.; Shoosmith, J. *Nature* **1959**, 183, 1801

Herzberg, G. *Proc. Roy. Soc. London* **1961**, 262A, 291
Mackay, C.; Wolfgang, R. *J. Am. Chem. Soc.* **1961**, 83, 2399
Gutsche, C.D.; Bachman, G.L.; Coffey, R.S. *Tetrahedron* **1962**, 18, 617
Bradley, J.N.; Ledwith, A. *J. Chem. Soc.* **1963**, 3480
Schoellkopf, U.; Lerch, A.; Paust, J. *Chem. Ber.* **1963**, 96, 2266
Skatteboel, L. *Acta Chem. Scand.* **1963**, 17, 1683
Bradley, J.N.; Cowell, G.W.; Ledwith, A. *J. Chem. Soc.* **1964**, 353
Hamilton, G. *J. Am. Chem. Soc.* **1964**, 86, 3391
Sargeant, P.B.; Shechter, H. *Tetrahedron Lett.* **1964**, 3957

Herzberg, G.; Johns, J.W.C. *Proc. Roy. Soc. London* **1967**, 295A, 107

Carbenes (triplet)



Reviews:
Tomioka, H. *Acc. Chem. Res.* **1997**, 30, 315
Kirmse, W. *Angew. Chem. Int. Ed.* **2003**, 42, 2117

Herzberg, G.; Shoosmith, J. *Nature* **1959**, 183, 1801

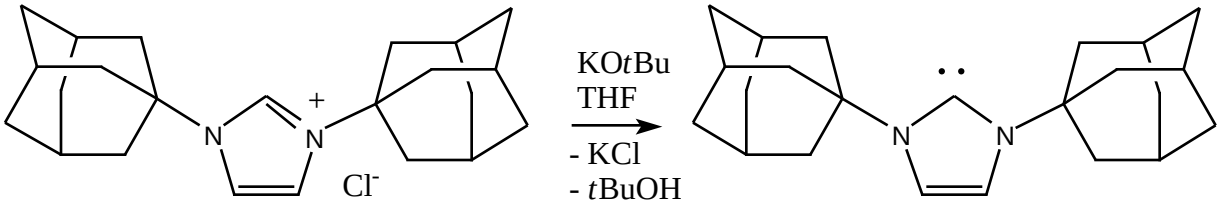
Herzberg, G. *Proc. Roy. Soc. London* **1961**, 262A, 291
Skell, P.S.; Klebe, J. *J. Am. Chem. Soc.* **1960**, 82, 247
MacKay, C.; Wolfgang, R. *J. Am. Chem. Soc.* **1961**, 83, 2399
Schoellkopf, U.; Lerch, A.; Pitteroff, W. *Tetrahedron Lett.* **1962**, 241
D'yakonov, I.A.; Danilkina, L.P. *Zh. Obshch. Khim.* **1962**, 32, 1008
Bradley, J.N.; Ledwith, A. *J. Chem. Soc.* **1963**, 3480

Cowan, D.O.; Couch, M.M.; Kopecky, K.R.; Hammond, G. *J. Org. Chem.* **1964**, 29, 1922
Sloan, M.F.; Prosser, T.J.; Newburg, N.R.; Breslow, D.S. *Tetrahedron Lett.* **1964**, 2945
Hamilton, G.A. . *J. Am. Chem. Soc.* **1964**, 86, 3391
Frey, H.M. *Chem. Commun.* **1965**, 260
Padwa, A.; Layton, R. *Tetrahedron Lett.* **1965**, 2167
Moritani, I.; Obata, N. *Tetrahedron Lett.* **1965**, 2817

Carbene (Arduengo)

Reviews:

Arduengo, A.J. III *Acc. Chem. Res.* **1999**, 32, 913 (stable carbenes)
Arduengo, A.J. III *Tetrahedron* **1999**, 55, 14523 (imidazolylidenes and imidazolinylidenes)

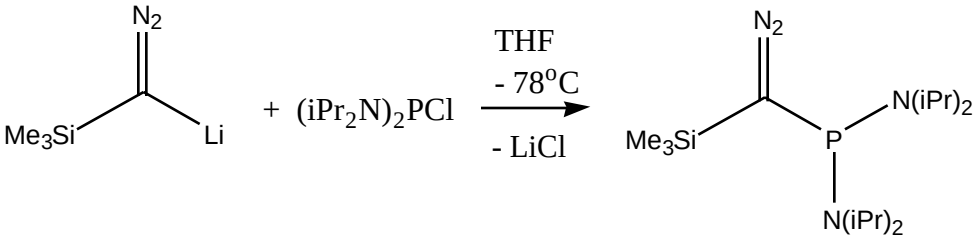


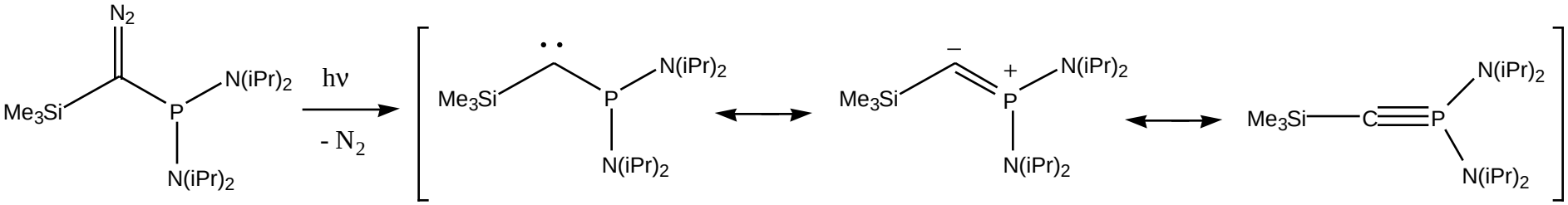
Arduengo, A.J. III; Harlow, R.L.; Kline, M. *J. Am. Chem. Soc.* **1991**, 113, 361
Dixon, D.A.; Arduengo, A.J. III *J. Phys. Chem.* **1991**, 95, 4180
Arduengo, A.J. III; Dias, H.V.R.; Harlow, R.L.; Kline, M. *J. Am. Chem. Soc.* **1992**, 114, 5530

Carbene (Bertrand)

Reviews:

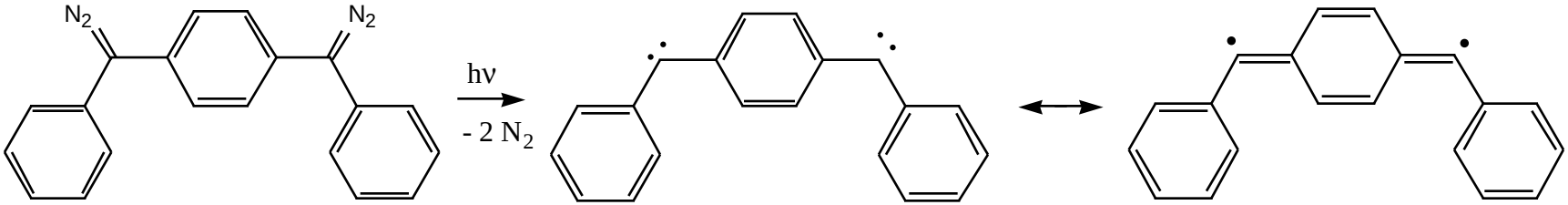
Bertrand, G. *Chem. Rev.* **2000**, 100, 39 (stable carbenes)



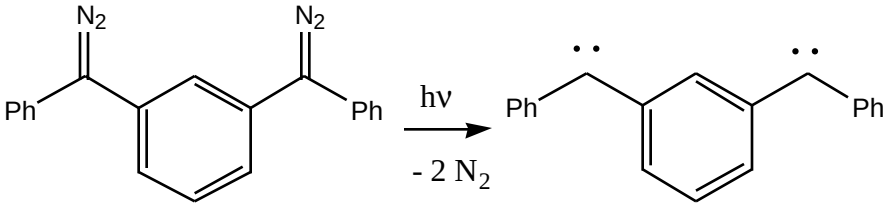


Baceiredo, A.; Bertrand, G.; Sicard, G. *J. Am. Chem. Soc.* **1985**, 107, 4781
Igau, A.; Grützmacher, H.; Baceiredo, A.; Bertrand, G. *J. Am. Chem. Soc.* **1988**, 110, 6463
Igau, A.; Baceiredo, A.; Trinquier, G.; Bertrand, G. *Angew. Chem. Int. Ed.* **1989**, 28, 621

Dicarbenes

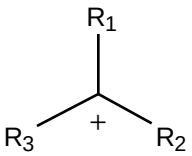


Trozzolo, A.M.; Murray, R.W.; Smolinsky, G.; Yager, W.A.; Wasserman, E. *J. Am. Chem. Soc.* **1963**, 85, 2526



Wasserman, E.; Murray, R.W.; Yager, W.A.; Trozzolo, A.M.; Smolinksy, G. *J. Am. Chem. Soc.* **1967**, 89, 5076

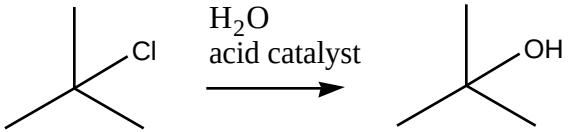
Carbocations



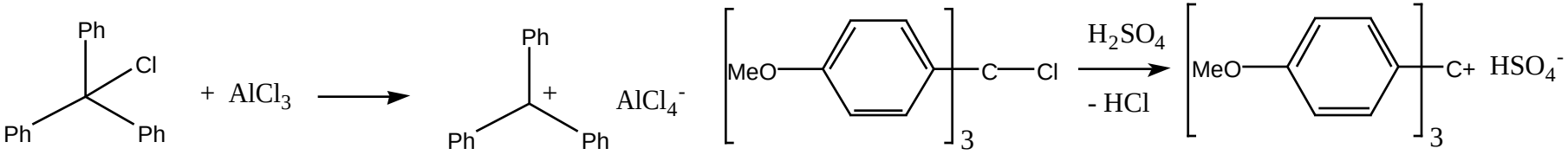
Reviews:
Ingold, C.K. *Ann. Rep. Prog. Chem. (Chem. Soc. London)* **1927**, 24, 156
Whitmore, F.C. *Ann. Rep. Prog. Chem. (Chem. Soc. London)* **1933**, 30, 177
Whitmore, F.C. *Chem. Eng. News* **1948**, 26, 688
Deno, N.C. *Prog. Phys. Org. Chem.* **1964**, 2, 129
Olah, G.; Pittman, C.U. Jr. *Adv. Phys. Org. Chem.* **1966**, 4, 305
Bethell, D.; Gold, V. *Carbonium Ions: an introduction*, Academic Press: London, 1967
More O'Ferrall, R.A. *Adv. Phys. Org. Chem.* **1967**, 5, 331
Olah, G.A.; Schleyer, P.v.R., eds. *Carbonium Ions*, Wiley-Interscience: New York, 1968 - 1976, Vol. I - IV, 1968 - 1973
Nenitzescu, C.N. in *Carbonium Ions* (G.A. Olah; P.v.R. Schleyer, eds.) Wiley-Interscience: New York, 1968, Vol. 1, p. 1 - 75
Cacace, F. *Adv. Phys. Org. Chem.* **1970**, 8, 79
Brouwer, D.M.; Hogeveen, H. *Prog. Phys. Org. Chem.* **1972**, 9, 179
Hogeveen, H. *Adv. Phys. Org. Chem.* **1972**, 10, 29
Cabell-Whiting, P.W.; Hogeveen, H. *Adv. Phys. Org. Chem.* **1972**, 10, 129
McManus, S.P.; Pittman, C.U. Jr. in *Organic Reactive Intermediates*, (S.P. McManus, ed.) Academic Press: New York, 1973, p. 193
Olah, G.A. *Carbocations and Electrophilic Reactions*, Wiley: New York, 1974
Ahlberg, P.; Jönsall, G.; Engdahl, C. *Adv. Phys. Org. Chem.* **1983**, 19, 223
Olah, G.A.; Prakash, G.K.S.; Sommer, J. *Superacids*, Wiley: New York, 1985
Vogel, P. *Carbocation Chemistry*, Elsevier: Amsterdam, 1985
Traynham, J.G. *J. Chem. Educ.* **1986**, 63, 930 (carbocation names)
Traynham, J.G. *J. Chem. Educ.* **1989**, 66, 451 (carbocation names)
Prakash, G.K.S.; Schleyer, P.v.R. *Stable Carbocation Chemistry*, Wiley: New York, 1997
Rappoport, Z.; Stang, P.J. *Diccoordinated Carbocations*, Wiley: New York, 1997
Abboud, J.L.M.; Herreros, M.; Notario, R.; Lomas, J.S.; Mareda, J.; Müller, P.; Rossier, J.C. *J. Org. Chem.* **1999**, 64, 6401 (bridgehead carbocations)
Richard, J.P.; Amyes, T.L.; Lin, S.S.; O'Donoghue, A.C.; Toteva, M.M.; Tsuji, Y.; Williams, K.B. *Adv. Phys. Org. Chem.* **2000**, 35, 67
Olah, G.A. *J. Org. Chem.* **2001**, 65, 5943
Abboud, J.L.M.; Alkorta, I.; Dávalos, J.Z.; Müller, P.; Quintanilla, E. *Adv. Phys. Org. Chem.* **2002**, 37, 57

stabilities of carbocations:

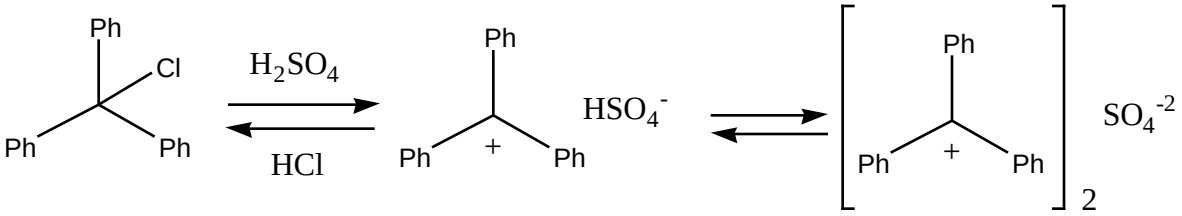
Deno, N.C.; Jaruzelski, J.; Schriescheim, A. *J. Am. Chem. Soc.* **1955**, 77, 3044 (triarylcarbonium ions by H_R acidity function)
Jenson, E.D.; Taft, R.W. *J. Am. Chem. Soc.* **1964**, 86, 116 (triarylcarbonium ions by potentiometric measurements)
Taft, R.W.; McKeever, L.D. *J. Am. Chem. Soc.* **1965**, 87, 2489 (triarylcarbonium ions by potentiometric measurements)
Diffenbach, R.A.; Sano, K.; Taft, R.W. *J. Am. Chem. Soc.* **1966**, 88, 4747 (triarylcarbonium ions by potentiometric measurements)
Feldman, M.; Flythe, W.C. *J. Am. Chem. Soc.* **1969**, 91, 4577 (triarylcarbonium ion reduction potentials)
Breslow, R.; Balasubramanian, K. *J. Am. Chem. Soc.* **1969**, 91, 5182 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Breslow, R.; Chu, W. *J. Am. Chem. Soc.* **1970**, 92, 2165 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Breslow, R.; Chu, W. *J. Am. Chem. Soc.* **1973**, 95, 411 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Breslow, R.; Mazur, M. *J. Am. Chem. Soc.* **1973**, 95, 584 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Breslow, R.; Drury, R.F. *J. Am. Chem. Soc.* **1974**, 96, 4702 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Breslow, R. *Pure Appl. Chem.* **1974**, 40, 493 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Wasielewski, M.R.; Breslow, R. *J. Am. Chem. Soc.* **1976**, 98, 4222 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Breslow, R.; Goodin, R. *J. Am. Chem. Soc.* **1976**, 98, 6077 (thermodynamic stabilities of cations and anions via electrochemical oxidations)
Bank, S.; Ehrlich, C.L.; Zubieta, J.A. *J. Org. Chem.* **1979**, 44, 1454 (trityl carbonium ions)
Bank, S.; Ehrlich, C.L.; Mazur, M.; Zubieta, J.A. *J. Org. Chem.* **1981**, 46, 1243 (trityl carbonium ions)



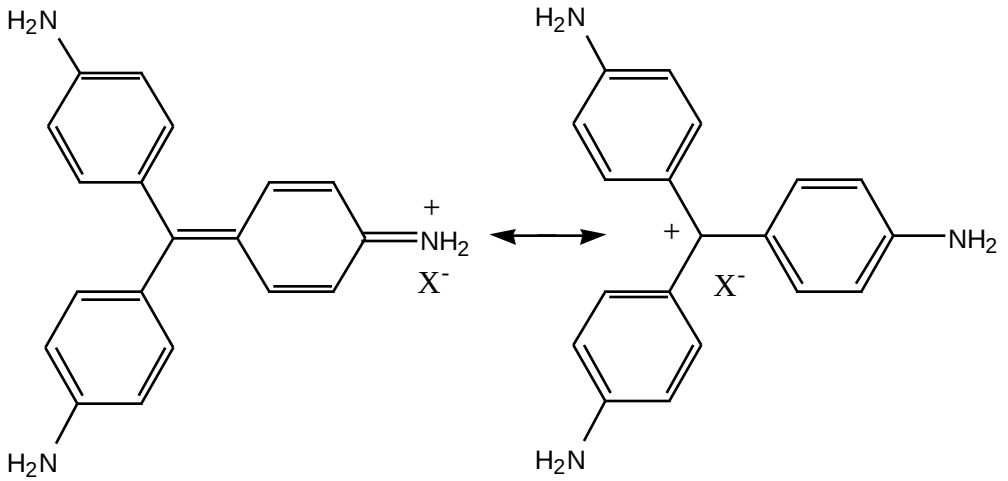
Stieglitz, J. *Am. Chem. J.* **1899**, 21, 101



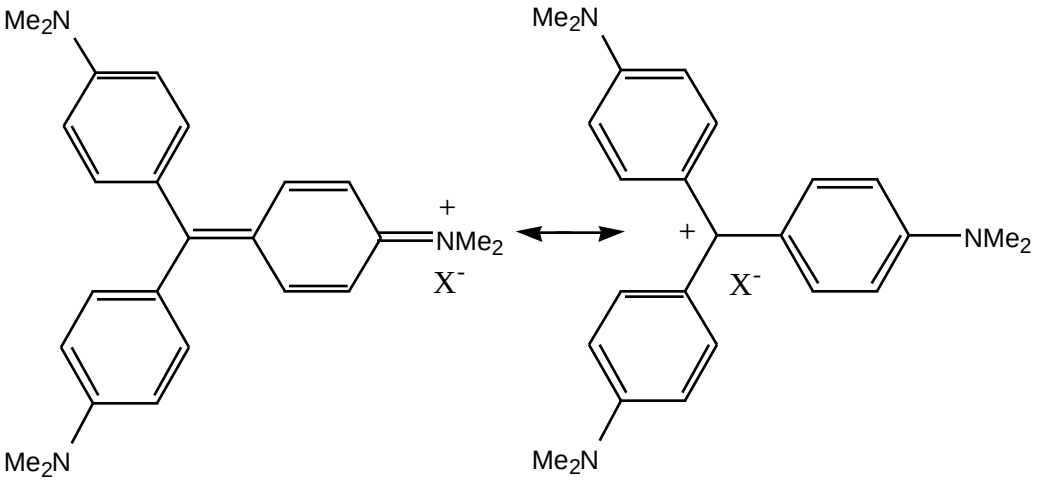
Norris, J.F.; Sanders, W.W. *Am. Chem. J.* **1901**, 25, 54
Norris, J.F. *Am. Chem. J.* **1901**, 25, 117
Norris, J.F. *Am. Chem. J.* **1907**, 38, 627



Gomberg, M. *Chem. Ber.* **1902**, 35, 2397; 2405
Walden, P. *Chem. Ber.* **1902**, 35, 2018
Hantzsch, A. *Z. Physik. Chem.* **1907**, 61, 257
Hantzsch, A. *Chem. Ber.* **1921**, 54, 2573; 2578

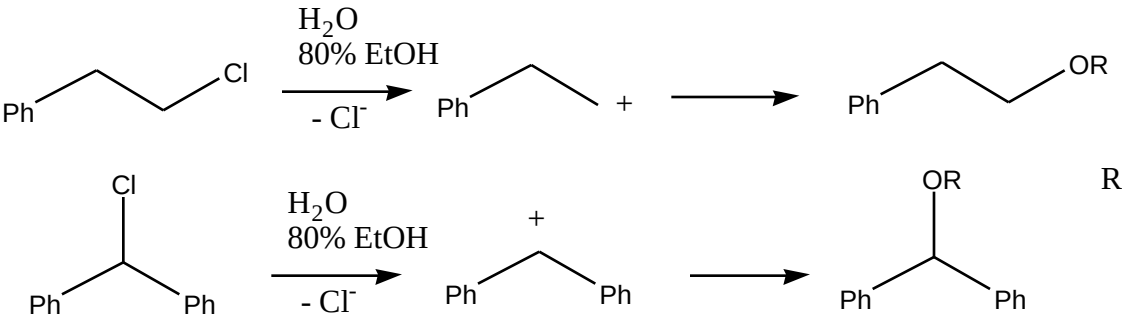


fuchsine



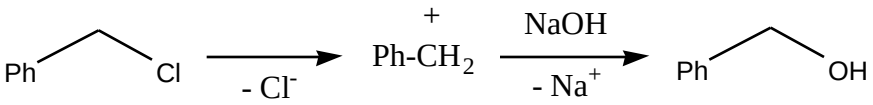
crystal violet

Kehrmann, F.; Wentzel, F. *Chem. Ber.* **1901**, 34, 3815
Baeyer, A.; Villiger, V. *Chem. Ber.* **1902**, 35, 1189
Baeyer, A.; Villiger, V. *Chem. Ber.* **1902**, 35, 3013
Baeyer, A.; Villiger, V. *Chem. Ber.* **1903**, 36, 2774
Baeyer, A.; Villiger, V. *Chem. Ber.* **1904**, 37, 597
Baeyer, A.; Villiger, V. *Chem. Ber.* **1904**, 37, 1183
Baeyer, A.; Villiger, V. *Chem. Ber.* **1904**, 37, 2848
Baeyer, A.; Villiger, V. *Chem. Ber.* **1904**, 37, 3191
Baeyer, A. *Chem. Ber.* **1905**, 38, 569
Baeyer, A. *Chem. Ber.* **1905**, 38, 1156

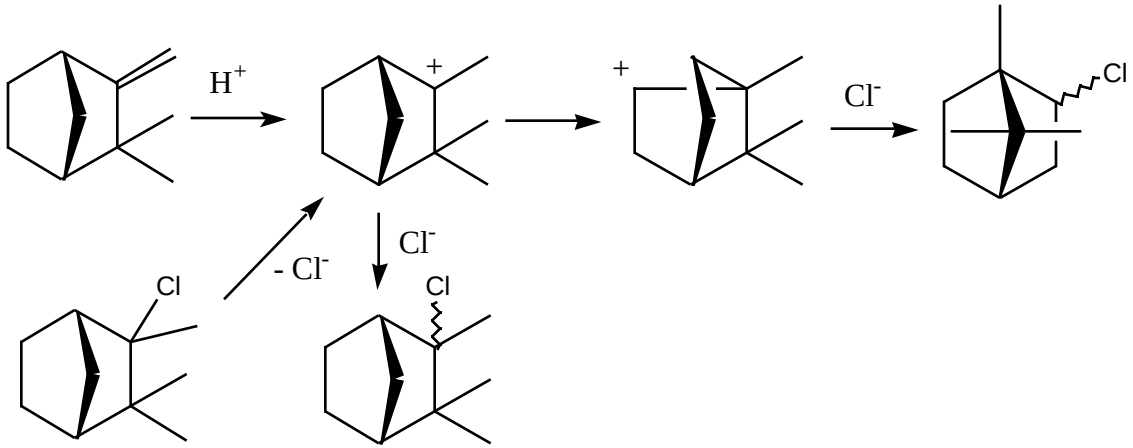


R = H, Et

Ward, A.M. *J. Chem. Soc.* **1927**, 445; 2285

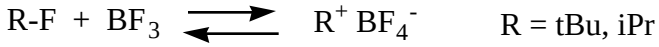


Ingold, C.K.; Rothstein, E. *J. Chem. Soc.* **1928**, 1217
Steigman, J.; Hammett, L.P. *J. Am. Chem. Soc.* **1937**, 59, 2536
Whitmore, F.C. *J. Am. Chem. Soc.* **1932**, 54, 3274



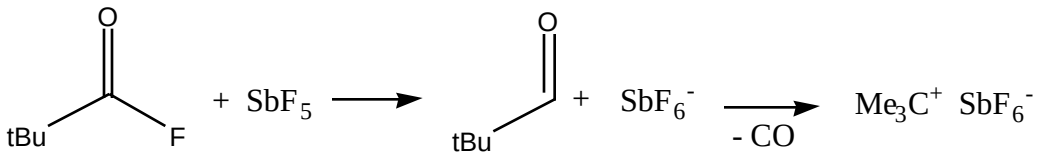
Wagner, G.; Brickner, W. *Chem. Ber.* **1899**, 32, 2302
Meerwein, H.; van Emster, K. *Chem. Ber.* **1922**, 55, 2500
Meerwein, H.; Hammel, O.; Serini, A.; Vorster, J. *Ann. Chem.* **1927**, 453, 16

Ziegler, K.; Wollschitt, H. *Ann. Chem.* **1930**, 479, 104 (stabilities of cations in SO2)

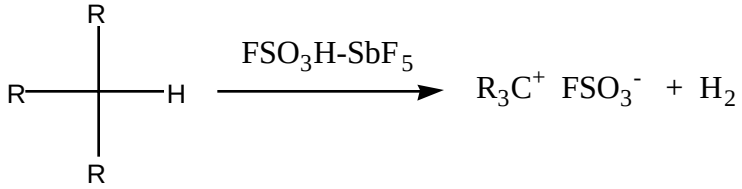


R = tBu, iPr

Olah, G.A.; Kuhn, S.J.; Opal, J. *J. Chem. Soc.* **1957**, 2174

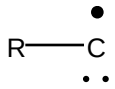


Olah, G.A.; Kuhn, S.J.; Tolgyesi, W.S.; Baker, E.B. *J. Am. Chem. Soc.* **1962**, 84, 2733
Olah, G.A. *Rev. Roum. Chim.* **1962**, 7, 1129

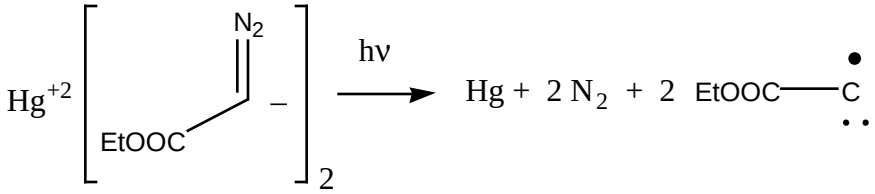


Olah, G.A.; Lukas, J. *J. Am. Chem. Soc.* **1967**, 89, 2227; 4743
Olah, G.A.; Tolgyesi, W.S.; Kuhn, S.J.; Moffatt, M.E.; Bastien, I.J.; Baker, E.B. *J. Am. Chem. Soc.* **1963**, 85, 1328
Olah, G.A.; Comisarow, M.B.; Cupas, C.A.; Pittman, C.U. Jr. *J. Am. Chem. Soc.* **1965**, 87, 2997
Olah, G.A.; Schlosberg, R.H. *J. Am. Chem. Soc.* **1968**, 90, 2726
Olah, G.A. *J. Am. Chem. Soc.* **1972**, 94, 808 (proposal to change definition of carbonium ion; introduction of carbenium ion terminology)

Carbynes

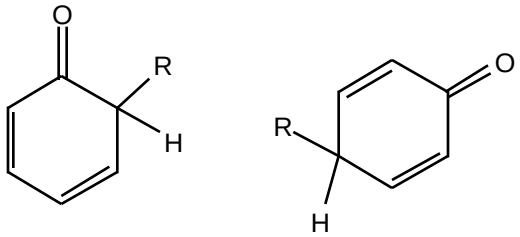


Reviews:
Connor, J.A. *J. Organometallic Chem.* **1975**, 4, 235 (carbenes and carbynes)



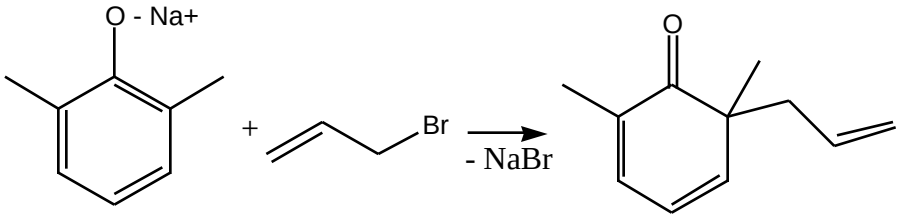
Strausz, O.P.; Kennepohl, G.J.A.; Garneau, F.X.; DoMinh, T.; Kim, B.; Valenty, S.; Skell, P.S. *J. Am. Chem. Soc.* **1974**, 96, 5723

2,4- and 2,5-Cyclohexadienones



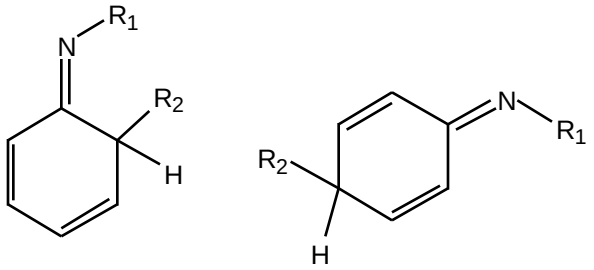
Reviews:
Schuster, D.I. *Acc. Chem. Res.* **1978**, 11, 65

Crowther, H.L.; McCombie, H. *J. Chem. Soc.* **1913**, 103, 536
Crowther, H.L.; McCombie, H. *Proc. Chem. Soc.* **1913**, 29, 68

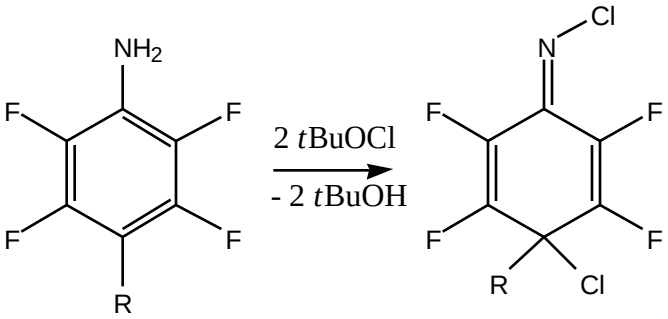


Curtin, D.Y.; Crawford, R.J. *Chem. Ind.* **1956**, 313

2,4- and 2,5-Cyclohexadienimines

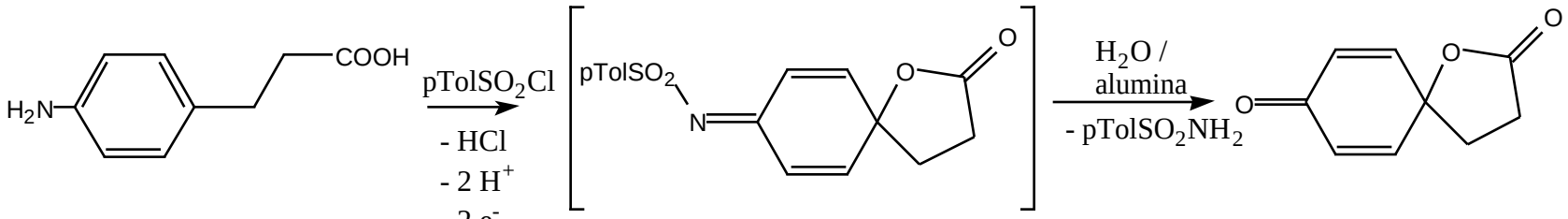


Reviews:
None

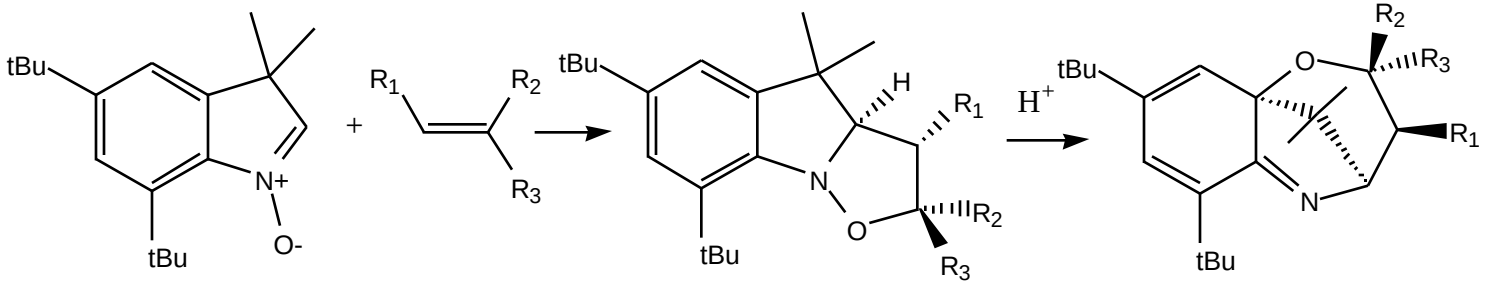


R = Me, MeO, nBu

Andreevskaya, O.I.; Markovskii, L.N.; Poleshchuk, O.K.; Furin, G.G.; Shermolovich, Y.G.; Yakobson, G.G. *Zh. Org. Khim.* **1980**, 16, 817

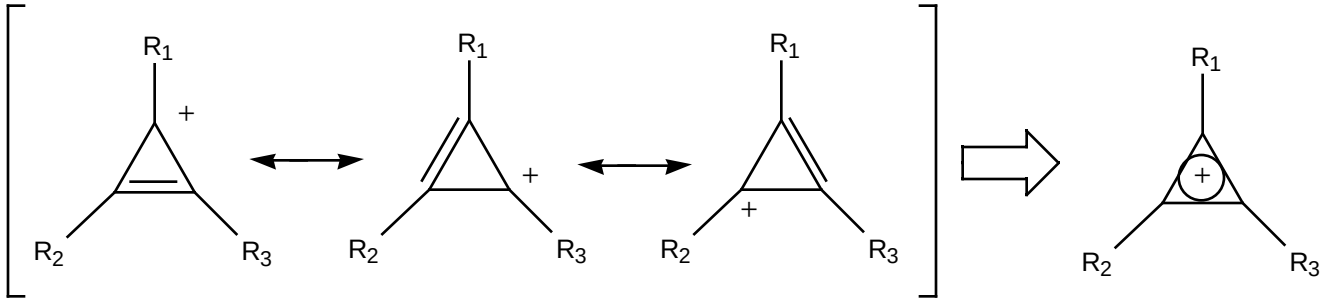


Coutts, I.G.C.; Edwards, M.; Musto, D.R.; Richards, D.J. *Tetrahedron Lett.* **1980**, 21, 5055

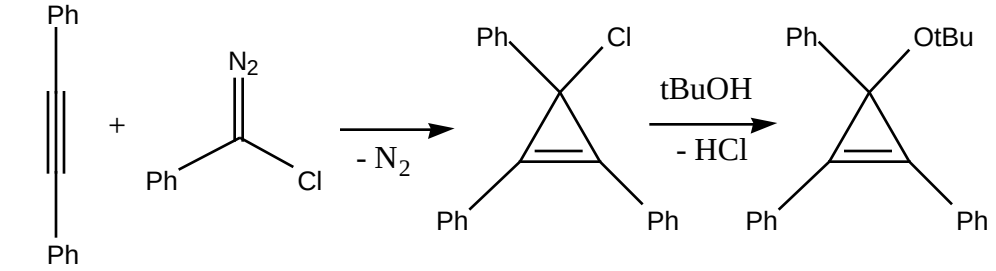


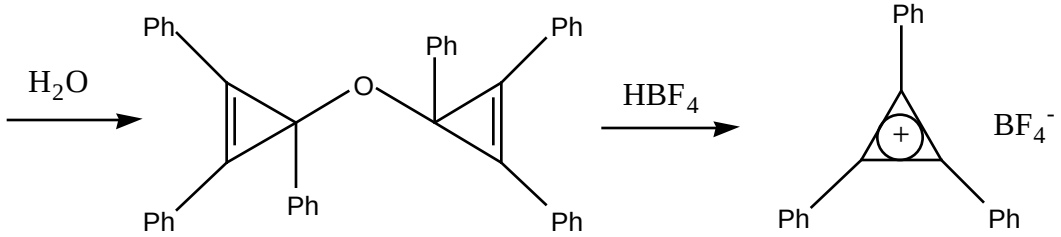
Doepp, D.; Krueger, C.; Makedakis, G.; Nour-el-Din, A.M. *Chem. Ber.* **1985**, 118, 510

Cyclopropenyl cations



Reviews:
Krivun, S.V.; Alferova, O.F.; Sayapina, S.V. *Usp. Khim.* **1974**, 43, 1739
Allen, A.D.; Tidwell, T.T. *Chem. Rev.* **2001**, 101, 1333
Komatsu, K.; Kitagawa, T. *Chem. Rev.* **2003**, 103, 1371





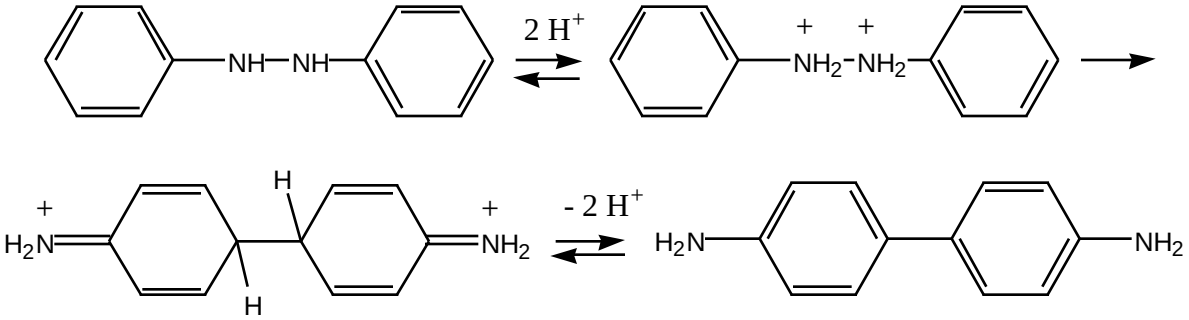
Breslow, R. *J. Am. Chem. Soc.* **1957**, 79, 5318

Breslow, R.; Yuan, C. *J. Am. Chem. Soc.* **1958**, 80, 5991
Breslow, R.; Höver, H. *J. Am. Chem. Soc.* **1960**, 82, 2644
Breslow, R.; Bahary, W.; Reinmuth, W. *J. Am. Chem. Soc.* **1961**, 83, 1763
Breslow, R.; Lockhart, J.; Chang, H.W. *J. Am. Chem. Soc.* **1961**, 83, 2375
Breslow, R.; Höver, H.; Chang, H.W. *J. Am. Chem. Soc.* **1962**, 84, 3168
Breslow, R.; Groves, J.T.; Ryan, G. *J. Am. Chem. Soc.* **1967**, 89, 5048

Dications

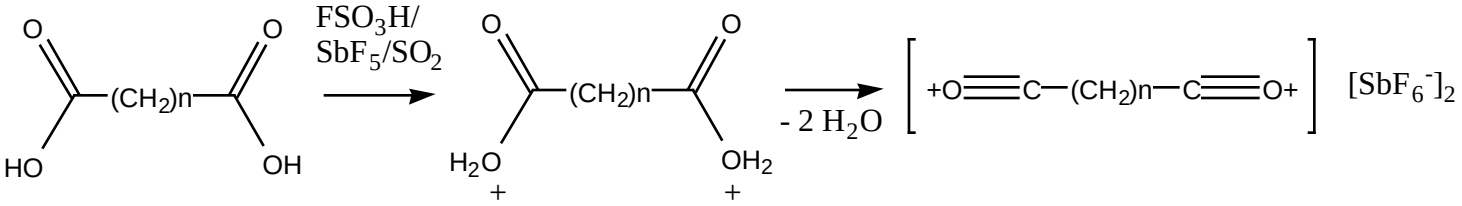
Reviews:
Nenajdenko, V.G.; Shevchenko, N.E.; Balenkova, E.S.; Alabugin, I.V. *Chem. Rev.* **2003**, 103, 229

(i) Benzidine rearrangement

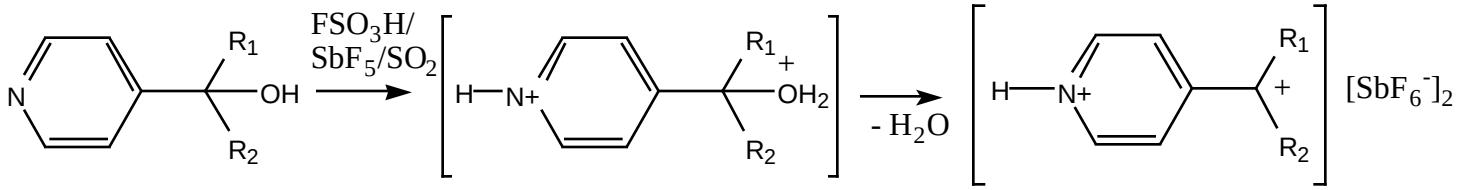


Hofmann, A.W. *Proc. Roy. Soc. London* **1863**, 12, 576
Jacobson, P.; Henrich, F.; Klein, J. *Chem. Ber.* **1893**, 26, 688
Olah, G.A.; Dunne, K.; Kelly, D.P.; Mo, Y.K. *J. Am. Chem. Soc.* **1972**, 94, 7438

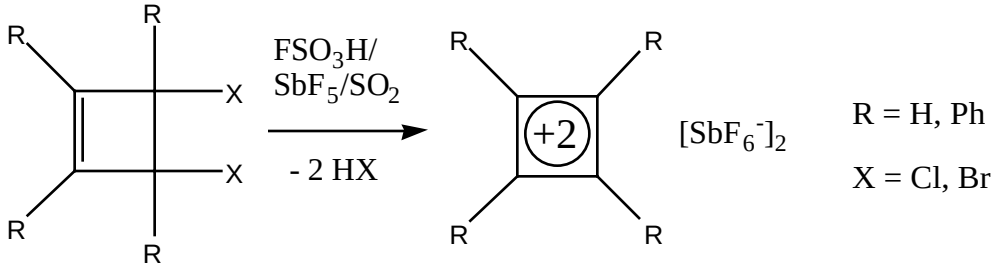
(ii) Dications synthesized in magic acid



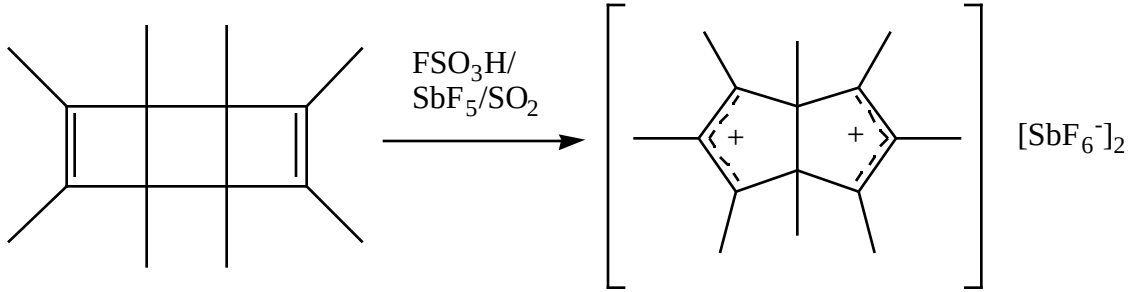
Olah, G.A.; Comisarow, M.B. *J. Am. Chem. Soc.* **1966**, 88, 3313



Olah, G.A.; Calin, M. *J. Am. Chem. Soc.* **1968**, 90, 943

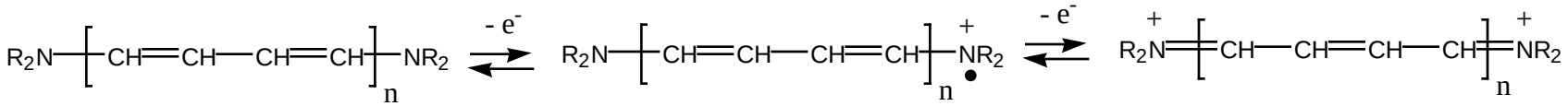


Olah, G.A.; Bollinger, J.M.; White, A.M. *J. Am. Chem. Soc.* **1969**, 91, 3667
Olah, G.A.; Mateescu, G.D. *J. Am. Chem. Soc.* **1970**, 92, 1430



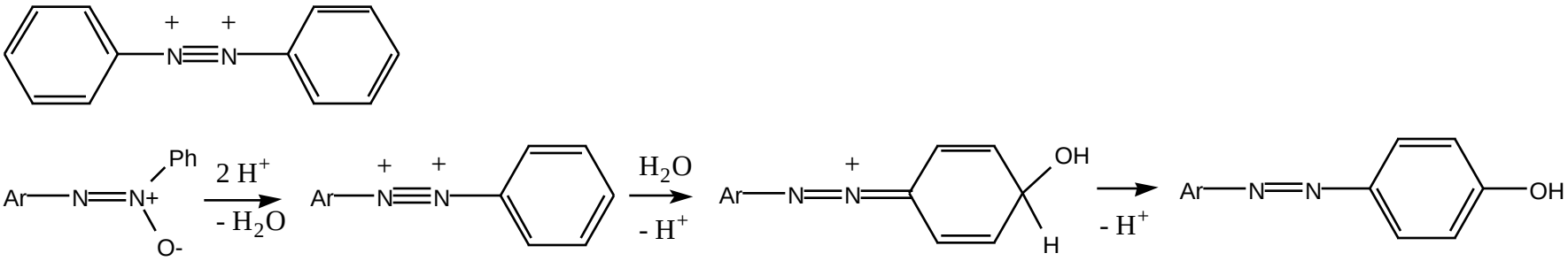
Bollinger, J.M.; Olah, G.A. *J. Am. Chem. Soc.* **1969**, 91, 3380

(iii) Violenes



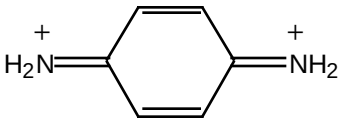
Hunig, S. *Ann. Chem.* **1964**, 676, 32
Hunig, S.; Balli, H.; Conrad, H.; Schott, A. *Ann. Chem.* **1964**, 676, 36; 52
Hunig, S. *Chem. Eng. News* **1966**, 44, 102
Hunig, S.; Geiger, H.; Kaupp, G.; Kniese, W. *Ann. Chem.* **1966**, 697, 116

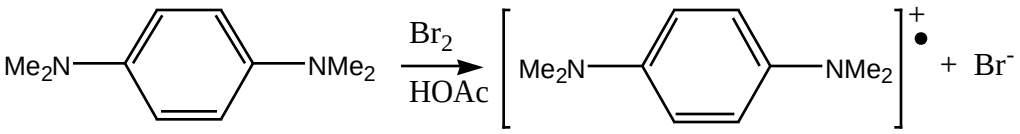
(iv) Wallach intermediate



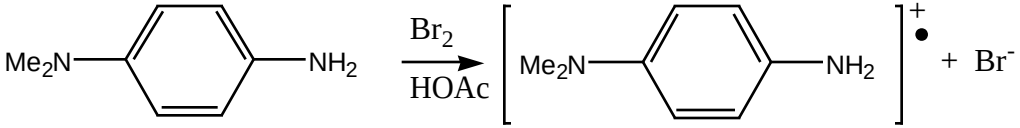
Wallach, O.; Belli, E. *Chem. Ber.* **1880**, 13, 525
Buncel, E.; Lawton, B.T. *Chem. Ind.* **1963**, 1835
Buncel, E.; Lawton, B.T. *Can. J. Chem.* **1965**, 43, 862
Olah, G.A.; Dunne, K.; Kelly, D.P.; Mo, Y.K. *J. Am. Chem. Soc.* **1972**, 94, 7438
Cox, R.A.; Fung, D.Y.K.; Csizmadia, I.G.; Buncel, E. *Can. J. Chem.* **2003**, 81, 535

(v) Wurster salts



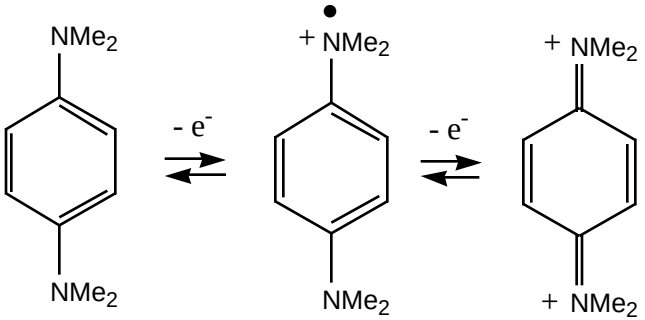


Wurster's blue



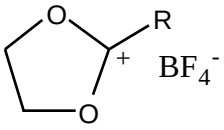
Wurster's red

Wurster, C. *Chem. Ber.* **1879**, 12, 522
Wurster, C.; Sendtner, R. *Chem. Ber.* **1879**, 12, 1803
Wurster, C.; Schobig, E. *Chem. Ber.* **1879**, 12, 1807
Wurster, C. *Chem. Ber.* **1879**, 12, 2071
Wurster, C. *Chem. Ber.* **1886**, 19, 3195

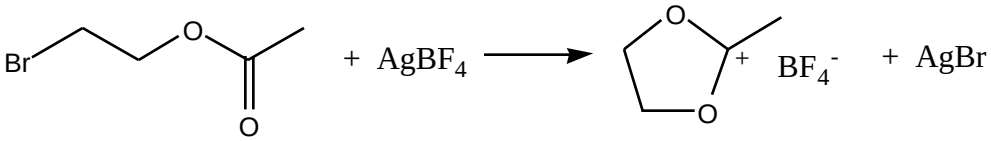


Michaelis, L. *J. Am. Chem. Soc.* **1931**, 53, 2953
Katz, H. *Z. Physik* **1933**, 87, 238
Michaelis, L.; Schubert, M.P.; Granick, S. *J. Am. Chem. Soc.* **1939**, 61, 1981

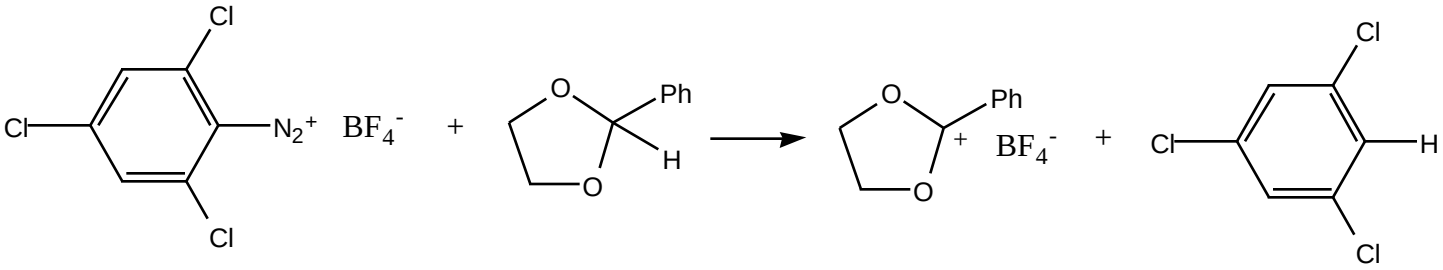
1,3-Dioxolenium salts



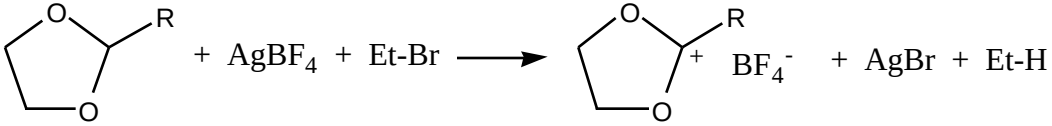
Reviews:
Paulsen, H. *Pure Appl. Chem.* **1975**, 41, 69



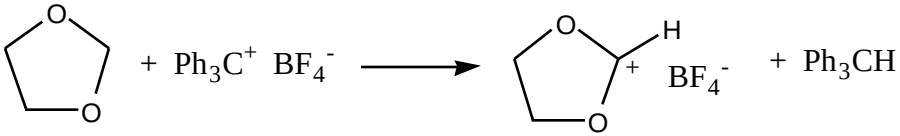
Meerwein, H.; Wunderlich, K. *Angew. Chem.* **1957**, 69, 481



Meerwein, H.; Allendorfer, H.; Beckmann, P.; Kunert, F.; Morschel, H.; Pawellek, F.; Wunderlich, K. *Angew. Chem.* **1958**, 70, 211



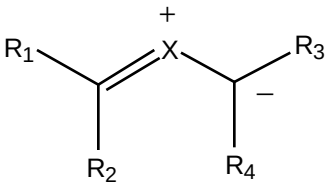
Meerwein, H.; Hederich, V.; Wunderlich, K. *Arch. Pharm.* **1958**, 291, 541

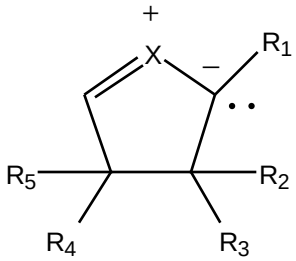


Meerwein, H.; Hederlich, V.; Morschel, H.; Wunderlich, K. *Ann. Chem.* **1960**, 635, 1

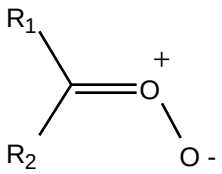
1,3-Dipoles

carbene traps

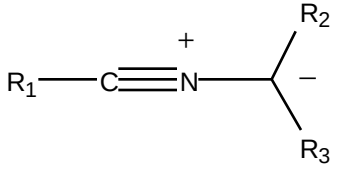




carbonyl ylide (X = O)
thiocarbonyl ylide (X = S)
azomethine ylide (X = N-R)



carbonyl oxide



nitrile ylides

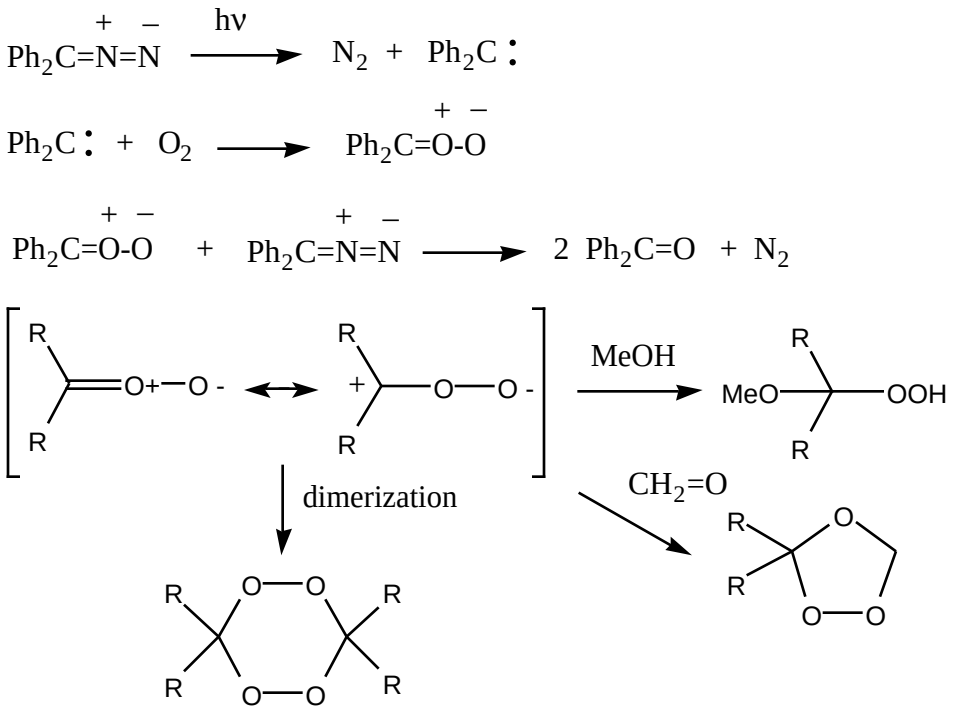
Reviews:
Smith, L.I. *Chem. Rev.* **1938**, 23, 193
Huisgen, R. *Proc. Chem. Soc.* **1961**, 357

(i) Azomethine ylide
Reviews:
Surpateanu; Karzazi *Heterocycles* **1999**, 51, 863 (cyclic azomethine ylides)
Eberbach, W. *Science of Synthesis* **2004**, 27, 441

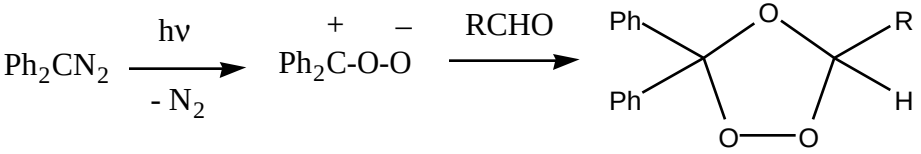
Huisgen, R. *Angew. Chem.* **1963**, 75, 604
Huisgen, R. *Angew. Chem.* **1963**, 75, 742

(ii) Carbonyl oxide (Criegee zwitterion)
Reviews:
Criegee, R. *Record Chem. Prog.* **1957**, 18, 111
Bailey, R.S. *Chem. Rev.* **1958**, 58, 925
Criegee, R. in *Peroxide Reaction Mechanisms* (J.O. Edwards, ed.) Interscience Publishers, Inc.: New York, 1962, p. 32

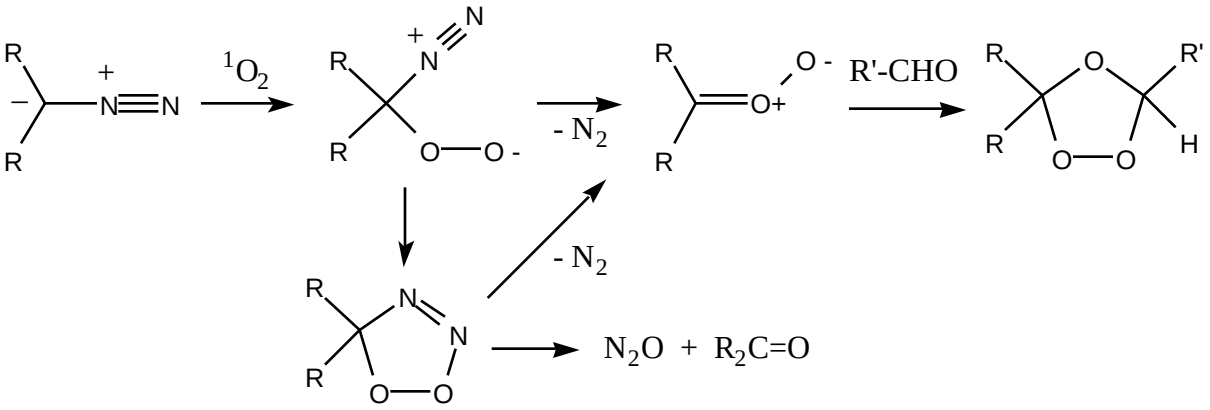
Huisgen, R. *Angew. Chem. Int. Ed.* **1963**, 2, 565
Kuczkowski, R.L. in *1,3-Dipolar Cycloaddition Chemistry*, (A. Padwa, ed.) Wiley: New York, 1984, Vol. 2, p. 197 - 276
Sander, W. *Angew. Chem.* **1990**, 102, 362
Bunnelle, W.H. *Chem. Rev.* **1991**, 91, 335
Ishiguro, K.; Nojima, T.; Sawaki, Y. *J. Phys. Org. Chem.* **1997**, 10, 787
Block, K.; Kappert, W.; Kirschfeld, A.; Muthusamy, S.; Schroeder, K.; Sander, W.; Kraka, E.; Sosa, C.; Cremer, D. in *Peroxide Chemistry*, (W. Adam, ed.) Wiley-VCH: Weinheim, 2000, p. 139 - 156



Bartlett, P.D.; Traylor, T.G. *J. Am. Chem. Soc.* **1962**, 84, 3408



Murray, R.W.; Suzui, A. *J. Am. Chem. Soc.* **1971**, 93, 4963



Higley, D.P.; Murray, R.W. *J. Am. Chem. Soc.* **1974**, 96, 3330

(iii) Carbonyl ylide

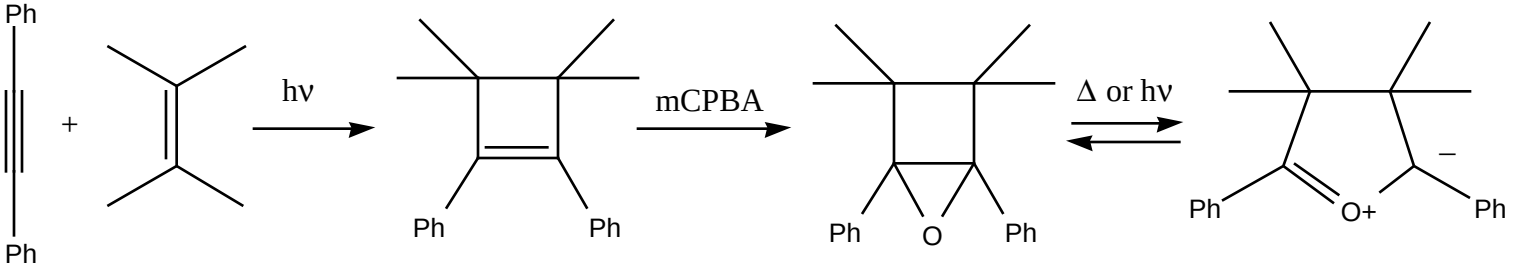
Reviews:

Padwa, A. *Acc. Chem. Res.* **1991**, 24, 22

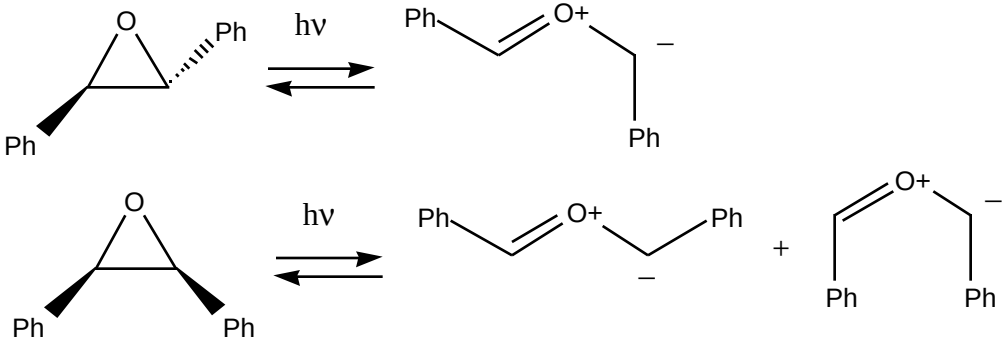
Padwa, A. *Trends Org. Chem.* **1993**, 4, 139

McMills, M.C.; Wright, D. *Chem. Heterocyclic Compounds* **2002**, 59, 253

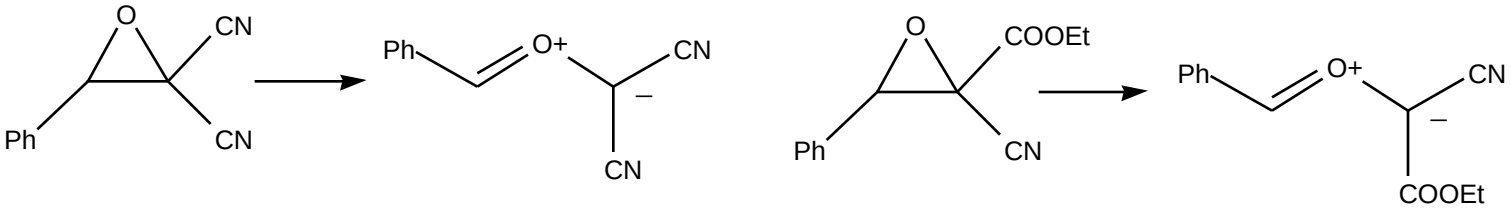
Tomioka, H. in *Nitrogen, Oxygen and Sulfur Ylide Chemistry*, (J.S. Clark, ed.) Oxford University Press: Oxford, 2002, p. 213 - 218



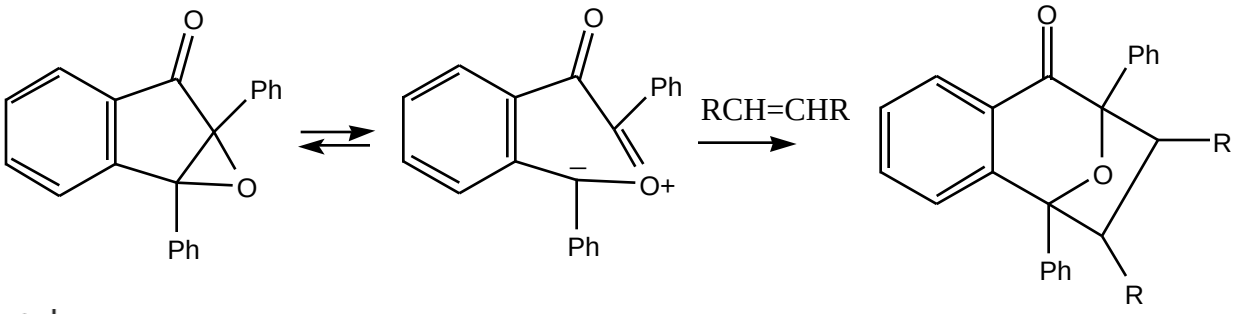
Arnold, D.R.; Karnischky, L.A. *J. Am. Chem. Soc.* **1970**, 92, 1404



Thap, D.M.; Trozzolo, A.M.; Griffin, G.W. *J. Am. Chem. Soc.* **1970**, 92, 1402

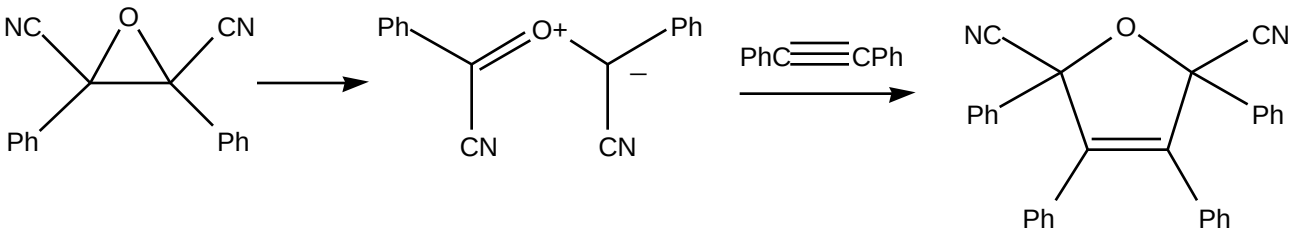


Robert, A.; Pommeret, J.J.; Foucaud, A. *Compt. Rend.* **1970**, 270, 1739
Pommeret, J.J.; Robert, A. *Compt. Rend.* **1971**, 272, 333
Pommeret, J.J.; Robert, A. *Tetrahedron* **1971**, 27, 2977
Robert, A.; Pommeret, J.J.; Foucaud, A. *Tetrahedron* **1972**, 28, 2085

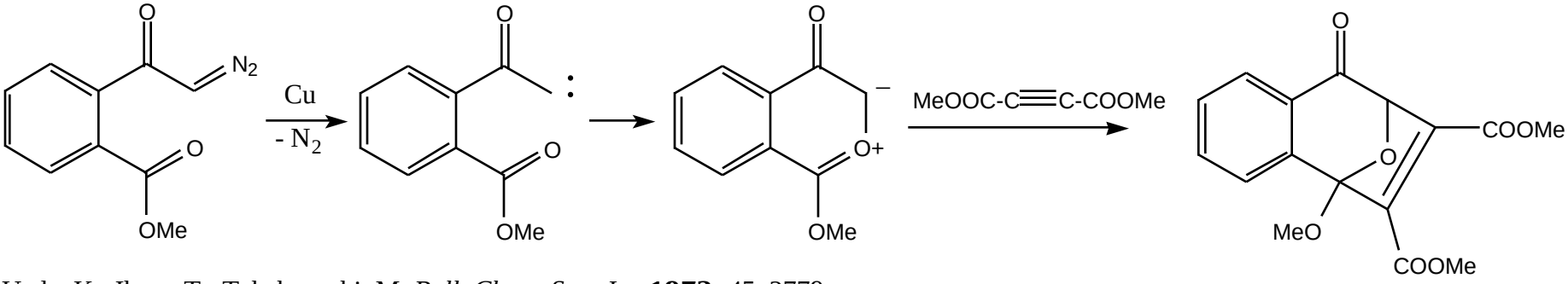


Lown, J.W.; Matsumoto, K. *Can. J. Chem.* **1971**, 49, 3443

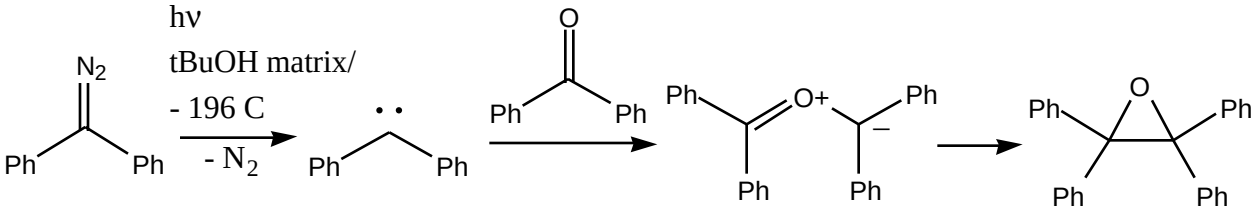
Vukov, V.; Crawford, R.J. *Can. J. Chem.* **1975**, 53, 1367 (secondary deuterium kinetic isotope effects)



Hamsberger, H.; Huisgen, R. *Chem. Commun.* **1971**, 1190



Ueda, K.; Ibata, T.; Takebayashi, M. *Bull. Chem. Soc. Jpn* **1972**, 45, 2779

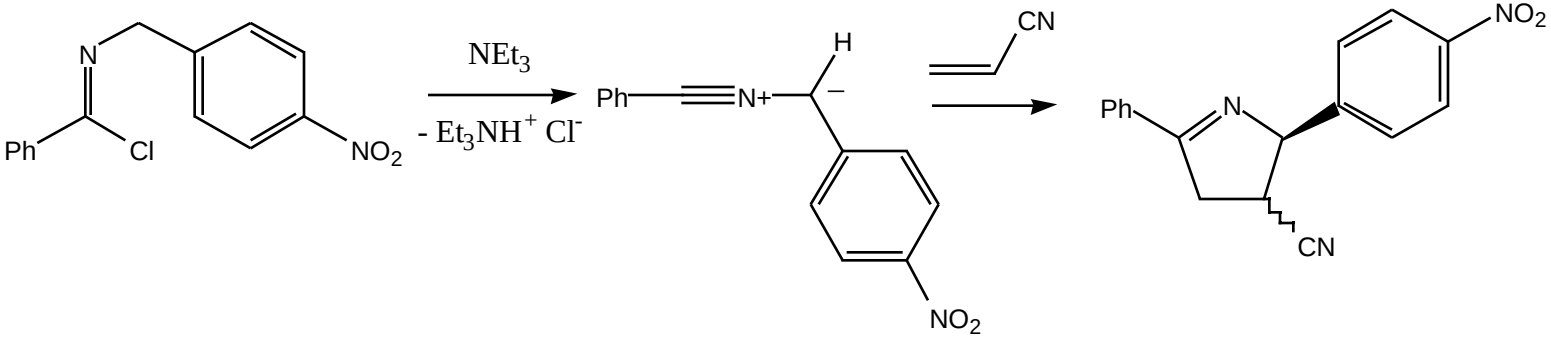


Tomioka, H.; Miwa, T.; Suzuki, S.; Izawa, Y. *Bull. Chem. Soc. Jpn* **1980**, 53, 753

(iv) Nitrile ylide

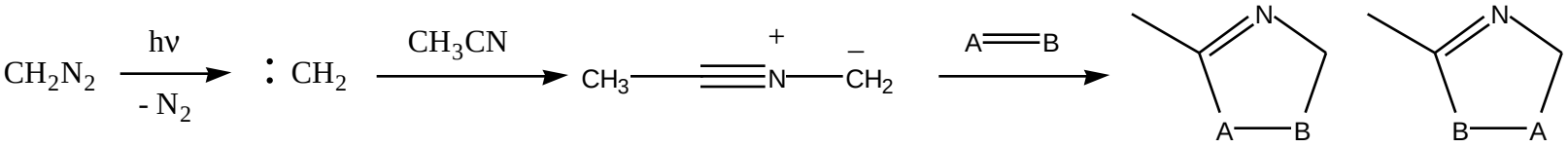
Reviews:

Huisgen, R.; Grashey, R.; Sauer, J. in *The Chemistry of Alkenes*, (S. Patai, ed.) Wiley-Interscience: New York, 1964, p. 806
Padwa, A.; Carlsen, P.H.J. *Reactive Intermediates* **1982**, 2, 55
Hansen, H.J.; Hiemgartner, H. in *1,3-Dipolar Cycloaddition Chemistry*, (A. Padwa, ed.) Wiley: New York, 1984, p. 177
Wentrup, C.; Reisinger, A.; Qiao, G.G.; Visser, P. *Pure Appl. Chem.* **1997**, 69, 847

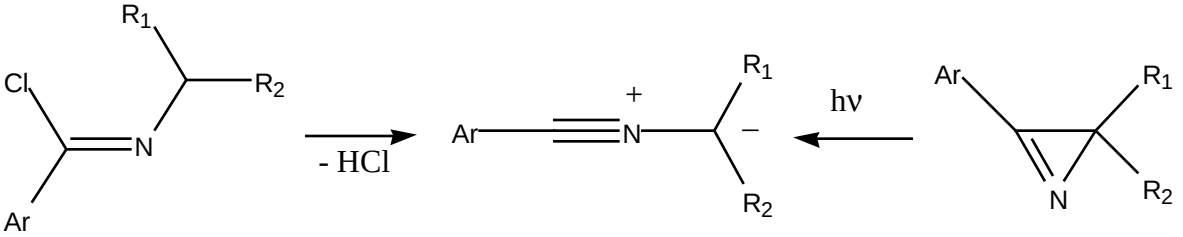


Huisgen, R.; Stangl, H.; Sturm, H.J.; Wagenhofer, H. *Angew. Chem.* **1962**, 74, 31
Huisgen, R.; Stangl, H.; Sturm, H.J.; Wagenhofer, H. *Angew. Chem. Int. Ed.* **1962**, 1, 50
Huisgen, R. *Angew. Chem. Int. Ed.* **1963**, 2, 565; 633
Huisgen, R.; Raab, R. *Tetrahedron Lett.* **1966**, 649
Huisgen, R. *Helv. Chim. Acta* **1967**, 50, 2421
Huisgen, R. *J. Org. Chem.* **1968**, 33, 2291
Huisgen, R. *J. Org. Chem.* **1976**, 41, 403

Turro, N.J.; Cha, Y.; Gould, I.R.; Padwa, A.; Gasdaska, J.R.; Thomas, M. *J. Org. Chem.* **1985**, 50, 4415



Padwa, A.; Gasdaska, J.R.; Thomas, M.; Turro, N.J.; Cha, Y.; Gould, I.R. *J. Am. Chem. Soc.* **1986**, 108, 6739
Turro, N.J.; Cha, Y.; Gould, I.R. *J. Am. Chem. Soc.* **1987**, 109, 2101

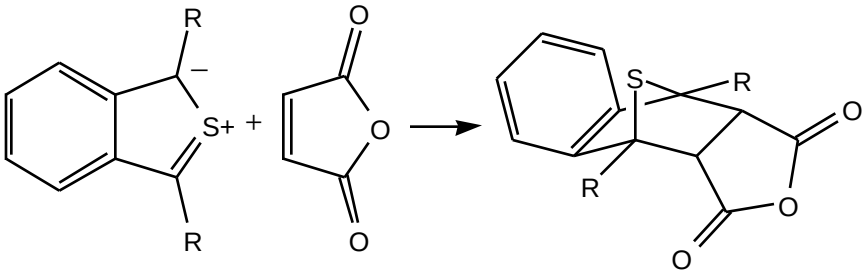


Ar = p-NO_2-C_6H_4; R1 = {H, CF_3}; R2 = {H, CF_3}

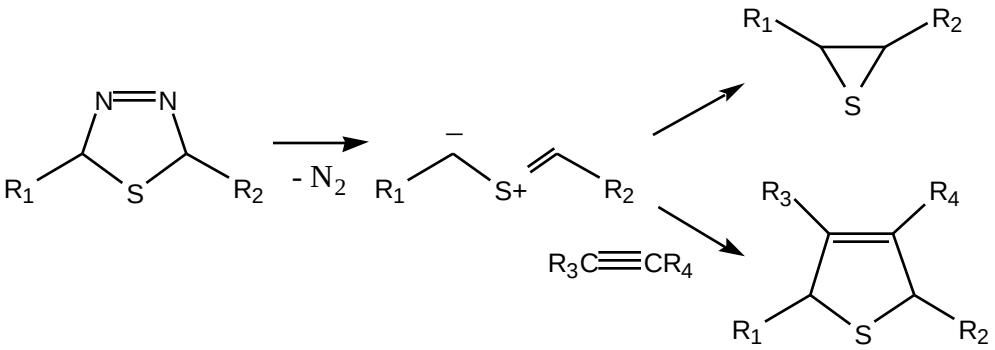
Hegarty, A.F.; Eustace, S.J.; Tynan, N.M.; Pham-Tran, N.N.; Nguyen, M.T. *J. Chem. Soc. Perkin Trans. 2* **2001**, 1239
Fergus, S.; Eustace, S.J.; Hegarty, A.F. *J. Org. Chem.* **2004**, 69, 4663

(v) Thiocarbonyl ylide

Reviews:
Mloston, G.; Heingartner, H. *Pol. J. Chem.* **2000**, 74, 1503 (thiocarbonyl ylides)
Mloston, G.; Heingartner, H. *Chem. Heterocyclic Compounds* **2002**, 59, 315 (thiocarbonyl ylides)

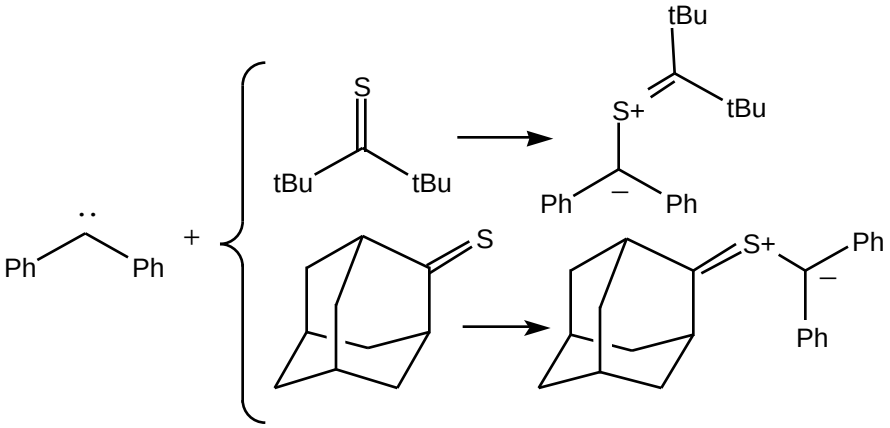


Wittig, G.; Knaus, E.; Niethammer, K. *Ann. Chem.* **1960**, 630, 10
Mayer, R.; Kleinert, H.; Richter, S.; Gewald, K. *Angew. Chem.* **1962**, 74, 118
Pedersen, C.T. *Acta Chem. Scand.* **1966**, 20, 2314



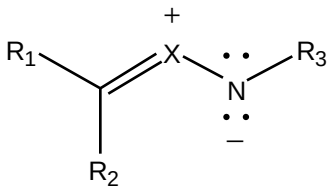
Kellogg, R.M.; Wassenaar, S. *Tetrahedron Lett.* **1970**, 1987
Buter, J.; Wassenaar, S.; Kellogg, R.M. *J. Org. Chem.* **1972**, 37, 4045

Ueno, Y.; Okawara, M. *Bull. Chem. Soc. Jpn* **1972**, 45, 1797
Kellogg, R.M. *J. Org. Chem.* **1973**, 38, 844
Buter, J.; Raynolds, P.W.; Kellogg, R.M. *Tetrahedron Lett.* **1974**, 2901

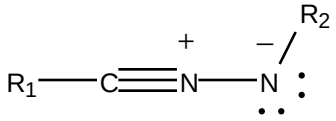


McGimpsey, W.G.; Scaiano, J.C. *Tetrahedron Lett.* **1986**, 27, 547

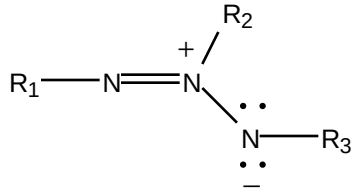
nitrene traps



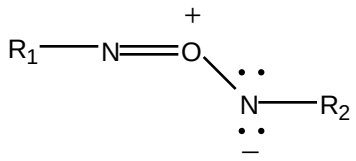
carbonyl imines (X = O)
thiocarbonyl imines (X = S)
azomethine imines (X = N-R)



nitrilimines



azonium imines



nitrosoimines

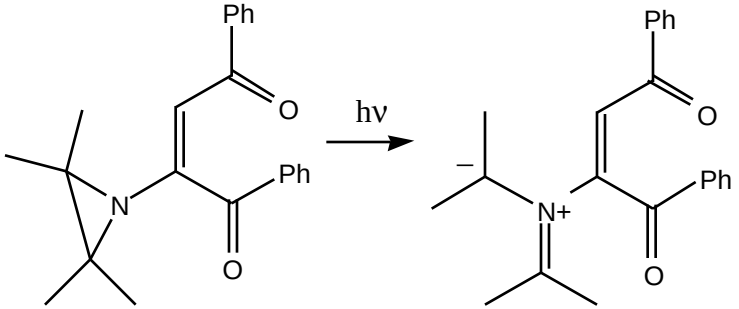
(i) Azomethines

Reviews:

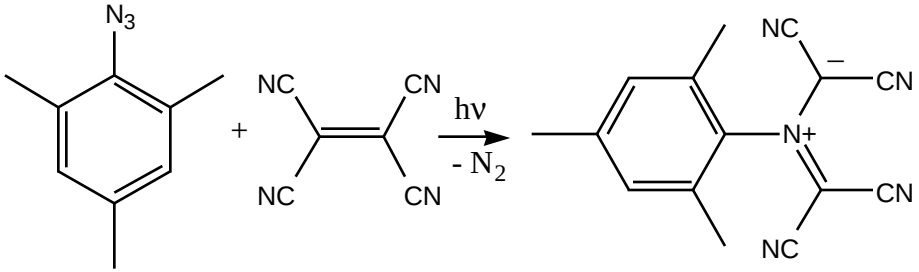
Boyer, J.H. *Mechanisms of Molecular Migrations* **1969**, 2, 267

Bach, F.L. Jr.; Karliner, J.; van Lear, G.E. *Chem. Commun.* **1969**, 1110

Boyer, J.H.; Frints, P.J.A. *J. Heterocyclic Chem.* **1970**, 7, 59; 71



Barik, R.; Kumar, C.V.; Das, P.K.; George, M.V. *J. Org. Chem.* **1985**, 50, 4309



Murata, S.; Abe, S.; Tomioka, H. *J. Org. Chem.* **1997**, 62, 3055

(ii) Azonium imines
Reviews:
None.

(iii) Carbonyl imines
Reviews:
Kayam, R.; Shizuka, H.; Sekiguchi, S.; Matsui, K. *Bull. Chem. Soc. Jpn* **1975**, 48, 3309
Tomioka, H. *Bull. Chem. Soc. Jpn* **1998**, 71, 1501

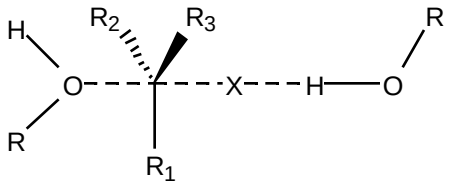
(iv) Nitrilimines

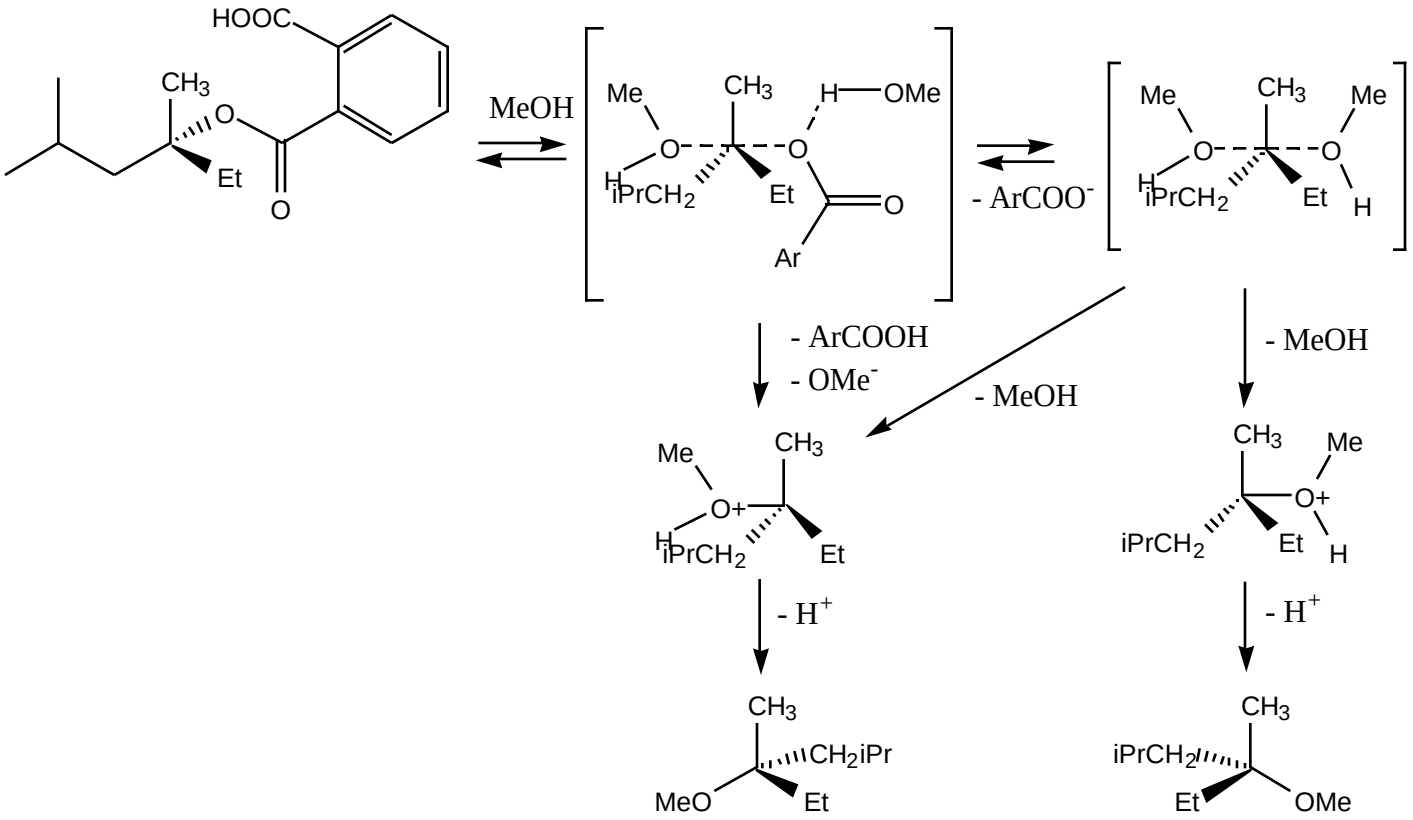
Reviews:
Granier, M.; Baceiredo, A.; Gruetzmacher, H.; Pritzkow, H.; Bertand, G. *Angew. Chem. Int. Ed.* **1990**, 102, 671

(v) Nitrosoimines
Reviews:
Akiba, K.; Inamoto, N. *Heterocycles* **1977**, 7, 1131
Challis, B.C.; Challis, J.A. in *The Chemistry of Amino, Nitroso, Nitro Compounds and Their Derivatives* (S. Patai, ed.) Wiley: Chichester, 1982, Vol. 2, p. 1151

(vi) Thiocarbonyl imines
Reviews:
None.

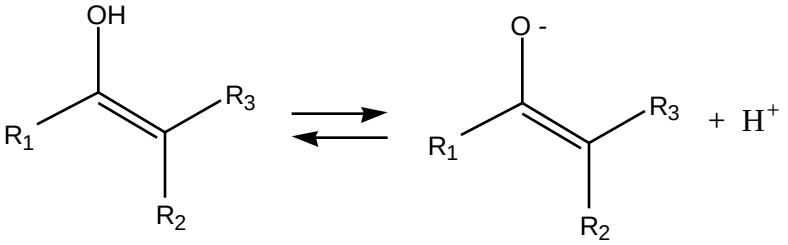
Doering-Zeiss intermediate





Doering, W.v.E.; Zeiss, H.H. *J. Am. Chem. Soc.* **1953**, 75, 4733

Enols and Enolates

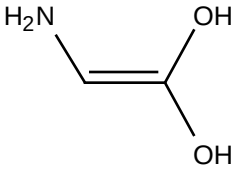


Reviews:
Toullec, J. *Adv. Phys. Org. Chem.* **1982**, 18, 1
Rappoport, Z.; Biali, S.E. *Acc. Chem. Res.* **1988**, 21, 442 (sterically crowded simple enols)
Rappoport, Z. (ed.) *The Chemistry of Enols*, Wiley: Chichester, 1990
Kresge, A.J. *Acc. Chem. Res.* **1990**, 23, 43
Rochlin, E. *Pure Appl. Chem.* **1997**, 69, 1933
Wirz, J. *Pure Appl. Chem.* **1998**, 70, 2221

Erlenmeyer, E. *Chem. Ber.* **1875**, 8, 309 (first suggestion)
Erlenmeyer, E. *Chem. Ber.* **1881**, 14, 320
Wheeler, A.S.; Edwards, V.C. *Ann. Chem.* **1895**, 286, 27
Knorr, L. *Ann. Chem.* **1899**, 306, 363
Lapworth, A.; Hann, A.C.O. *J. Chem. Soc.* **1902**, 1508
Lapworth, A. *J. Chem. Soc.* **1904**, 30
Moore, T.S. *J. Chem. Soc.* **1907**, 91-92, 1373
Dimroth, O. *Chem. Ber.* **1907**, 40, 2404
Zelinsky, N.; Schlesinger, N. *Chem. Ber.* **1907**, 40, 2886
Wohl, A.; Claussner, P. *Chem. Ber.* **1907**, 40, 2308
Wohl, A. *Chem. Ber.* **1907**, 40, 2282
Stoermer, R.; Martinsen, O. *Ann. Chem.* **1907**, 352, 322
Petrenko-Kritshenko, P. *J. Russ. Phys. Chem. Soc.* **1907**, 39, 179
Hantzsch, A. *Chem. Ber.* **1907**, 40, 15; 23; 42

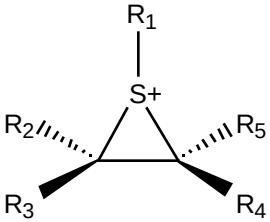
Stobbe, H. *Ann. Chem.* **1907**, 352, 132
Henle, F. *Ann. Chem.* **1907**, 352, 45
Piutti, A. *Gazz. Chim. Ital.* **1907**, 36, 364
Bulow, C.; Busse, F. *Chem. Ber.* **1906**, 39, 3861
Kohler, E.P. *Am. Chem. J.* **1907**, 36, 529
Meyer, K.H. *Ann. Chem.* **1911**, 380, 212;220
Meyer, K.H.; Kappelmeier, P. *Chem. Ber.* **1911**, 44, 2718
Meyer, K.H. *Chem. Ber.* **1912**, 45, 2843;2864
Meyer, K.H. *Chem. Ber.* **1914**, 47, 826
Dieckmann, W. *Chem. Ber.* **1922**, 55B, 2470
Conant, J.B.; Thompson, A.F. Jr. *J. Am. Chem. Soc.* **1932**, 54, 4039
Ingold, C.K.; Wilson, C.L. *J. Chem. Soc.* **1934**, 773

Pedersen, K.J. *J. Phys. Chem.* **1934**, 38, 581
Bartlett, P.D.; Stauffer, C.H. *J. Am. Chem. Soc.* **1935**, 57, 2580
Hsu, S.K.; Wilson, C.L. *J. Chem. Soc.* **1936**, 623
Reitz, O. *Z. Phys. Chem. A* **1937**, 179, 119
Hsu, S.K.; Ingold, C.K.; Wilson, C.L. *J. Chem. Soc.* **1938**, 78



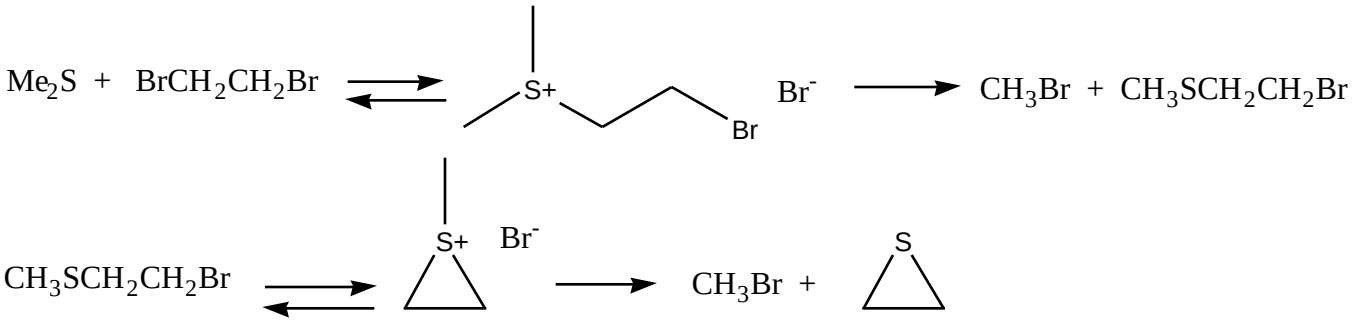
Polce, M.J.; Wesdemiotis, C. *J. Mass. Spectrom.* **2000**, 35, 251

Episulfonium ions (thiiranium ions)

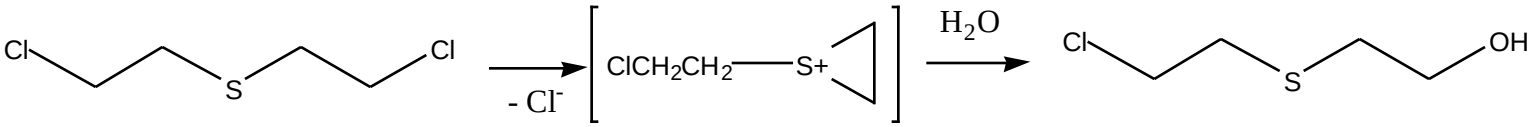


Reviews:

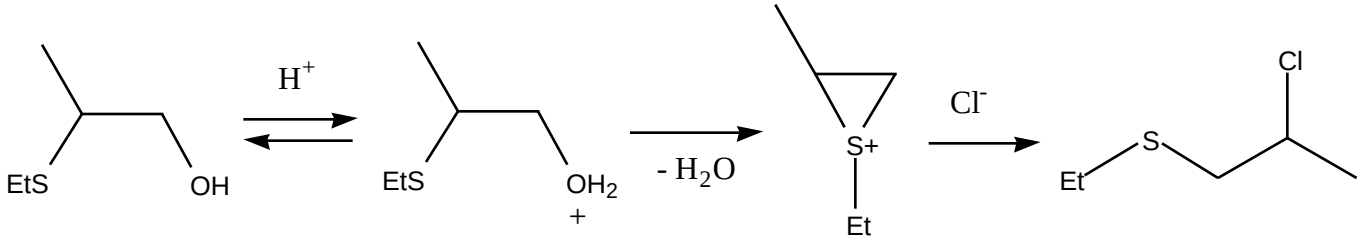
Schmid, G.H.; Garratt, D. in *The Chemistry of Double Bonded Functional Groups*, (S. Patai, ed.) Wiley: New York, 1977, Chapter 9
Smit, W.A.; Zefirov, N.S.; Bodrikov, I.V.; Krimer, M.Z. *Acc. Chem. Res.* **1979**, 12, 282
Smit, V.A.; Zefirov, N.S.; Bodrikov, I.V. in *Organic Sulfur Chemistry, Invited Lecture Int. Symp.*, (R.K. Friedlina; A.E. Skorova, eds.) Pergamon: Oxford, 1981, p. 159
Harring, S.R.; Edstrom, E.D.; Livinghouse, T. *Adv. Heterocyclic Natural Product Synthesis* **1992**, 2, 299
Pasquato, L.; Destro, R.; Lucchini, V.; Modena, G. *Phosphorus, Sulfur, Silicon and the related Elements* **1999**, 153-154, 235



Cahours, A. *Ann. Chem.* **1865**, 135, 354
Cahours, A. *Ann. Chem.* **1865**, 136, 151
Cahours, A. *Compt. Rend.* **1865**, 60, 620; 1174
Ray, F.E.; Levine, I. *J. Org. Chem.* **1937**, 2, 267



Peters, R.A.; Walker, E. *Biochem. J.* **1923**, 17, 260
Ogston, A.G.; Holiday, E.R.; St. L. Philpot, J.; Stocken, L.A. *Trans. Faraday Soc.* **1948**, 44, 45
Bartlett, P.D; Swain, G. *J. Am. Chem. Soc.* **1949**, 71, 1406

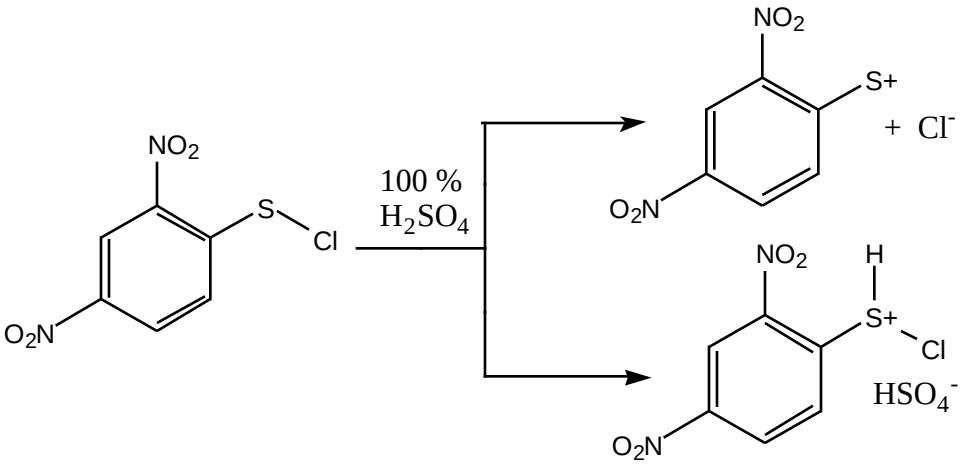


Fuson, R.C.; Speziale, A. *J. Am. Chem. Soc.* **1940**, 71, 1582
Fuson, R.C.; Price, C.C.; Burness, D.M. *J. Org. Chem.* **1946**, 11, 475

Sulfenium ions

R——S+

Reviews:
Parker, A.; Kharasch, N. *Chem. Rev.* **1959**, 59, 583
Kharasch, N. in *Organic Sulfur Compounds*, (N. Kharasch, ed.) Pergamon Press: London, 1961, p. 375 - 396
Okuyama, T. in *Chemistry of Sulfenic Acids and their Derivatives*, (S. Patai, ed.) Wiley: Chichester, 1990, p. 743 - 763



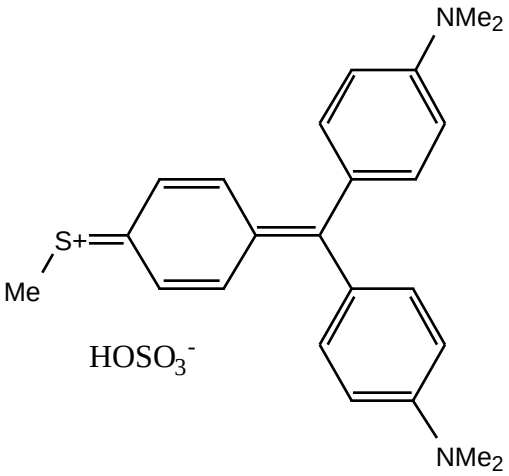
Kharasch, N.; Buess, C.M.; King, W. *J. Am. Chem. Soc.* **1953**, 75, 6035
Robinson, E.A.; Zaidi, S.A.A. *Can. J. Chem.* **1966**, 46, 3927

$$R\text{-}S\text{-}S\text{-}R + H^+ \longrightarrow R\text{-}S^+ + R\text{-}SH$$

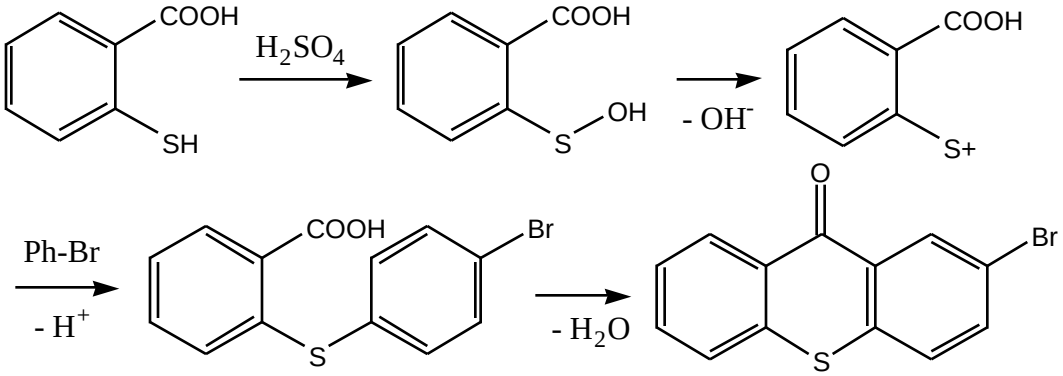
$$R\text{-}S^+ + R'\text{-}S\text{-}S\text{-}R' \longrightarrow R\text{-}S\text{-}S\text{-}R' + R'\text{-}S^+$$

$$R\text{-}S^+ + R'\text{-}SH \longrightarrow R\text{-}S\text{-}S\text{-}R' + H^+$$

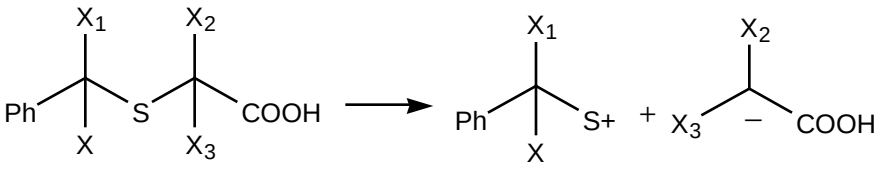
Benesch, R.E.; Benesch, R. *J. Am. Chem. Soc.* **1958**, 80, 1666



Neunhöffer, O.; Nowak, A. *Naturwiss.* **1958**, 45, 491

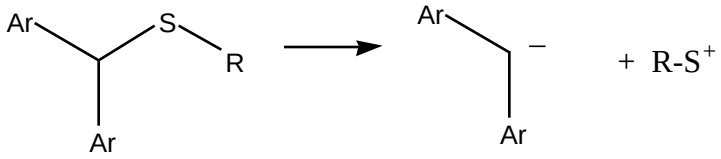


Gilman, H.; Diehl, J.W. *J. Org. Chem.* **1959**, 24, 1914



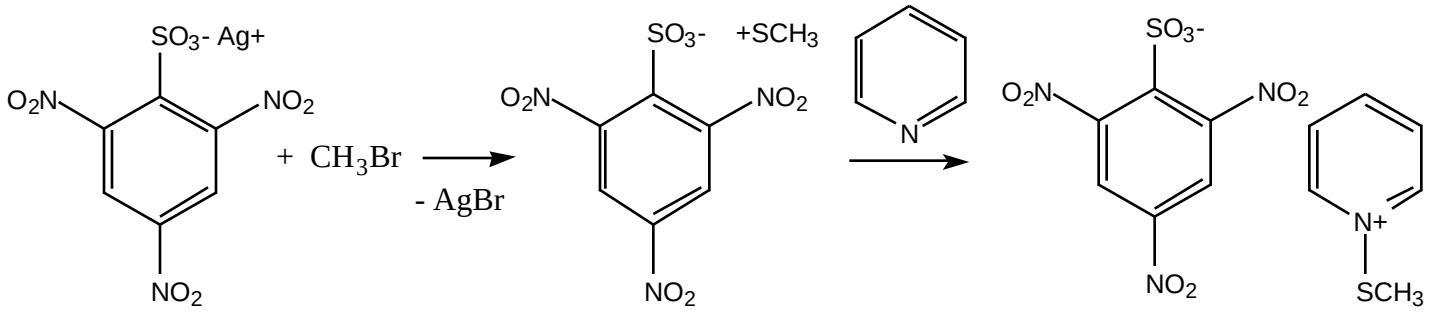
X_2, X_3 = H, Ph

Iskander, Y.; Tewfik, R. *J. Chem. Soc.* **1961**, 2393



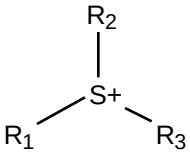
Ar = p-O_2N-C_6H_4

Iskander, Y.; Riad, Y. *J. Chem. Soc.* **1961**, 2397



Helmkamp, G.K.; Owsley, D.C. *Quart. Rep. Sulfur Chem.* **1967**, 2, 303
Helmkamp, G.K.; Owsley, D.C.; Barnes, W.M.; Cassey, H.N. *J. Am. Chem. Soc.* **1968**, 90, 1635

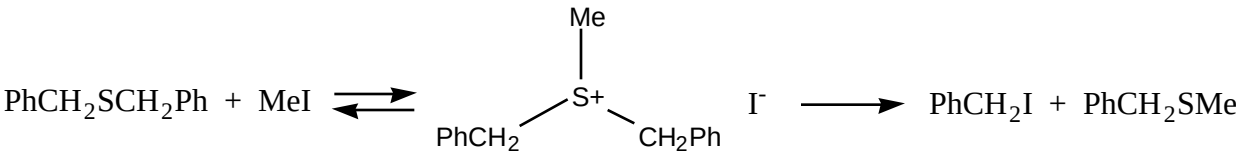
Sulfonium Ions

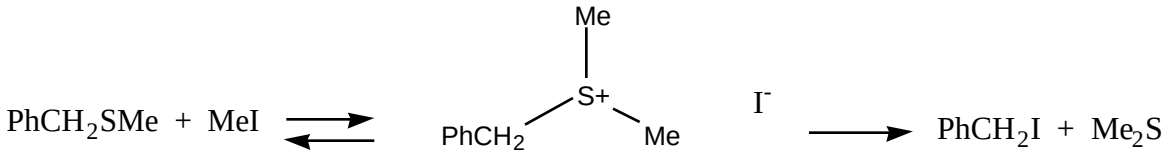


Reviews:
Stirling, C.J.M. in *Organic Chemistry of Sulfur*, (S. Oae, ed.) Plenum: New York, 1977, p. 473
Barrett, G.C. *Compr. Org. Chem.* **1979**, 3, 105
Stirling, C.J.M. (ed.) *Chemistry of the Sulphonium Group*, Vol. 1, 2, Wiley: Chichester, 1981
Wilson, G.E. Jr. *Tetrahedron* **1982**, 38, 2597
Capozzi, G.; Modena, G. *Studies in Org. Chem. (Amsterdam)* **1985**, 19, 246
Anklam, E.; Margaretha, P. *Res. Chem. Intermed.* **1989**, 11, 127
Ando, W.; Matsuyama, H. in *Nitrogen, Oxygen, and Sulfur Ylide Chemistry*, (J.S. Clark, ed.) Oxford University Press: Oxford, 2002, p. 175
Nenaidenko, V.G.; Balenkova, E.S. *Russ. J. Org. Chem.* **2003**, 39, 291

$Et_2S + Et\text{-}I \longrightarrow Et_3S^+ I^-$

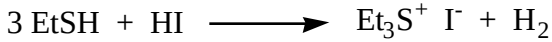
von Oefele, A. *Ann. Chem.* **1864**, 132, 82





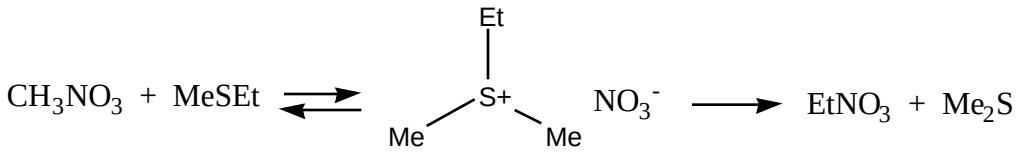
$Me_2S + MeI \longrightarrow Me_3S^+ I^-$

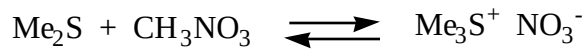
Schöller, C. *Chem. Ber.* **1874**, 7, 1274
Ray, F.E.; Levine, I. *J. Org. Chem.* **1937**, 2, 267

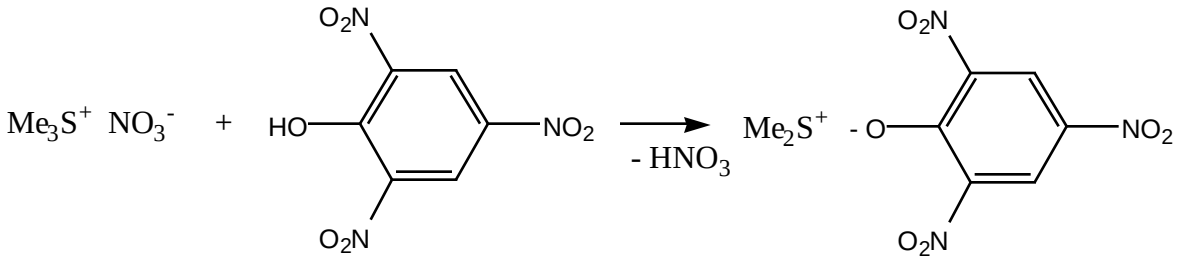


Cahours, A. *Compt. Rend.* **1875**, 80, 1317
Cahours, A. *Compt. Rend.* **1875**, 81, 1163
Ray, F.E.; Levine, I. *J. Org. Chem.* **1937**, 2, 267

Collier, H.B.; Allen, D.E. *Can. J. Res.* **1942**, 20B, 284







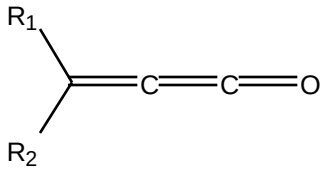
Ray, F.E.; Szasz, G.J. *J. Org. Chem.* **1943**, 8, 121

Hughes, E.D.; Ingold, C.K.; Maw, G.A. *J. Chem. Soc.* **1948**, 2072
Hughes, E.D.; Ingold, C.K.; Maw, G.A.; Woolf, L.I. *J. Chem. Soc.* **1948**, 2077

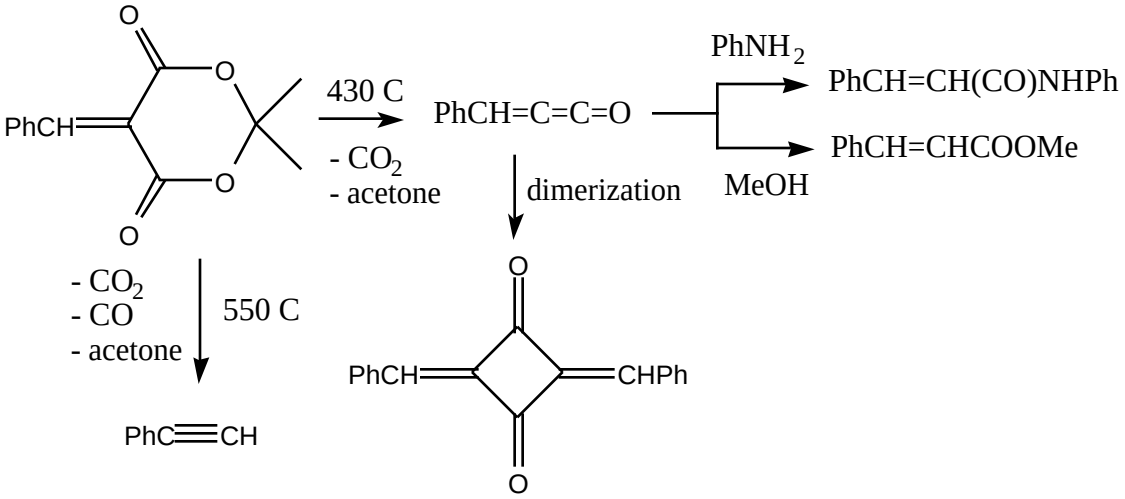
Extended Cumulenones

Reviews:
Runge, W. *Prog. Phys. Org. Chem.* **1981**, 13, 315

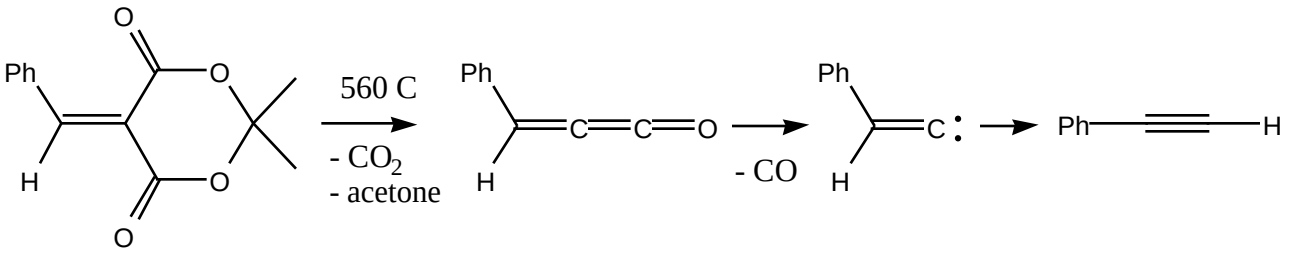
Propadienones (methyleneketenes)



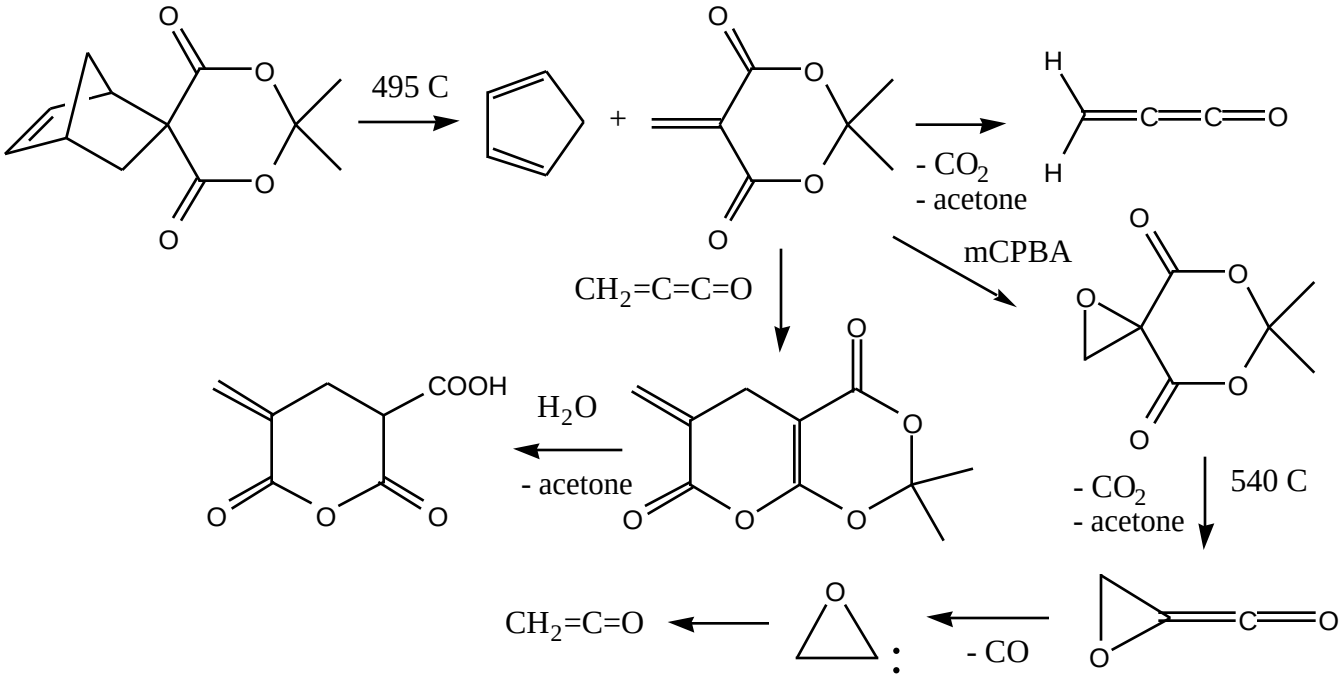
Reviews:
Brown, R.F.C.; Eastwood, F.W. in *The Chemistry of Ketenes, Allenes, and Related Compounds*, Part 2, (S. Patai, ed.) Wiley: New York, 1980, Chapter 19, p. 757
Brown, R.F.C.; Eastwood, F.W. *Synlett* **1993**, 9
Gaber, A. El-A.; McNab, H. *Synthesis* **2001**, 2059



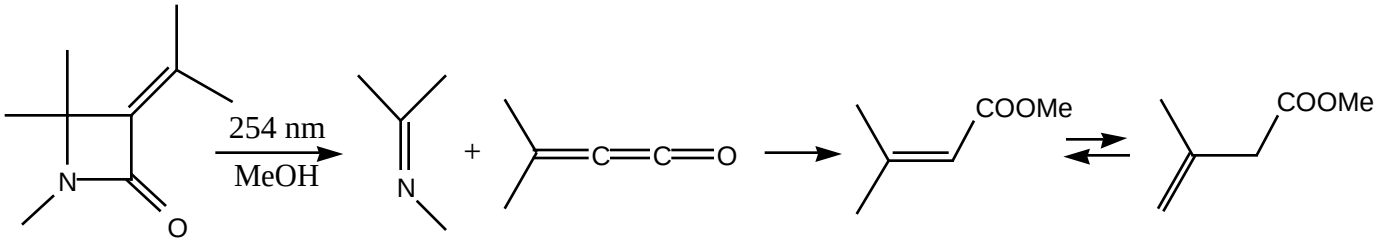
Brown, R.F.C.; Eastwood, F.W.; Harrington, K.J. *Austr. J. Chem.* **1974**, 27, 2373



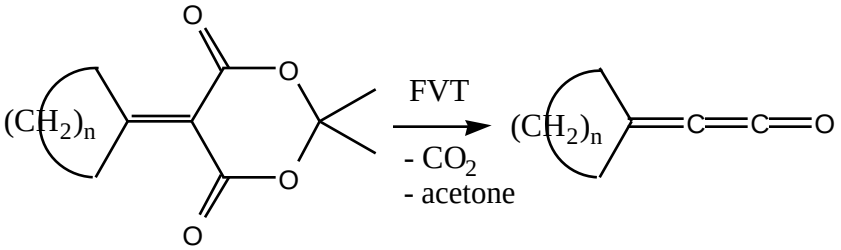
Brown, R.F.C.; Eastwood, F.W.; Harrington, K.J.; McMullen, G.L. *Austr. J. Chem.* **1974**, 27, 2393



Brown, R.F.C.; Eastwood, F.W.; McMullen, G.L. *J. Am. Chem. Soc.* **1976**, 98, 7421
Brown, R.F.C.; Eastwood, F.W.; McMullen, G.L. *Austr. J. Chem.* **1977**, 30, 179

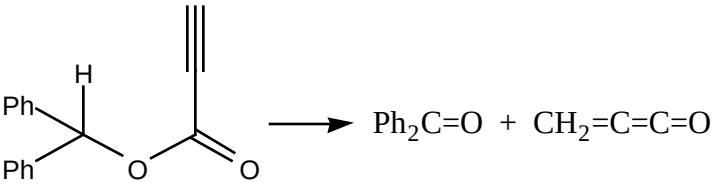


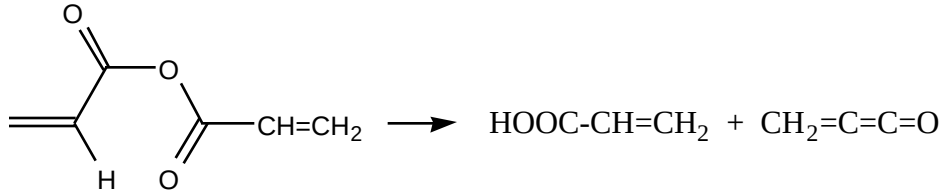
Mazzocchi, P.H.; Bowen, M.W.; Kachinsky, J. *Chem. Commun.* **1977**, 53



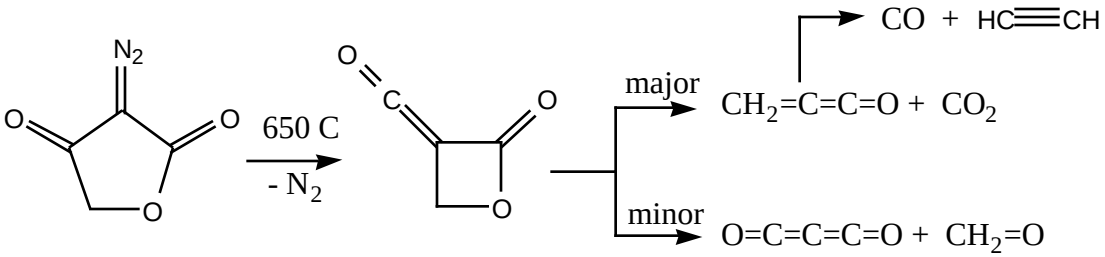
n = 2, 3, 4, 5, 6, 10

Baxter, G.J.; Brown, R.F.C. *Austr. J. Chem.* **1978**, 31, 327

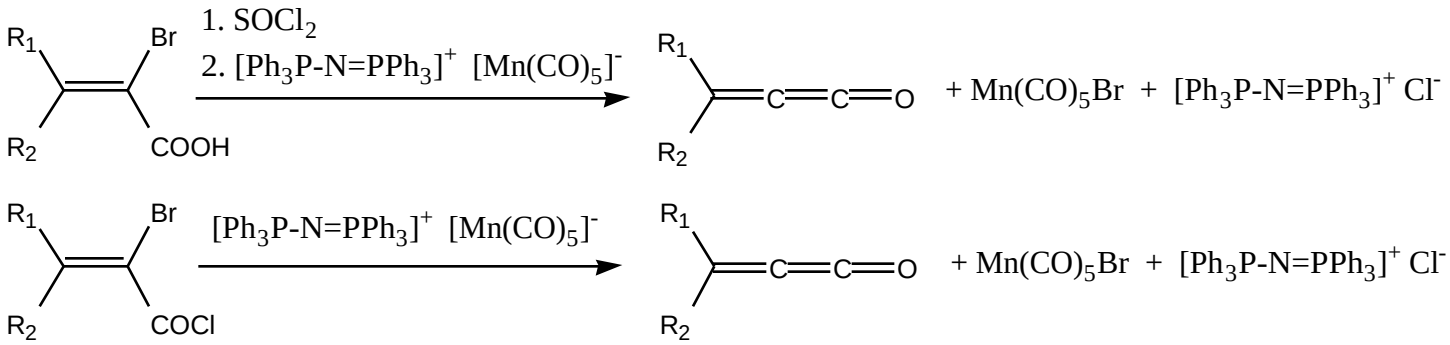




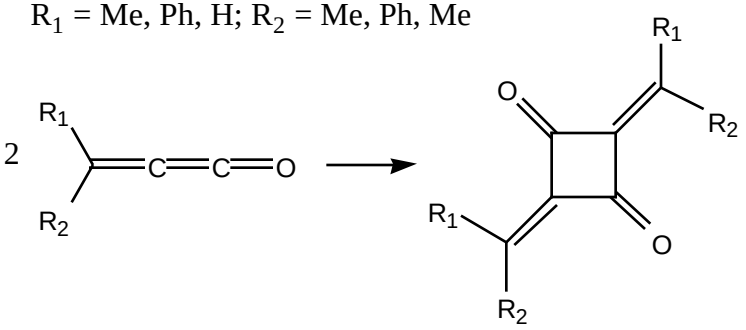
Blackman, G.L.; Brown, R.D.; Brown, R.F.C.; Eastwood, F.W.; McMullen, G.L.; Robertson, M.L. *Austr. J. Chem.* **1978**, 31, 209



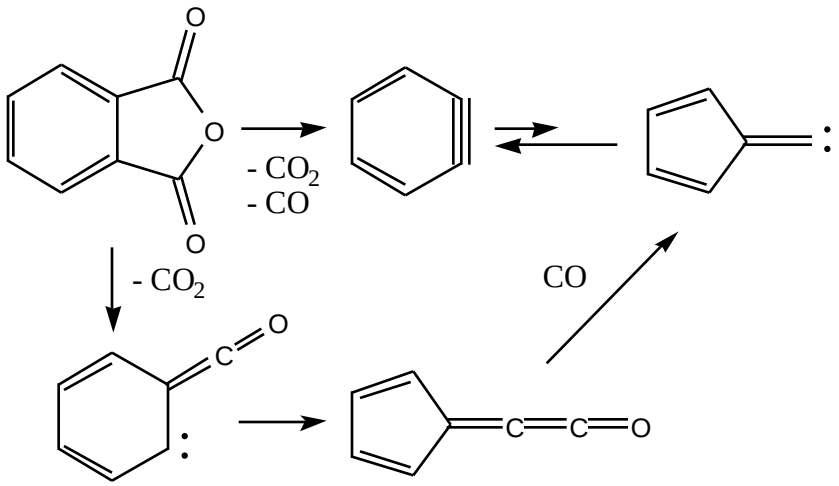
Chapman, O.L.; Miller, M.D.; Pitzenberger, S.M. *J. Am. Chem. Soc.* **1987**, 109, 6867



R_1 = Me, Ph, H; R_2 = Me, Ph, Me



Masters, A.P.; Sorensen, T.S.; Tran, P.M. *Can. J. Chem.* **1987**, 65, 1499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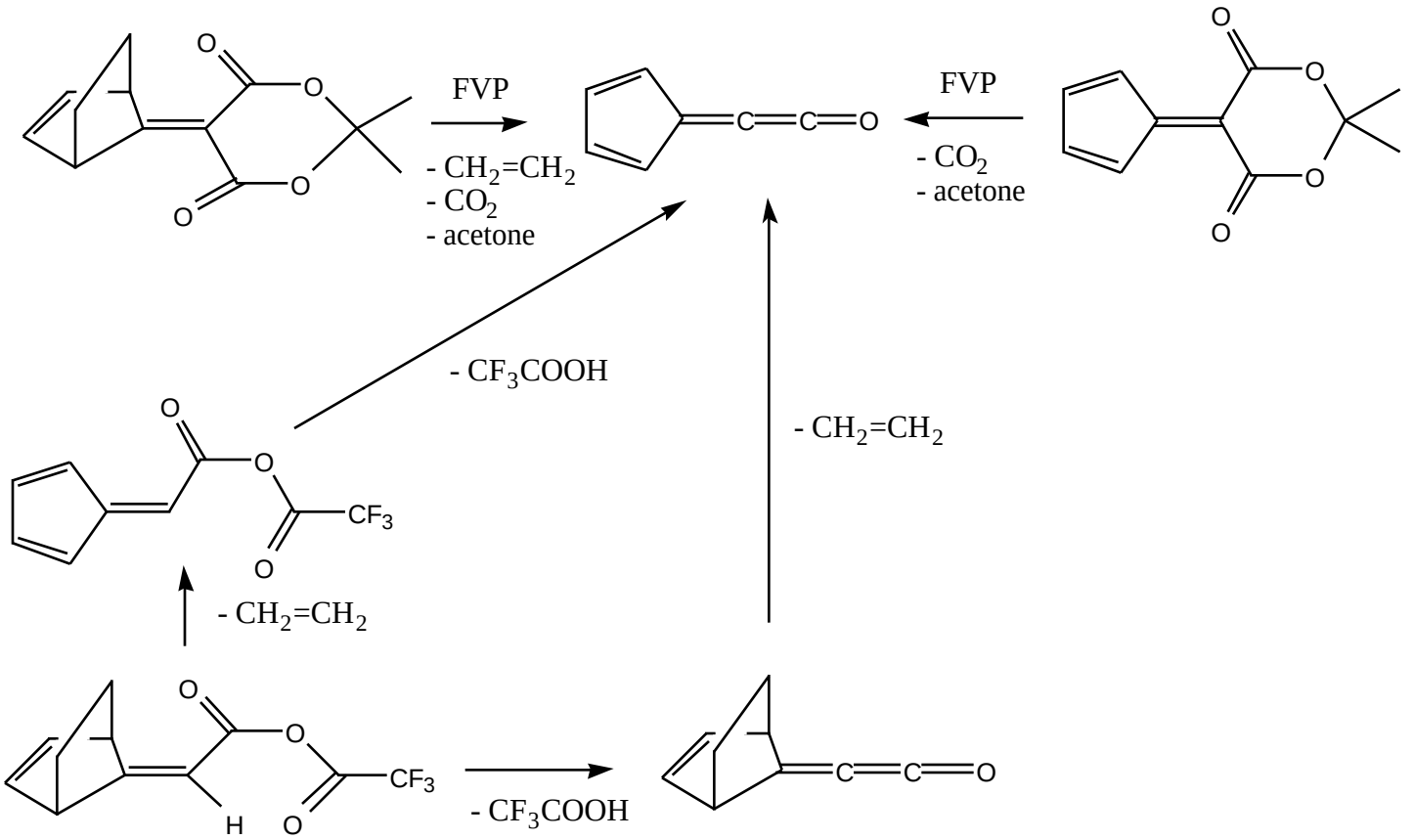
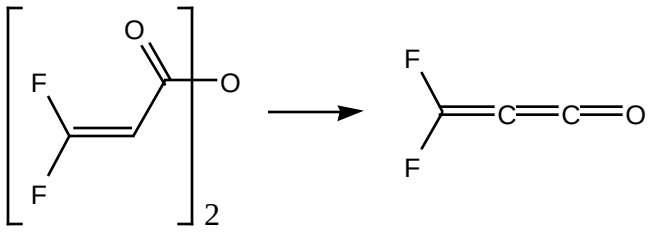
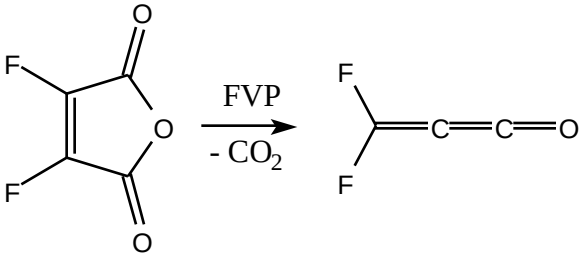


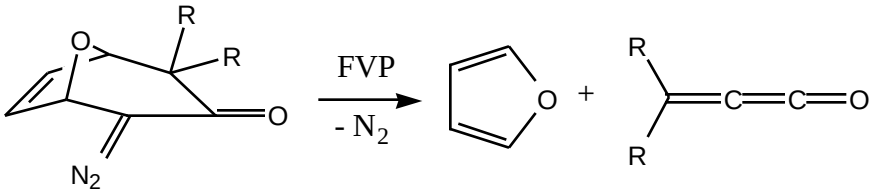
Brown, R.F.C.; Browne, N.R.; Coulston, K.J.; Eastwood, F.W.; Irvine, M.J.; Pullin, D.E.; Wiersum, U.E. *Austr. J. Chem.* **1989**, 42, 1321



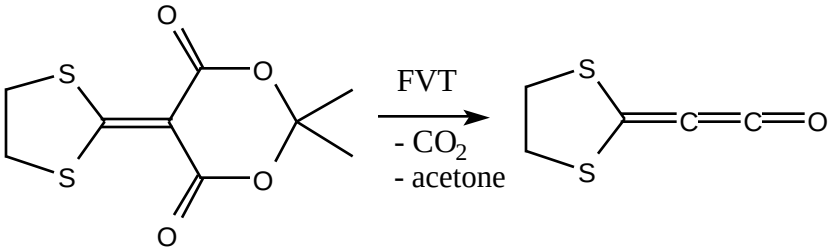
Brahms, J.C.; Dailey, W.P. *J. Am. Chem. Soc.* **1989**, 111, 3071



Brahms, J.C.; Dailey, W.P. *J. Am. Chem. Soc.* **1989**, 111, 8940

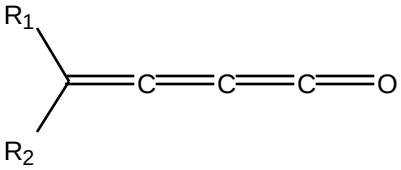


Brahms, J.C.; Dailey, W.P. *Tetrahedron Lett.* **1990**, 31, 1381

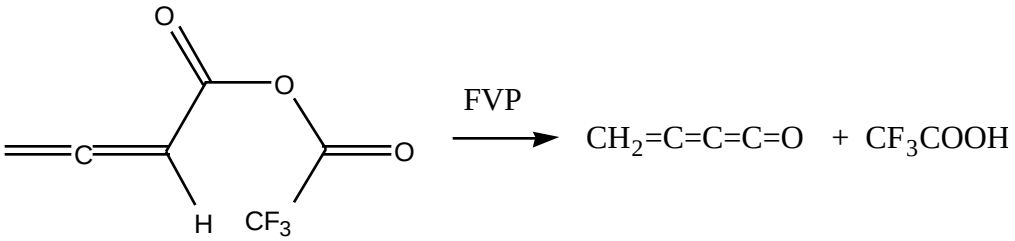


Chuburn, F.; Lacombe, S.; Pfister-Guillouzo, G.; Chiek, A.B.; Chuche, J.; Pommelet, J.C. *J. Am. Chem. Soc.* **1991**, 113, 1954

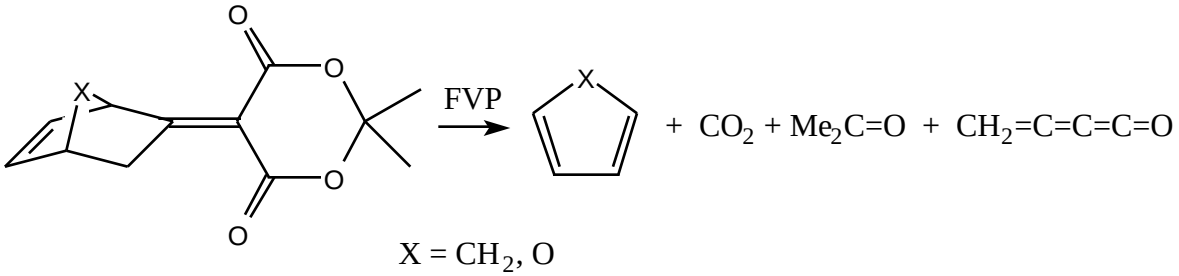
Butatrienones



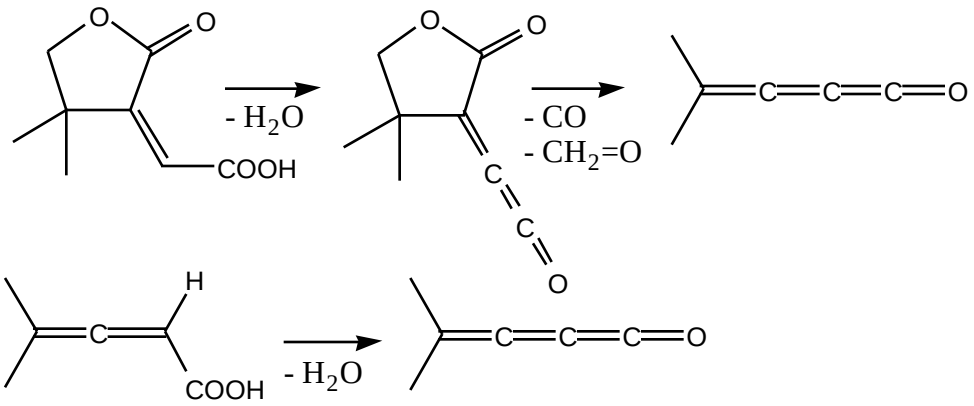
Reviews:
None.



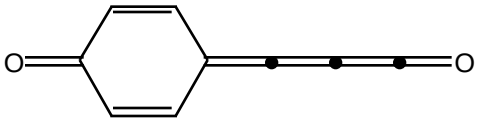
Brown, R.D.; Brown, R.F.C.; Eastwood, F.W.; Godfrey, P.D.; McNaughton, D. *J. Am. Chem. Soc.* **1979**, 101, 4705



Brown, R.F.C.; Coulston, K.J.; Eastwood, F.W.; Gatehouse, B.M.; Guddatt, L.W.; Pfenninger, M.; Rainbow, I. *Austr. J. Chem.* **1984**, 37, 2509



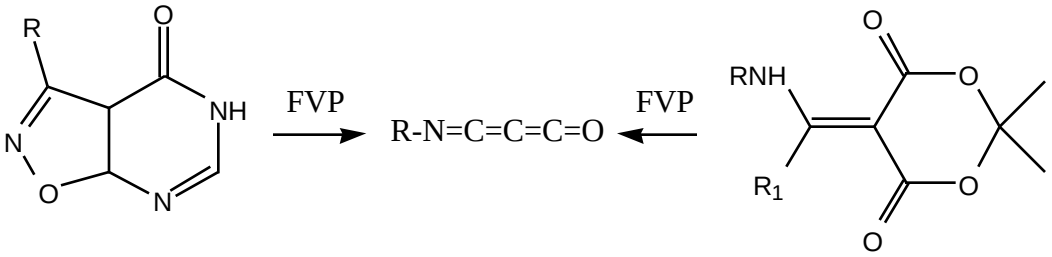
Brown, R.F.C.; Coulston, K.J.; Eastwood, F.W.; Irvine, M.J. *Austr. J. Chem.* **1991**, 44, 87



Cevasco, G.; Pardini, R.; Thea, S. *Eur. J. Org. Chem.* **1998**, 665

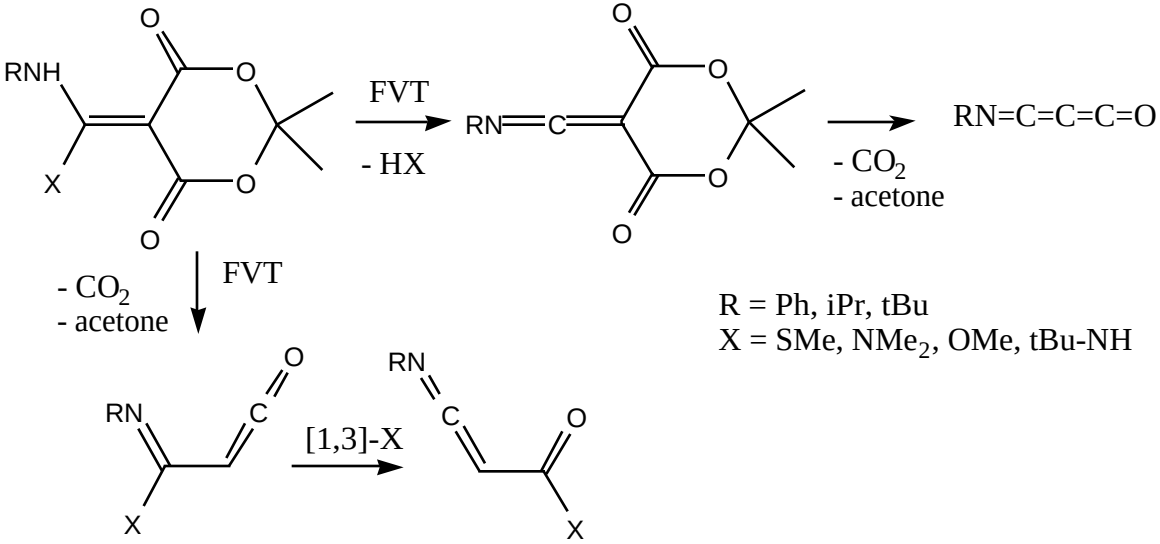
Heterocumulenones (iminopropadienones)

Reviews:
Wentrup, C.; Kappe, C.O.; Wong, M.W. *Pure Appl. Chem.* **1995**, 67, 749
Yranzo, G.I.; Elguero, J.; Flammang, R.; Wentrup, C. *Eur. J. Org. Chem.* **2001**, 2209



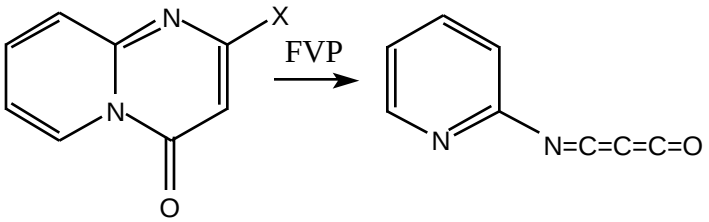
R = Me, Ph; R_1 = MeS, Me_2N

Mosandl, T.; Kappe, C.O.; Flammang, R.; Wentrup, C. *Chem. Commun.* **1992**, 1571
Mosandl, T.; Stadtmuller, S.; Wong, M.W.; Wentrup, C. *J. Phys. Chem.* **1994**, 98, 1080
Kappe, C.O.; Flammang, R.; Wentrup, C. *Heterocycles* **1994**, 37, 1615



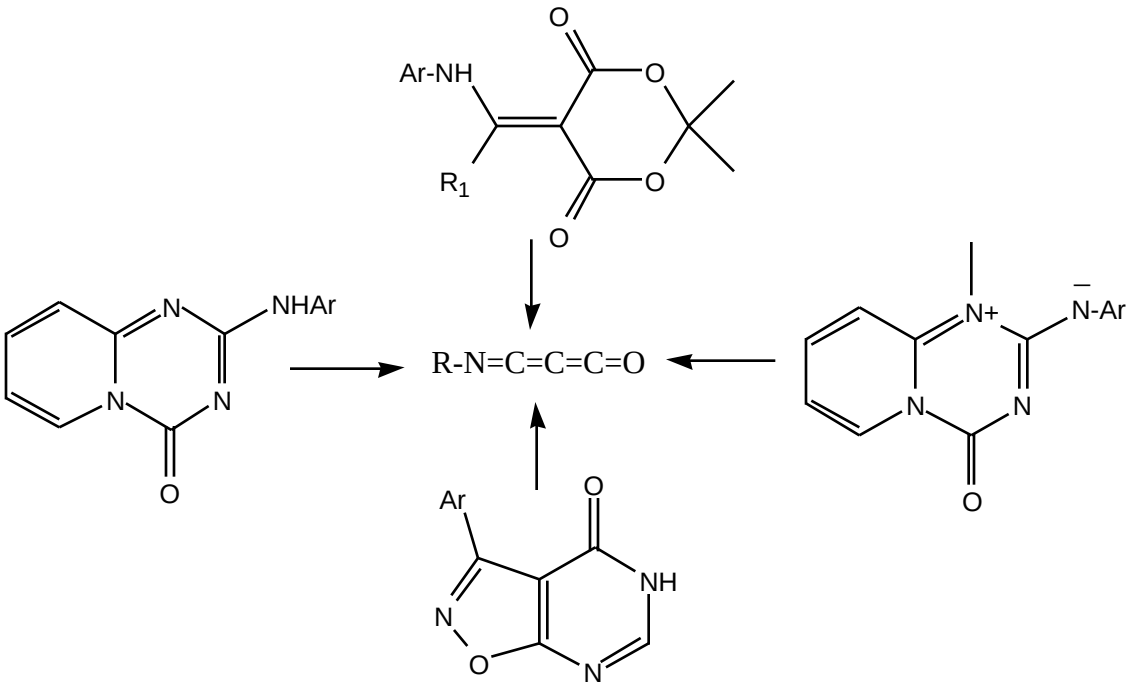
R = Ph, iPr, tBu
X = SMe, NMe_2, OMe, tBu-NH

Moloney, D.W.J.; Wong, M.W.; Flammang, R.; Wentrup, C. *J. Org. Chem.* **1997**, 62, 4240



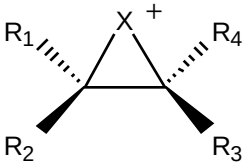
X = SMe, Cl, NMe_2, NEt_2, OMe

Plug, C.; Frank, W.; Wentrup, C. *J. Chem. Soc. Perkin Trans. 2* **1999**, 1087



Shtaiwi, M.; Wentrup, C. *J. Org. Chem.* **2002**, 67, 8558

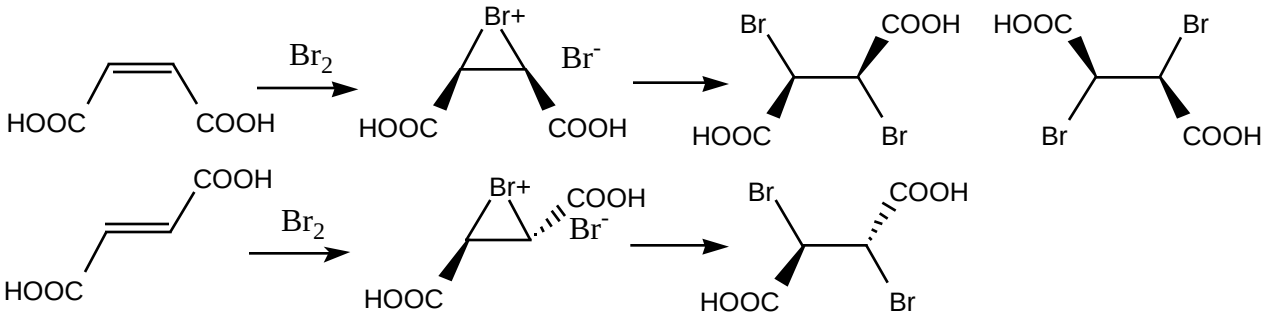
Halonium Ions



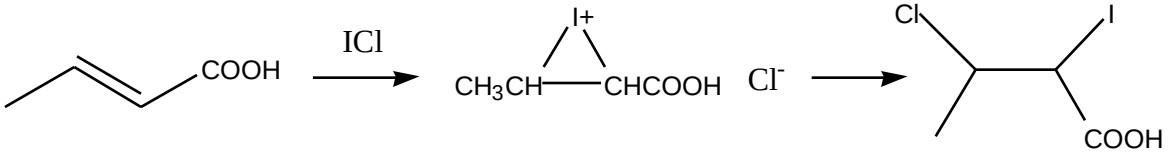
X = Cl, Br, I

Reviews:
Sandin, R.B. *Chem. Rev.* **1943**, 32, 249
Banks, D.F. *Chem. Rev.* **1966**, 66, 243
Crist, D.R.; Leonard, N.J. *Angew. Chem. Int. Ed.* **1969**, 8, 962
Peterson, P.E. *Acc. Chem. Res.* **1971**, 4, 407
Olah, G.A. *Aldrichimica Acta* **1973**, 6, 7

Olah, G.A. *Halonium Ions*, Wiley-Interscience: New York, 1975
Grushin, V.V. *Acc. Chem. Res.* **1992**, 25, 529
Ruasse, F. *Adv. Phys. Org. Chem.* **1993**, 28, 207
Koser, G.F. in *The Chemistry of Halides, Pseudo-Halides, Azides* (S. Patai, Z. Rappoport, eds.) Wiley: Chichester, 1983, Vol. 2, p. 1265
Koser, G.F. in *The Chemistry of Halides, Pseudo-Halides, Azides* (S. Patai, Z. Rappoport, eds.) Wiley: Chichester, 1995, Vol. 2, p. 1173

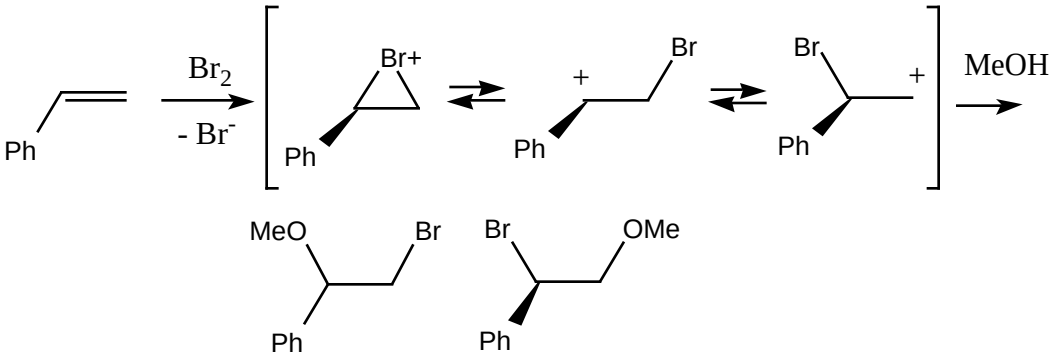


McKenzie, A. *Proc. Chem. Soc.* **1911**, 27, 150
McKenzie, A. *J. Chem. Soc.* **1912**, 101, 1196
Frankland, P.F. *J. Chem. Soc.* **1912**, 101, 673
Kuhn, R.; Wagner-Jauregg, T. *Chem. Ber.* **1928**, 61, 519

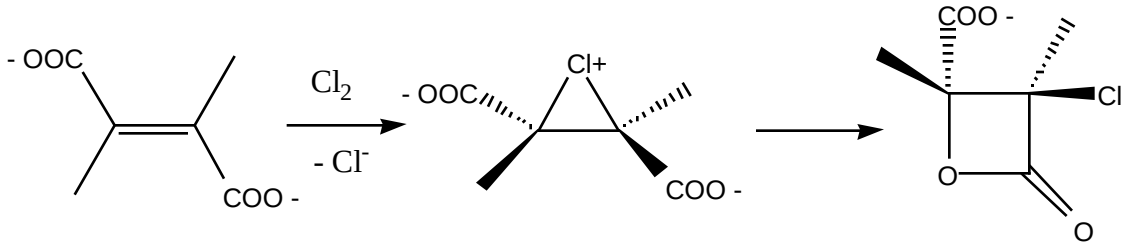


Ingold, C.K.; Smith, H.G. *J. Chem. Soc.* **1931**, 2742

Roberts, I.; Kimball, G.E. *J. Am. Chem. Soc.* **1937**, 59, 947

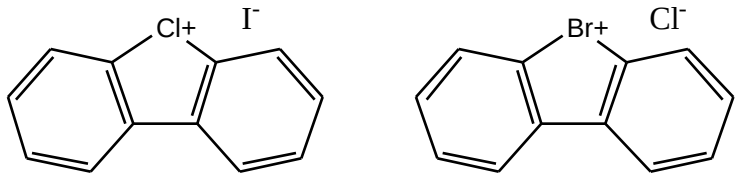


Bartlett, P.D.; Tarbell, D.S. *J. Am. Chem. Soc.* **1936**, 58, 466



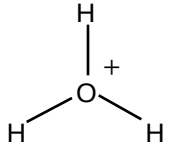
Tarbell, D.S.; Bartlett, P.D. *J. Am. Chem. Soc.* **1937**, 59, 407

Lucas, H.J.; Winstein, S. *J. Am. Chem. Soc.* **1939**, 61, 1576; 2845
Lucas, H.J.; Garner, H.K. *J. Am. Chem. Soc.* **1950**, 72, 2145
Lucas, H.J.; Gould, C.W. Jr. *J. Am. Chem. Soc.* **1941**, 63, 2541
Barton, D.H.R.; Miller, E.; Young, H.T. *J. Chem. Soc.* **1951**, 2698
Lemieux, R.U.; Fraser-Reid, B. *Can. J. Chem.* **1965**, 43, 1458
Olah, G.A.; Bollinger, J.M. *J. Am. Chem. Soc.* **1967**, 89, 4744



Sandin, R.B.; Hay, A.S. *J. Am. Chem. Soc.* **1952**, 74, 274 (first stable bromonium and chloronium salts)

Hydronium ions



Reviews:
Williams, J.H. in *Hydrogen Bond* (P. Schuster, G. Zundel, C. Sandorfy, eds.) North-Holland: Amsterdam, 1976, Vol. 2, p. 655
Lundgren, J.O.; Olovsson, I. in *Hydrogen Bond* (P. Schuster, G. Zundel, C. Sandorfy, eds.) North-Holland: Amsterdam, 1976, Vol. 2, p. 471

Giguere, P.A. *J. Chem. Educ.* **1979**, 56, 571

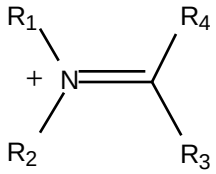
$H_2O + HBr \rightleftharpoons H_3O^+ Br^-$ (SO_2 solvent)

Bagster, L.S.; Cooling, G. *J. Chem. Soc.* **1920**, 117, 693

$H_3O^+ ClO_4^-$ $H_3O^+ NO_3^-$ $H_3O^+ HBF_3^-$

Volmer, M. *Ann. Chem.* **1924**, 440, 200
Klinkenberg, L.J.; Ketelaar, J.A.A. *Rec. Trav. Chim.* **1935**, 54, 959
Richards, R.E.; Smith, J.A.S. *Trans. Faraday Soc.* **1951**, 47, 1261
Kakiuchi, H.; Shono, H.; Komatsu, K.; Kigoshi, K. *J. Chem. Phys.* **1951**, 19, 1069
Bethell, D.E.; Sheppard, N. *J. Chem. Phys.* **1953**, 21, 1421

Iminium Ions

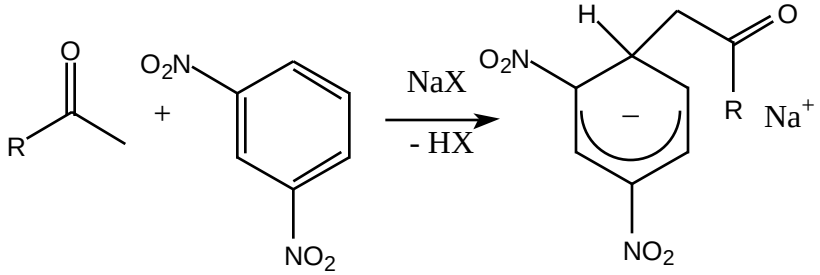


Reviews:
Paukstelis, J.V. in *Enamines: synthesis, structure, and reactivity* (G. Stork, ed.) Marcel Dekker: New York, 1969, p. 169
Pihlaja, K. in *The Chemistry of Amidines, Imidates* (S. Patai, Z. Rappoport, eds.) Wiley: Chichester, 1991, Vol. 2, p. 323

Stewart, T.D.; Bradley, W.E. *J. Am. Chem. Soc.* **1932**, 54, 4172
Julg, A.; Carles, P. *Compt. Rend.* **1960**, 251, 1782

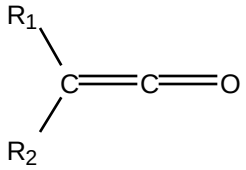
Janovsky complex

Reviews:
None.



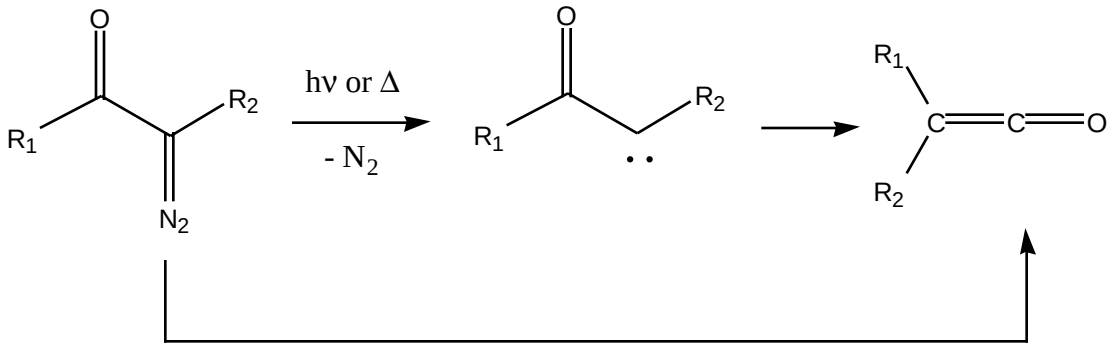
Janovsky, J.V. *Chem. Ber.* **1886**, 19, 2155

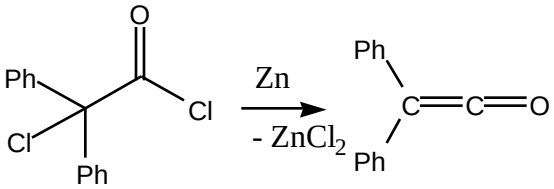
Ketenes



Reviews:
Staudinger, H. *Die Ketene*, Verlag Enke: Stuttgart, 1912
Patai, S. (ed.) *The Chemistry of Ketenes, Allenes, and Related Compounds*, Wiley: Chichester, 1980
Dötz, K.H.; Fuengen-Koester, B. *Chem. Ber.* **1980**, 113, 1449
Tidwell, T.T. *Ketenes*, Wiley: New York, 1995
Kollenz, G.; Heilmayer, W.; Kappe, C.O.; Wallfisch, B.; Wentrup, C. *Croatica Chem. Acta* **2001**, 74, 815

Kirmse, W. *Eur. J. Org. Chem.* **2002**, 2193
Singh, G.S.; Mdee, L.K. *Curr. Org. Chem.* **2003**, 7, 1821

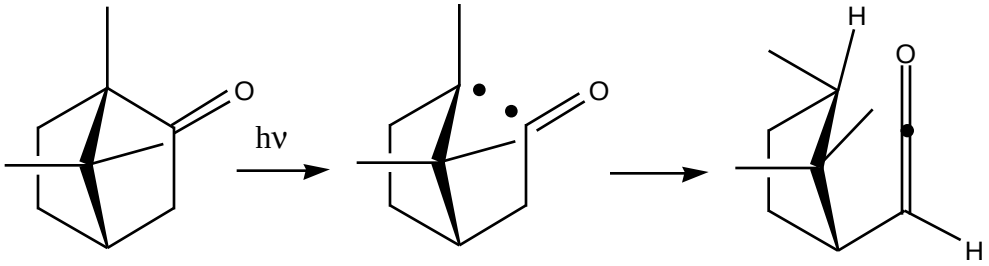


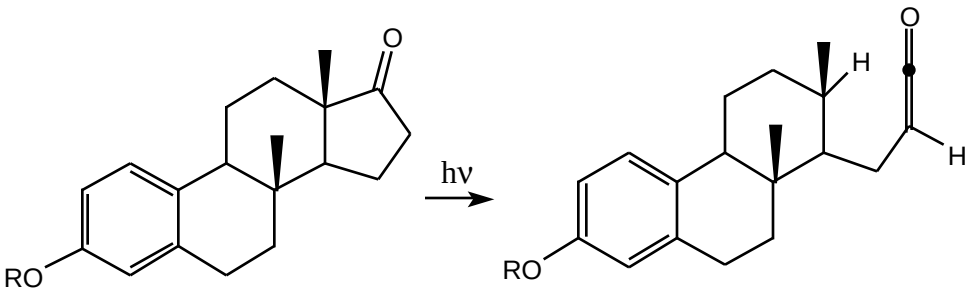


Staudinger, H. *Chem. Ber.* **1905**, 38, 1735
Staudinger, H. *Chem. Ber.* **1907**, 40, 1145
Staudinger, H. *Ann. Chem.* **1908**, 356, 51
Wilsmore, N.T.M. *Proc. Chem. Soc.* **1908**, 23, 229
Wilsmore, N.T.M. *J. Chem. Soc.* **1908**, 91-92, 1938
Collie, J.N. *Proc. Chem. Soc.* **1908**, 23, 280
Wilsmore, N.T.M.; Stewart, A.W. *Proc. Chem. Soc.* **1908**, 23, 309
Collie, J.N. *J. Chem. Soc.* **1908**, 91-92, 1806
Smith, L.I.; Hoehn, H.H. *Org. Synth. Coll. Vol.* **1955**, 3, 356
Taylor, E.C.; McKillop, A.; Hawks, G.H. *Org. Synth.* **1972**, 52, 36

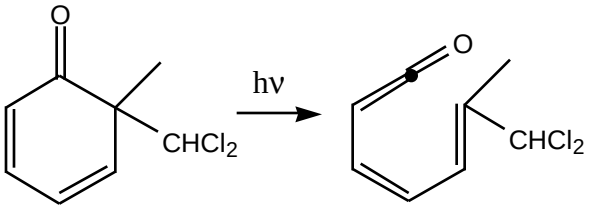
Staudinger, H.; Klever, H.W. *Chem. Ber.* **1908**, 41, 594
Staudinger, H.; Klever, H.W. *Chem. Ber.* **1908**, 41, 906
Wilsmore, N.T.M.; Stewart, A.W. *Chem. Ber.* **1908**, 41, 1025
Staudinger, H.; Klever, H.W. *Chem. Ber.* **1908**, 41, 1516
Staudinger, H. *Chem. Ber.* **1908**, 41, 1355

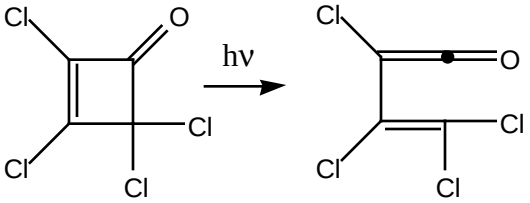
Staudinger, H. *Chem. Ber.* **1908**, 41, 1493
Staudinger, H.; Ott, E. *Chem. Ber.* **1908**, 41, 2208
Schroeter, G. *Chem. Ber.* **1909**, 42, 2336
Staudinger, H.; Kubinsky, J. *Chem. Ber.* **1909**, 42, 4213
Staudinger, H.; Bereza, S. *Chem. Ber.* **1909**, 42, 4908
Staudinger, H.; Klever, H.W.; Kober, P. *Ann. Chem.* **1910**, 374, 1
Leuchs, H.; Theodorescu, G. *Chem. Ber.* **1910**, 43, 1239
Schmidlin, J.; Bergman, M. *Chem. Ber.* **1910**, 43, 2821
Schmidlin, J.; Huber, M. *Chem. Ber.* **1910**, 43, 2824
Staudinger, H.; Jelagin, S. *Chem. Ber.* **1911**, 44, 365
Staudinger, H. *Chem. Ber.* **1911**, 44, 521; 533; 543
Staudinger, H.; Bereza, S. *Ann. Chem.* **1911**, 380, 243
Staudinger, H.; Ruzicka, L. *Ann. Chem.* **1911**, 380, 278
Staudinger, H. *Chem. Ber.* **1911**, 44, 1619
Staudinger, H.; Ott, E. *Chem. Ber.* **1911**, 44, 1631
Staudinger, H.; Kupfer, O. *Chem. Ber.* **1911**, 44, 1638; 2194
Staudinger, H.; Kon, N. *Ann. Chem.* **1912**, 384, 38
Staudinger, H. *Ann. Chem.* **1912**, 387, 254
Staudinger, H.; Kupfer, O. *Chem. Ber.* **1912**, 45, 501
Staudinger, H. *Z. Angew. Chem.* **1914**, 27, 354
Staudinger, H.; Gohring, O.; Scholler, M. *Chem. Ber.* **1914**, 47, 40
Staudinger, H.; Maier, J. *Ann. Chem.* **1914**, 401, 292
Staudinger, H.; Hirzel, H. *Chem. Ber.* **1916**, 49, 2522





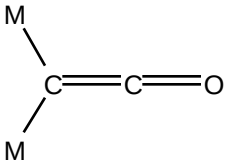
Quinkert, G.; Wegemund, B.; Blanke, E. *Tetrahedron Lett.* **1962**, 221





Chapman, O.L.; Lassila, J.D. *J. Am. Chem. Soc.* **1968**, 90, 2449

Metal Ketenides



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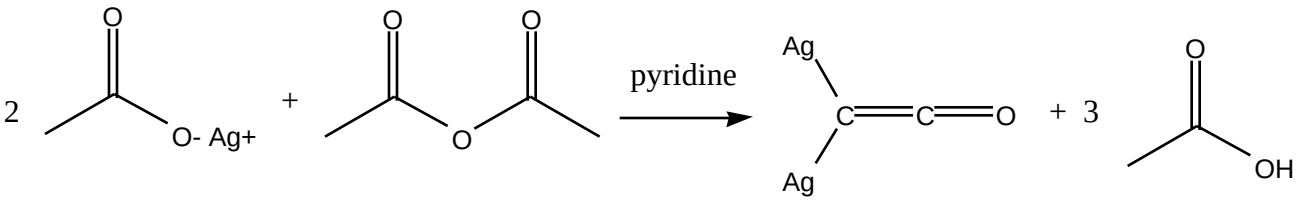
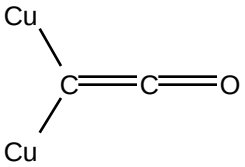
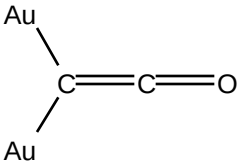


Blues, E.T.; Bryce-Smith, D.; Hirsch, H.; Simons, M.J. *J. Chem. Soc. D* **1970**, 699
Bryce-Smith, D.; Blues, E.T. DE 2,047,373 (1971)
Bryce-Smith, D. *Chem. Ind.* **1975**, 154

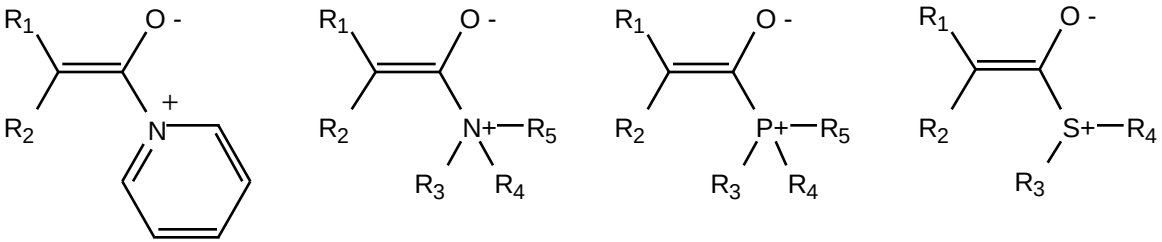


Blues, E.T.; Bryce-Smith, D.; Kettlewell, B.; Roy, M. *Chem. Commun.* **1973**, 921



Blues, E.T.; Bryce-Smith, D.; Lawston, I.W.; Wall, G.D. *Chem. Commun.* **1974**, 513

Ketene zwitterions



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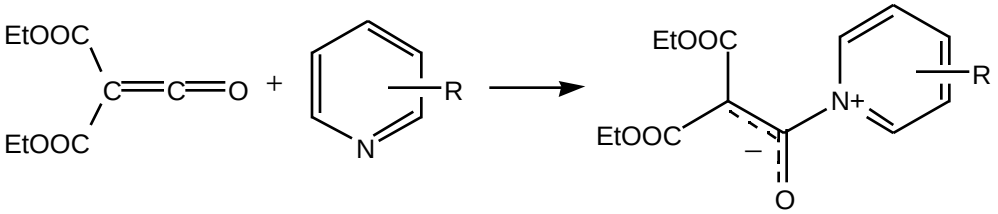
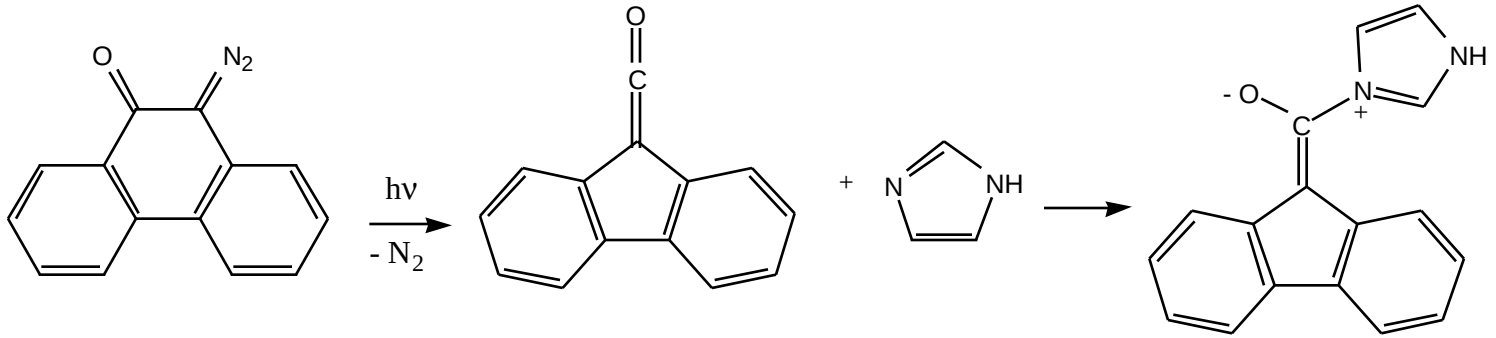
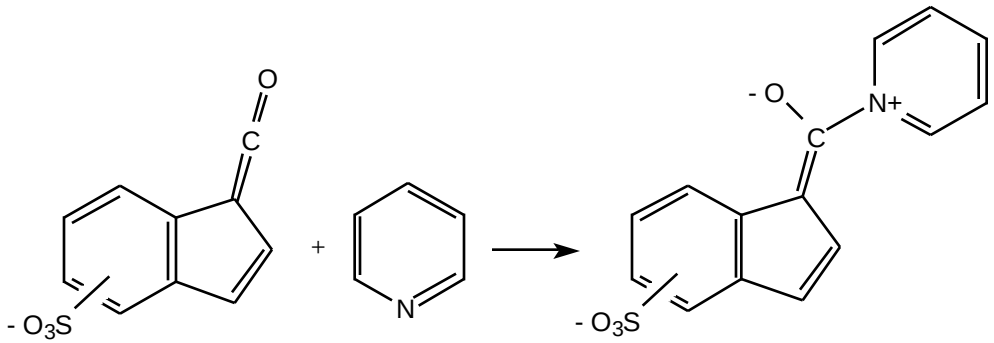


Gompper, R.; Wolf, U. *Ann. Chem.* **1979**, 1388

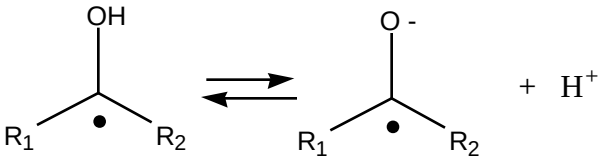


Pacansky, J.; Chang, J.S.; Brown, D.W.; Schwarz, W. *J. Org. Chem.* **1982**, 47, 2233

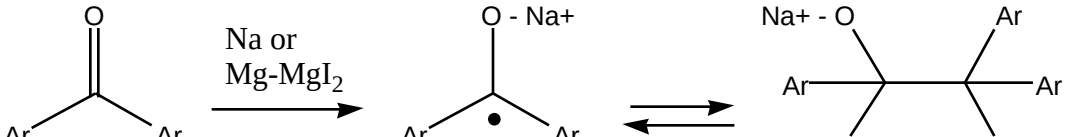


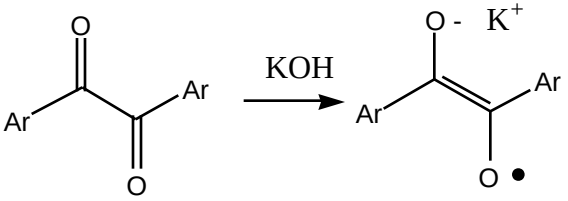
Barra, M.; Fisher, T.A.; Cenigliaro, G.J.; Sinta, R.; Scaiano, J.C. *J. Am. Chem. Soc.* **1992**, 114, 2630

Ketyl Radicals and Ketyl Radical Ions

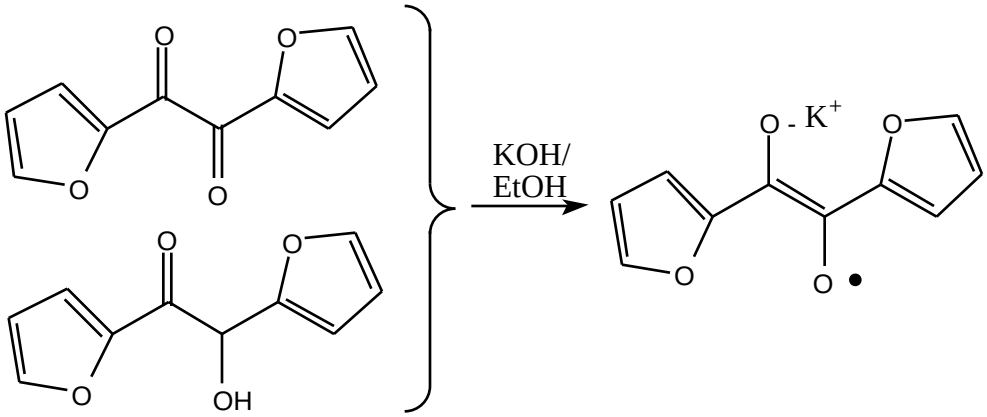


Reviews:
Michaelis, L. *Chem. Rev.* **1935**, 16, 243
Holy, N.L.; Marcum, J.D. *Angew. Chem. Int. Ed.* **1971**, 10, 115
Netto-Ferreira, J.C.; Scaiano, J.C. *Res. Chem. Intermediates* **1989**, 12, 187





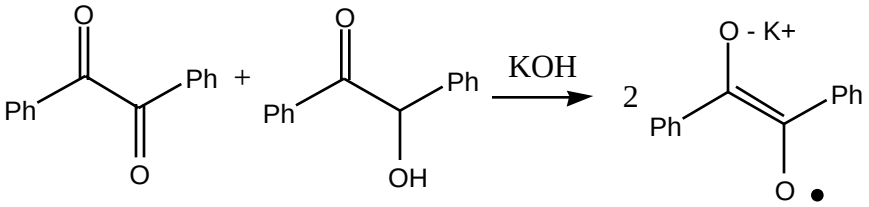
Laurent, A. *Ann. Chim. Phys.* **1835**, 59, 367
Laurent, A. *Ann. Chim. Phys.* **1836**, 17, 89; 91
Liebermann, C.; Homeyer, J. *Chem. Ber.* **1879**, 12, 1971
Bamberger, E. *Chem. Ber.* **1885**, 18, 865
Beckmann, E. *Chem. Ber.* **1889**, 22, 912
Beckmann, E.; Paul, T. *Ann. Chem.* **1891**, 266, 1
Schlenk, W.; Weichel, T. *Chem. Ber.* **1911**, 44, 1182
Schlenk, W.; Thal, A. *Chem. Ber.* **1913**, 46, 2840
Schlenk, W.; Appenrodt, J.; Michael, A.; Thal, A. *Chem. Ber.* **1914**, 47, 473



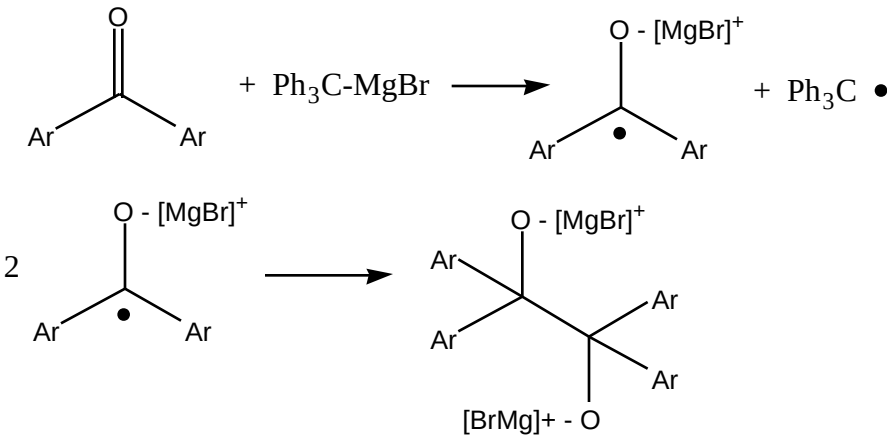
Fischer, E. *Ann. Chem.* **1882**, 211, 314

Weitz, E.; Schwechten, H.W. *Chem. Ber.* **1926**, 59, 2307
Weitz, E.; Schwechten, H.W. *Chem. Ber.* **1927**, 60, 545; 1203

Hantzsch, A. *Chem. Ber.* **1921**, 54B, 1267



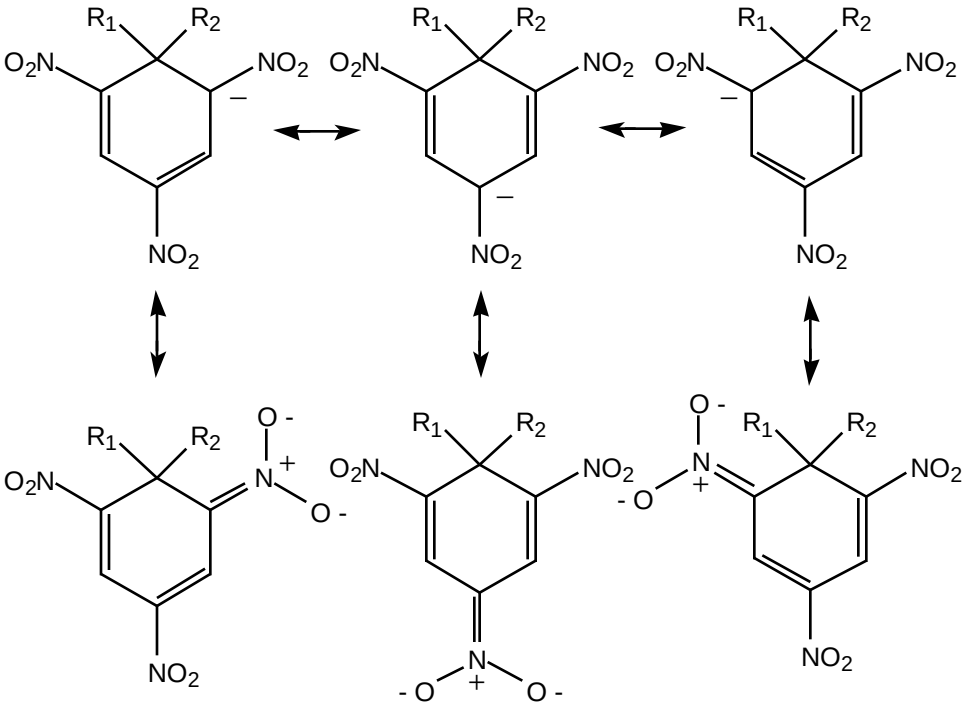
Scholl, R. *Chem. Ber.* **1899**, 32, 1809
Scholl, R.; Hahle, H. *Chem. Ber.* **1923**, 56B, 918



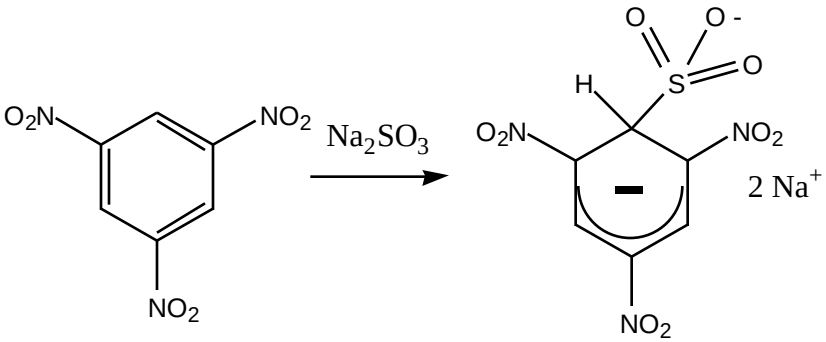
Gomberg, M.; Bachmann, W.E. *J. Am. Chem. Soc.* **1927**, 49, 236
Bachmann, W.E. *J. Am. Chem. Soc.* **1931**, 53, 2758
Bachmann, W.E. *J. Am. Chem. Soc.* **1933**, 55, 770
Bachmann, W.E. *J. Am. Chem. Soc.* **1933**, 55, 1179
Arbuzov, A.E.; Arbuzova, I.A. *J. Gen. Chem. USSR* **1932**, 2, 388
Nazarov, N. *Compt. Rend. Acad. Sci. URSS* **1934**, 1, 123
Nazarov, N. *Compt. Rend. Acad. Sci. URSS* **1934**, 1, 325

magnetic susceptibility measurements:
Sugden, S. *Trans. Faraday Soc.* **1934**, 30, 18
Wooster, C.R.; Dean, J.G. *J. Chem. Soc.* **1935**, 57, 112
Müller, E.; Teschner, F. *Ann. Chem.* **1936**, 525, 1
Anschutz, L. *Chem. Ber.* **1938**, 71B, 1902
Müller, E.; Wiesemann, W. *Chem. Ber.* **1936**, 69, 2156
Müller, E. *Ann. Chem.* **1938**, 537, 86
Müller, E. *Angew. Chem.* **1938**, 51, 657
Müller, E.; Janke, W. *Z. Elektrochem.* **1939**, 45, 380
Bowden, S.T.; John, T. *J. Chem. Soc.* **1940**, 213

Meisenheimer-Jackson Complexes



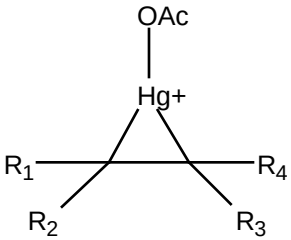
Reviews:
Huisgen, R.; Sauer, J. *Angew. Chem.* **1960**, 72, 91
Huisgen, R.; Sauer, J. *Angew. Chem.* **1960**, 72, 294
Ross, S.D. *Prog. Phys. Org. Chem.* **1963**, 1, 31
Crampton, M.R. *Adv. Phys. Org. Chem.* **1969**, 7, 211



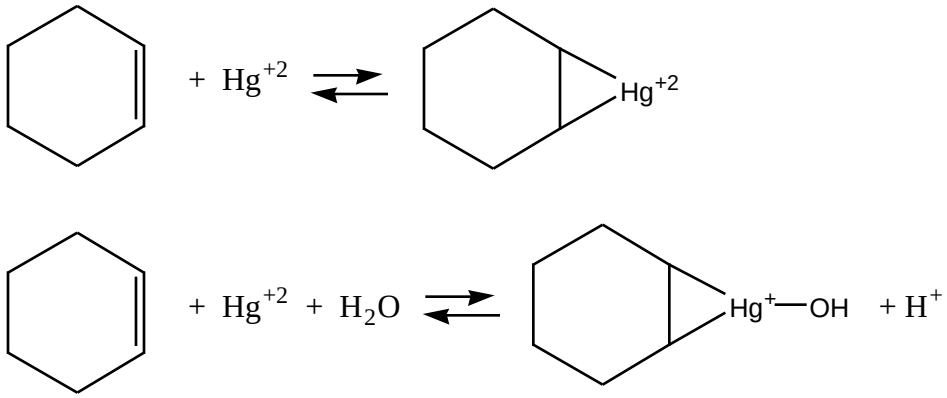
Jackson, C.L.; Robinson, W.S. *Am. Chem. J.* **1889**, 11, 93
Jackson, C.L.; Gazzolo, F.H. *Am. Chem. J.* **1900**, 23, 376
Jackson, C.L.; Earle, R.B. *Am. Chem. J.* **1903**, 29, 89
Meisenheimer, J., *Ann. Chem.* **1902**, 323, 205

Servis, K. *J. Am. Chem. Soc.* **1965**, 87, 5495 (NMR studies)

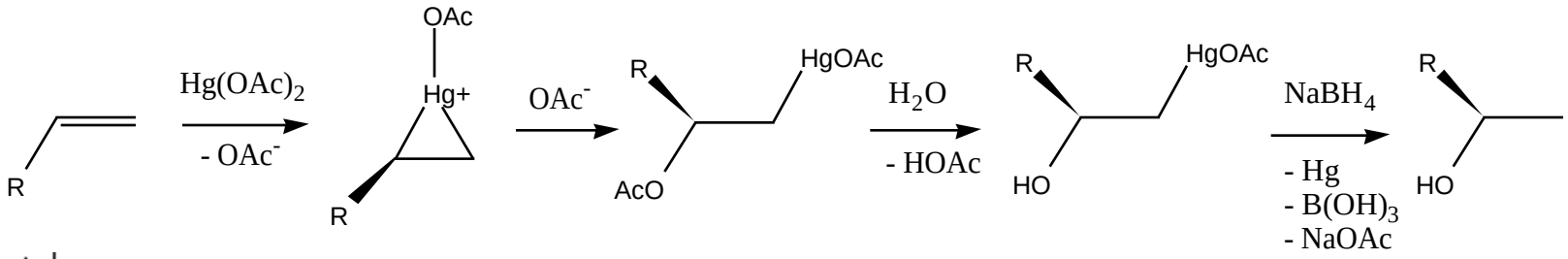
Mercurinium ions



Reviews:
Zefirov, N.S. *Usp. Khim.* **1965**, 34, 1272
Zefirov, N.S. *Russ. Chem. Rev.* **1965**, 34, 527
Chatt, J. *Chem. Rev.* **1951**, 48, 7
Kitching, W. *Organometallic Chem. Rev.* **1968**, 3, 61



Lucas, H.J.; Hepner, F.R.; Winstein, S. *J. Am. Chem. Soc.* **1939**, 61, 3102

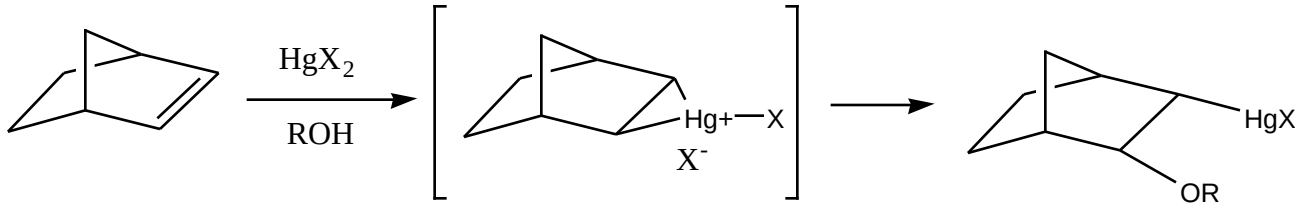


Brook, A.G.; Wright, G.F. *Can. J. Res.* **1950**, 28B, 623

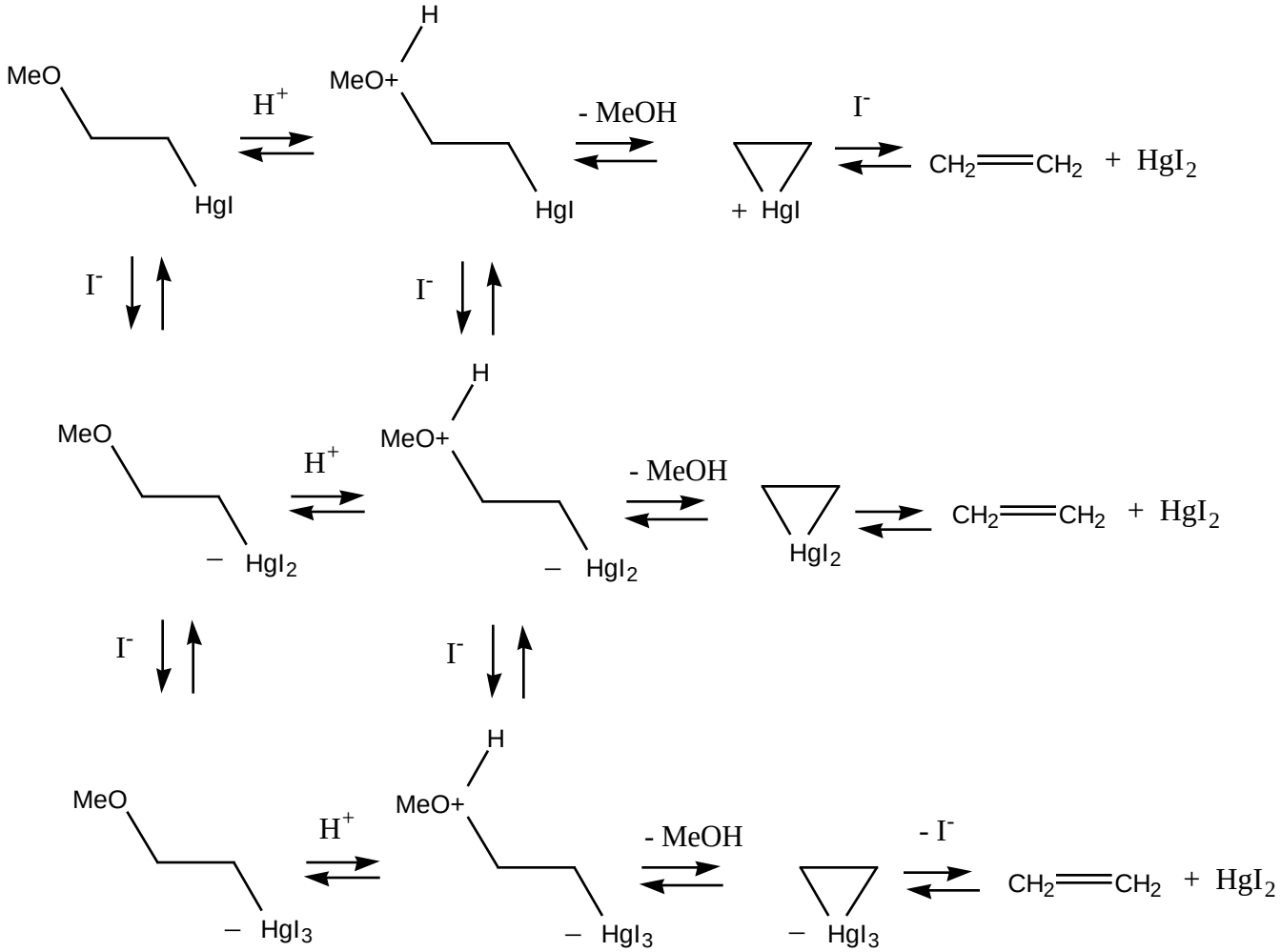
Wright, G.F. *Chemistry in Canada* **1950**, 2(9), 29

Wright, G.F. *Ann. N.Y. Acad. Sci.* **1957**, 65, 436

Abercrombie, M.J.; Rodgman, A.; Bharucha, K.R.; Wright, G.F. *Can. J. Chem.* **1959**, 37, 1328

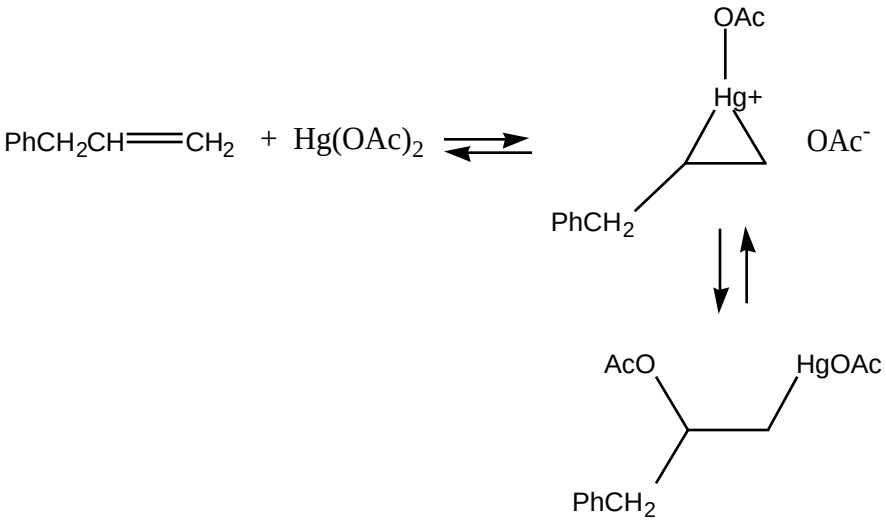


Traylor, T.G.; Baker, A.W. *J. Am. Chem. Soc.* **1963**, 85, 2746

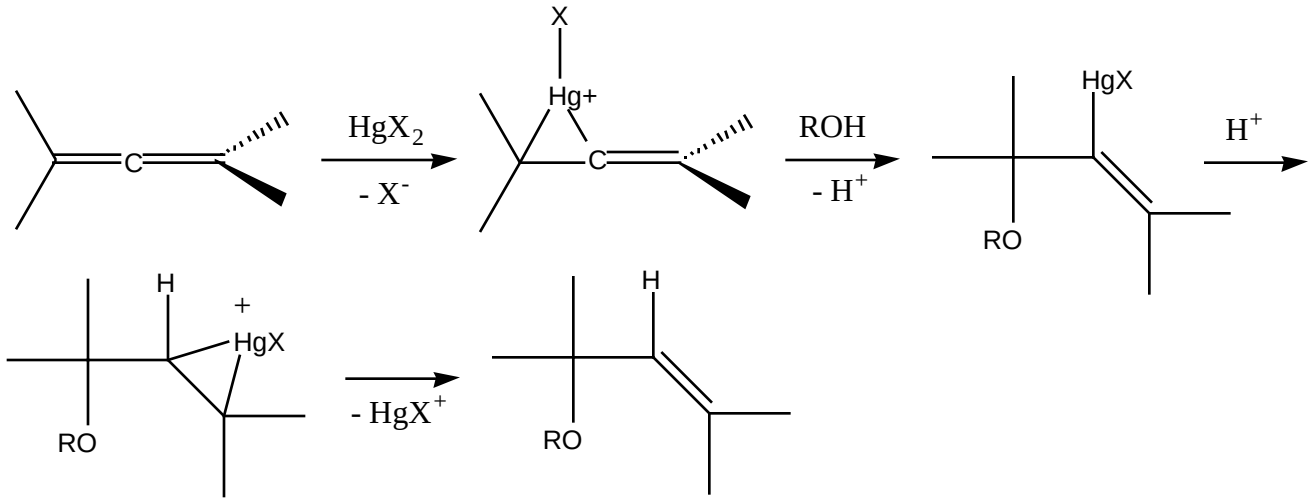


Kreevoy, M.M.; Stokker, G.; Kretchmer, R.A.; Ahmed, A.K. *J. Org. Chem.* **1963**, 28, 3184

Ichikawa, K.; Nishimura, N.; Takayama, S. *J. Org. Chem.* **1965**, 30, 1593

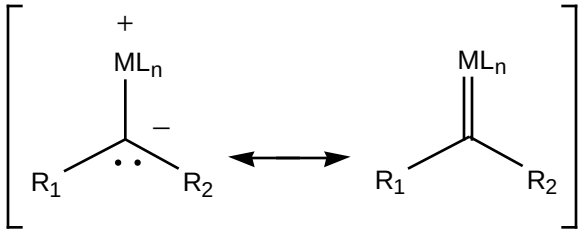


Wolfe, S.; Campbell, P.G.C. *Tetrahedron Lett.* **1966**, 4203
Treibs, W.; Lucius, G.; Hogler, H.; Breslauer, H. *Ann. Chem.* **1953**, 581, 59
Treibs, W.; Bast, H. *Ann. Chem.* **1949**, 561, 165

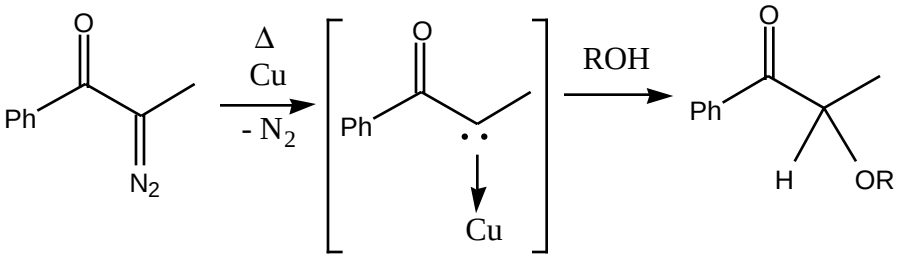


Waters, W.L.; Kiefer, E.F. *J. Am. Chem. Soc.* **1967**, 89, 6261
Bach, R.D. *Tetrahedron Lett.* **1968**, 5841
Bach, R.D. *J. Am. Chem. Soc.* **1969**, 91, 1771

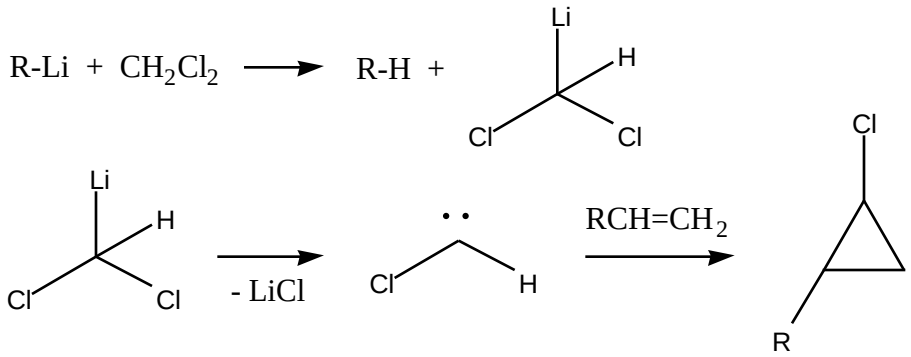
Metal carbenoids



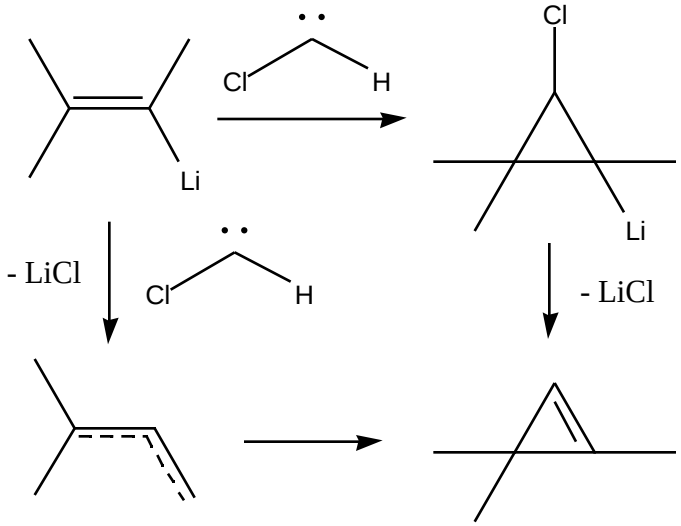
Reviews:
Koebrich, G. *Angew. Chem. Int. Ed.* **1972**, 11, 473
Wulfman, D.S.; Poling, B. *Reactive Intermediates* **1980**, 1, 321
Miller, D.J.; Moody, C.J. *Tetrahedron* **1995**, 51, 10811
Bruce, M.I. *Chem. Rev.* **1998**, 98, 2797



Yates, P. *J. Am. Chem. Soc.* **1952**, 74, 5376

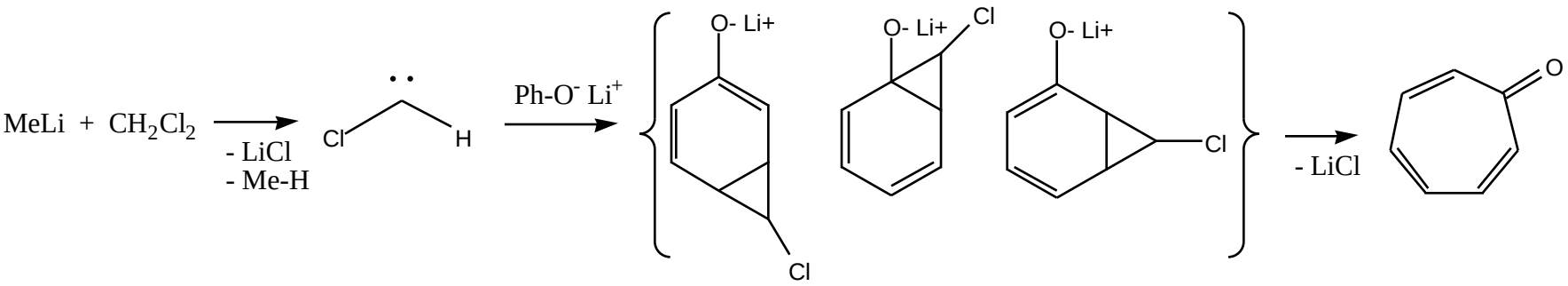


Closs, G.L.; Closs, L.E. *J. Am. Chem. Soc.* **1960**, 82, 5723
Closs, G.L.; Schwartz, G.M. *J. Am. Chem. Soc.* **1960**, 82, 5729
Closs, G.L.; Moss, R.A.; Coyle, J.J. *J. Am. Chem. Soc.* **1962**, 84, 4985 (sterics)
Closs, G.L. *J. Am. Chem. Soc.* **1962**, 84, 809
Closs, G.L.; Moss, R.A. *J. Am. Chem. Soc.* **1964**, 86, 4042

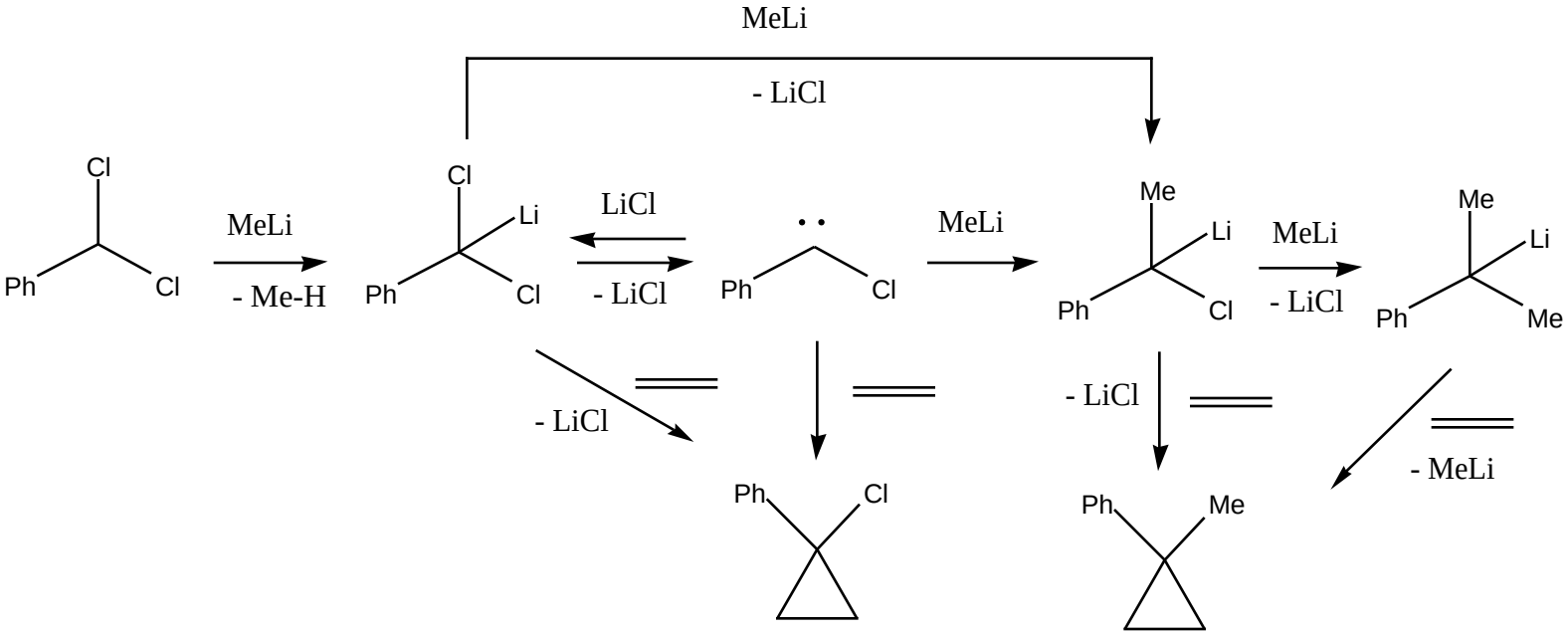


Closs, G.L.; Closs, L.E. *J. Am. Chem. Soc.* **1961**, 83, 1003
Closs, G.L.; Closs, L.E. *J. Am. Chem. Soc.* **1961**, 83, 2015

Closs, G.L.; Closs, L.E. *J. Am. Chem. Soc.* **1963**, 85, 99

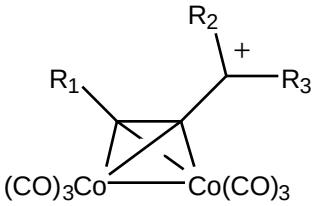


Closs, G.L.; Closs, L.E. *J. Am. Chem. Soc.* **1961**, 83, 599

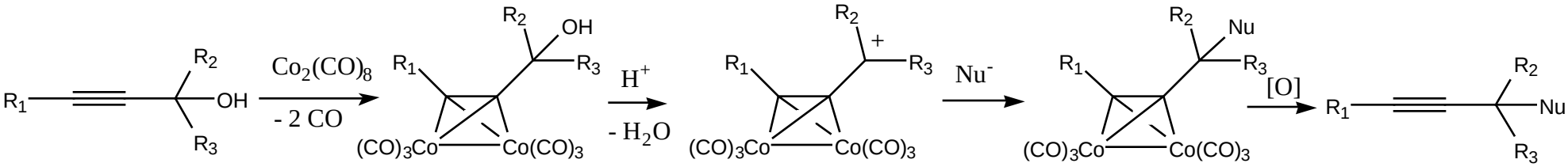


Closs, G.L.; Coyle, J.J. *J. Org. Chem.* **1966**, 31, 2759

Nicholas cation



Reviews:
Nicholas, K.M. *Acc. Chem. Res.* **1987**, 20, 207



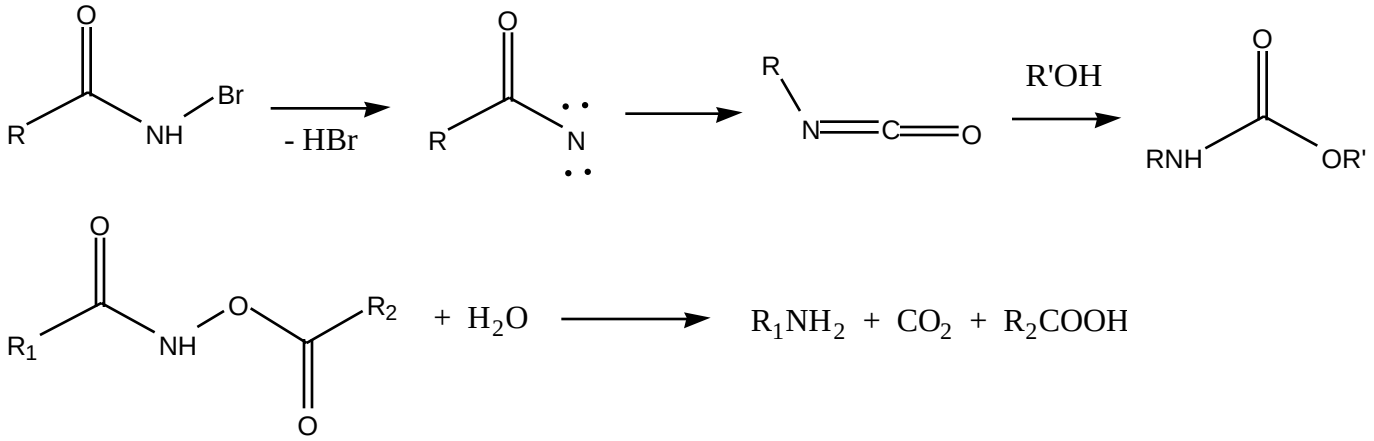
Nicholas, K.M.; Pettit, R. *Tetrahedron Lett.* **1971**, 37, 3475
Nicholas, K.M.; Pettit, R. *J. Organometallic Chem.* **1972**, 44, C21
Connor, R.E.; Nicholas, K.M. *J. Organometallic Chem.* **1977**, 125, C45

Nitrenes

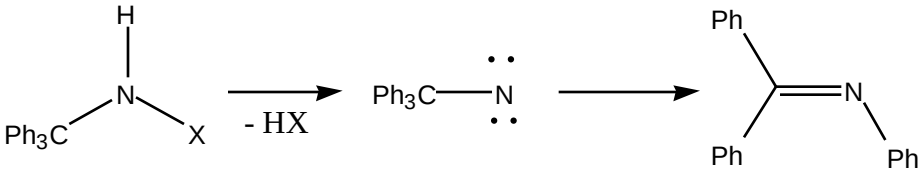
singlet triplet

Reviews:
Kirmse, W. *Angew. Chem.* **1959**, 71, 540
Horner, L.; Christmann, A. *Angew. Chem.* **1963**, 75, 707
Abramovitch, R.A.; Davis, B.A. *Chem. Rev.* **1964**, 64, 149
Lwowski, W. *Angew. Chem. Int. Ed.* **1967**, 6, 897
Gilcrist, T.L.; Rees, C.W. *Carbenes, Nitrenes, and Arynes*, Appleton-Century Crofts: New York, 1969
Lwowski, W. (ed.) *Nitrenes*, Wiley: New York, 1970
Abramovitch, R.A. *Chem. Soc. Spec. Publ.* **1970**, 24, 323

Abramovitch, R.A.; Sutherland, R.G. *Forsch. Chem. Forsch.* **1970**, 16, 1
Wasserman, E. *Prog. Phys. Org. Chem.* **1971**, 8, 319
Abramovitch, R.A. in *Organic Reactive Intermediates*, (S.P. McManus, ed.) Academic Press: New York, 1973, p. 127
Tomioka, H. *Bull. Chem. Soc. Jpn* **1998**, 71, 1501
Gritsan, N.P.; Platz, M.S. *Adv. Phys. Org. Chem.* **2001**, 36, 255



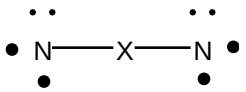
Lossen, W., *Ann. Chem*. **1872**, 161, 347 (Lossen rearrangement)
Tiemann, F. *Chem. Ber.* **1891**, 24, 4162 (first proposed as transients in Lossen rearrangement)
Lengfeld, F.; Stieglitz, J. *Am. Chem. J.* **1893**, 15, 215
Stieglitz, J. *Am. Chem. J.* **1896**, 18, 751
Stieglitz, J. *Am. Chem. J.* **1903**, 29, 49



Morgan, A.F. *J. Am. Chem. Soc.* **1916**, 38, 2095
Vosburgh, I. *J. Am. Chem. Soc.* **1916**, 38, 2081
Stagner, B.A. *J. Am. Chem. Soc.* **1916**, 38, 2069

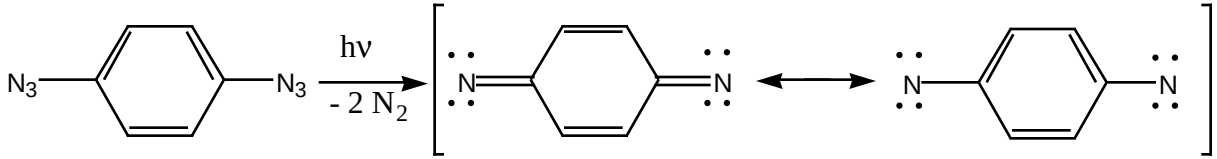
Staudinger, H.; Miescher, K. *Arch. Sci. Phys. Nat.* **1917**, 44, 387
Staudinger, H.; Miescher, K. *Helv. Chim. Acta* **1919**, 2, 554
Curtius, T.; Schmidt, F. *Chem. Ber.* **1922**, 55, 1571
Curtius, T. *Z. Angew. Chem.* **1913**, 26(3), 134
Bertho, A. *J. Prakt. Chem.* **1928**, 120[2], 89
Taylor, T.W.J.; Owen, J.S.; Whittaker, D. *J. Chem. Soc.* **1938**, 206

Dinitrenes

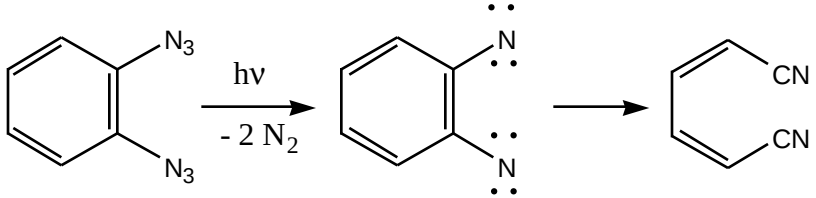


quintet

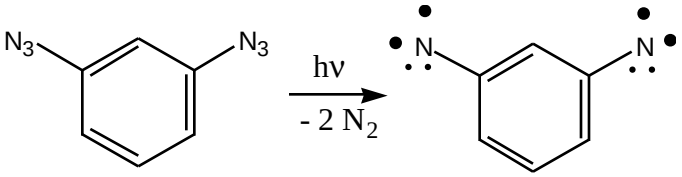
Reviews:
Nimura, S.; Yabe, A. in *Magnetic Properties of Organic Materials*, (P.M. Lahti, ed.) Marcel Dekker: New York, 1999, Chapter 7, p. 127



Trozzolo, A.M.; Murray, R.W.; Smolinsky, G.; Yager, W.A.; Wasserman, E. *J. Am. Chem. Soc.* **1963**, 85, 2526



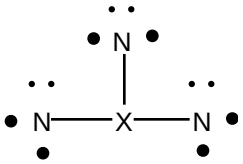
Hall, J.H. *J. Am. Chem. Soc.* **1965**, 87, 1147



Wasserman, E.; Murray, R.W.; Yager, W.A.; Trozzolo, A.M.; Smolinsky, G. *J. Am. Chem. Soc.* **1967**, 89, 5076 (first quintet nitrene observed)

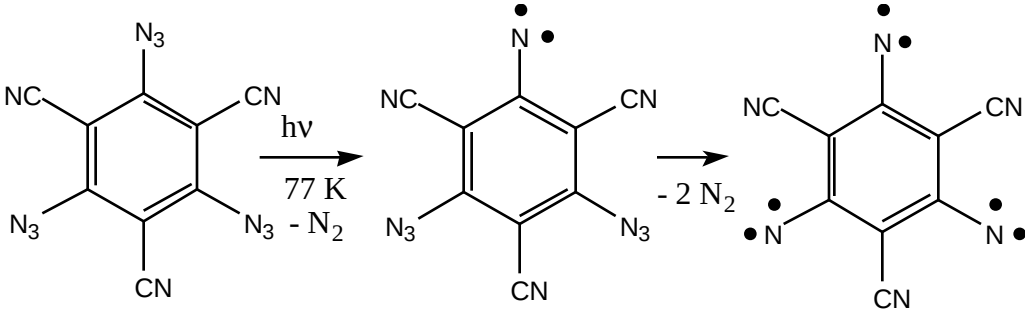
Chapyshev, S.V.; Tomioka, H. *Bull. Chem. Soc. Jpn* **2003**, 76, 2075

Trinitrenes



septet

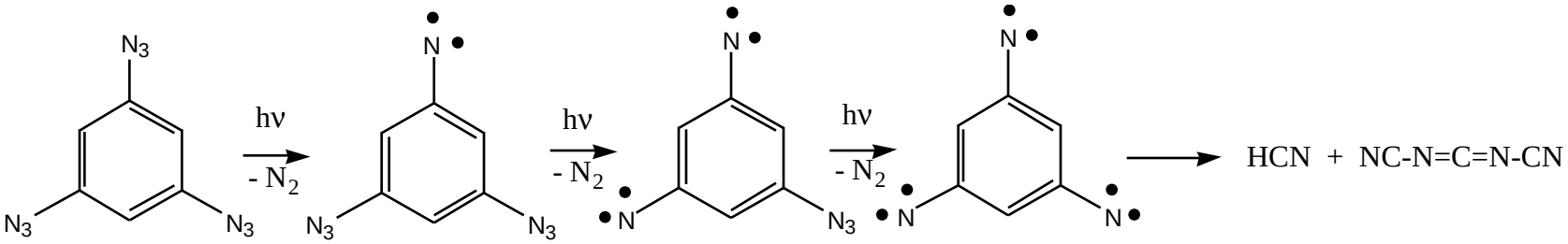
Reviews:
None.



Wasserman, E.; Schueller, K.; Yager, W.A. *Chem. Phys. Lett.* **1968**, 2, 259

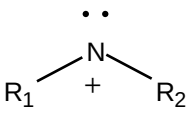
Chapyshev, S.V.; Walton, R.; Sanborn, J.A.; Lahti, P.M. *J. Am. Chem. Soc.* **2000**, 122, 1580

Chapyshev, S.V.; Kuhn, A.; Wong, M.; Wentrup, C. *J. Am. Chem. Soc.* **2000**, 122, 1572
Chapyshev, S.V. *Mendeleev Commun.* **2002**, 168
Oda, N.; Nakai, T.; Sato, K.; Shiomi, D.; Kozaki, M.; Okada, K.; Takui, T. *Synth. Met.* **2001**, 121, 1840



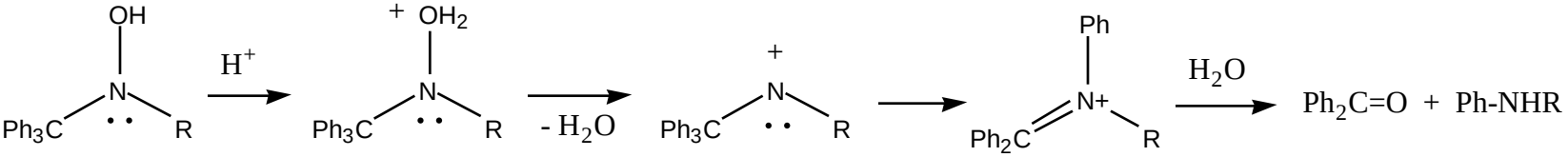
Sato, T.; Narazaki, A.; Kawaguchi, Y.; Niino, H.; Bucher, G. *Angew. Chem. Int. Ed.* **2003**, 42, 5206
Sato, T.; Narazaki, A.; Kawaguchi, Y.; Niino, H.; Bucher, G.; Grote, D.; Wolff, J.J.; Wenk, H.H.; Sander, W.W. *J. Am. Chem. Soc.* **2004**, 126, 7846

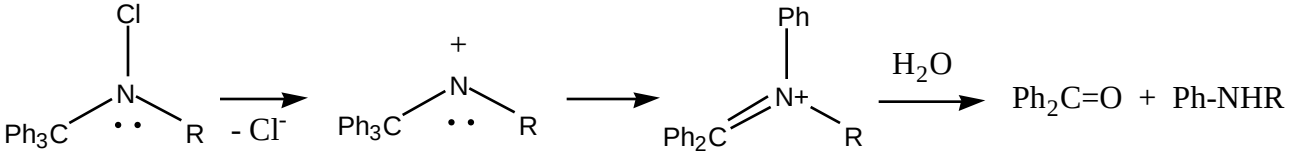
Nitrenium Ions



Reviews:

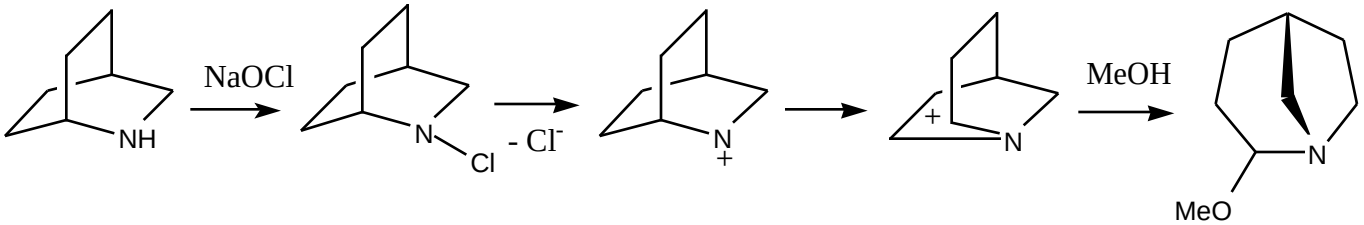
Gassman, P.G. *Acc. Chem. Res.* **1970**, 3, 26
Abramovitch, R.A.; Jerayaman, R. in *Azides and Nitrenes: reactivity and utility*, (E.F.V. Scriven, ed.) Academic Press: Orlando, FL, 1984, p. 297
Simonova, T.P.; Nefedov, V.D.; Toropova, M.A.; Kirillov, N.F. *Russ. Chem. Rev.* **1992**, 61, 584
McClelland, R.A. *Tetrahedron* **1996**, 52, 6823
Novak, M.; Rajagopal, S. *Adv. Phys. Org. Chem.* **2001**, 36, 167



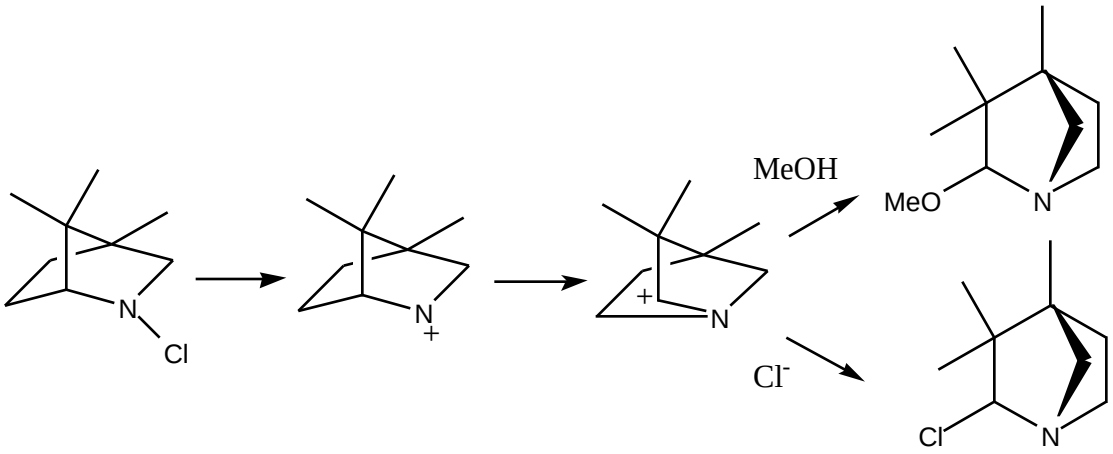


Stieglitz, J.; Leech, P.N. *Chem. Ber.* **1913**, 46, 2147
Stieglitz, J.; Leech, P.N. *J. Am. Chem. Soc.* **1914**, 36, 272
Stieglitz, J.; Stagner, B.A. *J. Am. Chem. Soc.* **1916**, 38, 2046

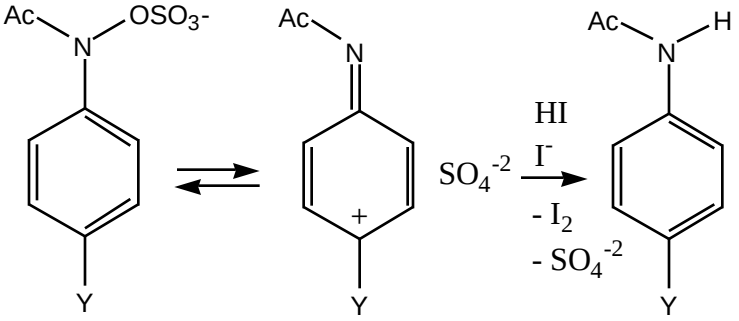
Heller, H.E.; Hughes, E.D.; Ingold, C.K. *Nature* **1951**, 168, 909 (first kinetic evidence)



Gassman, P.G.; Fox, B.L. *Chem. Commun.* **1966**, 153
Gassman, P.G.; Fox, B.L. *J. Am. Chem. Soc.* **1967**, 89, 338



Gassman, P.G.; Cryberg, R.L. *J. Am. Chem. Soc.* **1968**, 90, 1355
Gassman, P.G.; Cryberg, R.L. *J. Am. Chem. Soc.* **1969**, 91, 2047; 5176

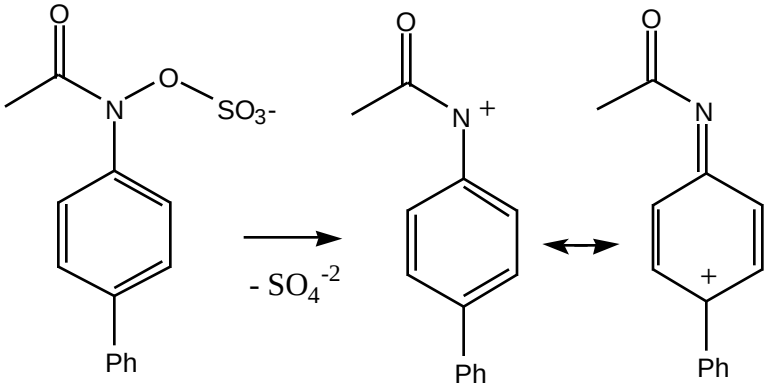


Pelecanou, M.; Novak, M. *J. Am. Chem. Soc.* **1985**, 107, 4499

Fishbein, J.C.; McClelland, R.A. *J. Am. Chem. Soc.* **1987**, 109, 2824

Novak, M.; Kahley, M.J.; Lin, J.; Kennedy, S.A.; Swanegan, L.A. *J. Am. Chem. Soc.* **1994**, 116, 11626
Novak, M.; Kennedy, S.A. *J. Am. Chem. Soc.* **1995**, 117, 574
Novak, M.; Kahley, M.J.; Lin, J.; Kennedy, S.A.; James, T.J. *J. Org. Chem.* **1995**, 60, 8294

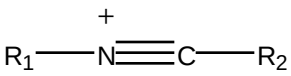
McClelland, R.A.; Davidse, P.A.; Hadzialic, G. *J. Am. Chem. Soc.* **1995**, 117, 4173



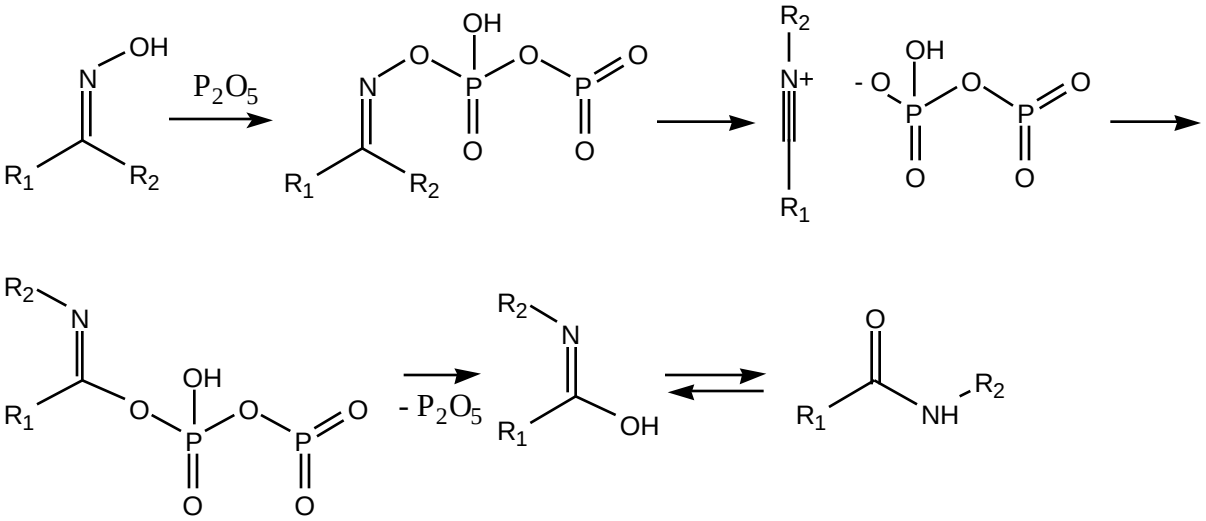
Novak, M.; Kahley, M.J.; Eiger, E.; Helmick, J.S.; Peters, H.E. *J. Am. Chem. Soc.* **1993**, 115, 9453

Novak, M.; Lin, J. *J. Org. Chem.* **1999**, 64, 6032

Nitrilium Ions



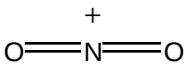
Reviews:
Hegarty, A.F. *Acc. Chem. Res.* **1980**, 13, 448



Beckmann, E., *Chem. Ber*. **1886**, 19, 988 (Beckmann rearrangement)

Klages, F.; Grill, W. *Ann. Chem.* **1956**, 594, 21
Ugi, I.; Beck, F.; Fetzer, U. *Chem. Ber.* **1962**, 95, 126
Hassner, A.; Levy, L.A.; Gault, R. *Tetrahedron Lett.* **1966**, 27, 3119

Nitronium Ions

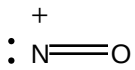


Reviews:

Ridd, J.H. *Studies in Chemical Structure and Reactivity* **1966**, 133
Stock, L.M. *Prog. Phys. Org. Chem.* **1976**, 12, 21
Ridd, J.H. *Adv. Phys. Org. Chem.* **1978**, 16, 1
Olah, G.A. *Acc. Chem. Res.* **1980**, 13, 330
Olah, G.A.; Narang, S.C.; Olah, J.A.; Lammertsma, K. *Proc. Natl. Acad. Sci. USA* **1982**, 79, 4487
Ridd, J.H. *Chem. Soc. Rev.* **1991**, 20, 149
Eberson, L.; Hartshorn, M.P.; Radner, F. *Acta Chem. Scand.* **1994**, 48, 937

Lauer, K.; Oda, R. *J. Prakt. Chem.* **1937**, 148, 287
Hughes, E.D.; Ingold, C.K.; Reed, R.I. *Nature* **1946**, 158, 448
Gillespie, R.J.; Graham, J.; Hughes, E.D.; Ingold, C.K.; Peeling, E.R.A. *Nature* **1946**, 158, 480
Ingold, C.K.; Millen, D.J.; Poole, H.G. *Nature* **1946**, 158, 480
Goddard, D.R.; Hughes, E.D.; Ingold, C.K. *Nature* **1946**, 158, 480
Titov, A.I. *J. Gen. Chem. USSR* **1947**, 17, 382

Nitrosonium Ions

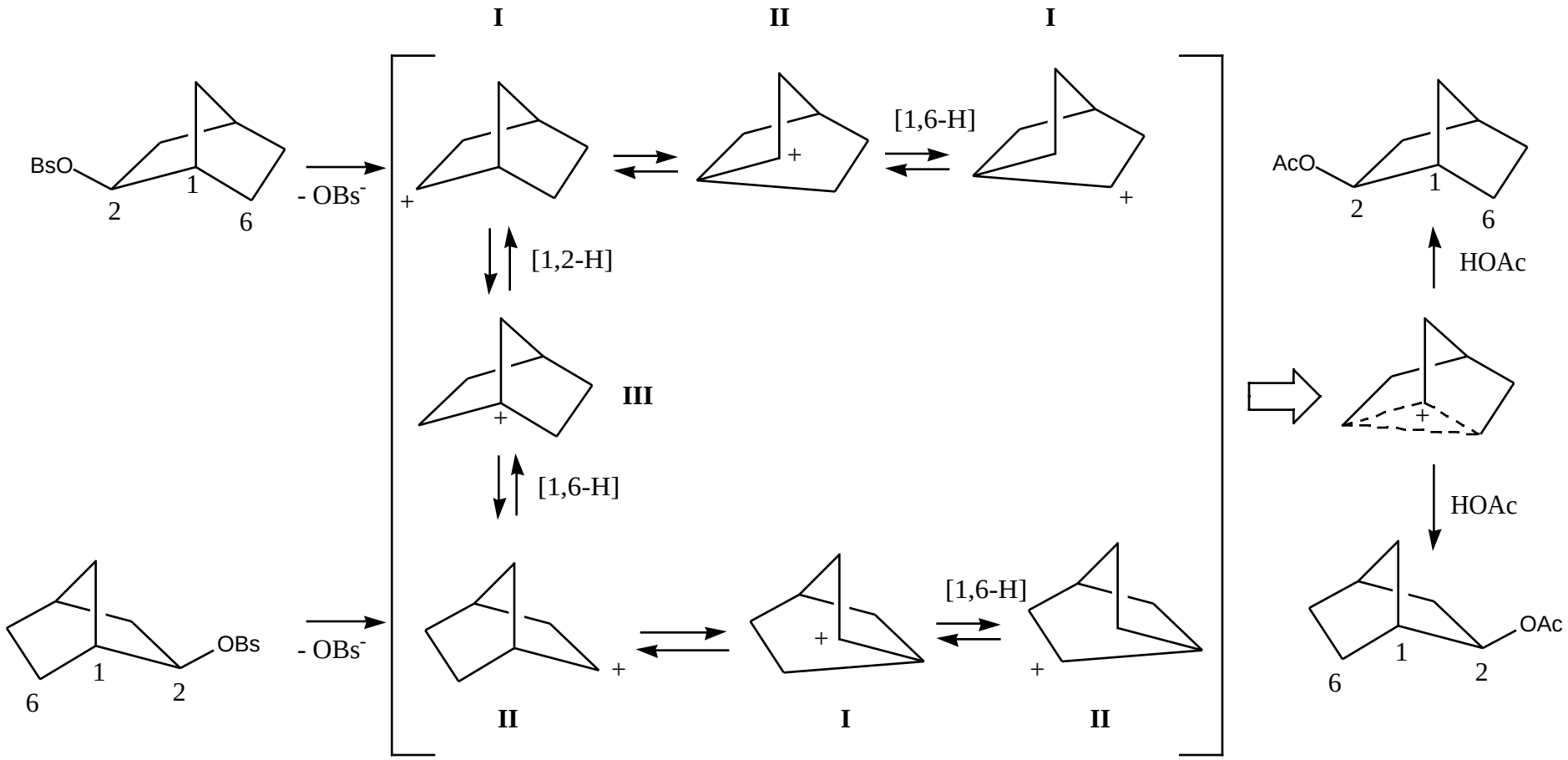


Reviews:
Kreher, R. *Angew. Chem. Int. Ed.* **1973**, 12, 1022
Mocella, M.T.; Okamoto, M.S.; Barefield, E.K. *Synthesis and Reactivity in Inorganic and Metal-Organic Chemistry* **1974**, 4, 69
Ridd, J.H. *Adv. Phys. Org. Chem.* **1978**, 16, 1
Olah, G.A. *Acc. Chem. Res.* **1980**, 13, 330
Williams, D.L.H. *Adv. Phys. Org. Chem.* **1983**, 19, 381
Bobbitt, J.M.; Flores, M.G.L. *Heterocycles* **1988**, 27, 509

Blackall, E.L.; Hughes, E.D.; Ingold, C.K. *J. Chem. Soc.* **1952**, 28
Deschamps, J. *Mem. Services Chim. Etat (Paris)* **1953**, 38, 335
Lang, F.M. *Chim. Industrie* **1954**, 71, 913
Lewis, J.; Wilkins, R.G. *Chem. Ind.* **1954**, 634
Szabo, Z.G.; Bartha, L.G.; Lakatos, B. *J. Chem. Soc.* **1956**, 1784
Bayliss, N.S.; Watts, D.W. *Austral. J. Chem.* **1956**, 9, 319
Beattie, I.R. . *J. Chem. Soc.* **1957**, 367

Sharp, D.W.A.; Thorley, J. *J. Chem. Soc.* **1963**, 3557 (IR spectrum of nitrosonium ion)

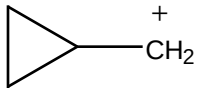
Non-classical ions (hypercoordinate carbocations, sigma-bridged cations)



Reviews:
Winstein, S. *Quart. Rev. (London)* **1969**, 23, 1411
Bartlett, P.D. *Non-classical Ions: reprints and commentary*, W.A. Benjamin, Inc.: New York, 1965
Kramer, G.M. *Adv. Phys. Org. Chem.* **1975**, 11, 177
Brown, H.C. *The Non-classical Ion Problem*, Plenum Press: New York, 1977

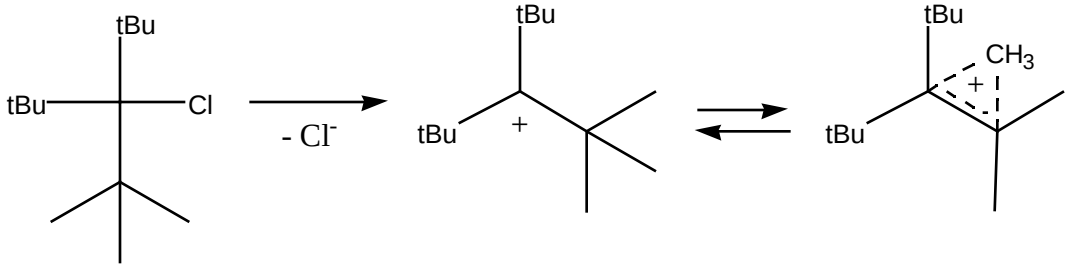
Brown, H.C. *Top. Curr. Chem.* **1979**, 80, 1
Saltzman, M.D.; Wilson, C.L. *J. Chem. Educ.* **1980**, 57, 289 (non-classical name)
Brown, H.C. *Acc. Chem. Res.* **1983**, 16, 432
Olah, G. *Acc. Chem. Res.* **1983**, 16, 440
Walling, C. *Acc. Chem. Res.* **1983**, 16, 448

Nevell, T.P.; de Salas, E.; Wilson, C.L. *J. Chem. Soc.* **1939**, 1188 (first suggestion of bridged carbocations)
Winstein, S.; Trifan, D. *J. Am. Chem. Soc.* **1949**, 71, 2953
Winstein, S.; Morse, B.K.; Grunwald, E.; Jones, H.W.; Corse, J.; Trifan, D.; Marshall, H. *J. Am. Chem. Soc.* **1952**, 74, 1127
Winstein, S.; Trifan, D. *J. Am. Chem. Soc.* **1952**, 74, 1147; 1154
Olah, G.A.; White, A.M. *J. Am. Chem. Soc.* **1969**, 91, 3954; 3958; 5801

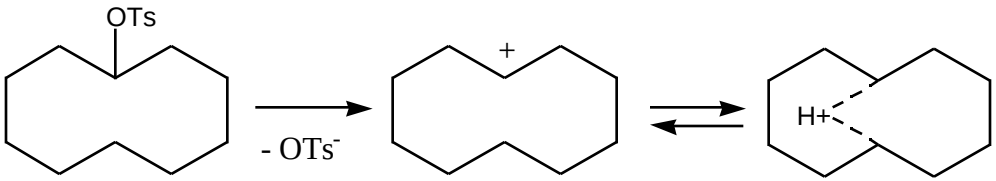


Roberts, J.D.; Mazur, R.H. *J. Am. Chem. Soc.* **1951**, 73, 3542

Brown, H.C. *Science* **1946**, 103, 385
Brown, H.C.; Fletcher, R.S. *J. Am. Chem. Soc.* **1949**, 71, 1845
Brown, H.C.; Berneis, H.L. *J. Am. Chem. Soc.* **1953**, 75, 10

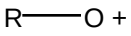


Bartlett, P.D. *J. Chem. Educ.* **1953**, 30, 22

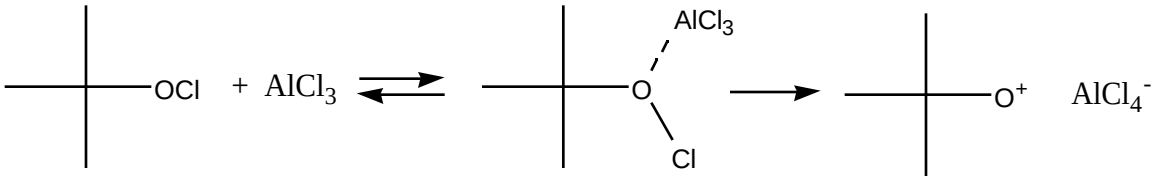


Heck, R.; Prelog, V. *Helv. Chim. Acta* **1955**, 38, 1541

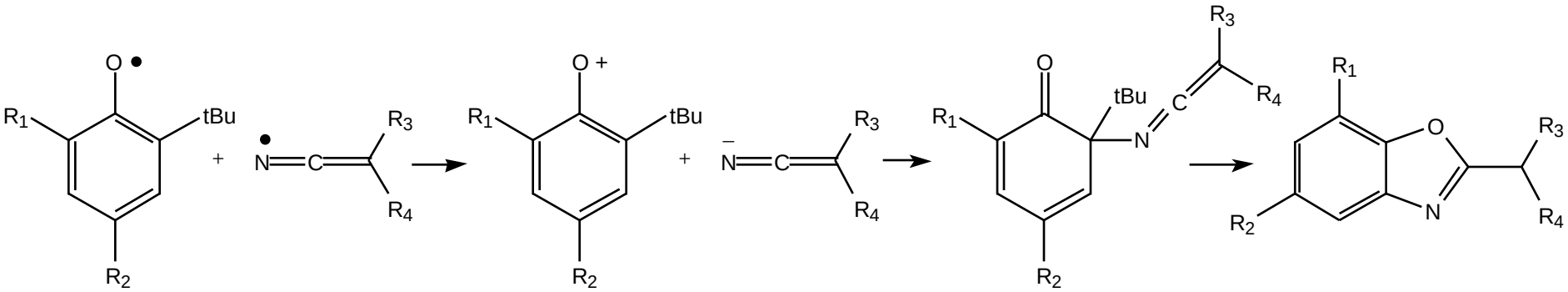
Oxenium ions



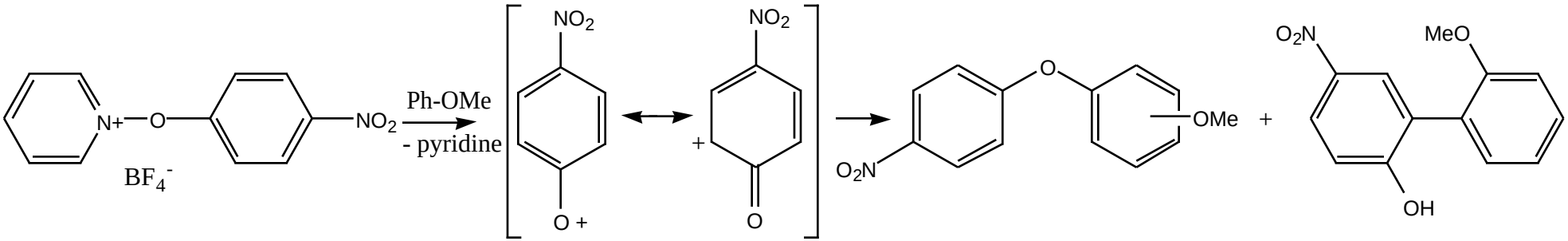
Reviews:
Dimroth, K. *Top. Current Chem.* **1985**, 129, 99



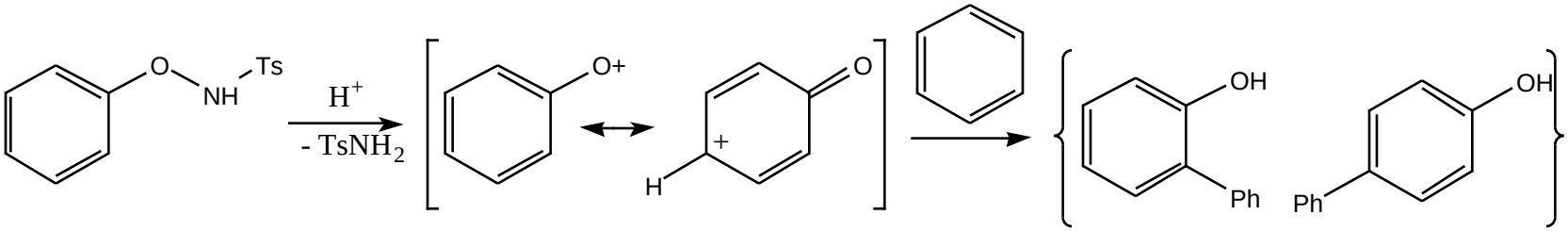
Martin, D.; Weise, A.; Becker, J. *Chem. Ber.* **1966**, 99, 1266



Rieker, A. *Tetrahedron Lett.* **1969**, 2611

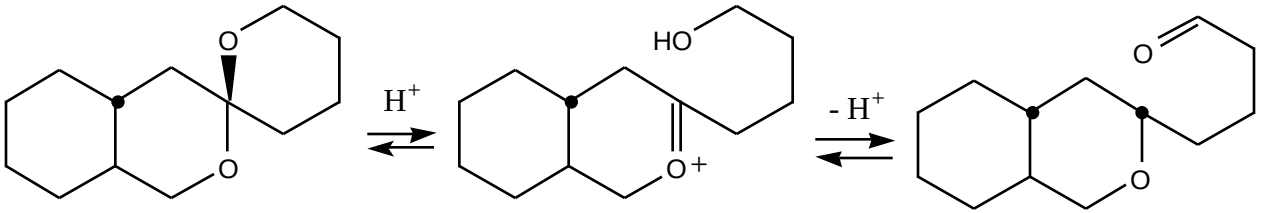


Abramovitch, R.A.; Inbasekaran, M.; Kato, S. *J. Am. Chem. Soc.* **1973**, 95, 5428
Abramovitch, R.A.; Alvernhe, G.; Inbasekaran, M.N. *Tetrahedron Lett.* **1977**, 1113
Abramovitch, R.A.; Inbasekaran, M.N. *Chem. Commun.* **1978**, 149
Abramovitch, R.A.; Alvernhe, G.; Bartnik, R.; Dassanayake, N.L.; Inbasekaran, M.N.; Kato, S. *J. Am. Chem. Soc.* **1981**, 103, 4558
Abramovitch, R.A.; Bartnik, R.; Cooper, M.; Dassanayake, N.L.; Hwang, H.Y.; Inbasekaran, M.N.; Rusek, G. *J. Org. Chem.* **1982**, 47, 4817
Abramovitch, R.A.; Bartnik, R.; Besse, J.; Kato, S. *Nouveau J. Chim.* **1984**, 8, 571
Li, Y.; Abramovitch, R.A.; Houk, K.N. *J. Org. Chem.* **1989**, 54, 2911



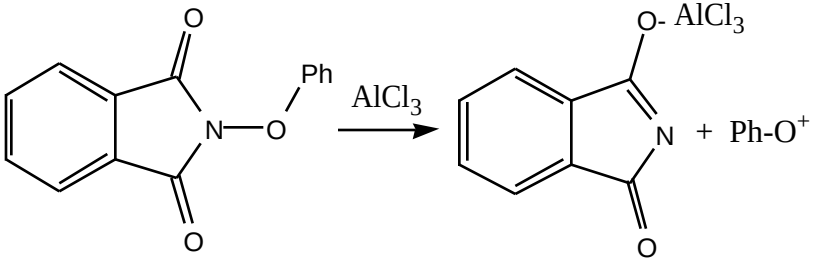
Endo, Y.; Shudo, K.; Okamoto, T. *J. Am. Chem. Soc.* **1977**, 99, 7721
Shudo, K.; Orihara, Y.; Ohta, T.; Okamoto, T. *J. Am. Chem. Soc.* **1981**, 103, 943
Endo, Y.; Shudo, K.; Okamoto, T. *J. Am. Chem. Soc.* **1982**, 104, 6393

Bursey, M.M.; Hass, J.R.; Harvan, D.J.; Parker, C.E. *J. Am. Chem. Soc.* **1979**, 101, 5489

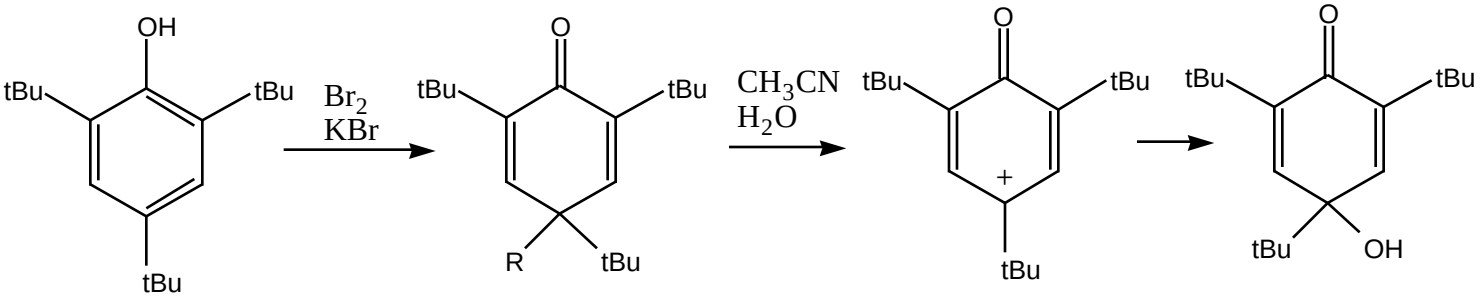


Deslongchamps, P.; Rowan, D.D.; Pothier, N. *Heterocycles* **1981**, 15, 1093

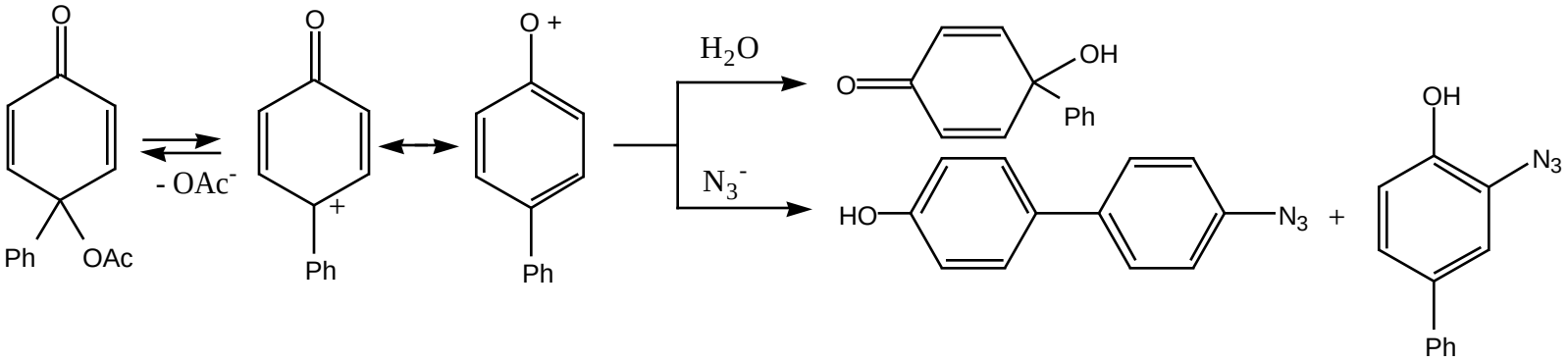
Deslongchamps, P.; Rowan, D.D.; Pothier, N. *Can. J. Chem.* **1981**, 59, 2787



Uto, K.; Miyazawa, E.; Ito, K.; Sakamoto, T.; Kikugawa, Y. *Heterocycles* **1998**, 48, 2593

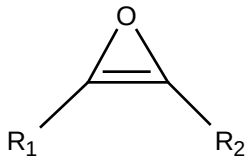


Hegarty, A.F.; Keogh, J.P. *J. Chem. Soc. Perkin Trans. 2* **2001**, 758

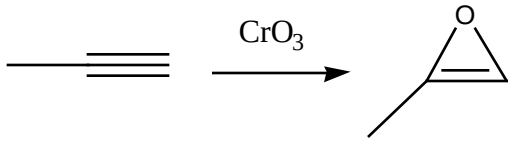


Novak, M.; Glover, S.A. *J. Am. Chem. Soc.* **2004**, 126, 7748

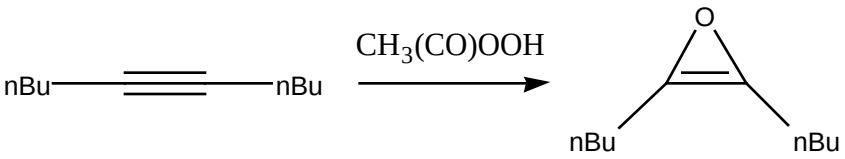
Oxirene



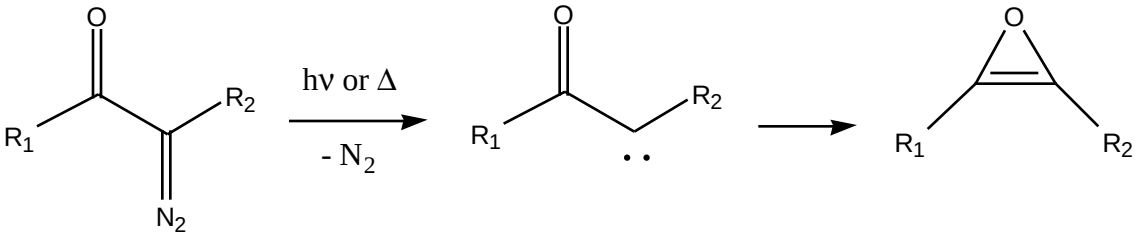
Reviews:
Hopkinson, A.C.; Lien, M.; Yates, K.; Csizmadia, I.G. *Prog. Theor. Org. Chem.* **1977**, 2, 230
Lewars, E.G. *Chem. Rev.* **1983**, 83, 519



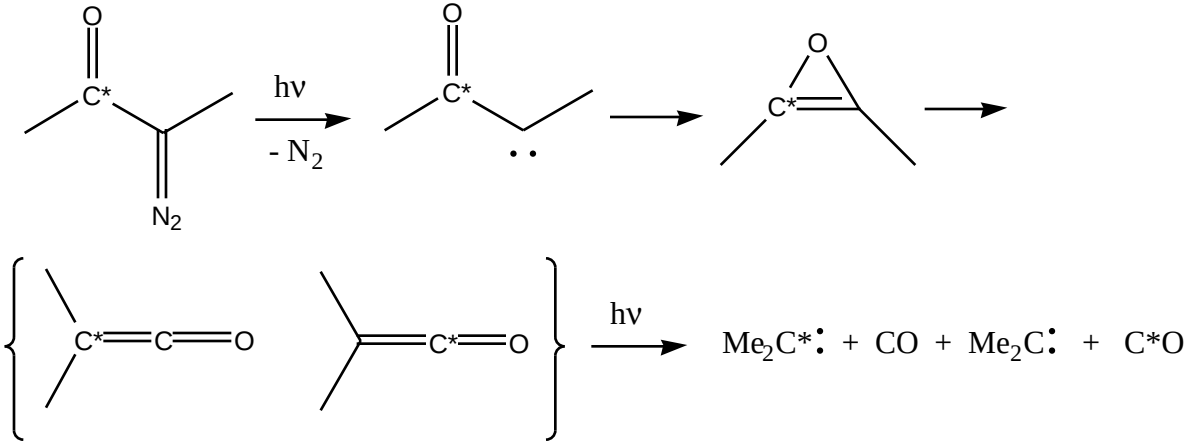
Berthelot, M. *Bull. Soc. Chim. Fr.* **1870**, 14, 113 (first claim; proven false)
Madelung, W.; Oberwegner, M.E. *Naturwissenshaften* **1929**, 17, 430 (coining of acetylene oxide name)
Madelung, W.; Oberwegner, M.E. *Ann. Chem.* **1931**, 490, 201 (second claim; proven false)



Schubach, H.; Franzen, V. *Ann. Chem.* **1952**, 557, 60 (third claim; proven false)

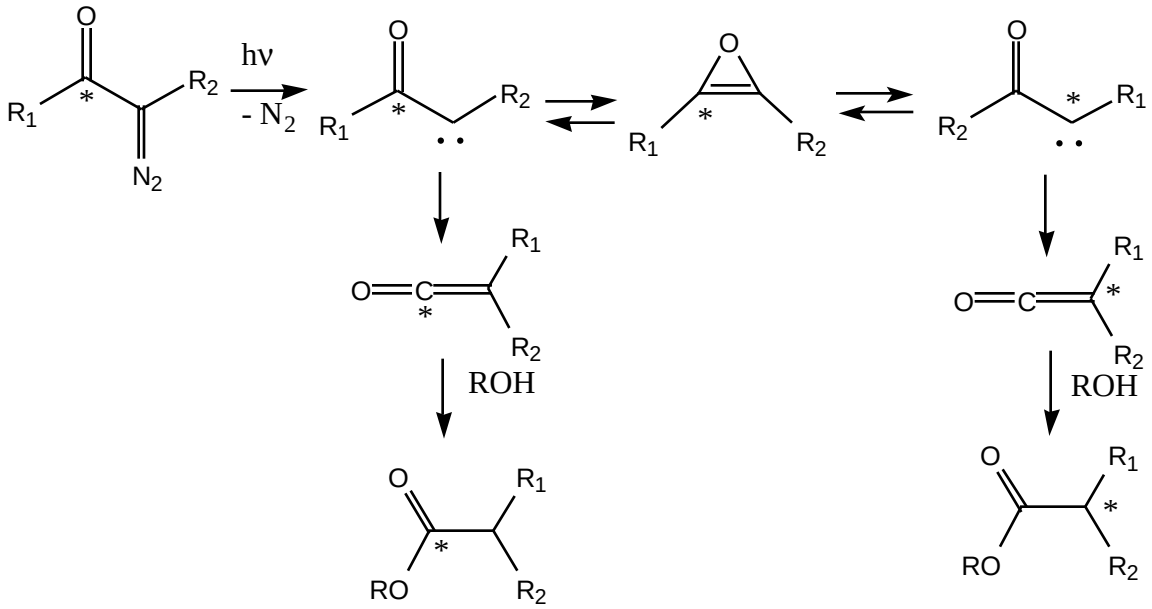


McDonald, R.N.; Schwab, P.A. *J. Am. Chem. Soc.* **1964**, 86, 4866
Stille, J.K.; Whitehurst, D.D. *J. Am. Chem. Soc.* **1964**, 86, 4871
Barnes, M.F.; MacMillan, J. *J. Chem. Soc. C* **1967**, 361



Csizmadia, I.G.; Font, J.; Strausz, O. *J. Am. Chem. Soc.* **1968**, 90, 7360
Clark, D.T. *Theor. Chim. Acta* **1969**, 15, 225
Thornton, D.E.; Gosavi, R.K.; Strausz, O. *J. Am. Chem. Soc.* **1970**, 92, 1768

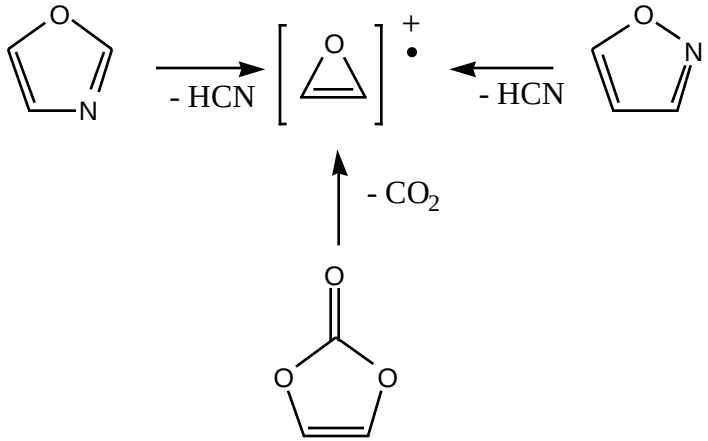
Dewar, M.J.S.; Trinajstic, N. *Theor. Chim. Acta* **1970**, 17, 235
Rowland, F.S.; Russell, R.L. *J. Am. Chem. Soc.* **1970**, 92, 7508



Zeller, K.P.; Meier, H.; Kolshorn, H.; Mueller, E. *Chem. Ber.* **1972**, 105, 1875
Meier, H.; Zeller, K.P. in *Proc. 7th IUPAC Symp. Photochem.*, Katholieke U. Louvain: Louvain, Belgium, 1978, p. 234
Zeller, K.P. *Chem. Ber.* **1979**, 112, 678
Zeller, K.P. *Ann. Chem.* **1979**, 2036
Haiss, P.; Zeller, K.P. *Z. Naturforsch. B* **2003**, 58, 595

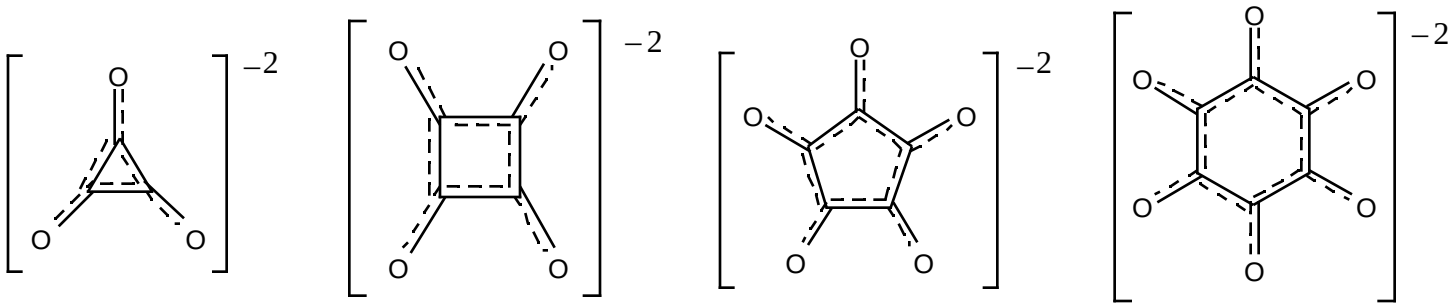
Tanigaki, K.; Ebbesen, T.W. *J. Am. Chem. Soc.* **1987**, 109, 5883 (proven to be false)

Tanaka, K.; Yoshimine, M. *J. Am. Chem. Soc.* **1980**, 102, 7635 (ab initio calculations at 4-31G)



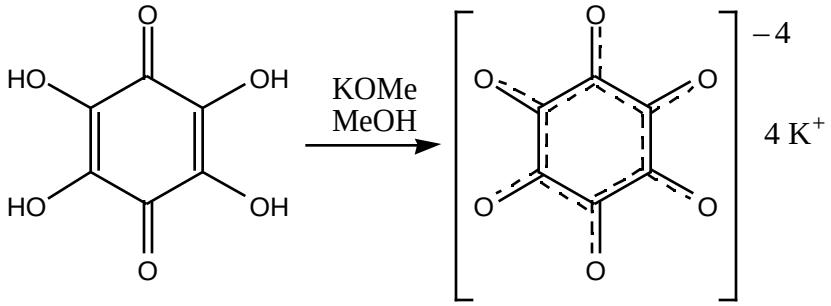
Hop, C.E.C.A.; Holmes, J.L.; Terlouw, J.K. *J. Am. Chem. Soc.* **1989**, 111, 441

Oxocarbons



deltate **squarate** **croconate** **rhodizonate**

Reviews:
West, R. *Aldrichimica Acta* **1968**, 1, 3
West, R.; Niu, J. in *Chemistry of the Carbonyl Group,* (J. Zabicky, ed.) Interscience: New York, 1970, Vol. 2, p. 241 - 275
West, R. *Isr. J. Chem.* **1980**, 20, 300
West, R. (ed.) *Oxocarbons*, Academic Press: New York, 1980



West, R.; Niu, H.Y. *J. Am. Chem. Soc.* **1962**, 84, 1324

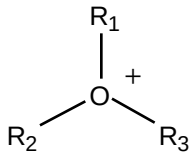
$C_nO_n^{-m}$

West, R.; Powell, D.L. *J. Am. Chem. Soc.* **1963**, 85, 2577
Ito, M.; West, R. *J. Am. Chem. Soc.* **1963**, 85, 2580 (squarate, croconate)

Patton, E.; West, R. *J. Phys. Chem.* **1970**, 74, 2512 (rhodizonate)

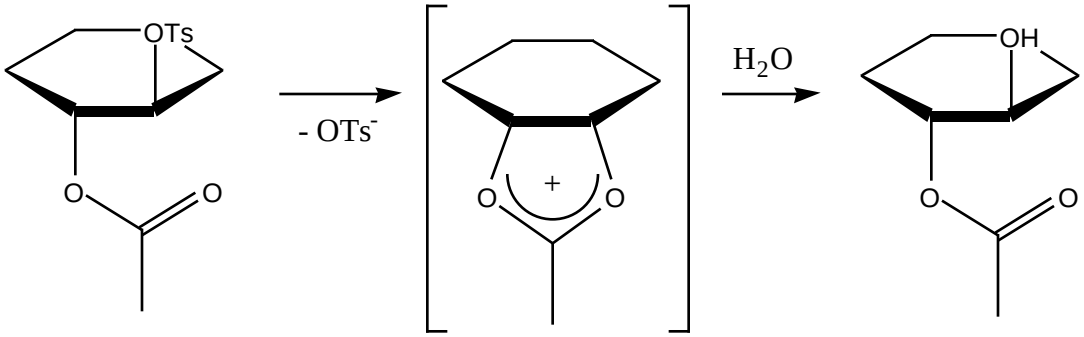
West, R.; Eggerding, D.; Perkins, J.; Handy, D.; Tuazon, E.C. *J. Am. Chem. Soc.* **1979**, 101, 1710 (deltate)

Oxonium ions



Reviews:
Perst, H. *Oxonium Ions in Organic Chemistry*, Verlag Chemie: Weinheim, 1971
Perst, H. in *Carbonium Ions,* (G. Olah, P.v.R. Schleyer, eds.) Wiley: New York, 1976, Vol. 5, p. 1961

(i) Acetoxonium ions
Reviews:
None.

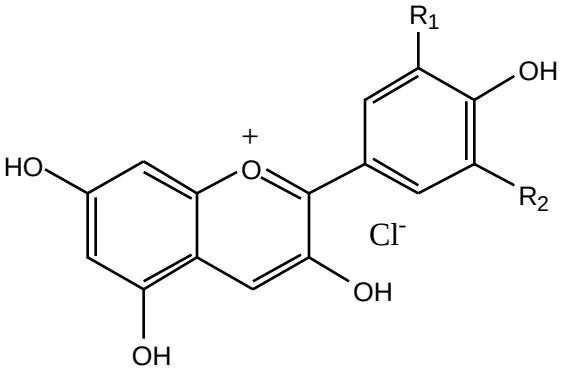


Winstein, S.; Hess, H.V.; Buckles, R.E. *J. Am. Chem. Soc.* **1942**, 64, 2796
Winstein, S.; Buckles, R.E. *J. Am. Chem. Soc.* **1942**, 64, 2780; 2787; **1943**, 65, 613

(ii) Flavinium salts
Reviews:
None.

Blackburn, M.; Sankey, G.B.; Robertson, A.; Whalley, W.B. *J. Chem. Soc.* **1957**, 1573
Dudley, K.H.; Ehrenberg, A.; Hemmerich, P.; Mueller, F. *Helv. Chim. Acta* **1964**, 47, 1354
Dudley, K.H.; Hemmerich, P. *Helv. Chim. Acta* **1964**, 47, 355
Walker, W.H.; Hemmerich, P.; Massey, V. *Helv. Chim. Acta* **1967**, 50, 2269

(iii) Flavylium salts
Reviews:
Jurd, L. *Recent Adv. Phytochem.* **1972**, 5, 135
Iacobucci, G.A.; Sweeny, J.G. *Tetrahedron* **1983**, 39, 3005



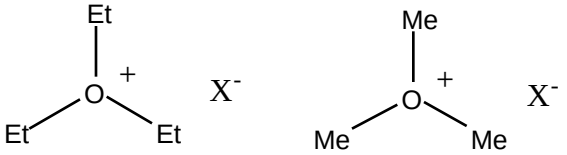
R_1	R_2	Name
H	H	pelargonin
H	OH	cyanidin
OH	OH	delphinidin
OMe	OMe	enidin (malvidin, syringidin)

Pratt, D.D.; Robinson, R.; Williams, P.N. *J. Chem. Soc.* **1924**, 125, 199
Robertson, A.; Robinson, R. *J. Chem. Soc.* **1926**, 1713
Robertson, A.; Robinson, R. *J. Chem. Soc.* **1927**, 242; 1710
Robertson, A.; Robinson, R. *J. Chem. Soc.* **1928**, 1455; 1460

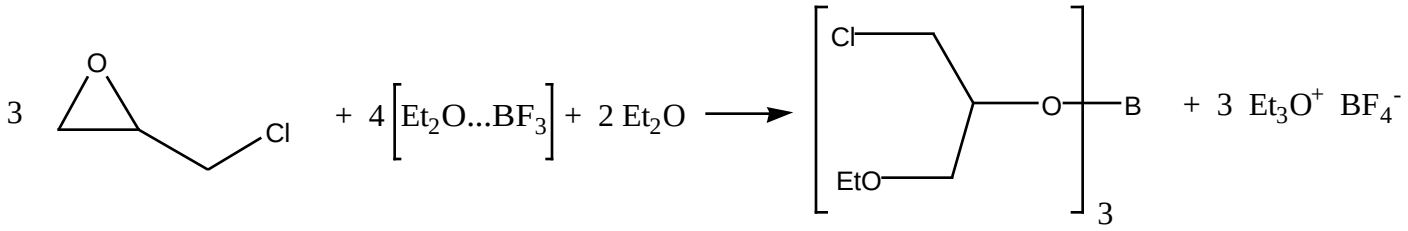
(iv) Meerwein salts

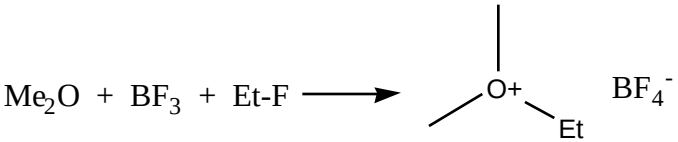
Reviews:

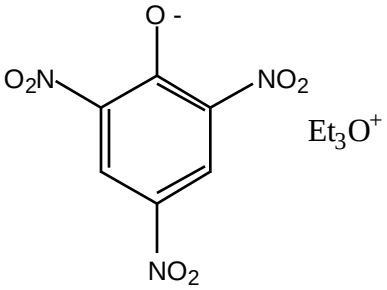
Kreher, R. *Angew. Chem. Int. Ed.* **1973**, 12, 1022



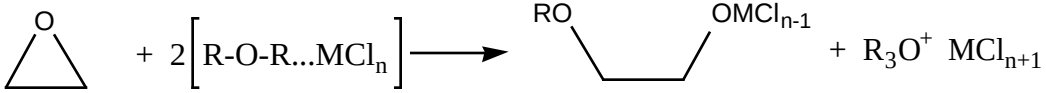
X = BF_4, $SbCl_6$, $AuCl_4$, Bi_2I_7, HgI_3, picrate, 1/2 $SnCl_6$, 1/2 $PtCl_6$





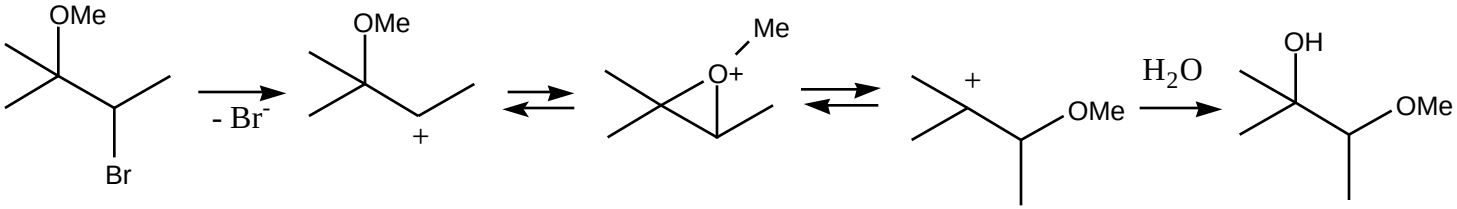


Meerwein, H.; Hinz, G.; Hofmann, P.; Kronig, E.; Pfeil, E. *J. Prakt. Chem.* **1937**, 147, 257



Meerwein, H.; Battenberg, E.; Gold, H.; Pfeil, E.; Willfang, G. *J. Prakt. Chem.* **1939**, 154, 83
Meerwein, H. *Org. Synth.* **1966**, 46, 120

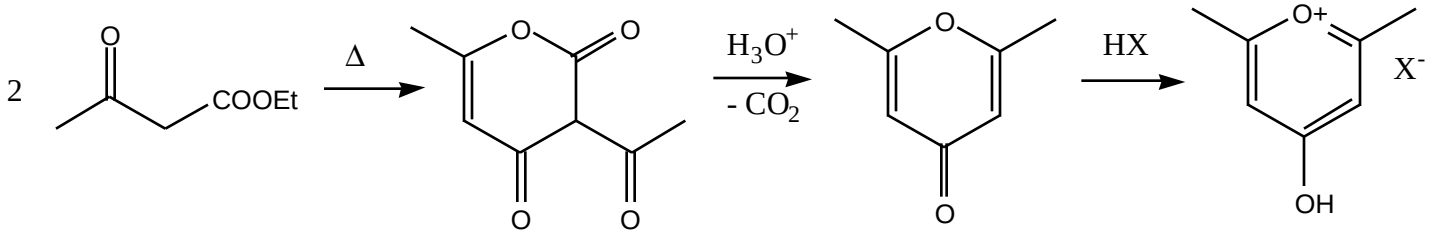
(v) Methoxonium ions
Reviews:
None.



Winstein, S.; Ingraham, L.L. *J. Am. Chem. Soc.* **1952**, 74, 1160

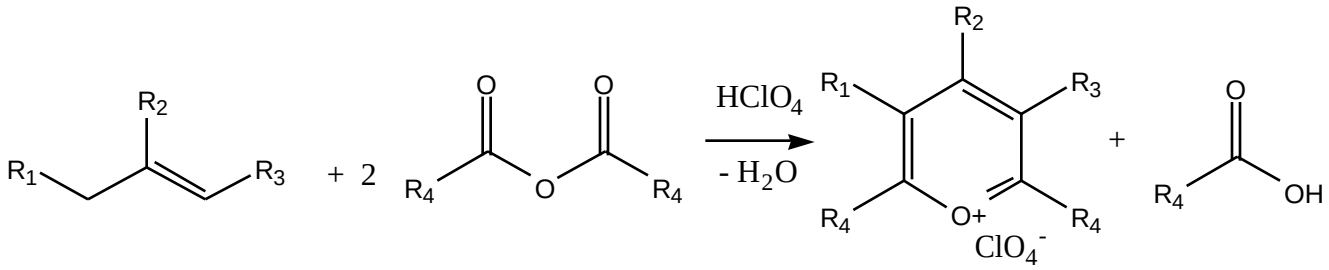
(vi) Pyrylium salts

Reviews:
Balaban, A.T.; Schroth, W.; Fischer, G.W. *Adv. Heterocyclic Chem.* **1969**, 10, 241
Balaban, A.T. *Studies in Org. Chem.* **1979**, 3, 79



X = Cl, Br, I, $PtCl_6$, NO_3, oxalate, tartrate, picrate, salicylate

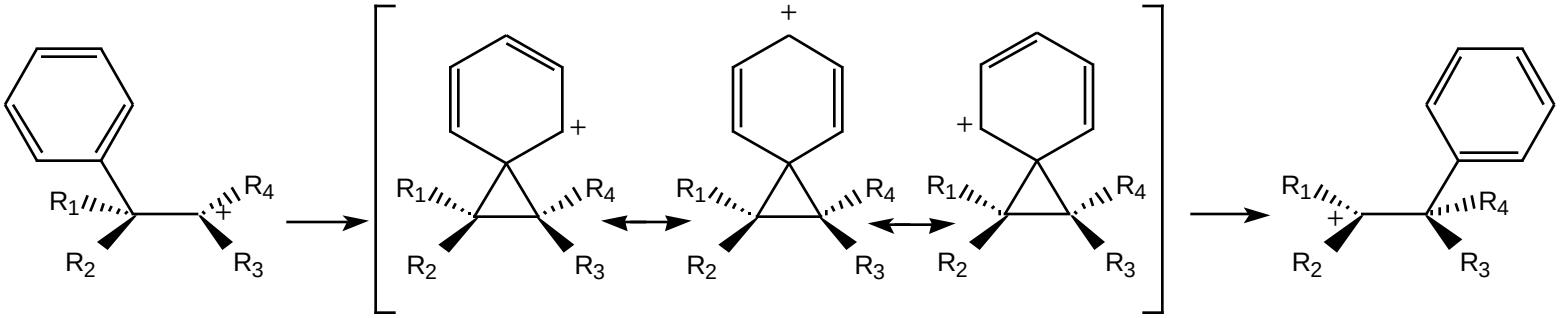
Collie, J.N.; Tickle, T. *J. Chem. Soc. Trans.* **1899**, 75, 710
Werner, A. *Chem. Ber.* **1901**, 34, 3300
Decker, H.; von Fellen, T. *Ann. Chem.* **1907**, 356, 281
Baeyer, A. *Chem. Ber.* **1910**, 43, 2337
Willstätter, R. *Sitzber. Preuss. Akad. Wissensch.* **1914**, 402
Willstätter, R.; Mallison, H. *Sitzber. Preuss. Akad. Wissensch.* **1914**, 769
Dilthey, W. *J. Prakt. Chem.* **1916**, 94, 53
Pfeiffer, P. *Ann. Chem.* **1917**, 412, 253
Hanztsch, A. *Chem. Ber.* **1919**, 52, 1535; 1544
Dilthey, W. *J. Prakt. Chem.* **1921**, 102, 209
Gastaldi, C. *Gazz. Chim. Ital.* **1921**, 5, 169
Dilthey, W. *J. Prakt. Chem.* **1922**, 104, 28



Balaban, A.T.; Nenitzescu, C.D. *Ann. Chem.* **1959**, 625, 74

Balaban, A.T.; Nenitzescu, C.D. *J. Chem. Soc.* **1961**, 3553; 3561; 3564
Praill, P.F.G.; Whitear, A.L. *J. Chem. Soc.* **1961**, 3573
Praill, P.F.G.; Whitear, A.L. *Proc. Chem. Soc.* **1961**, 312

Phenonium Ions

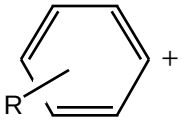


Reviews:
None.

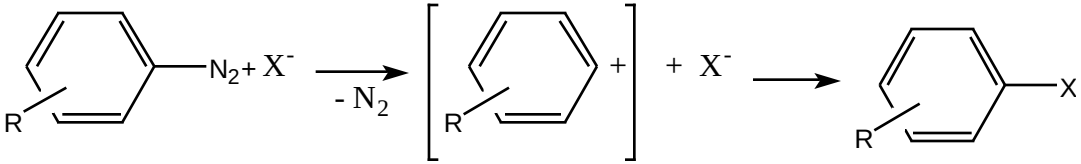
Cram, D.J. *J. Am. Chem. Soc.* **1949**, 71, 3863
Cram, D.J. *J. Am. Chem. Soc.* **1949**, 71, 3871
Cram, D.J. *J. Am. Chem. Soc.* **1949**, 71, 3875
Cram, D.J. *J. Am. Chem. Soc.* **1949**, 71, 3883
Winstein, S.; Morse, B.K.; Grunwald, E.; Schreiber, K.C.; Corse, J. *J. Am. Chem. Soc.* **1952**, 74, 1113
Winstein, S.; Brown, M.; Schreiber, K.C.; Schlesinger, A.H. *J. Am. Chem. Soc.* **1952**, 74, 1140
Cram, D.J.; Elhafez, F.A.A.; Weingartner, H. *J. Am. Chem. Soc.* **1953**, 75, 2293
Cram, D.J.; Elhafez, F.A.A. *J. Am. Chem. Soc.* **1953**, 75, 3189
Laurent, A.; Mison, P. *Bull. Soc. Chim. Fr.* **1962**, 956
Kresge, A.J.; Barry, G.W.; Charles, K.R.; Chiang, Y. *J. Am. Chem. Soc.* **1962**, 84, 4343
Cram, D.J. *J. Am. Chem. Soc.* **1964**, 86, 3767
Seidl, G.; Huisgen, R.; Wimmer, I. *Ann. Chem.* **1964**, 677, 34
Olah, G.A.; Pittman, C.U. Jr. *J. Am. Chem. Soc.* **1965**, 87, 3509

Olah, G.A.; Head, N.J.; Rasul, G.; Prakash, G.K.S. *J. Am. Chem. Soc.* **1995**, 117, 875

Phenyl Cation (phenylium ion, arylium ion, benzene cation)

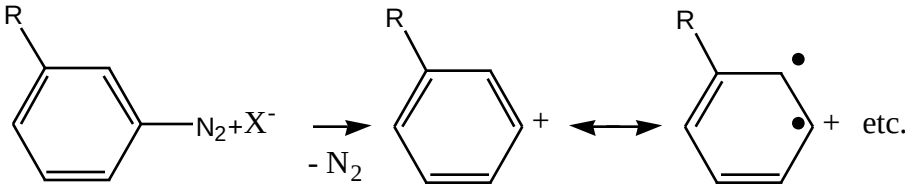


Reviews:
Ambroz, H.B.; Kemp, T.J. *Chem. Soc. Rev.* **1979**, 8, 353

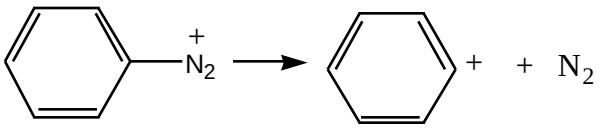


Sandmeyer, T., *Chem. Ber*. **1884**, 17, 1633
Sandmeyer, T., *Chem. Ber*. **1884**, 17, 2650

Lewis, E.S. *J. Am. Chem. Soc.* **1958**, 80, 1371
Kursanov, D.N.; Vol'pin, M.E.; Parnes, Z.N. *Khim. Nauka i Prom.* **1958**, 3, 159
Franzen, V. *Chem. Ztg.* **1959**, 83, 677

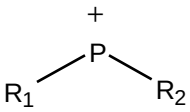


Taft, R.W. Jr. *J. Am. Chem. Soc.* **1961**, 83, 3350
Hey, D.H.; Liang, K.S.Y.; Perkins, M.J. *Tetrahedron Lett.* **1967**, 1477
Vul'fson, N.S.; Puchkov, V.A.; Nekrasov, Y.S. *Izv. Akad. Nauk SSSR Ser. Khim.* **1967**, 1881
Friedman, L.; Chlebowski, J. *J. Org. Chem.* **1968**, 33, 1633
Evleth, E.M.; Horowitz, P.M. *J. Am. Chem. Soc.* **1971**, 93, 5636
Gleiter, R.; Hoffmann, R.; Stohrer, W.D. *Chem. Ber.* **1972**, 105, 8
Kamigata, N.; Kobayashi, M.; Minato, H. *Bull. Chem. Soc. Jpn.* **1972**, 45, 2047
Boettcher, H.; Becker, H.G.O.; Inanov, V.L.; Kusmin, M.G. *Chimia* **1973**, 27, 437

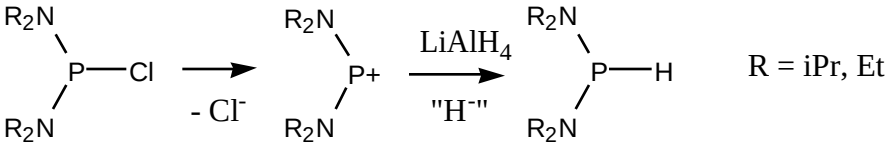


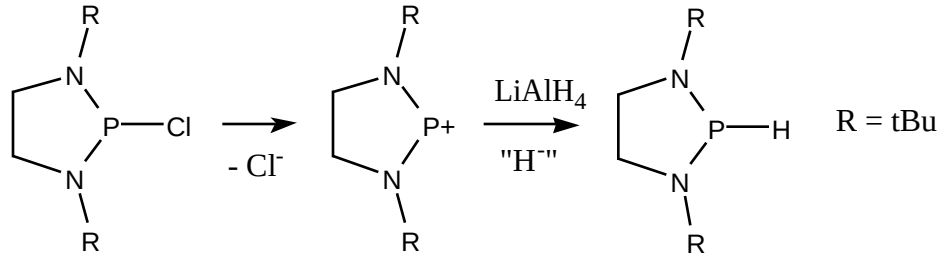
Swain, C.G.; Sheats, J.E.; Harbison, K.G. *J. Am. Chem. Soc.* **1975**, 97, 783
Swain, C.G.; Sheats, J.E.; Gorenstein, D.G.; Harbison, K.G. *J. Am. Chem. Soc.* **1975**, 97, 791

Phosphenium ions

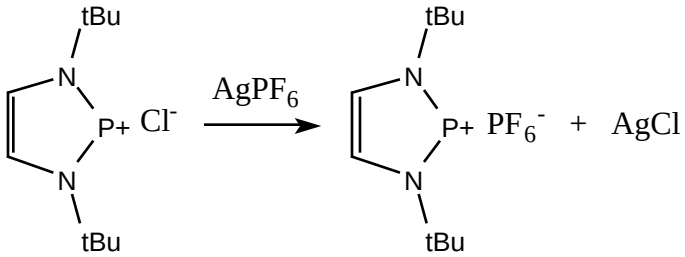


Reviews:
Cowley, A.H.; Kemp, R.A. *Chem. Rev.* **1985**, 85, 367
Mazieres, M.R.; Roques, C.; Khim, T.; Majoral, J.P.; Wolf, R.; Sanchez, M. *Phosphorus, Sulfur, and Silicon and the related elements* **1990**, 49-50, 309
Burford, N.; Clyburne, J.A.C.; Losier, P.; Parks, T.M.; Cameron, T.S.; Richardson, J.F. *Phosphorus, Sulfur, and Silicon and the related elements* **1994**, 53-54, 301
Guerret, O.; Bertrand, G. *Acc. Chem. Res.* **1997**, 30, 486
Nakazawa, H. *J. Organometallic Chem.* **2000**, 611, 349
Nakazawa, H. *Adv. Organometallic Chem.* **2004**, 50, 108



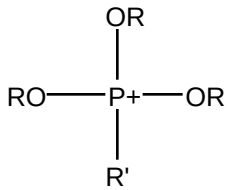


King, R.B.; Sundaram, P.M. *J. Org. Chem.* **1984**, 49, 1784
Kibardin, A.M.; Litvinov, I.A.; Naumov, V.A.; Struchkov, Yu.T.; Gryaznova, T.V.; Mikhailov, Yu.B.; Pudovnik, A.N. *Dokl. Akad. Nauk SSSR* **1988**, 298, 369
Wrackmeyer, B.; Schiller, J. *Z. Naturforsch.* **1992**, 47B, 662
Kibardin, A.M.; Litvinov, I.A.; Naumov, V.A.; Struchkov, Yu.T.; Gryaznova, T.V.; Mikhailov, Yu.B.; Pudovnik, A.N. *Dokl. Akad. Nauk SSSR* **1994**, 312, 623



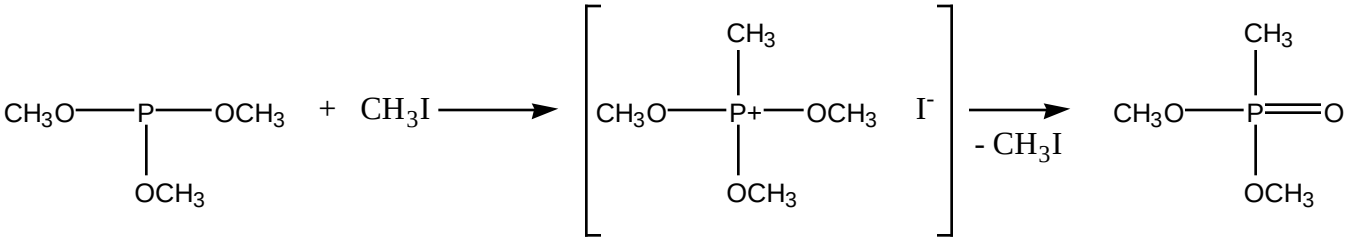
Denk, M.K.; Gupta, S.; Lough, A.J. *Eur. J. Inorg. Chem.* **1999**, 41

Phosphonium ions



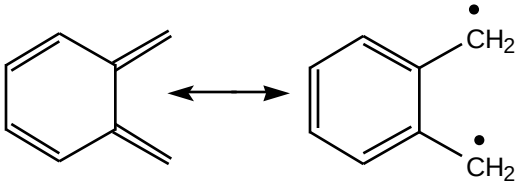
Reviews:

Smith, D.J.H. *Organophosphorus Chem.* **1972**, 4, 1
Smith, D.J.H. *Organophosphorus Chem.* **1973**, 5, 1
Smith, D.J.H. *Organophosphorus Chem.* **1974**, 6, 1
Smith, D.J.H. *Organophosphorus Chem.* **1976**, 7, 1
Allen, D.W. *Organophosphorus Chem.* **1977**, 8, 1
Allen, D.W. *Organophosphorus Chem.* **1978**, 9, 1
Allen, D.W. *Organophosphorus Chem.* **1979**, 10, 1
Smith, D.J.H. in *Comprehensive Organic Chemistry*, (I.O. Sutherland, ed.) Pergamon Press: Oxford, 1979, Vol. 2, p. 1127 - 1187
Allen, D.W. *Organophosphorus Chem.* **1980**, 11, 1
Allen, D.W. *Organophosphorus Chem.* **1981**, 12, 1
Allen, D.W. *Organophosphorus Chem.* **1983**, 14, 1
Allen, D.W. *Organophosphorus Chem.* **1984**, 15, 1
Allen, D.W. *Organophosphorus Chem.* **1985**, 16, 1
Allen, D.W. *Organophosphorus Chem.* **1986**, 17, 1
Allen, D.W. *Organophosphorus Chem.* **1987**, 18, 1
Allen, D.W. *Organophosphorus Chem.* **1988**, 19, 1
Allen, D.W. *Organophosphorus Chem.* **1989**, 20, 1
Allen, D.W. *Organophosphorus Chem.* **1990**, 21, 1
Allen, D.W. *Organophosphorus Chem.* **1991**, 22, 1
Allen, D.W. *Organophosphorus Chem.* **1992**, 23, 1
Allen, D.W. *Organophosphorus Chem.* **1993**, 24, 1
Allen, D.W. *Organophosphorus Chem.* **1994**, 25, 1
Cristan, H.J.; Plenat, F. in *Chemistry of Organophosphorus Compounds*, (F.R. Hartley, ed.) Wiley: Chichester, 1994, p. 45 - 183
Allen, D.W. *Organophosphorus Chem.* **1995**, 26, 1
Allen, D.W. *Organophosphorus Chem.* **1996**, 27, 1
Allen, D.W. *Organophosphorus Chem.* **1997**, 28, 1
Allen, D.W. *Organophosphorus Chem.* **1999**, 29, 1
Allen, D.W. *Organophosphorus Chem.* **2000**, 30, 1
Stephan, D.W. *Angew. Chem. Int. Ed.* **2000**, 39, 501
Allen, D.W. *Organophosphorus Chem.* **2001**, 31, 1
Allen, D.W. *Organophosphorus Chem.* **2002**, 32, 1
Allen, D.W. *Organophosphorus Chem.* **2003**, 33, 1

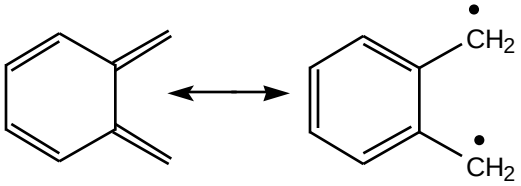


Michaelis, A.; Kaehne, R. *Chem. Ber*. **1898**, 31, 1048
Arbuzov, A.E. *J. Russ. Phys. Chem. Soc*. **1906**, 38, 687

o-Quinodimethanes (o-Xylylenes)

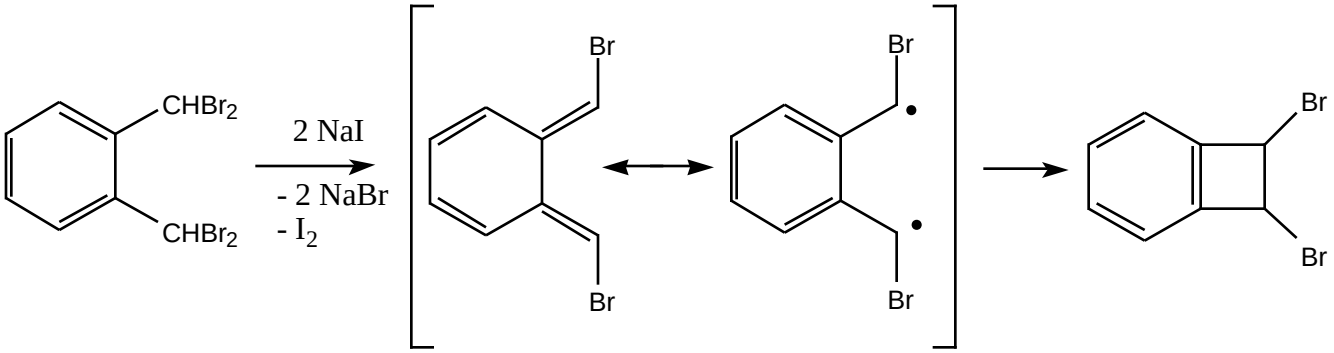


Reviews:
Segura, J.L.; Martin, N. *Chem. Rev.* **1999**, 99, 3199



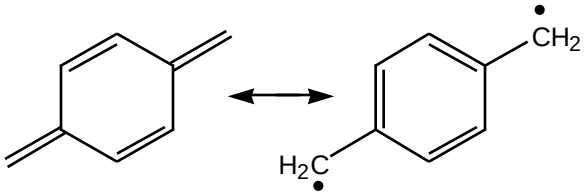
Willstätter, R.; Veraguth, H. *Chem. Ber.* **1907**, 40, 959
Bamberger, E.; Reber, E. *Chem. Ber.* **1907**, 40, 2258
Fecht, H. *Chem. Ber.* **1907**, 40, 3883
Ipatiev, V. *Chem. Ber.* **1908**, 41, 993
Tshitshibabin, A.E. *Chem. Ber.* **1908**, 41, 2770
Scholtz, M.; Wolfrum, R. *Chem. Ber.* **1910**, 43, 2304
Chelintzev, V.V. *Bull. Soc. Chim. Fr.* **1936**, 3, 1035
Esafov, V.I. *J. Gen. Chem. USSR* **1939**, 9, 1841
Beilenson, B.; Hamer, F.M.; Rathbone, R.J. *J. Chem. Soc*. **1945**, 222

Lu're, S.I.; Shemyakin, M.M. *J. Gen. Chem. USSR* **1947**, 17, 1356
Meyer, A.; Bouchet, G. *Compt. Rend.* **1948**, 227, 345
Wittig, G.; Mangold, R.; Felletschin, G. *Ann. Chem.* **1948**, 560, 116



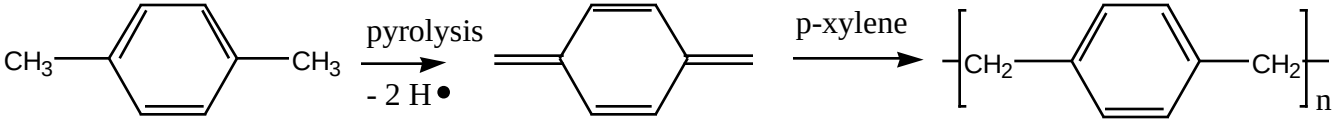
Cava, M.P.; Napier, D.R. *J. Am. Chem. Soc.* **1957**, 79, 1701

p-Quinodimethanes (p-Xylylenes)



Reviews:
None.

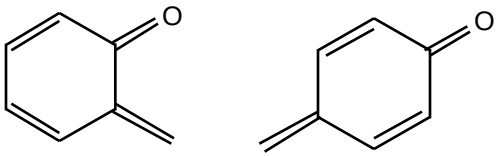
Schlenk, W.; Meyer, E. *Chem. Ber.* **1919**, 52B, 8



Szwarc, M. *Nature* **1947**, 160, 403

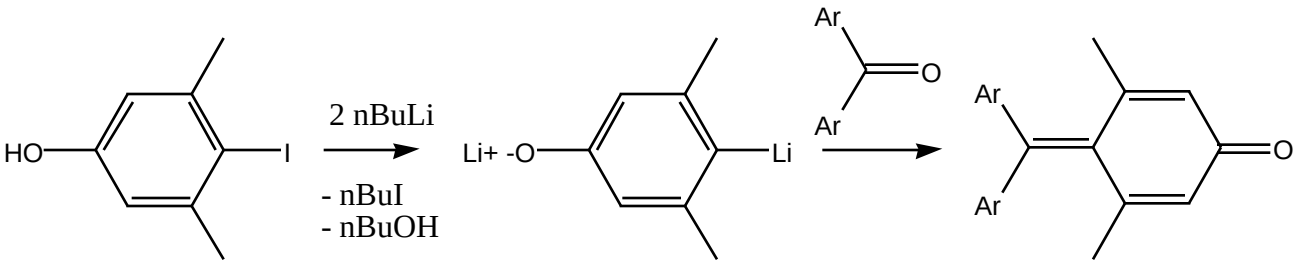
Szwarc, M. *Disc. Faraday Soc.* **1947**, 2, 46
Szwarc, M. *J. Chem. Phys.* **1951**, 16, 319
Farmer, J.B.; Marsden, D.G.H.; Lossing, F.P. *J. Chem. Phys.* **1955**, 23, 403
Errede, L.A.; Landrum, B.F. *J. Am. Chem. Soc.* **1957**, 79, 4952

o-Quinonemethides and p-Quinonemethides

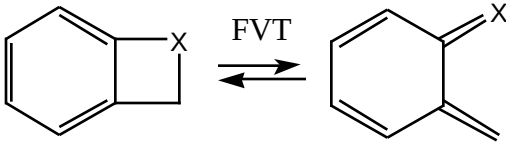


Reviews:
Fries, K.; Brandes, E. *Ann. Chem.* **1939**, 542, 48
Wagner, H.U.; Gompper, R. in *The Chemistry of Quinonoid Compounds*, (S. Patai, ed.) Wiley: Chichester, 1974, p. 1145
Volod'kin, A.A.; Ershov, V.V. *Usp. Khim. (Russ. Chem. Rev.)* **1988**, 57, 595
Wagner, H.U.; Gompper, R. in *The Chemistry of Quinonoid Compounds*, (S. Patai, Z. Rappoport, eds.) Wiley: Chichester, 1988. Vol. 2.
Amouri, H.; Le Bras, J. *Acc. Chem. Res.* **2002**, 35, 501

Staudinger, H.; Bereza, S. *Ann. Chem.* **1911**, 380, 243
Gomberg, M. *J. Am. Chem. Soc.* **1913**, 35, 1035
Schlenk, W.; Brauns, M. *Chem. Ber.* **1914**, 46, 4061
Pummerer, R.; Melamed, D.; Puttfarcken, H. *Chem. Ber.* **1922**, 55B, 3116
Lindemann, H. *Ann. Chem.* **1923**, 431, 270
Lindemann, H.; Forth, H. *Ann. Chem.* **1923**, 435, 219
Shoruigin, P. *Chem. Ber.* **1927**, 60B, 2373
Goldschmidt, S.; Sadler, A.; Gelber, E.; Schlosser, H.; Vogt, A. *Chem. Ber.* **1928**, 61B, 829
Shorigin, P. *Chem. Ber.* **1928**, 61B, 2516

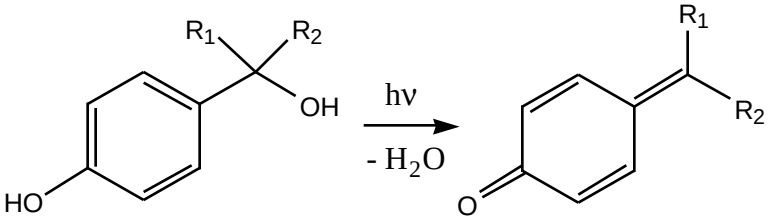


Hünig, S.; Schweeberg, H.; Schwarz, H. *Ann. Chem.* **1954**, 587, 132
Hünig, S.; Schwarz, H. *Ann. Chem.* **1956**, 599, 131



X = O, S, NH

Pfister-Guillouzo, G.; Gracian, F.; Senio, A.; Letulle, M.; Ripoll, J.L. *Tetrahedron Lett.* **1992**, 33, 5753



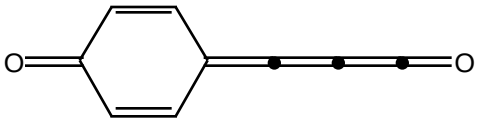
Wan, P.; Barker, B.; Diao, L.; Fischer, M.; Shi, Y.; Yang, C. *Can. J. Chem.* **1996**, 74, 465

Chiang, Y.; Kresge, A.J.; Zhu, Y. *J. Am. Chem. Soc.* **2000**, 122, 9854

Chiang, Y.; Kresge, A.J.; Zhu, Y. *J. Am. Chem. Soc.* **2002**, 124, 6349

Chiang, Y.; Kresge, A.J.; Zhu, Y. *Photochem. Photobiol. Sci.* **2002**, 1, 67

Chang, J.A.; Kresge, A.J.; Zhan, H.Q.; Zhu, Y. *J. Phys. Org. Chem.* **2004**, 17, 579



Cevasco, G.; Pardini, R.; Thea, S. *Eur. J. Org. Chem.* **1998**, 665

Radicals

Reviews:
Gomberg, M. *Chem. Rev.* **1925**, 1, 91
Trans. Faraday Soc. **1934**, 30, 1 - 246 (symposium on radicals)
Hey, D.H.; Waters, W.A. *Chem. Rev.* **1937**, 21, 169
Steacie, E.W.R. *Free Radical Mechanisms*, Reinhold Publishing Corp.: New York, 1946
Steacie, E.W.R. *Atomic and Free Radical Reactions*, 2nd ed., Reinhold Publishing Corp.: New York, 1954
Lossing, F.P. *Ann. N.Y. Acad. Sci.* **1957**, 67, 499
Waters, W.A. (ed.) *Vistas in Free-Radical Chemistry*, Pergamon Press: New York, 1959
Symons, M.C.R. *Adv. Phys. Org. Chem.* **1963**, 1, 284
Friedlina, R.K. *Adv. Free Radical Chem.* **1965**, 1, 211
Norman, R.O.C. *Adv. Phys. Org. Chem.* **1967**, 5, 53
Forrester, A.R.; Hay, J.M.; Thomson, R.H. *Organic Chemistry of Stable Free Radicals*, Academic Press: New York, 1968
Janzen, E.G. *Acc. Chem. Res.* **1969**, 2, 279
Bennett, J.E.; Mile, B.; Thomas, A.; Ward, B. *Adv. Phys. Org. Chem.* **1970**, 8, 1
Kochi, J.K. (ed.) *Free Radicals*, Wiley: New York, Vol. 1 - 2, 1973
Huyser, E.S. in *Organic Reactive Intermediates*, (S.P. McManus, ed.) Academic Press: New York, 1973, p. 1
Zahradnik, R.; Carsky, P. *Prog. Phys. Org. Chem.* **1973**, 10, 327
Neta, P. *Adv. Phys. Org. Chem.* **1976**, 12, 224
Griller, D.; Ingold, K.U. *Acc. Chem. Res.* **1976**, 9, 13
Griller, D.; Ingold, K.U. *Acc. Chem. Res.* **1980**, 13, 193
Ballester, M. *Acc. Chem. Res.* **1985**, 18, 380 (inert free radicals)

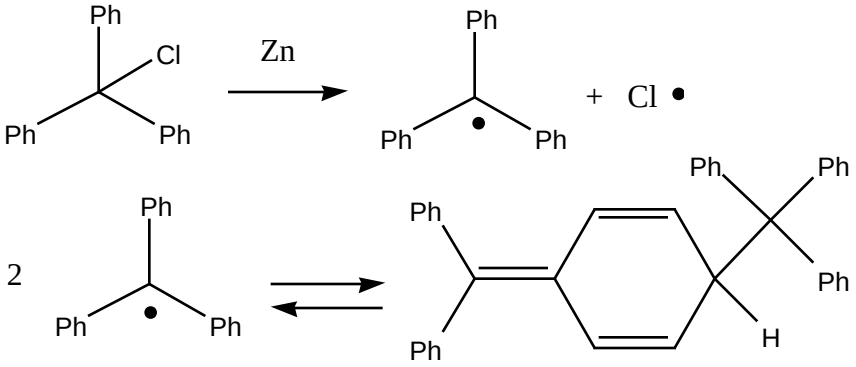
Russell, G.A. *Adv. Phys. Org. Chem.* **1987**, 23, 271
Ballester, M. *Adv. Phys. Org. Chem.* **1989**, 25, 307; 321 (inert free radicals)
Fossey, J.; Lefort, D.; Sorba, J. *Free Radicals in Organic Chemistry*, Wiley: New York, 1995
Arnold, B.R.; Bucher, G.; Netto-Ferreira, J.C.; Platz, M.S.; Scaiano, J.C. *Biradicals, Radicals in Excited States, Carbenes, and Related Species*, Springer-Verlag: Weinheim, 1998
Saveant, J.M. *Adv. Phys. Org. Chem.* **2000**, 35, 117
Rathore, R.; Kochi, J.K. *Adv. Phys. Org. Chem.* **2000**, 35, 193
Tidwell, T.T. *Adv. Phys. Org. Chem.* **2001**, 36, 1
Zipse, H. *Adv. Phys. Org. Chem.* **2003**, 38, 111
Power, P.P. *Chem. Rev.* **2003**, 103, 789 (stable radicals of heavier main group elements)
Hicks, R.G. *Can. J. Chem.* **2004**, 82, 1119 (stable radicals)

stabilities of free radicals:

Bowden, S.T.; Jones, W.J. *J. Chem. Soc.* **1928**, 1149 (from dimer dissociation equilibria)
Bent, H.E.; Cline, J.E. *J. Am. Chem. Soc.* **1936**, 58, 1624 (from thermochemical techniques)
Cohen, S.G.; Cohen, F.; Wang, C.H. *J. Org. Chem.* **1953**, 28, 1749 (from kinetic techniques)
Henglein, A. *Electroanal. Chem.* **1976**, 9, 163 (from pulse radiolysis polarography)

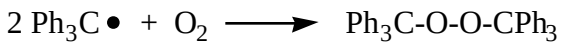
Carbon centred radicals

(i) Gomberg radical



Gomberg, M., *J. Am. Chem. Soc.* **1900**, 22, 757

Gomberg, M. *Chem. Ber.* **1900**, 33, 3150
Gomberg, M. *Chem. Ber.* **1901**, 34, 2726
Gomberg, M.; Bachmann, W.E. *J. Am. Chem. Soc.* **1924**, 46, 2339
Lankamp, H.; Nauta, W.T.; MacLean, C. *Tetrahedron Lett.* **1968**, 249 (correct structure of radical dimer product)

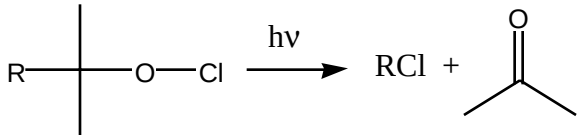


Gomberg, M.; Cone, L.H. *Chem. Ber.* **1904**, 37, 3538
Schmidlin, J. *Chem. Ber.* **1908**, 41, 2471

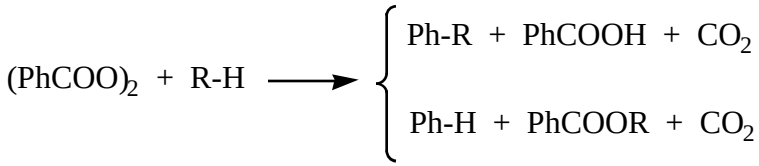
(ii) Alkyl radicals

Reviews:

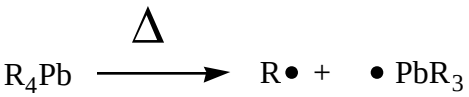
Steacie, E.W.R. *Atomic and Free Radical Reactions*, 2nd ed., Reinhold: New York, 1954
Norrish, R.G.W.; Thrush, B.A. *Quart. Rev. Chem. Soc.* **1956**, 10, 149
Davidson, N. *J. Chem. Educ.* **1957**, 34, 126
Ramsay, D.A. *Ann. N.Y. Acad. Sci.* **1957**, 67, 485
Lossing, F.P. *Ann. N.Y. Acad. Sci.* **1957**, 67, 499
Kutschke, K.O.; Steacie, E.W.R. in *Vistas in Free Radical Chemistry*, (W.A. Waters, ed.) Pergamon Press: New York, 1959, p. 162



Chattaway, F.D.; Backeberg, O.G. *J. Chem. Soc.* **1923**, 123, 2999

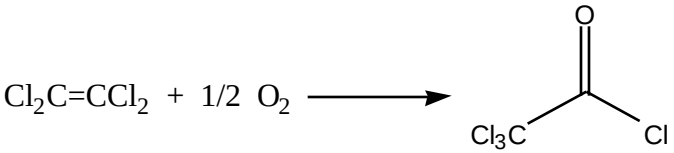


Gelissen, H.; Hermans, P.H. *Chem. Ber.* **1925**, 58, 984

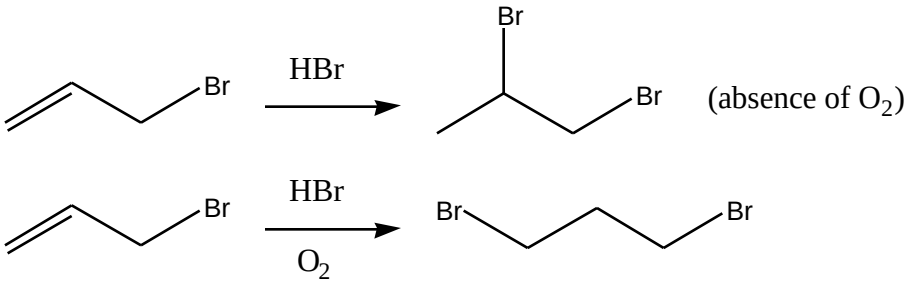


Paneth, F.; Hofeditz, W. *Chem. Ber.* **1929**, 62, 1335 (gas phase)
Paneth, F.; Lautsch, W. *Chem. Ber.* **1931**, 64, 2702
Paneth, F.; Herzfeld, K. *Z. Elektrochem.* **1931**, 37, 577
Paneth, F. *Trans. Faraday Soc.* **1934**, 30, 179

Pease, R.N.; Walz, F. *J. Am. Chem. Soc.* **1931**, 53, 3728



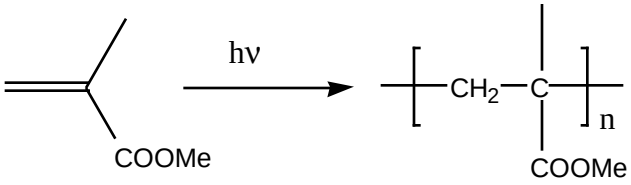
Dickinson, R.A.; Leermakers, P.A. *J. Am. Chem. Soc.* **1932**, 54, 3852



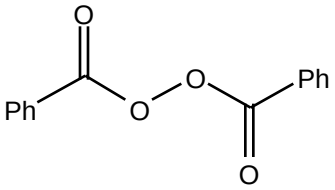
Kharasch, M.S.; Mayo, F.R. *J. Am. Chem. Soc.* **1933**, 55, 2468 (peroxide effect)
Kharasch, M.S.; Engelmann, H.; Mayo, F.R. *J. Org. Chem.* **1937**, 2, 288
Kharasch, M.S.; Mayo, F.R. *J. Am. Chem. Soc.* **1938**, 60, 3097

chlorination of aliphatic hydrocarbons:
Hass, H.B.; McBee, E.T.; Weber, P. *Ind. Eng. Chem.* **1935**, 27, 1190
Hass, H.B.; McBee, E.T.; Weber, P. *Ind. Eng. Chem.* **1936**, 28, 333
Vaughan, W.E.; Rust, F.F. *J. Org. Chem.* **1940**, 6, 449
Rust, F.F.; Vaughan, W.E. *J. Org. Chem.* **1941**, 7, 479

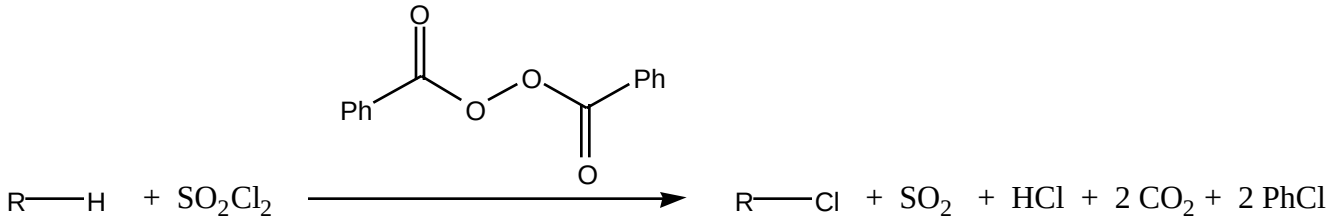
Kharasch, M.S.; Mansfield, J.V.; Mayo, F.R. *J. Am. Chem. Soc.* **1937**, 59, 1155



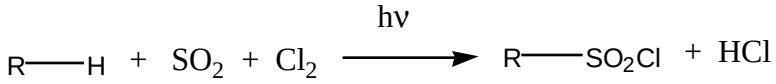
Melville, H.W. *Proc. Roy. Soc. London* **1937**, 163A, 511



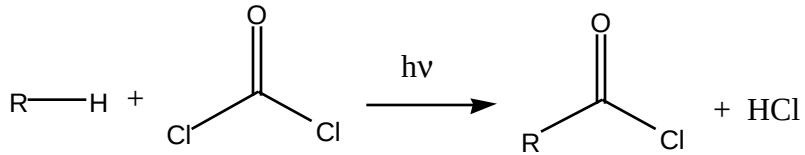
Brodie, B.C. *Ann. Chem.* **1858**, 108, 79

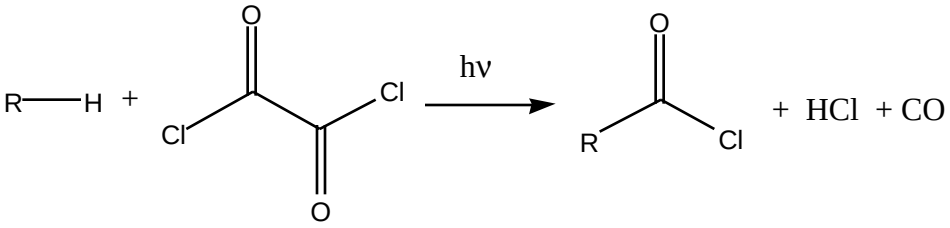


Kharasch, M.S.; Brown, H.C. *J. Am. Chem. Soc.* **1939**, 61, 2142; 3432
Kharasch, M.S.; Brown, H.C. *J. Am. Chem. Soc.* **1940**, 62, 925

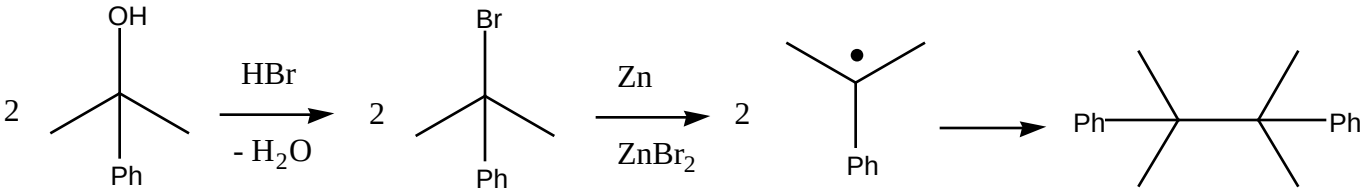


Reed, C.F. US 2,174,494 (1939)
Kharasch, M.S.; Chao, T.H.; Brown, H.C. *J. Am. Chem. Soc.* **1940**, 62, 2393

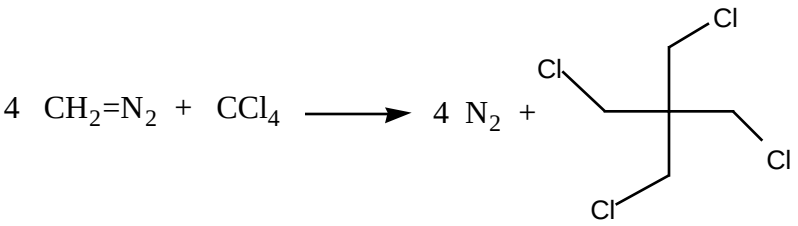




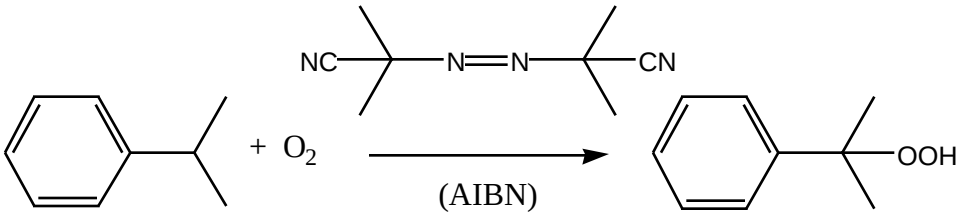
Kharasch, M.S.; Brown, H.C. *J. Am. Chem. Soc.* **1940**, 62, 454



Ziegler, K.; Deparade, W. *Ann. Chem.* **1950**, 567, 123



Urry, W.H.; Eiszner, J.R. *J. Am. Chem. Soc.* **1952**, 75, 5822

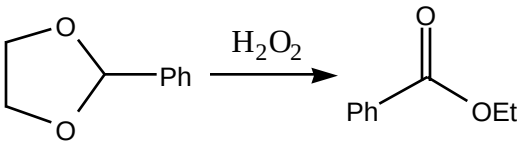


Jones, G.G. US 2,681,936 (1954)

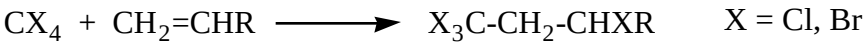
detection of free radicals in solution:

Kharasch, M.S.; Mulley, R.D.; Nudenberg, W. *J. Org. Chem.* **1954**, 19, 1477
Kharasch, M.S.; Holton, P.G.; Nudenberg, W. *J. Org. Chem.* **1954**, 19, 1600
Kharasch, M.S.; Nudenberg, W. *J. Org. Chem.* **1954**, 19, 1921
Kharasch, M.S.; Holton, P.G.; Nudenberg, W. *J. Org. Chem.* **1955**, 20, 920

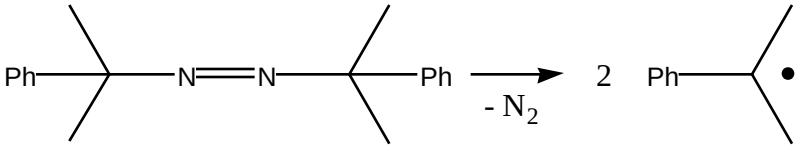
Herzberg, G.; Shoosmith, J. *Can. J. Phys.* **1956**, 34, 523 (detection of methyl radical)



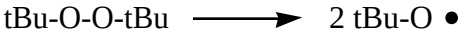
Huyser, E.S.; Garcia, Z. *J. Org. Chem.* **1962**, 27, 2716

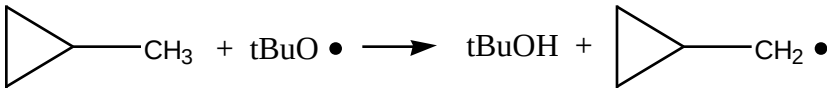


Walling, C.; Huyser, E.S. *Org. React.* **1963**, 13, 122

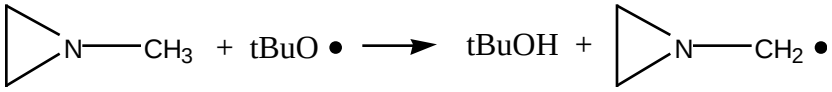


Nelsen, S.F.; Bartlett, P.D. *J. Am. Chem. Soc.* **1966**, 88, 137
Nelsen, S.F.; Bartlett, P.D. *J. Am. Chem. Soc.* **1966**, 88, 143





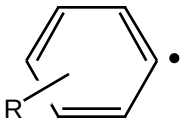
Kochi, J.K.; Krusic, P.J.; Eaton, D.R. *J. Am. Chem. Soc.* **1969**, 91, 1877
Kochi, J.K.; Krusic, P.J.; Eaton, D.R. *J. Am. Chem. Soc.* **1969**, 91, 1879

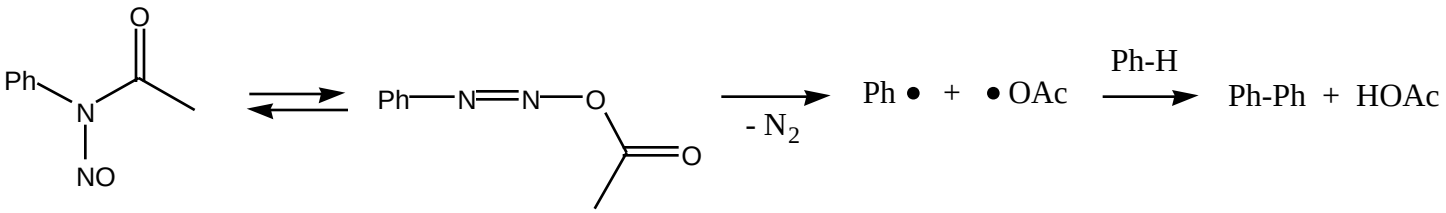


Danen, W.C.; West, C.T.; Kensler, T.T. *J. Am. Chem. Soc.* **1973**, 95, 5716
Danen, W.C.; West, C.T. *J. Am. Chem. Soc.* **1974**, 96, 2447

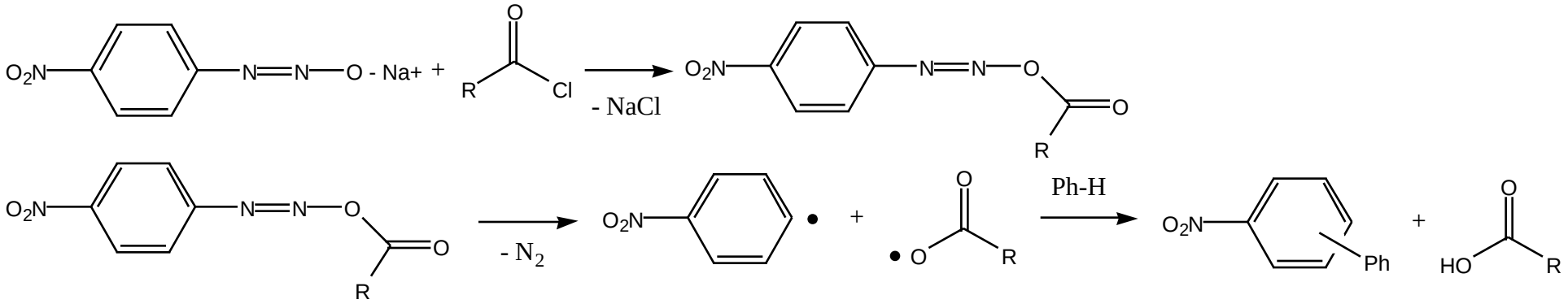
(iii) Aryl radical (phenyl radical)
Reviews:

Taylor, G.W. *Can. J. Chem.* **1957**, 35, 739
Williams, G.H. *Homolytic Aromatic Substitution*, Pergamon Press: London, 1960
Porter, G.G. in *Molecular Spectroscopy* (P. Hepple, ed.) *Proc. Conf. 4th*, 1968, 305
Bolton, R.; Williams, G.H. *Chem. Soc. Rev.* **1986**, 15, 261
Galli, C. *Chem. Rev.* **1988**, 88, 765
Brown, R.F.C. *Eur. J. Org. Chem.* **1999**, 3211

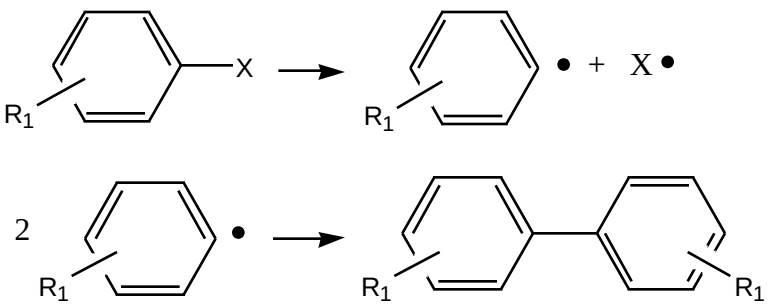




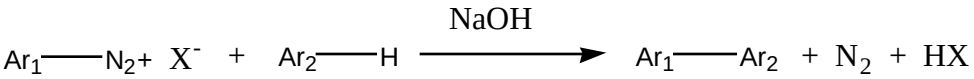
Bamberger, E. *Chem. Ber.* **1895**, 28, 403
Bamberger, E. *Chem. Ber.* **1897**, 30, 366
Waters, W.A. *J. Chem. Soc.* **1937**, 113



Kühling, O. *Chem. Ber.* **1895**, 28, 41
Kühling, O. *Chem. Ber.* **1896**, 29, 165



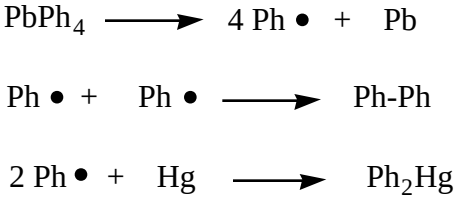
Ullmann, F. *Ann. Chem*. **1904**, 332, 38 (Ullmann coupling reaction)
Rapson, W.S.; Shuttleworth, R.G. *Nature* **1941**, 147, 675



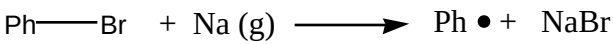
Gomberg, M.; Bachmann, W.E. *J. Am. Chem. Soc.* **1924**, 46, 2339
Gomberg, M.; Pernert, J.C. *J. Am. Chem. Soc.* **1926**, 48, 1372

Levy, J. *Bull. Soc. Chim. Fr.* **1923**, 33, 1655
Reihlen, H.; Illig, R.; Wittig, R. *Chem. Ber.* **1925**, 58B, 12
Levy, J. *Bull. Soc. Chim. Fr.* **1926**, 39, 67
Tiffeneau, M.; Levy, J. *Bull. Soc. Chim. Fr.* **1931**, 49, 1806

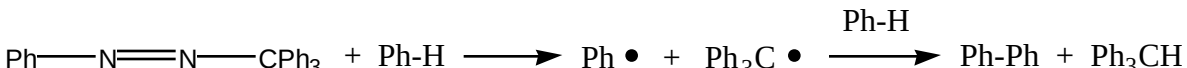
Bates, J.R.; Taylor, H.S. *J. Am. Chem. Soc.* **1927**, 49, 2438 (first free radical chain mechanism for gas phase polymerization of ethylene)

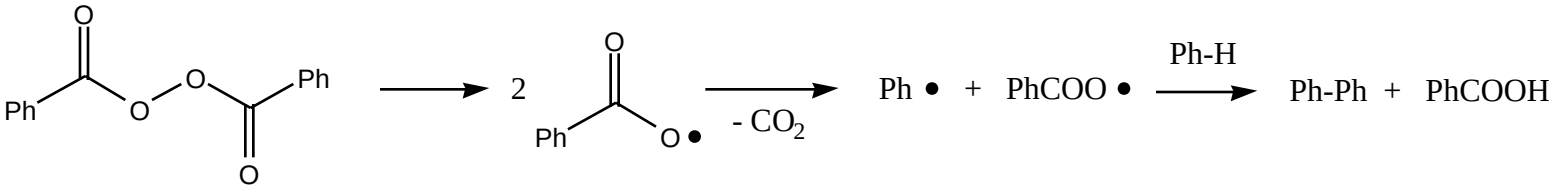


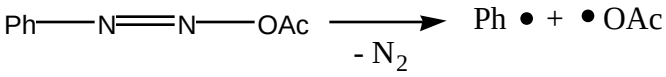
Dull, M.F.; Simons, J.H. *J. Am. Chem. Soc.* **1933**, 55, 3898

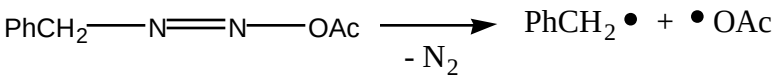


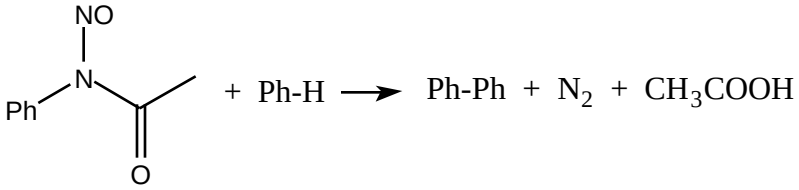
Horn, E.; Polanyi, M. *Z. Physik. Chem.* **1934**, 25B, 151

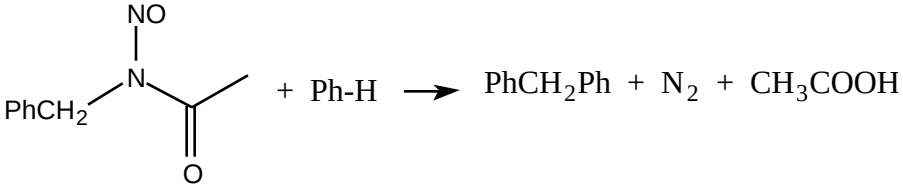




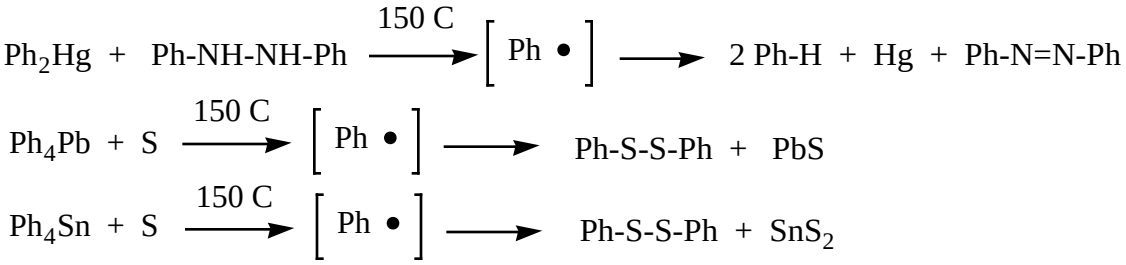




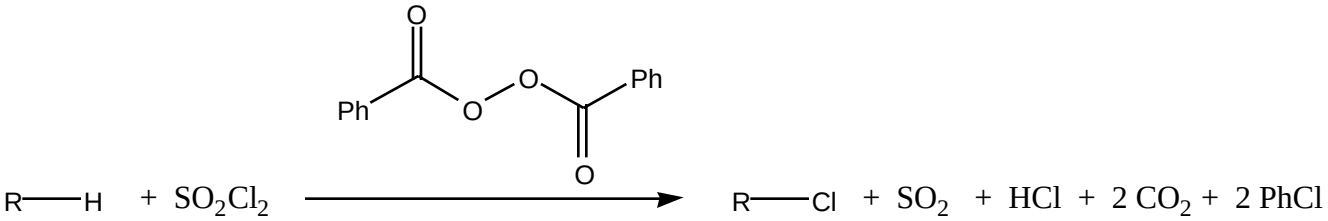




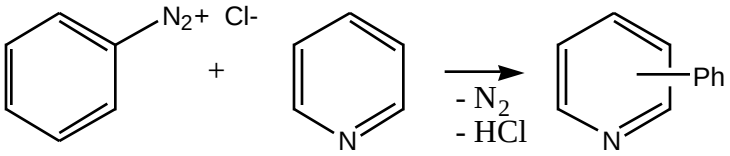
Grieve, W.S.M.; Hey, D.H. *J. Chem. Soc.* **1934**, 1797 (homolytic aromatic substitution)
Hey, D.H. *J. Chem. Soc.* **1934**, 1966



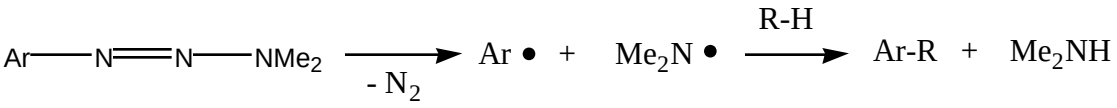
Razuvaev, G.A.; Koton, M.M. *Zh. Obshchei Khim.* **1935**, 5, 361
Koton, M.M. *Zh. Obshchei Khim.* **1932**, 2, 345



Kharasch, M.S.; Brown, H.C. *J. Am. Chem. Soc.* **1939**, 61, 2142; 3432
Kharasch, M.S.; Brown, H.C. *J. Am. Chem. Soc.* **1940**, 62, 925



Haworth, J.W.; Heilbron, I.M.; Hey, D.H. *J. Chem. Soc.* **1940**, 349
Hey, D.H.; Stirling, C.J.M.; Williams, G.H. *J. Chem. Soc.* **1955**, 3963



Elks, J.; Hey, D.H. *J. Chem. Soc.* **1943**, 441

Hardie, R.L.; Thomson, R.H. *J. Chem. Soc.* **1958**, 1286

Basterfield, S.; Dyck, A.J. *Can. J. Res.* **1942**, 20B, 240

Tiffeneau, M.; Tchoubar, B.; Le Tellier, S. *Compt. Rend.* **1943**, 217, 588

Huisgen, R.; Horeld, G. *Ann. Chem.* **1949**, 562, 137

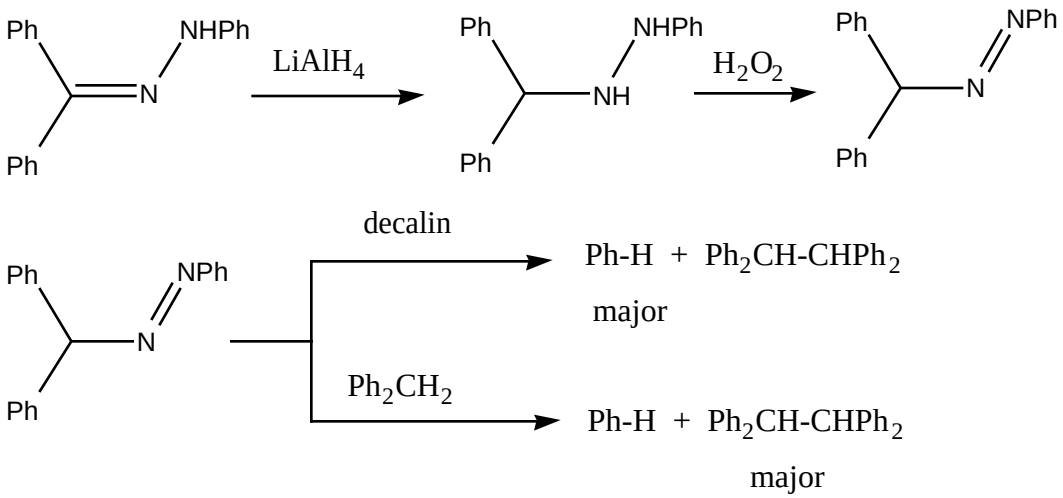
Szwarc, M.; Williams, D. *J. Chem. Phys.* **1952**, 20, 1171
Jacquiss, M.T.; Szwarc, M. *Nature* **1952**, 170, 312

Ingold, K.U.; Lossing, F.P. *Can. J. Chem.* **1953**, 31, 30

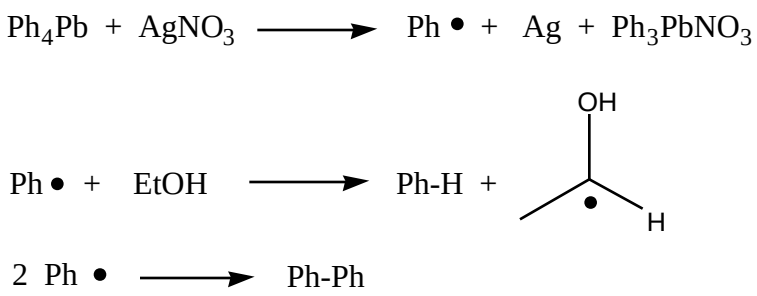
$[PhCOO]_4Pb \longrightarrow 4\ Ph\bullet + 4\ CO_2 + Pb$

$Ph\bullet + Ar\text{-}H \longrightarrow Ph\text{-}Ar + H\bullet$

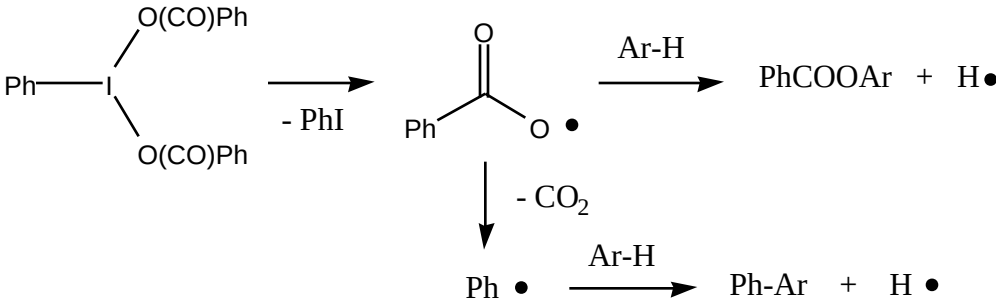
Hey, D.H. Stirling, C.J.M.; Williams, G.H. *J. Chem. Soc.* **1954**, 2747



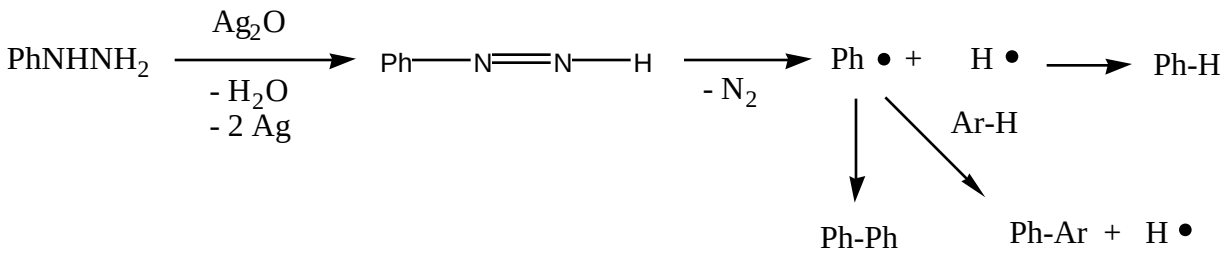
Cohen, S.G.; Wang, C.H. *J. Am. Chem. Soc.* **1955**, 77, 3628



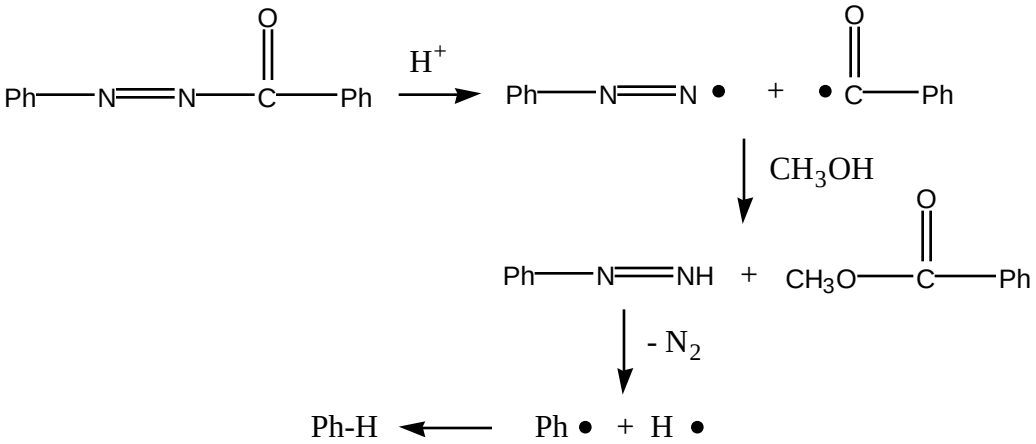
Spice, J.E.; Twist, W. *J. Chem. Soc.* **1956**, 3319



Hey, D.H.; Stirling, C.J.M.; Williams, G.H. *J. Chem. Soc.* **1956**, 1475

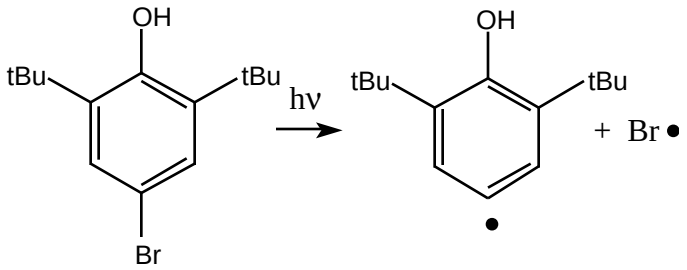


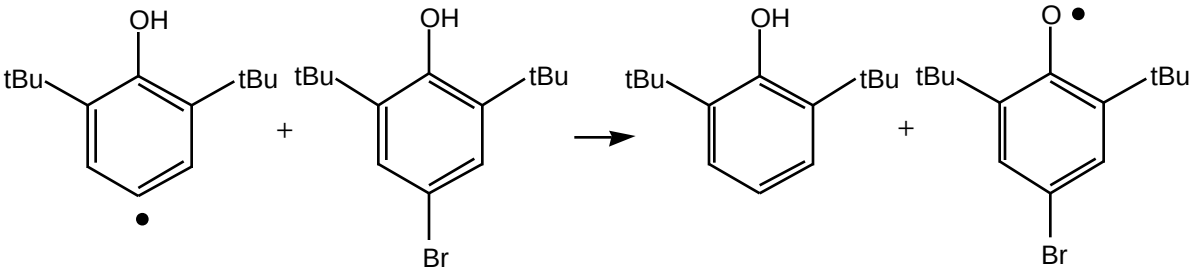
Hardie, R.L.; Thomson, R.H. *J. Chem. Soc.* **1957**, 2512



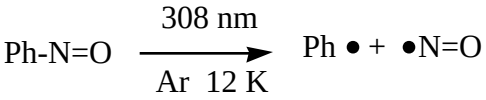
Cohen, S.G.; Nicholson, J. *J. Am. Chem. Soc.* **1964**, 86, 3892
Cohen, S.G.; Nicholson, J. *J. Org. Chem.* **1965**, 30, 1162

Porter, G.; Ward, B. *Proc. Roy. Soc. London A* **1965**, 287, 457 (UV spectrum in gas phase)
Cercek, B.; Kongshaug, M. *J. Phys. Chem.* **1970**, 74, 4319 (UV spectrum in aqueous solution)
Ikeda, N.; Nakashima, N.; Yoshihara, K. *J. Am. Chem. Soc.* **1985**, 97, 3381 (UV spectrum in gas phase)



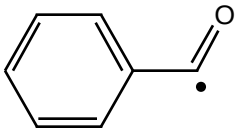


Lappin, G.R.; Zannucci, J.S. *Tetrahedron Lett.* **1969**, 5085

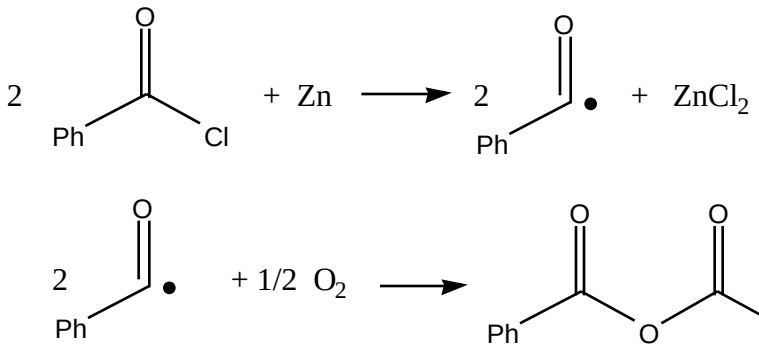


Engbert, J.M.; Dick, B. *Appl. Phys. B* **1996**, 63, 531
Engbert, J.M.; Slenczka, A.; Kensy, U.; Dick, B. *J. Phys. Chem.* **1996**, 100, 11883

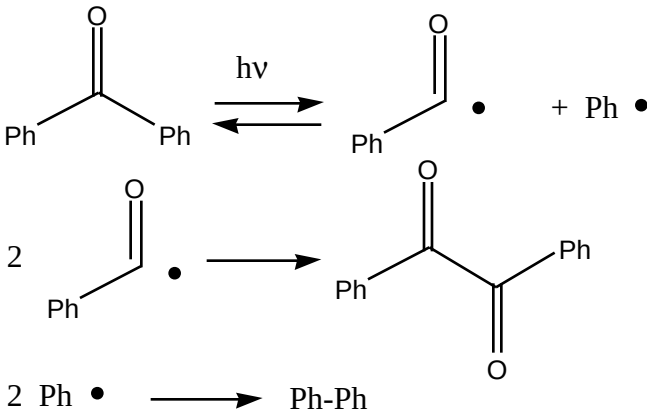
(iv) Benzoyl radical



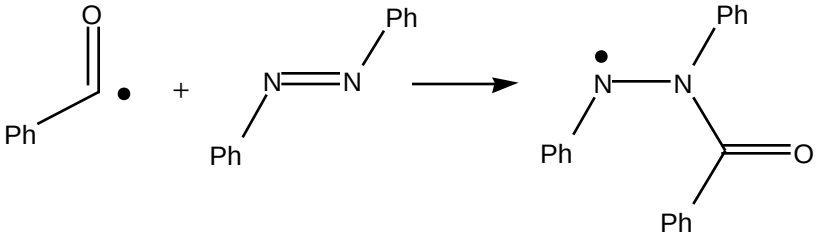
Reviews (acyl or acetyl radicals):
Vinogradov, M.G.; Nikishin, G.I. *Usp. Khim.* **1971**, 40, 1960
Caronna, T.; Minisci, F. *Rev. Reactive Species in Chemical Reactions* **1976**, 1, 263
Boger, D.L. *Isr. J. Chem.* **1997**, 37, 9349
Chatgilialoglu, C.; Crich, D.; Komatsu, M.; Ryu, I. *Chem. Rev.* **1999**, 99, 1991



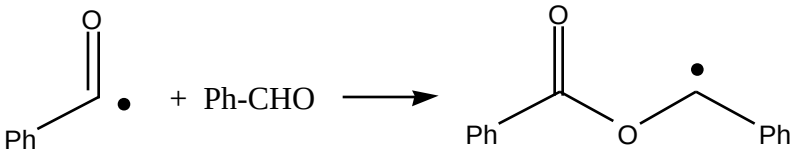
Norris, J.F.; Franklin, D.R. *Am. Chem. J.* **1903**, 29, 141 (suggestion)

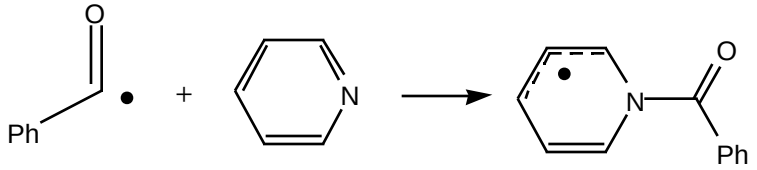


Glazebrook, H.H.; Pearson, T.G. *J. Chem. Soc.* **1939**, 589

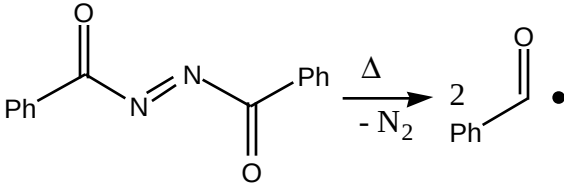


Kharasch, M.S.; Zimmerman, M.; Zimmt, W.; Nudenberg, W. *J. Org. Chem.* **1953**, 18, 1045

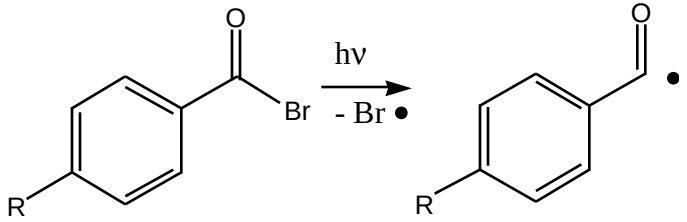




Kharasch, M.S.; Schwartz, D.; Zimmerman, M.; Nudenberg, W. *J. Org. Chem.* **1953**, 18, 1051

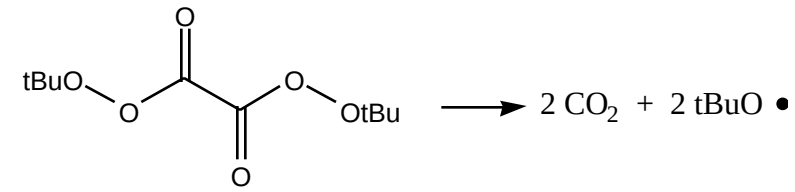


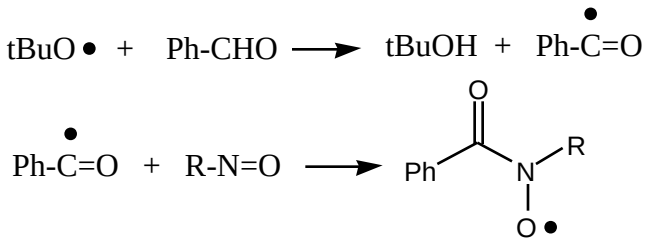
Mackay, D.; Marx, U.F.; Waters, W.A. *J. Chem. Soc.* **1964**, 4793



R = H, Cl, OMe

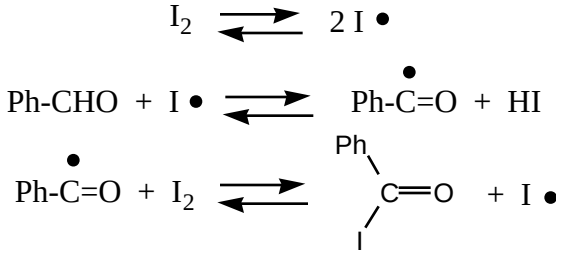
Schmidt, U.; Kabitzke, K.H.; Markau, K. *Angew. Chem.* **1965**, 77, 378
Schmidt, U.; Kabitzke, K.H.; Markau, K. *Monatsh. Chem.* **1966**, 97, 1000



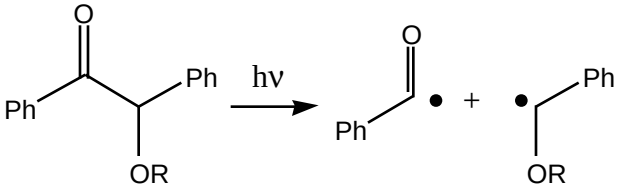


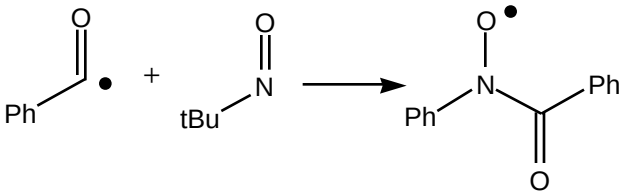
Mackor, A.; Wajer, T.A.J.W.; de Boer, T.J. *Tetrahedron* **1968**, 24, 1623

Krusic, P.J.; Rettig, T.A. *J. Am. Chem. Soc.* **1970**, 92, 724 (ESR)



Solly, R.K.; Benson, S.W. *J. Am. Chem. Soc.* **1971**, 93, 1592

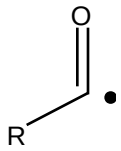




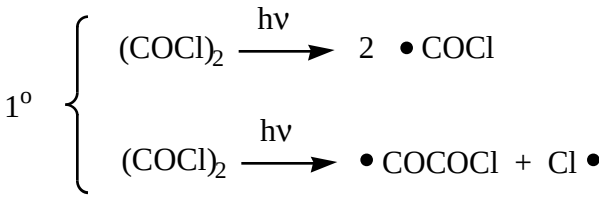
Ledwith, A.; Russell, P.J.; Sutcliffe, L.H. *J. Chem. Soc. Perkin Trans. 2* **1972**, 1925

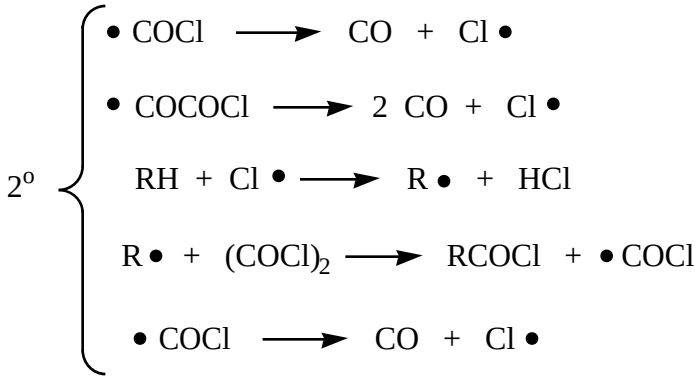
Simoes, J.A.M.; Griller, D. *Chem. Phys. Lett.* **1989**, 158, 175 (photoacoustic calorimetry of benzoyl radical)

(v) Acyl radical

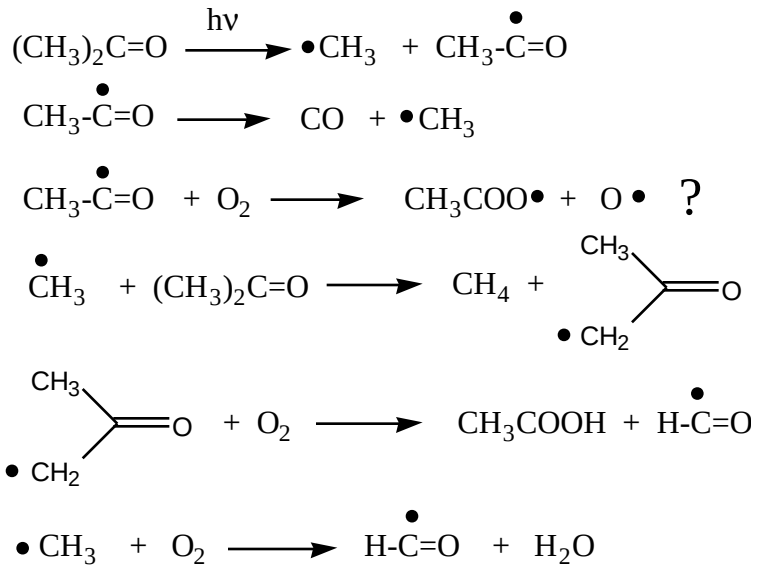


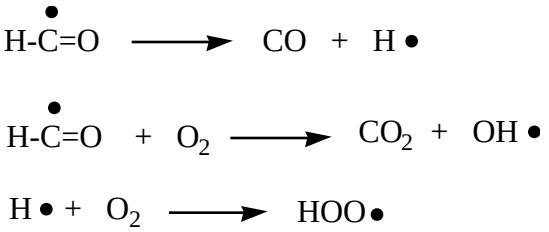
Reviews:
Vinogradov, M.G.; Nikishin, G.I. *Usp. Khim.* **1971**, 40, 1960
Caronna, T.; Minisci, F. *Rev. Reactive Species in Chemical Reactions* **1976**, 1, 263
Chatgilialoglu, C.; Crich, D.; Komatsu, M.; Ryu, I. *Chem. Rev.* **1999**, 99, 1991



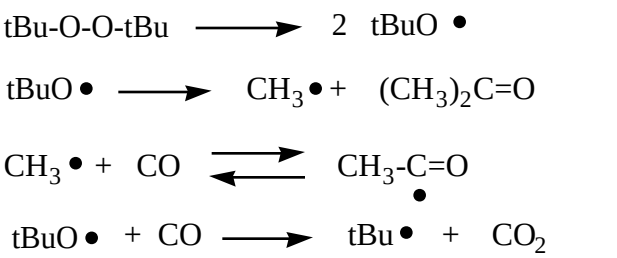


Kharasch, M.S.; Brown, H.C. *J. Am. Chem. Soc.* **1942**, 64, 329
Kharasch, M.S.; Kane, S.S.; Brown, H.C. *J. Am. Chem. Soc.* **1942**, 64, 1621

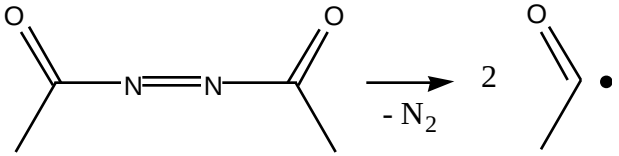




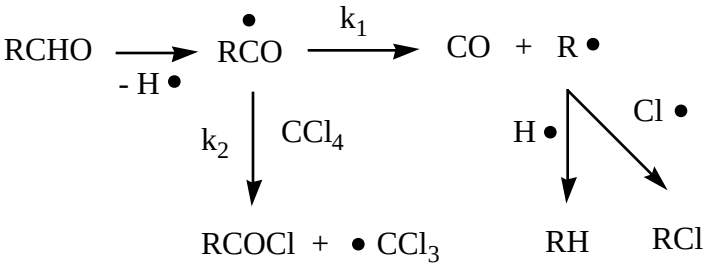
Marcotte, F.B.; Noyes, W.A. Jr. *J. Am. Chem. Soc.* **1952**, 74, 783



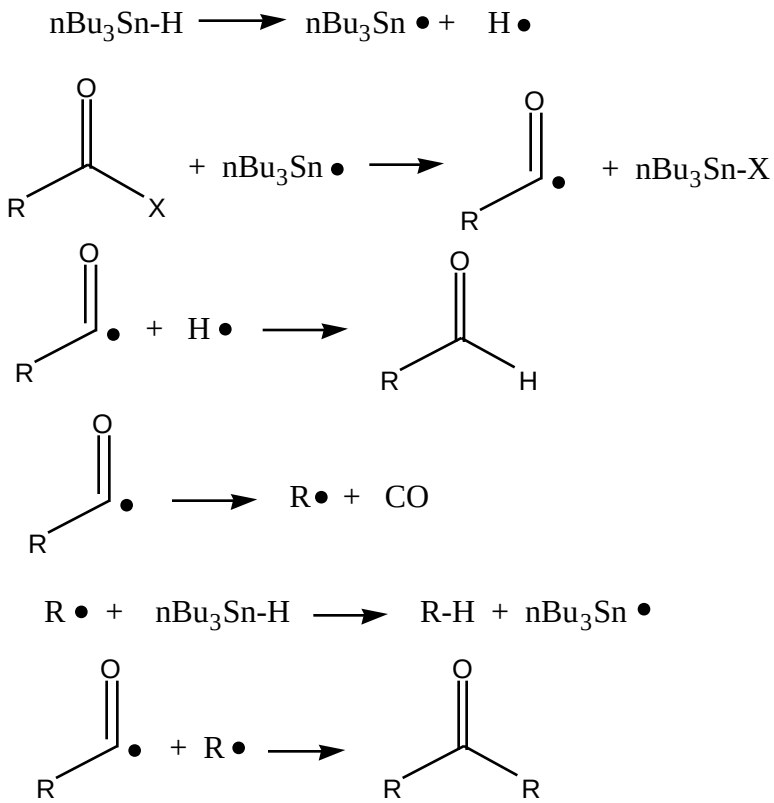
Porter, G.B.; Benson, S.W. *J. Am. Chem. Soc.* **1953**, 75, 2773



Cramer, R. *J. Am. Chem. Soc.* **1957**, 79, 6215

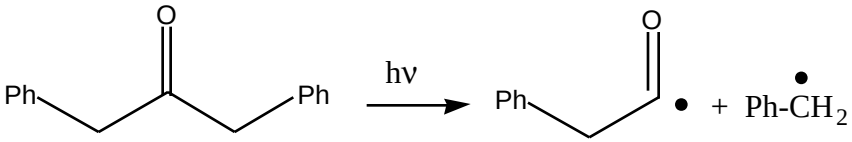


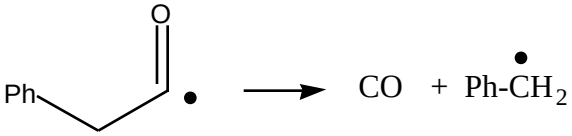
Applequist, D.E.; Kaplan, L. *J. Am. Chem. Soc.* **1965**, 87, 2194

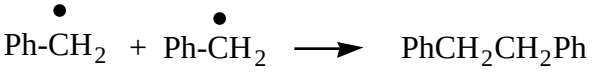


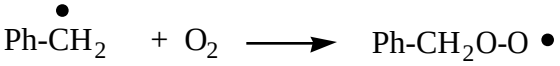
R = $PhCH_2$, Ph_3C, $PhCH_2O$

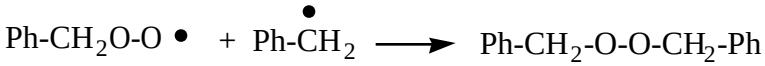
Kuivila, H.G.; Walsh, E.J. Jr. *J. Am. Chem. Soc.* **1966**, 88, 571
Walsh, E.J. Jr.; Kuivila, H.G. *J. Am. Chem. Soc.* **1966**, 88, 576





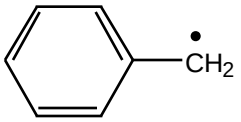




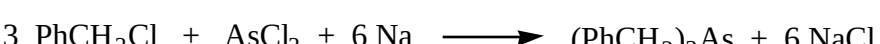


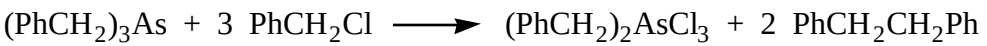
Maillard, B.; Ingold, K.U.; Scaiano, J.C. *J. Am. Chem. Soc.* **1983**, 105, 5095
Lunazzi, L.; Ingold, K.U.; Scaiano, J.C. *J. Phys. Chem.* **1983**, 87, 529

(vi) Benzyl radical



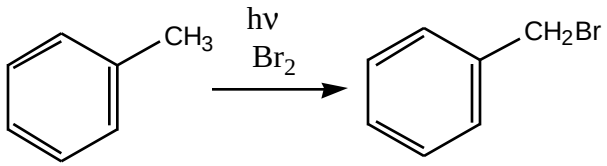
Reviews:
Porter, G. *Chem. Soc. Special Publ.* **1957**, 9, 139
Lei, X. *Res. Chem. Intermediates* **1990**, 14, 15





Michaelis, A.; Paetow, U. *Ann. Chem.* **1886**, 233, 60

Dodonov, J.; Medox, H. *Chem. Ber.* **1935**, 68B, 1254



Kharasch, M.S.; Margolis, E.; White, P.C.; Mayo, F.R. *J. Am. Chem. Soc.* **1937**, 59, 1405
Kharasch, M.S.; White, P.C.; Mayo, F.R. *J. Org. Chem.* **1938**, 3, 3

Blades, A.T.; Steacie, E.W.R. *Can. J. Chem.* **1954**, 32, 1142 (pyrolysis of toluene)

Norman, I.; Porter, G. *Proc. Roy. Soc. London* **1955**, 230A, 399
Porter, G.; Wright, F. *Trans. Faraday Soc.* **1955**, 51, 1469
Beckwith, A.L.J.; Waters, W.A. *J. Chem. Soc.* **1957**, 1001 (benzyl radicals reacting with anthracene)
Porter, G.; Windsor, M.W. *Nature* **1957**, 180, 187
Porter, G.; Strachan, E. *Trans. Faraday Soc.* **1958**, 54, 1595
Porter, G.; Strachan, E. *Spectrochim. Acta* **1958**, 12, 299

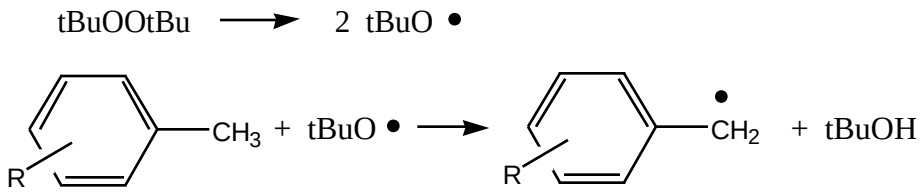
$$PhCH_2\text{-}Cl \longrightarrow PhCH_2^{+} + Cl^{-}$$

$$2\ PhCH_2^{+} + Fe \longrightarrow 2\ PhCH_2\bullet + Fe^{+2}$$

$$2\ PhCH_2\bullet \longrightarrow PhCH_2\text{-}CH_2Ph$$

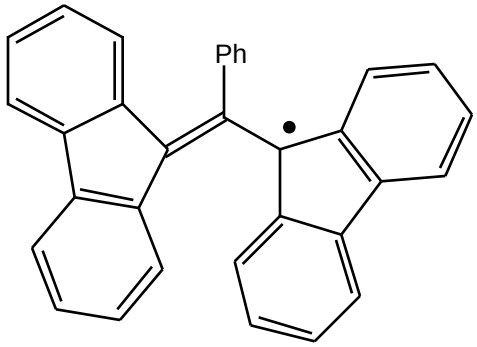
Sisido, K.; Udo, Y.; Nozaki, H. *J. Am. Chem. Soc.* **1960**, 82, 434

Hodgkins, J.E.; Megarity, E.D. *J. Am. Chem. Soc.* **1965**, 87, 5322 (EPA solid matrix)



Kennedy, B.R.; Ingold, K.U. *Can. J. Chem.* **1966**, 44, 2381

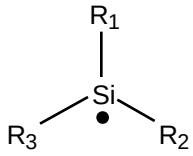
(vii) Koelsch radical



Koelsch, C.F. *J. Am. Chem. Soc.* **1932**, 54, 4744
Koelsch, C.F. *J. Am. Chem. Soc.* **1957**, 79, 4439

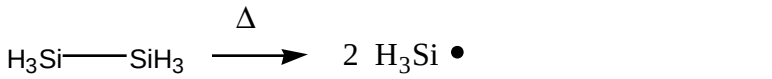
Group IV centred radicals except carbon (Si, Ge, Sn)

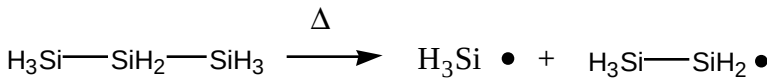
(i) Silyl

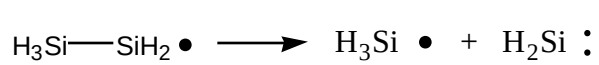


Reviews:
Jackson, R.A. *Adv. Free Radical Chem.* **1969**, 3, 231

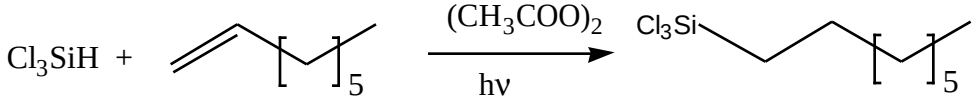
Jackson, R.A. *Chem. Soc. Special Publ.* **1970**, 295
Sakurai, H. in *Free Radicals*, (J.K. Kochi, ed.) Wiley: New York, 1973, Vol. 2, p. 741
Arthur, N.L.; Bell, T.N. *Rev. Chem. Intermediates* **1978**, 1, 37
Alberti, A.; Pedulli, G.F. *Rev. Chem. Intermediates* **1987**, 8, 207
Dohmaru, T. in *Reactions of Special Radicals in Chemical Kinetics of Small Organic Radicals*, (Z.B. Alfassi, ed.) CRC Press: Boca Raton, 1988, Vol. 3, p. 165
Chatgilialoglu, C. *NATO ASI Ser. Ser. C.* **1989**, 257, 119
Chatgilialoglu, C. *NATO ASI Ser. Ser. C.* **1989**, 260, 115
Chatgilialoglu, C. *Chem. Rev.* **1995**, 95, 1229
Korolev, V.A.; Nefedov, O.M. *Adv. Phys. Org. Chem.* **1995**, 30, 1
Chatgilialoglu, C.; Schiesser, C.H. in *The Chemistry of Organic Silicon Compounds*, (Z. Rappoport, S. Patai, eds.) Wiley: Chichester, 2001, Vol. 3, p. 341

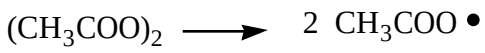


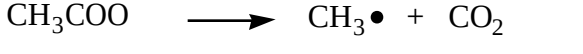


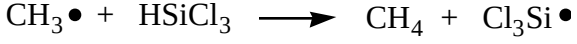


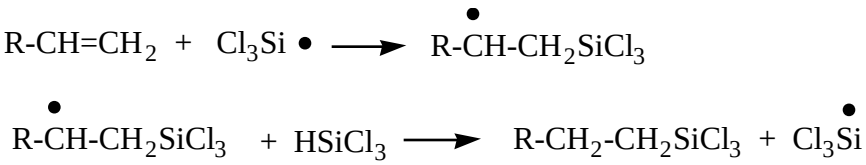
Emeleus, H.J.; Reid, C. *J. Chem. Soc.* **1939**, 1021 (pyrolysis of disilane and trisilane)



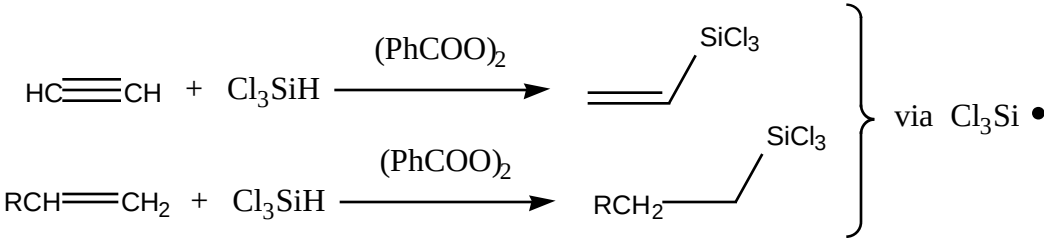




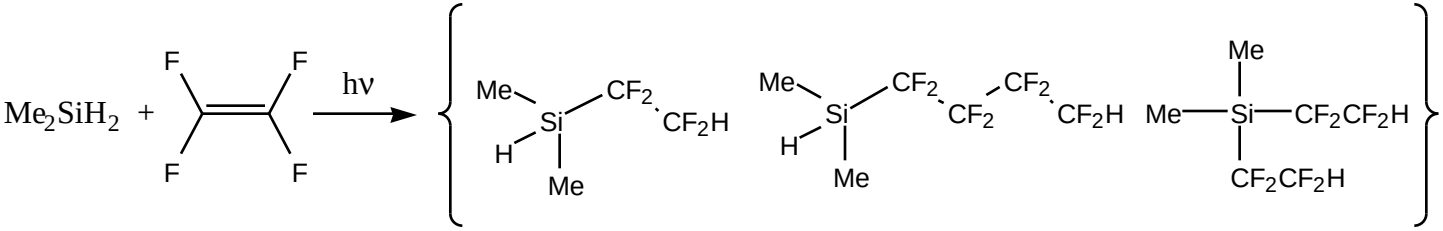




Sommer, L.H.; Pietrusza, E.W.; Whitmore, F.C. *J. Am. Chem. Soc.* **1947**, 69, 188 (first suggestion)
Burkhard, C.A.; Krieble, R.H. *J. Am. Chem. Soc.* **1947**, 69, 2687
Barry, A.J.; DePree, L.; Gilkey, J.W.; Hook, D.E. *J. Am. Chem. Soc.* **1947**, 69, 2916



Burkhard, C.A.; Krieble, R.H. *J. Am. Chem. Soc.* **1947**, 69, 2687



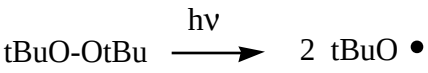
Geyer, A.M.; Haszeldine, R.N. *J. Chem. Soc.* **1957**, 1038

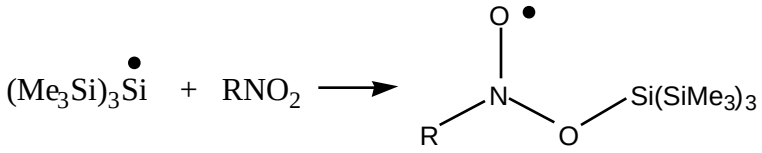
Menapace, L.W.; Kuivila, H.G. *J. Am. Chem. Soc.* **1964**, 86, 3047
Walling, C.; Cooley, J.H.; Ponaras, A.A.; Racah, E.J. *J. Am. Chem. Soc.* **1966**, 88, 5361

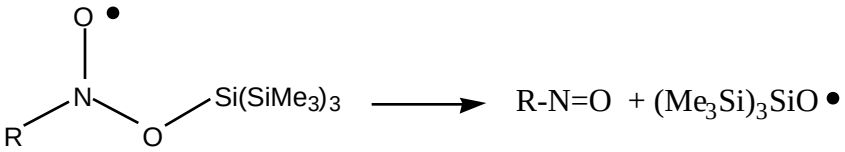
Bennett, S.W.; Eaborn, C.; Hudson, A.; Hussain, H.A.; Jackson, R.A. *J. Organometallic Chem* **1969**, 16, P36
Bennett, S.W.; Eaborn, C.; Hudson, A.; Jackson, R.A.; Root, K.D.J. *J. Chem. Soc. A* **1970**, 348
Krusic, P.J.; Kochi, J.K. *J. Am. Chem. Soc.* **1969**, 91, 3938

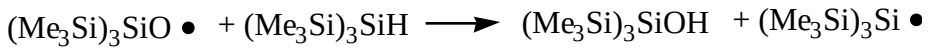
$(iPr)_3Si\bullet$ $(tBu)_3Si\bullet$

Jackson, R.A.; Weston, H. *J. Organometallic Chem.* **1984**, 277, 13 (ESR)



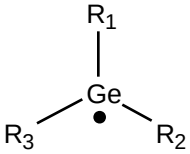




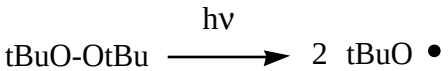


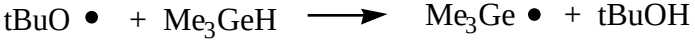
Ballestri, M.; Chatgilialoglu, C.; Lucarini, M.; Pedulli, G.F. *J. Org. Chem.* **1992**, 57, 948

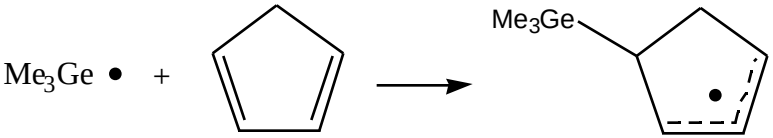
(ii) Germyl



Reviews:
Korolev, V.A.; Nefedov, O.M. *Adv. Phys. Org. Chem.* **1995**, 30, 1

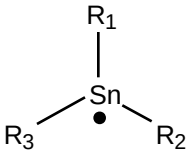






Kawamura, T.; Kochi, J.K. *J. Organometallic Chem.* **1973**, 47, 79

(iii) Stannyl

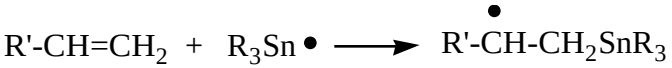


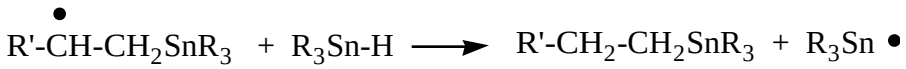
Reviews:

Baines, K.; Dicke, R.; Neumann, W.P.; Vorspohl, K. *NATO ASI Ser. Ser. C* **1989**, 260, 107

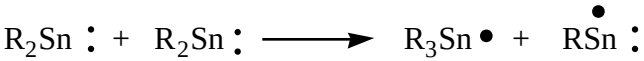
H_3Sn •

Morehouse, R.L.; Christiansen, J.J.; Gordy, W. *J. Chem. Phys.* **1966**, 45, 1751 (ESR, 4.2 K, Kr matrix)
Jackel, G.S.; Gordy, W. *Phys. Rev.* **1968**, 76, 443





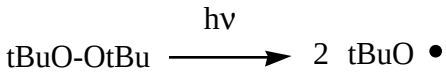
Neumann, W.P.; Albert, H.J.; Kaiser, W. *Tetrahedron Lett.* **1967**, 2041



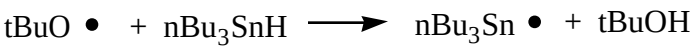
R_2Sn + R_2Sn → R_3Sn• + R$\overset{\bullet}{S}n$

R = $(Me_3Si)_2CH$

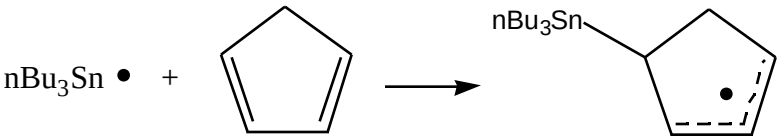
Davidson, P.J.; Hudson, A.; Lappert, M.F.; Lednor, P.W. *Chem. Commun.* **1973**, 829



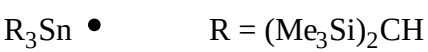
tBuO-OtBu $\xrightarrow{h\nu}$ 2 tBuO•



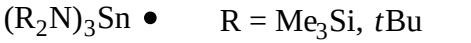
tBuO• + nBu_3SnH → nBu_3Sn• + tBuOH



Kawamura, T.; Kochi, J.K. *J. Organometallic Chem.* **1973**, 47, 79

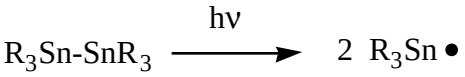


R_3Sn• R = $(Me_3Si)_2CH$

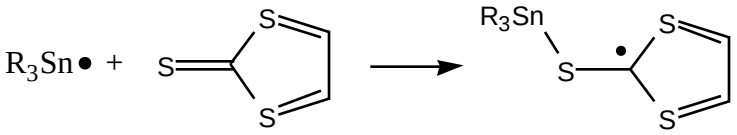


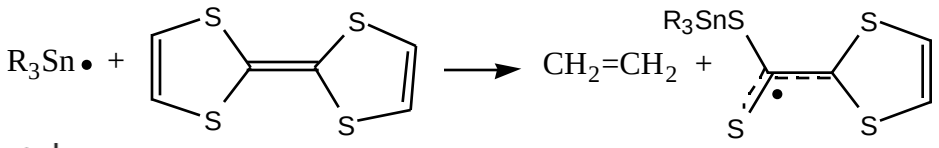
$(R_2N)_3Sn$• R = Me_3Si, *t*Bu

Hudson, A.; Lappert, M.F.; Lednor, P.W. *J. Chem. Soc. Dalton Trans.* **1976**, 2369



$R_3Sn-SnR_3$ $\xrightarrow{h\nu}$ 2 R_3Sn•



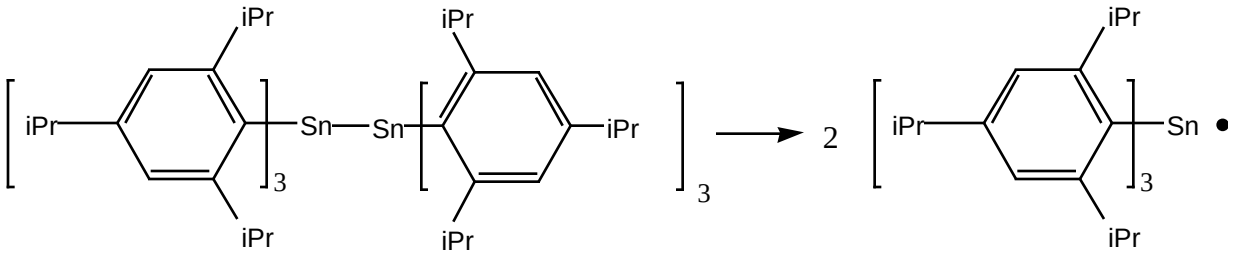



Forrest, D.; Ingold, K.U. *J. Am. Chem. Soc.* **1978**, 100, 3868

R_3Sn •

R = $PhC(CH_3)_2CH_2$, Ph, Mes, 2,4,6-triethylphenyl, 2,4,6-triisopropylphenyl

Lehnig, M.; Buschhaus, H.U.; Neumann, W.P.; Apoussidis, T. *Bull. Soc. Chim. Belges* **1980**, 89, 907

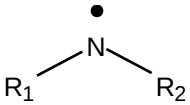


Lehnig, M.; Apoussidis, T.; Neumann, W.P. *Chem. Phys. Lett.* **1983**, 100, 189 (ESR)

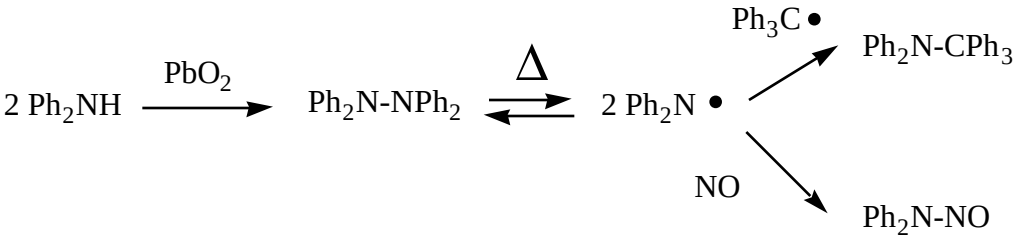
Group V centred radicals (N, P)
Nitrogen centred radicals:

Reviews:
Nelsen, S.F. in *Free Radicals* (J.K. Kochi, ed.) Wiley: New York, 1973, Vol. 2, p. 527
Michejda, C.J.; Campbell, D.H.; Sieh, D.H.; Koepke, S.R. *ACS Symp. Ser.* **1978**, 69, 292
Miura, Y. *Trends Org. Chem.* **1997**, 6, 197
Alfassi, Z.B. (ed.) *N-Centered Radicals*, Wiley: New York, 1998

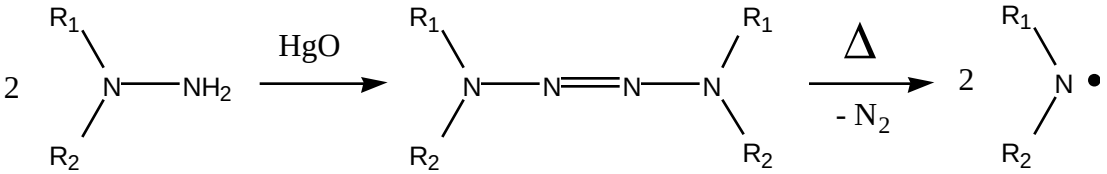
(i) Aminyl



Reviews:
Danen, W.C.; Neugebauer, F.A. *Angew. Chem.* **1975**, 87, 823

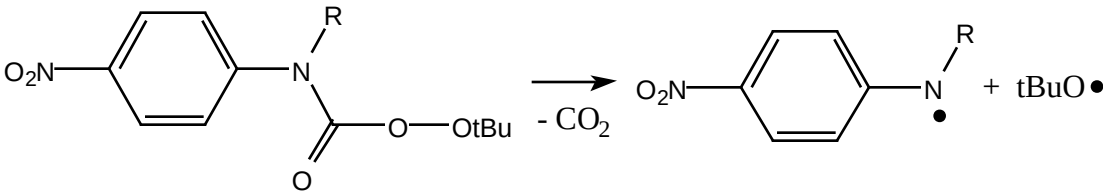


Wieland, H. *Ann. Chem.* **1911**, 381, 200
Wieland, H.; Gambajarin, S. *Chem. Ber.* **1906**, 36, 1499

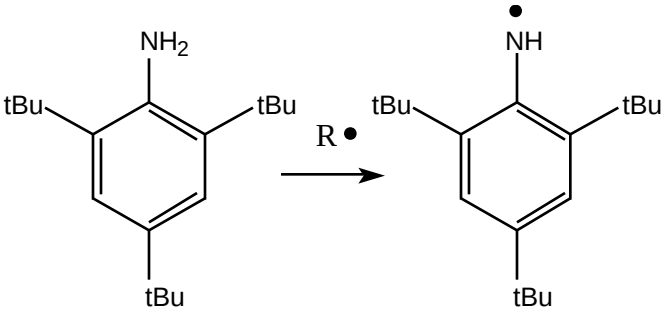


R_1 = Me, R_2 = Me; R_1 = Me, R_2 = Ph

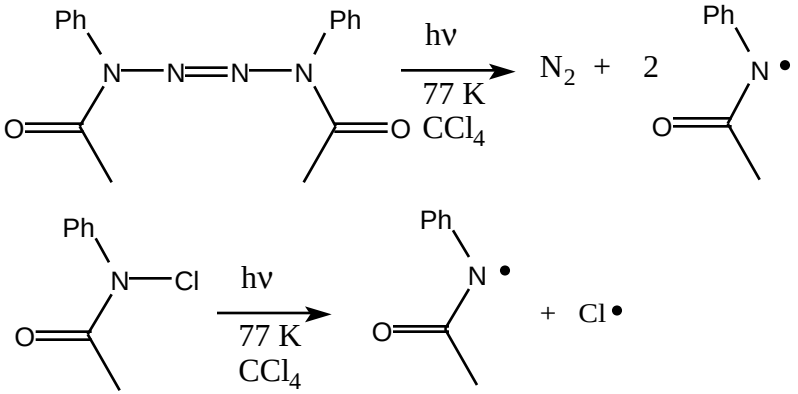
Erusalimskii, B.L.; Dolgoplosk, B.A.; Kavunenko, A.P. *Zh. Obshchei Khim.* **1957**, 27, 267; 301



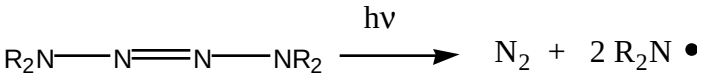
Pedersen, C.J. *J. Org. Chem.* **1958**, 23, 255



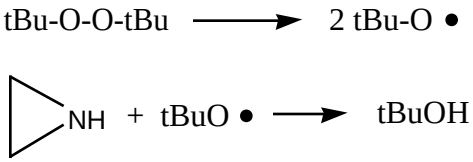
Atherton, N.M.; Land, E.J.; Porter, G. *Trans. Faraday Soc.* **1963**, 59, 818



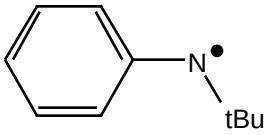
Johnston, K.M.; Williams, G.H.; Williams, H.J. *Chem. Ind.* **1966**, 991
Johnston, K.M.; Williams, G.H.; Williams, H.J. *J. Chem. Soc. Sect. B* **1966**, 1114



Kochi, J.K.; Krusic, P.J. *J. Am. Chem. Soc.* **1969**, 91, 6161
Danen, W.C.; Kensler, T.T. *J. Am. Chem. Soc.* **1970**, 92, 5235

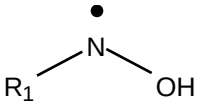


Danen, W.C.; Kensler, T.T. *Tetrahedron Lett.* **1971**, 2247

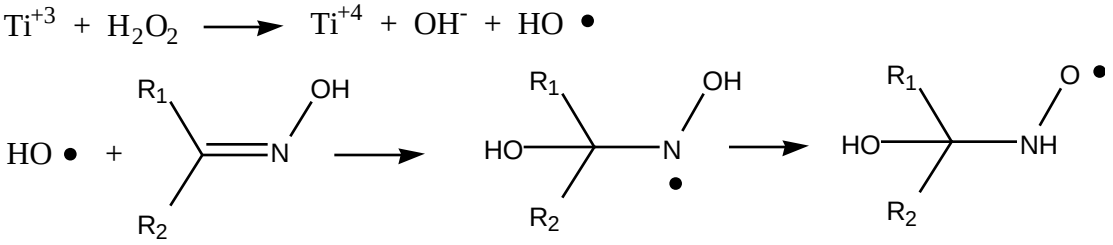


Nelsen, S.F.; Landis, R.T.; Kiehle, L.H.; Leung, T.H. *J. Am. Chem. Soc.* **1972**, 94, 1610

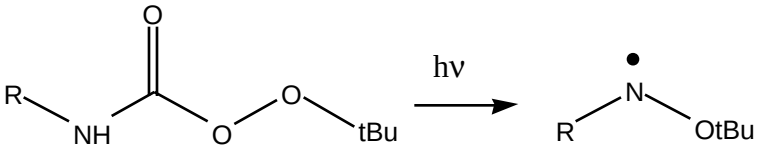
(ii) N-alkoxy-N-alkylamino radicals



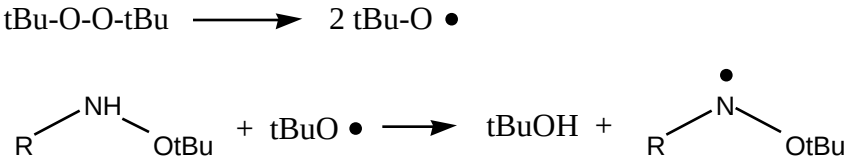
Reviews:
None.



Smith, P.; Fox, W.M. *Can. J. Chem.* **1969**, 47, 2227

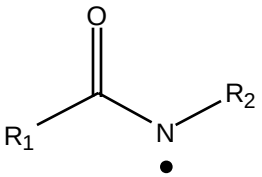


Danen, W.C.; West, C.T. *J. Am. Chem. Soc.* **1971**, 93, 5582

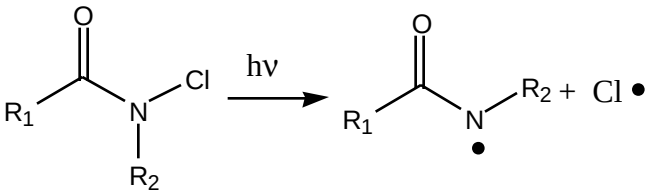


Danen, W.C.; West, C.T.; Kensler, T.T. *J. Am. Chem. Soc.* **1973**, 95, 5716

(iii) Amido radicals

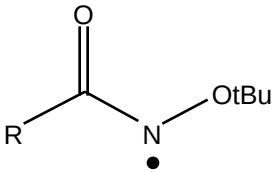


Reviews:
Goosen, A. *South African J. Chem.* **1979**, 32, 37

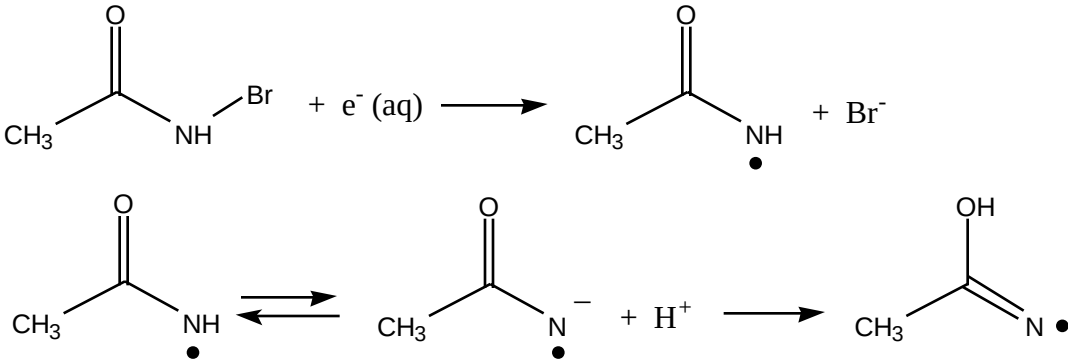


R1	**R2**
tBu	Me
Me	tBu

Danen, W.C.; Gellert, R.W. *J. Am. Chem. Soc.* **1972**, 94, 6853

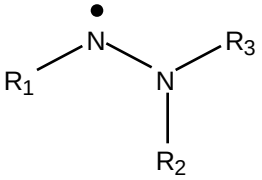


Koenig, T.; Hoobler, J.A.; Mabey, W.R. *J. Am. Chem. Soc.* **1972**, 94, 2514

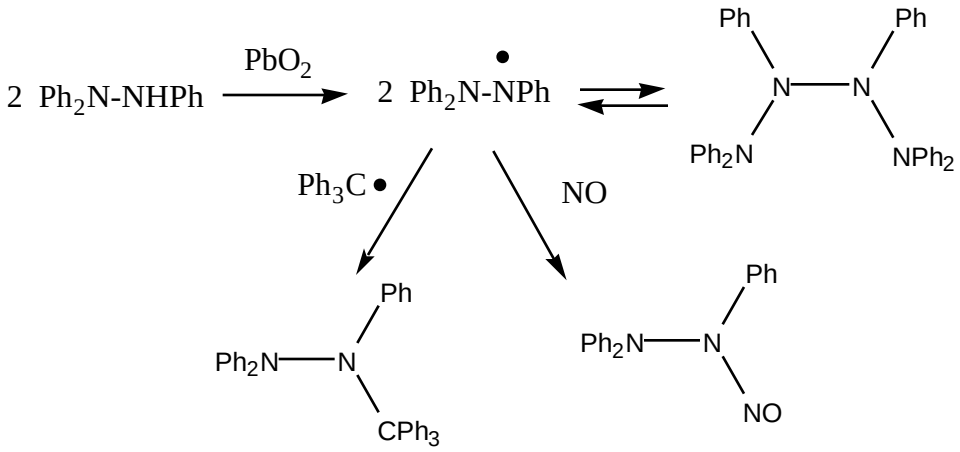


Fessenden, R.W. *Chem. Lett.* **1974**, 29, 364

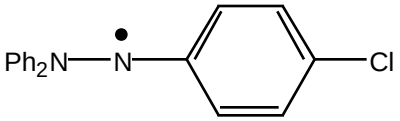
(iv) Hydrazyl



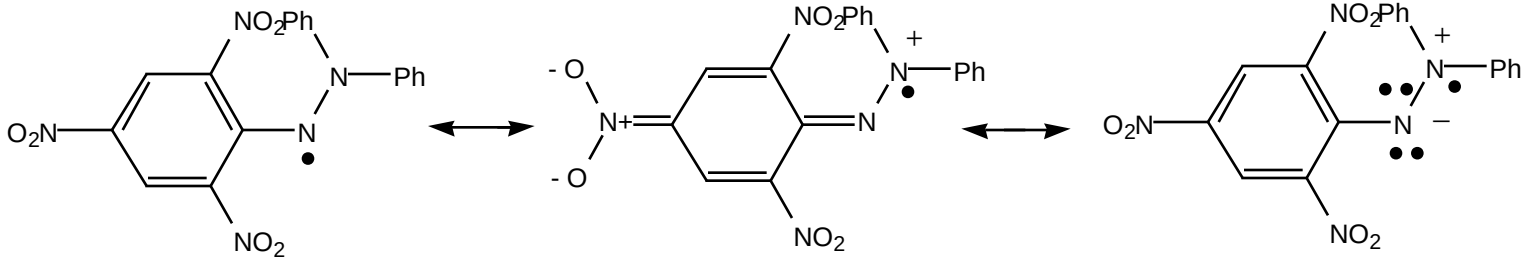
Reviews:
Nelsen, S.F. *ACS Symp. Ser.* **1978**, 69, 309



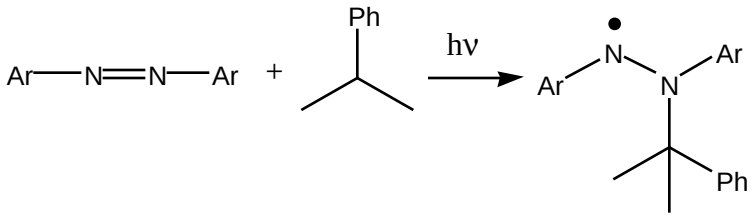
Goldschmidt, S. *Chem. Ber.* **1920**, 53, 44



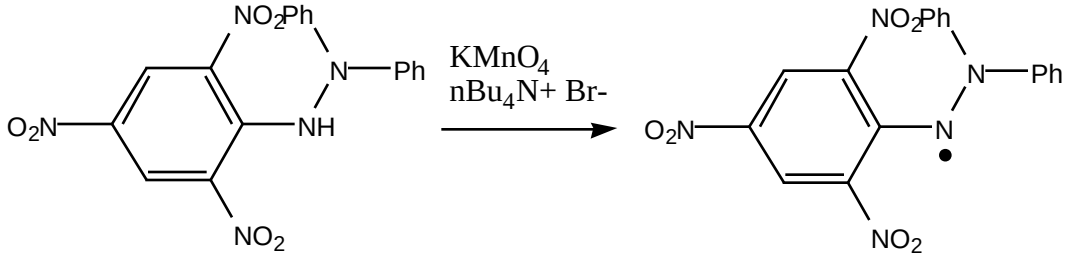
Goldschmidt, S.; Wolf, A.; Wolffhardt, E.; Drimmer, I.; Nathan, S. *Ann. Chem.* **1924**, 437, 194



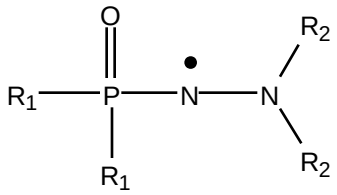
Turkevich, J.; Oesper, P.F.; Smyth, C.P. *J. Am. Chem. Soc.* **1942**, 64, 1179 (dipole moment measurement)



Wan, J.K.S.; Hess, L.D.; Pitts, J.N. *J. Am. Chem. Soc.* **1964**, 86, 2069

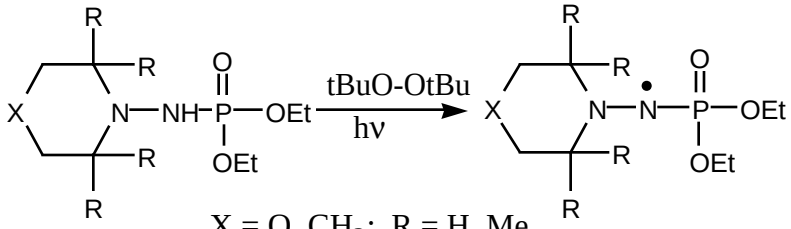


Brown, K.C.; Weil, J.A. *Can. J. Chem.* **1986**, 64, 1836



R1	R2
OEt	Me
Et	Me
OEt	H, *t*Bu
OPh	H, *t*Bu
Et	H, *t*Bu

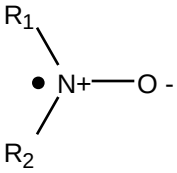
Tordo, P. *NATO ASI Ser. Ser. C* **1986**, 189, 191



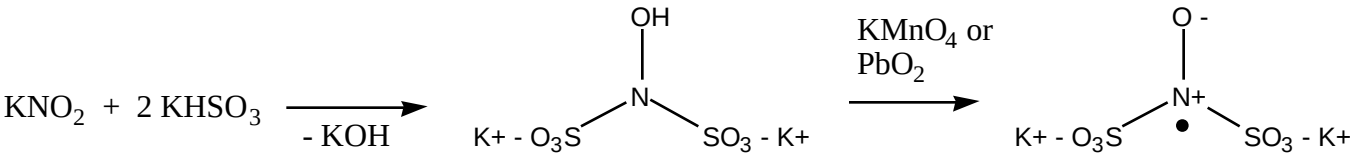
X = O, CH_2; R = H, Me

Lucarini, M.; Pedulli, G.F. *J. Org. Chem.* **2000**, 65, 2723

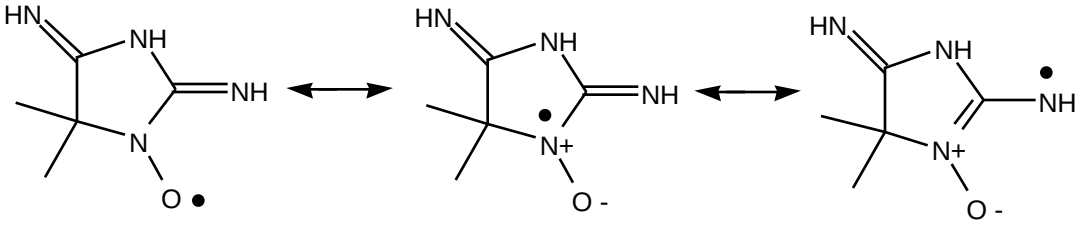
(v) Nitroxide radicals



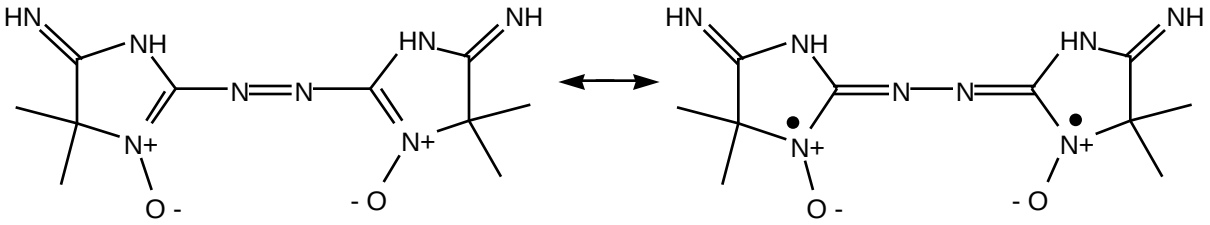
Reviews:
Keana, J.F.W. *Chem. Rev.* **1978**, 78, 37
Perkins, M.J. *Adv. Phys. Org. Chem.* **1980**, 17, 1
Volodarsky, L.B.; Reznikov, V.A.; Ovcharenko, V.I. *Synthetic Chemistry of Stable Nitroxides*, CRC Press: Boca Raton, FL, 1994



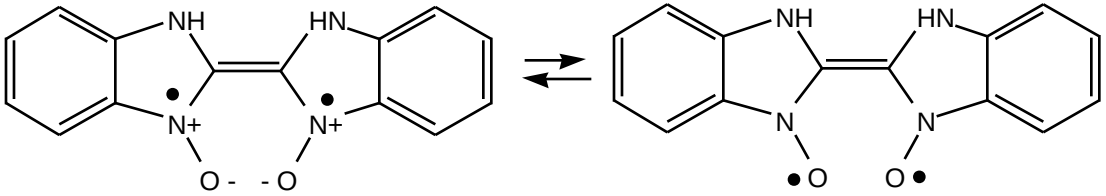
Fremy, E. *Ann. Chim. Phys.* **1845**, 15[3], 408; 459



Piloty, O.; Schwerin, B.G. *Chem. Ber.* **1901**, 34, 1870; 2354

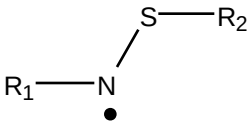


Piloty, O.; Vogel, W. *Chem. Ber.* **1907**, 36, 1283

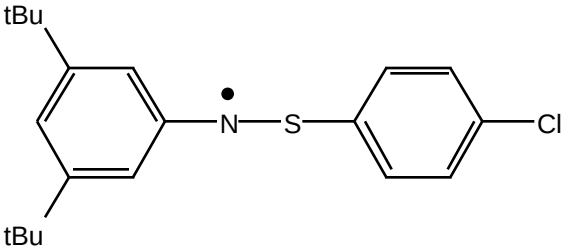


Niementowski, S. *Chem. Ber.* **1910**, 43, 3012
Kuhn, R.; Blau, W. *Ann. Chem.* **1958**, 615, 99

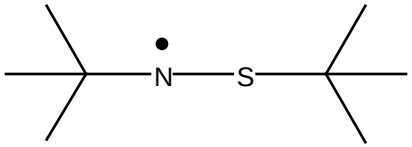
(vi) Thioaminyl radicals



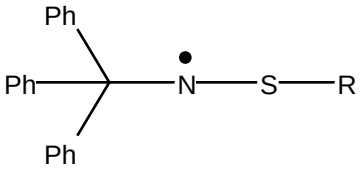
Reviews:
Bassindale, A.R.; Ipey, J. in *Chemistry of Sulphenic Acids and Their Derivatives*, (S. Patai, ed.) Wiley: Chichester, 1990, p. 101
Miura, Y. *Trends in Org. Chem.* **1997**, 6, 197
Miura, Y. *Recent Res. Development Org. Chem.* **1998**, 2(Pt. 2), 251



Miura, Y.; Katsura, Y.; Kinoshita, M. *Chem. Lett.* **1977**, 409



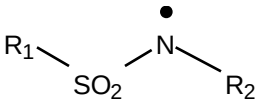
Miura, Y.; Asada, H.; Kinoshita, M.; Ohta, K. *J. Phys. Chem.* **1983**, 87, 3450



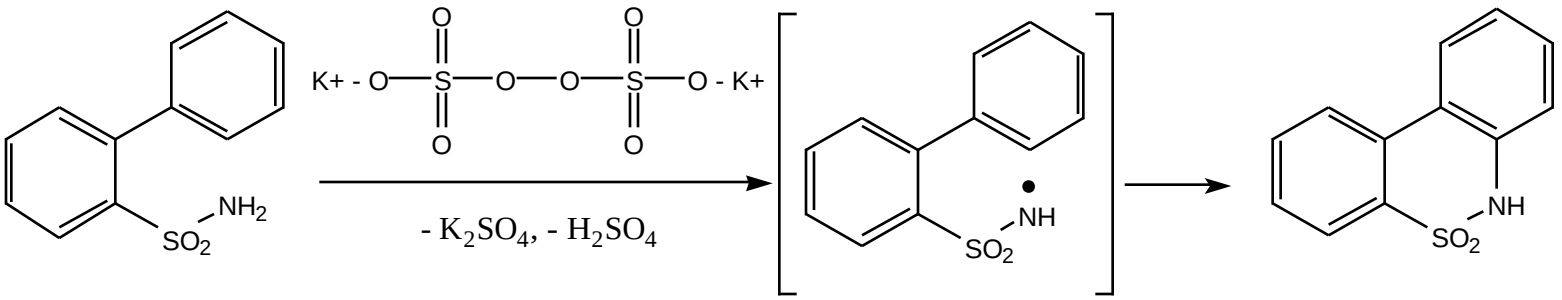
R = alkyl, aryl

Miura, Y.; Isogai, M.; Kinoshita, M. *Bull. Chem. Soc. Jpn* **1987**, 60, 3065

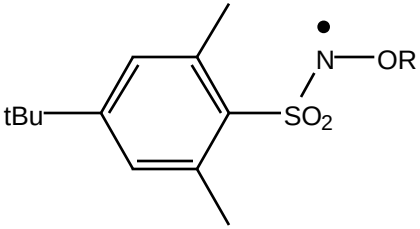
(vii) Sulfonamidyl radicals



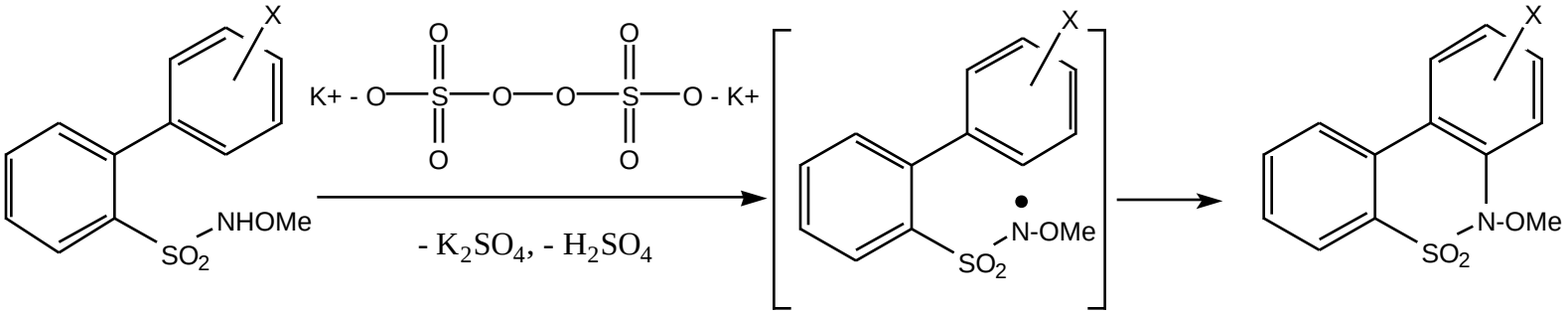
Reviews:
Bassindale, A.R.; Iley, J.N. in *Chemistry of Sulphonic Acids, Esters, and Their Derivatives* (S. Patai, ed.) Wiley: Chichester, 1991, p. 197 - 247



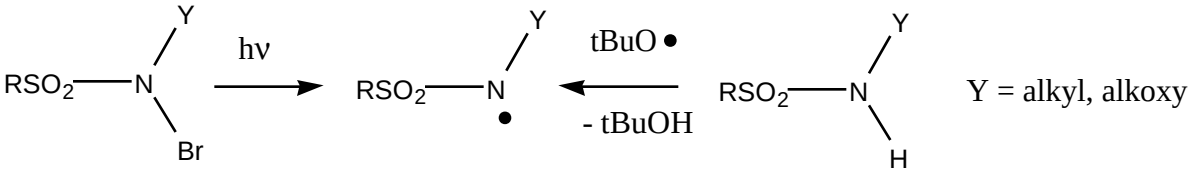
Dewar, P.S.; Forrester, A.R.; Thomson, R.H. *J. Chem. Soc. Perkin Trans. 1* **1972**, 2862

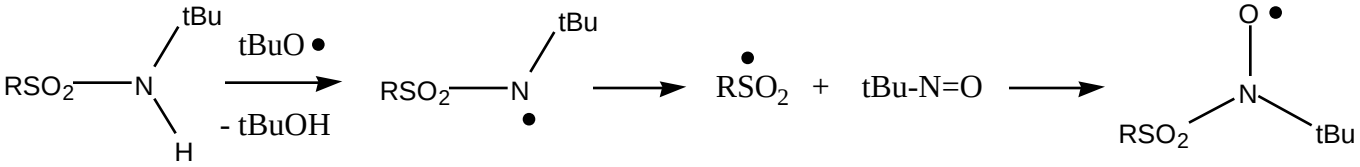


Teeninga, H.; Engberts, J.B.F.N. *Rec. Trav. Chim. Pays-Bas* **1978**, 97, 59

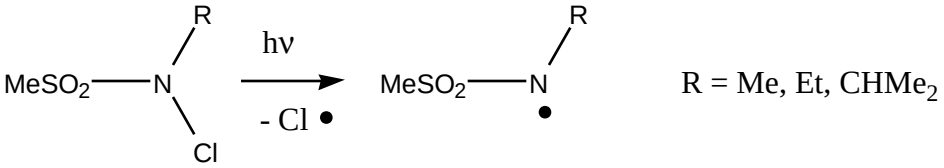


Forrester, A.R.; Johansson, E.M.; Thomson, R.H. *J. Chem. Soc. Perkin Trans. 1* **1979**, 1112



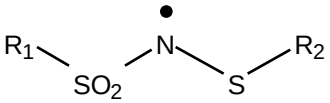


Teeninga, H.; Zomer, B.; Engberts, J.B.F.N. *J. Org. Chem.* **1979**, 44, 4717

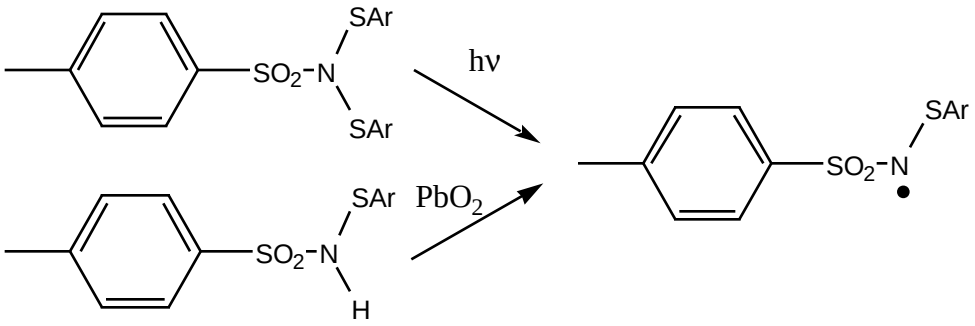


Danen, W.C.; Gellert, R.W. *J. Am. Chem. Soc.* **1980**, 102, 3264

(viii) N-Thiosulfonamidyl radicals



Reviews:
None.

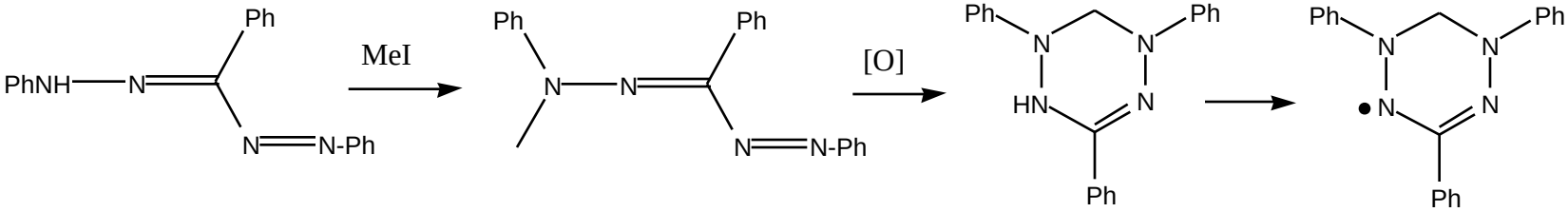


Miura, Y.; Kunishi, T.; Kinoshita, M. *J. Org. Chem.* **1985**, 50, 5862
Miura, Y.; Kunishi, T.; Kinoshita, M. *Bull. Chem. Soc. Jpn.* **1985**, 58, 1696

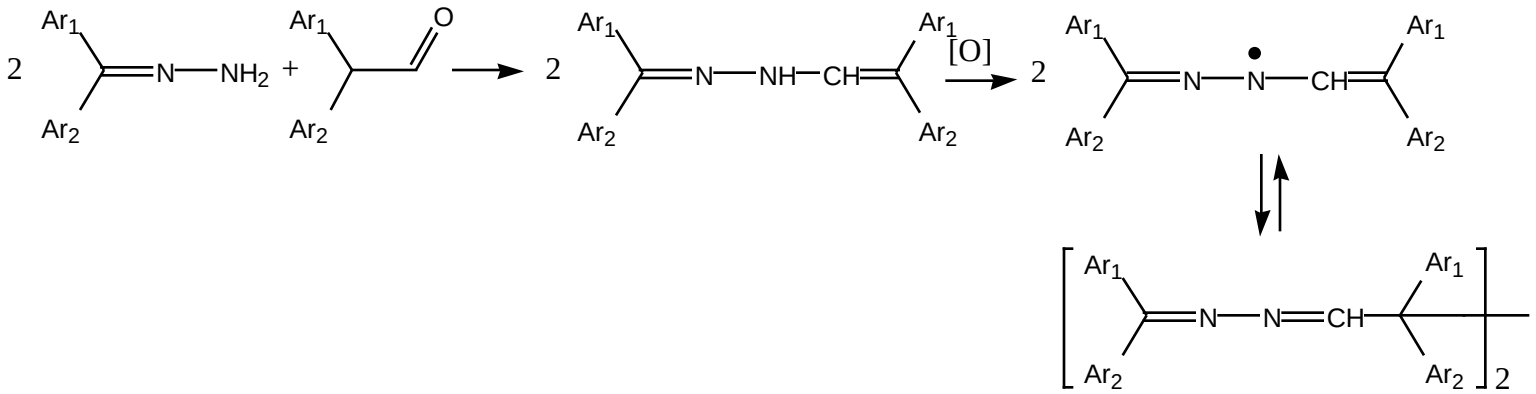
(ix) Verdazyls

Reviews:

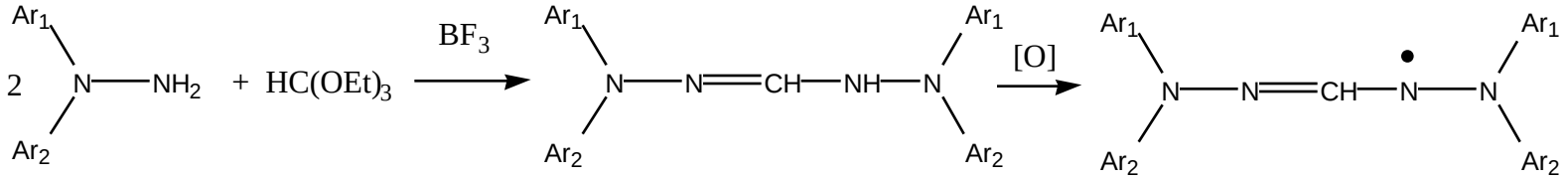
Power, P.P. *Chem. Rev.* **2003**, 103, 789



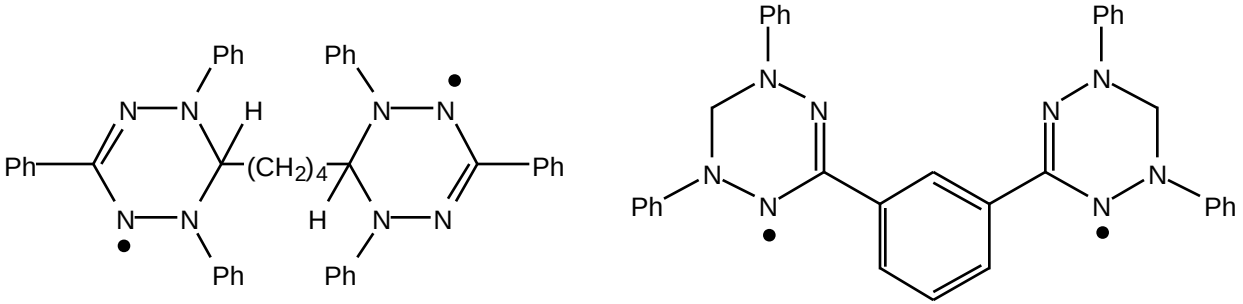
Kuhn, R.; Trischmann, H. *Angew. Chem. Int. Ed.* **1963**, 8, 155
Kuhn, R.; Trischmann, H. *Monatsh. Chem.* **1964**, 95, 457
Kuhn, R.; Neugebauer, F.A.; Trischmann, H. *Monatsh. Chem.* **1966**, 97, 846



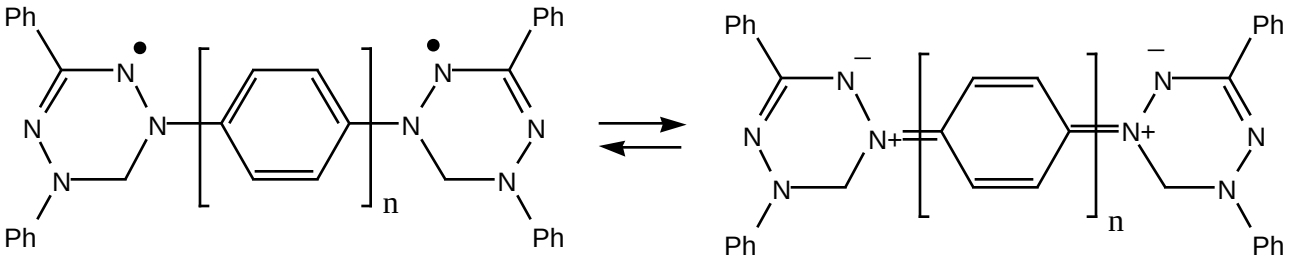
Kuhn, R.; Neugebauer, F.A. *Monatsh. Chem.* **1963**, 94, 1

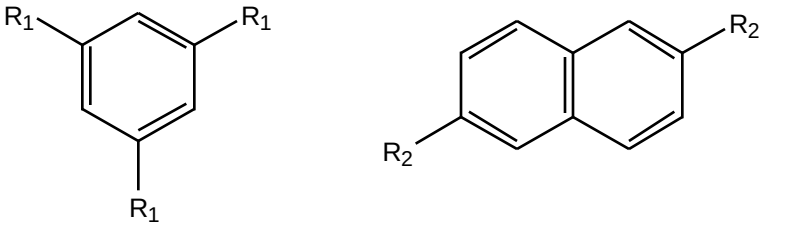


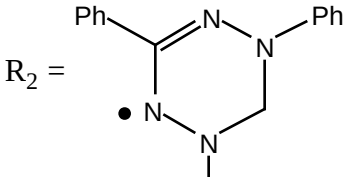
Kuhn, R.; Neugebauer, F.A.; Trischmann, H. *Angew. Chem. Int. Ed.* **1964**, 3, 232
Kuhn, R.; Trischmann, H. *Monatsh. Chem.* **1966**, 97, 554



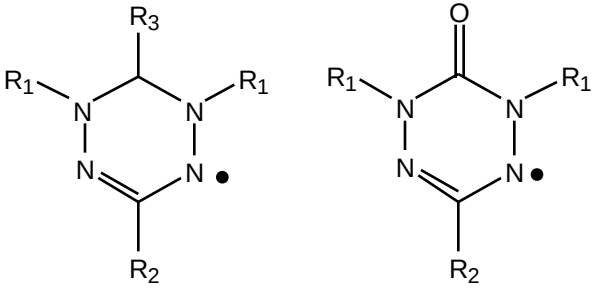
Kuhn, R.; Fischer-Schwarz, G. *Monatsh. Chem.* **1966**, 97, 517







Kuhn, R.; Neugebauer, F.A.; Trischmann, H. *Monatsh. Chem.* **1966**, 97, 525
Kuhn, R.; Neugebauer, F.A.; Trischmann, H. *Angew. Chem. Int. Ed.* **1965**, 4, 72
Kurusu, Y.; Yoshida, H.; Okawara, M. *Tetrahedron Lett.* **1967**, 3595



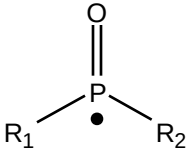
Neugebauer, F.A. *Angew. Chem. Int. Ed.* **1973**, 12, 455

Neugebauer, F.A.; Fischer, H.; Siegel, R. *Chem. Ber.* **1988**, 121, 815

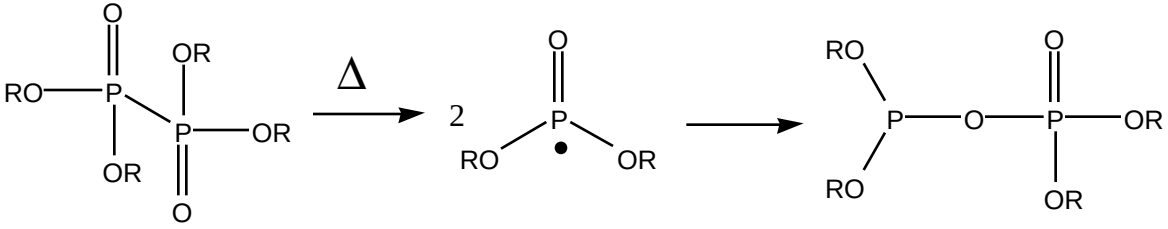
Phosphorus centred radicals:

Reviews:
Bentrude, W.G. in *Free Radicals*, (J.K. Kochi, ed.) Wiley: New York, 1973, Vol. 2, p. 595
Walling, C.; Pearson, M.S. *Topics Phosphorus Chem.* **1966**, 3, 1
Cadogan, J.I.G. *Adv. Free Radical Chem.* **1967**, 2, 203
Bentrude, W.G. *Ann. Rev. Phys. Chem.* **1967**, 18, 283

(i) Phosphinoyl (phosphonyl, phosphono) radicals

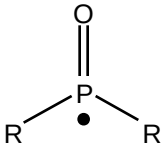


Reviews:
Rachon, J. *Pol. J. Environ. Studies* **1996**, 5, 62

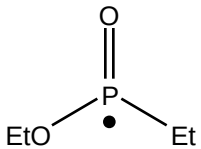


R = Et, nPr, nBu

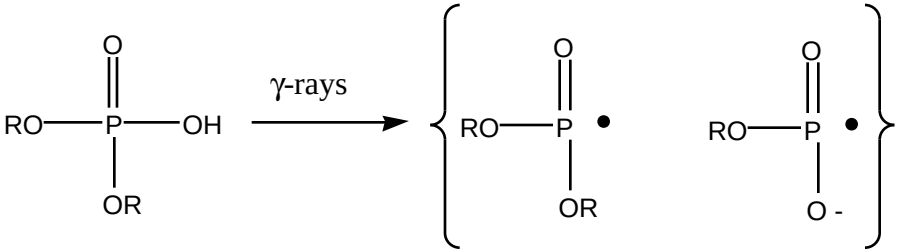
Michalski, J.; Stec, W.; Zwierzak, A. *Chem. Ind.* **1965**, 345



R = NMe_2, Et, $Me(CH_2)_5$

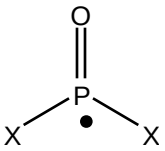


Davies, A.G.; Dennis, R.W.; Griller, D.; Ingold, K.U.; Roberts, B.P. *Molecular Physics* **1973**, 25, 989

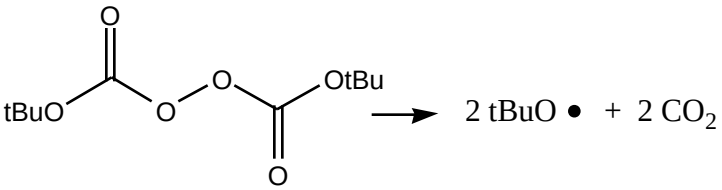


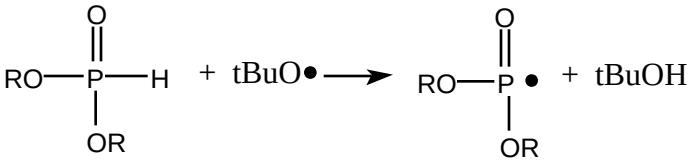
R = Me, Et

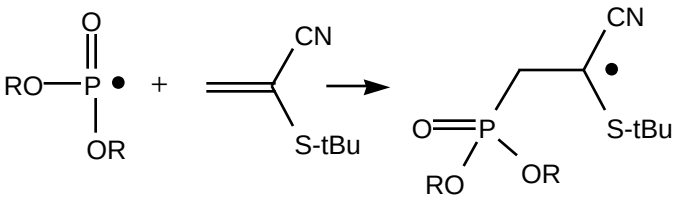
Kerr, M.C.L.; Webster, K.; Williams, F. *Molecular Physics* **1973**, 25, 1461
Geoffroy, M.; Ginet, L.; Lucken, E.A. *Molecular Physics* **1976**, 31, 745



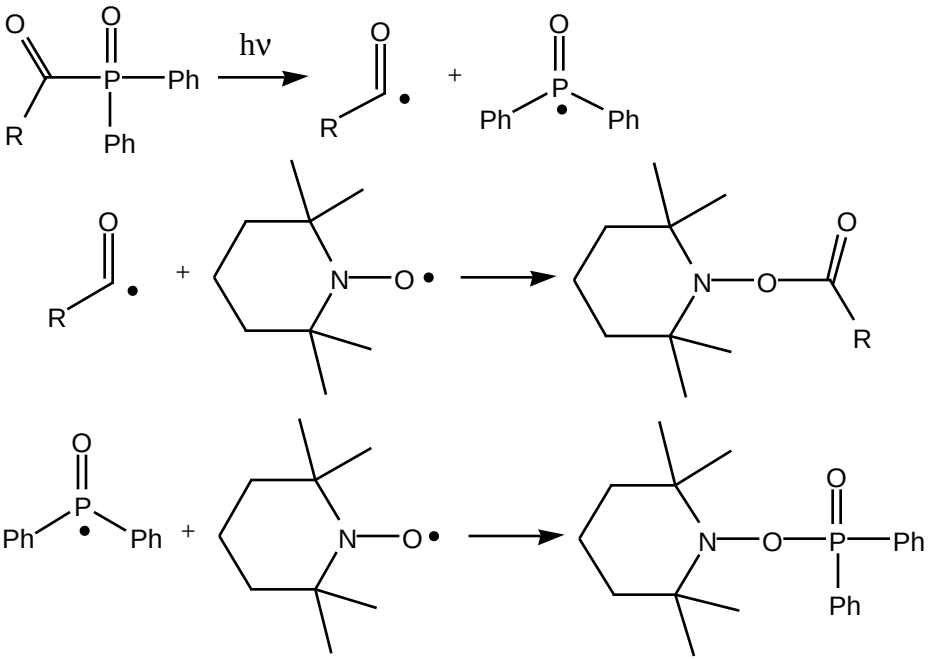
Roberts, B.P.; Singh, K. *J. Organometallic Chem.* **1978**, 159, 31 (ESR spectrum)



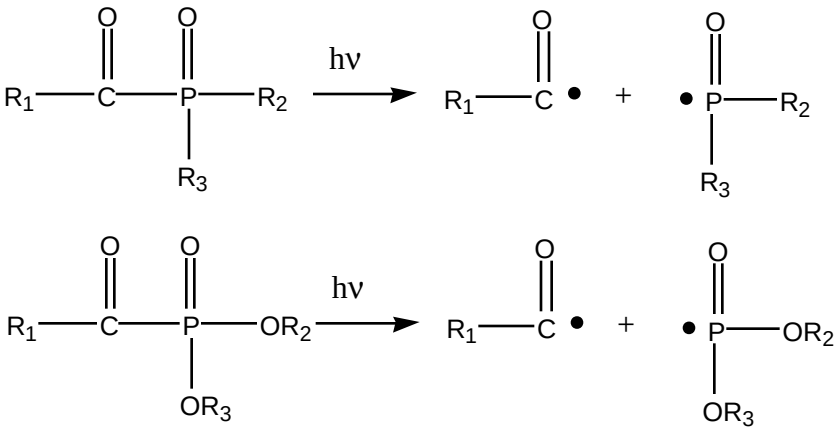




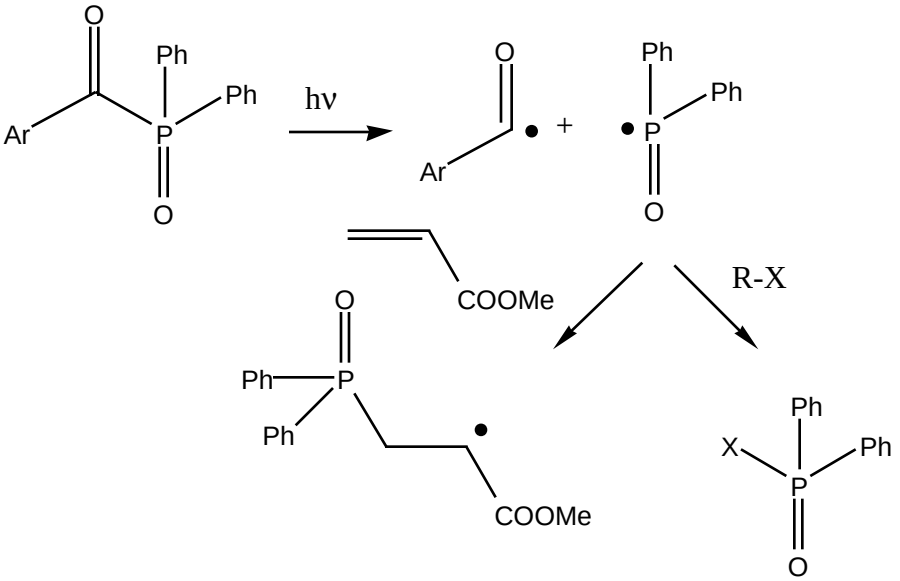
Stella, L.; Merenyi, R.; Janousek, Z.; Viehe, H.G. *J. Phys. Chem.* **1980**, 84, 304



Baxter, J.E.; Davidson, R.S.; Hageman, H.J.; Overeem, T. *Makromolec. Chem. Rapid Commun.* **1987**, 8, 311 (first nitroxide trapping of phosphinoyl radicals)

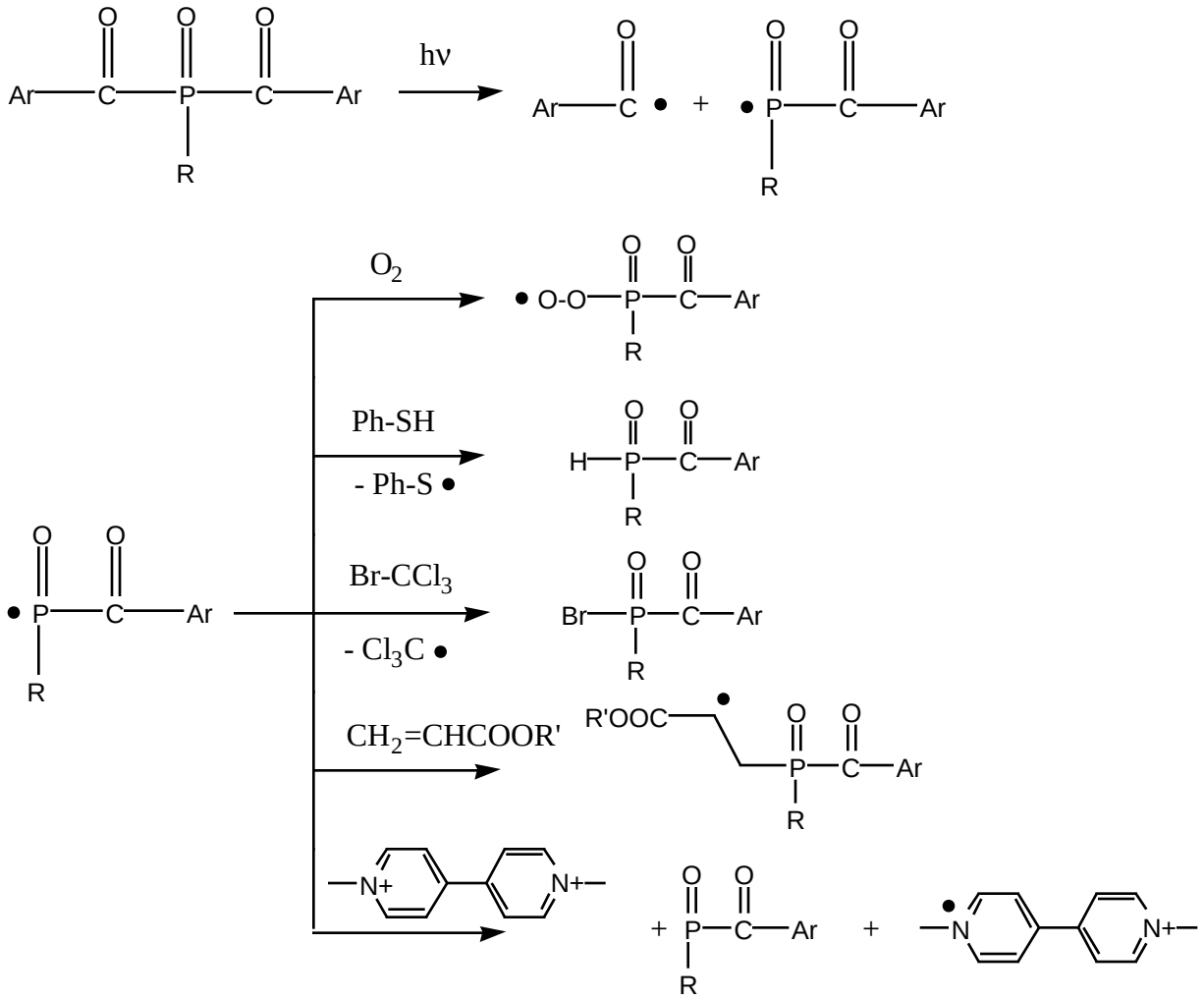


Majima, T.; Schnabel, W. *J. Photochem. Photobiol. A: Chem.* **1989**, 50, 31
Majima, T.; Konishi, Y.; Bottcher, A.; Kuwata, K.; Kamachi, M.; Schnabel, W. *J. Photochem. Photobiol. A: Chem.* **1991**, 58, 239

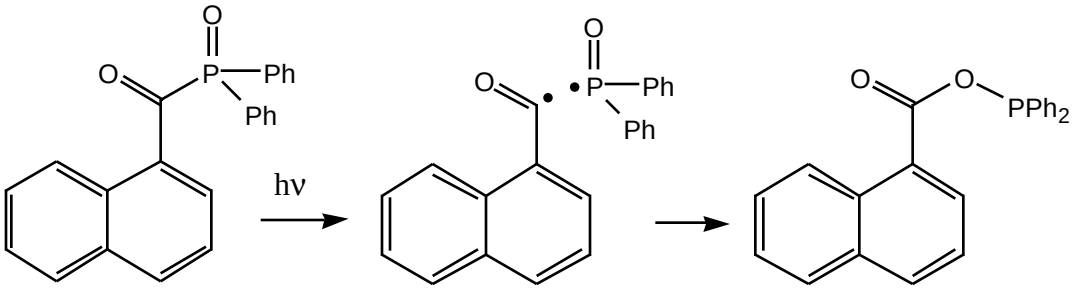


Sluggett, G.W.; McGarry, P.F.; Koptyug, I.V.; Turro, N.J. *J. Am. Chem. Soc.* **1996**, 118, 7367
Weber, M.; Khudyakov, I.V.; Turro, N.J. *J. Phys. Chem. A* **2002**, 106, 1938

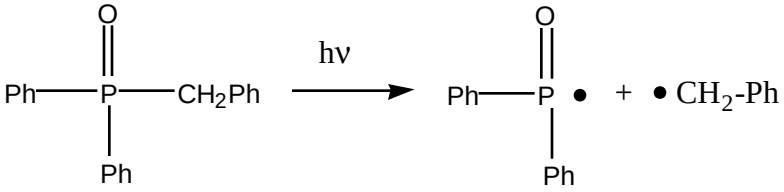
Weber, M.; Turro, N.J. *J. Phys. Chem. A* **2003**, 107, 3326



Jockusch, S.; Turro, N.J. *J. Am. Chem. Soc.* **1998**, 120, 11773

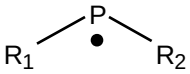


Zhao, N.; Strehmel, B.; Gorman, A.A.; Hamblett, I.; Neckers, D.C. *J. Phys. Chem. A* **1999**, 103, 7757

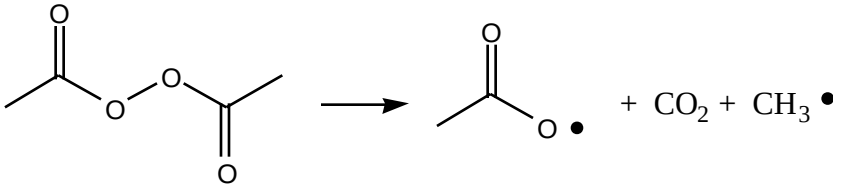


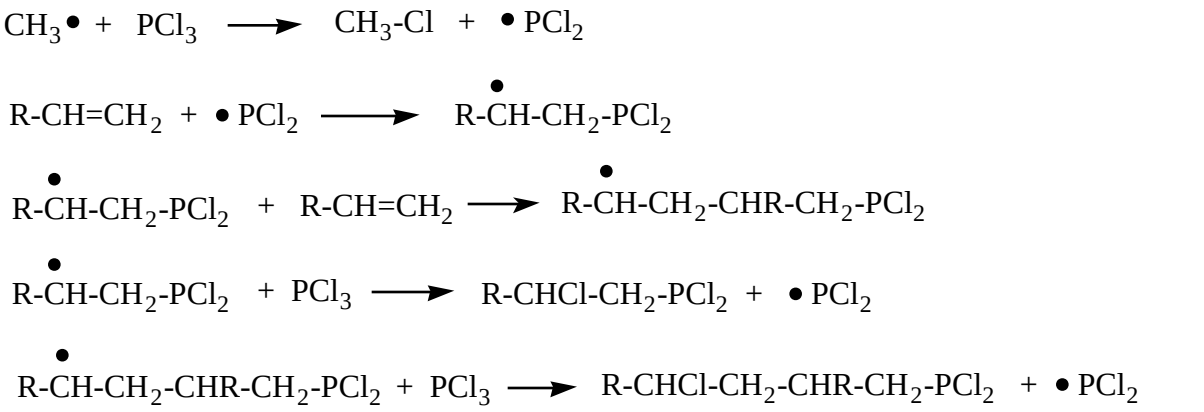
Zhao, N.; Neckers, D.C. *J. Org. Chem.* **2000**, 65, 2145

(ii) Phosphinyl radicals

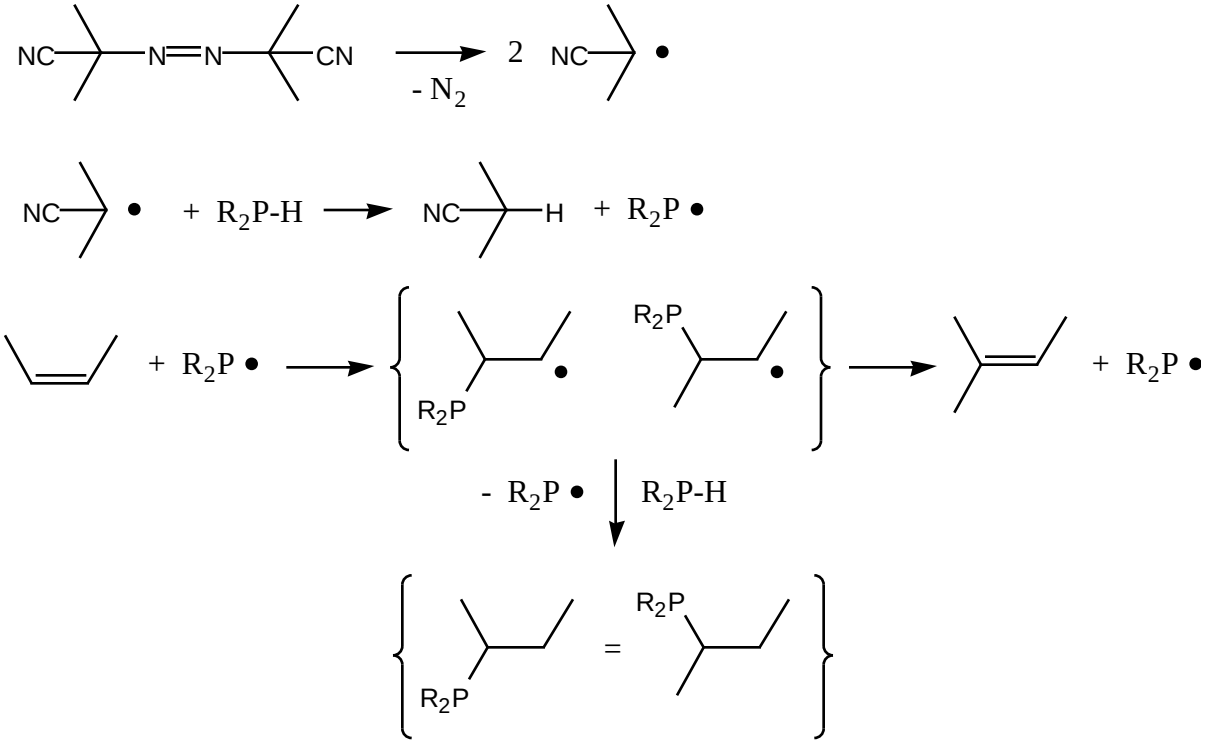


Reviews:
Bentrude, W.G. *Ann. Rev. Phys. Chem.* **1967**, 18, 283

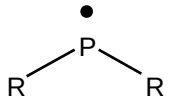




Kharasch, M.S.; Jensen, E.V.; Urry, W.H. *J. Am. Chem. Soc.* **1945**, 67, 1864

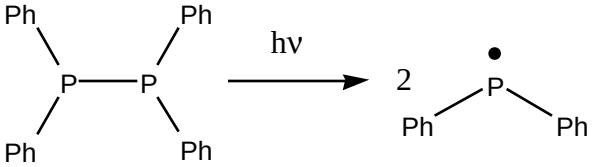


Pellon, J. *J. Am. Chem. Soc.* **1961**, 83, 1915

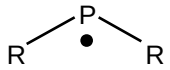


R = Cl, Br

Andrews, L.; Frederick, D.L. *J. Phys. Chem.* **1969**, 73, 2774 (IR spectra in solid Ar matrix)

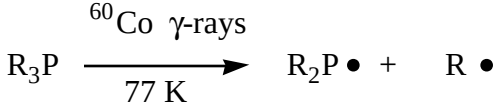


Wong, S.K.M.; Wan, J.K.S. *Spectrosc. Lett.* **1970**, 3, 135



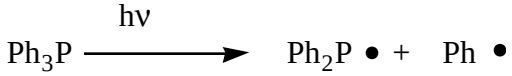
R = NMe_2, Et, EtO, $Me(CH_2)_5$

Davies, A.G.; Dennis, R.W.; Griller, D.; Ingold, K.U.; Roberts, B.P. *Molecular Physics* **1973**, 25, 989

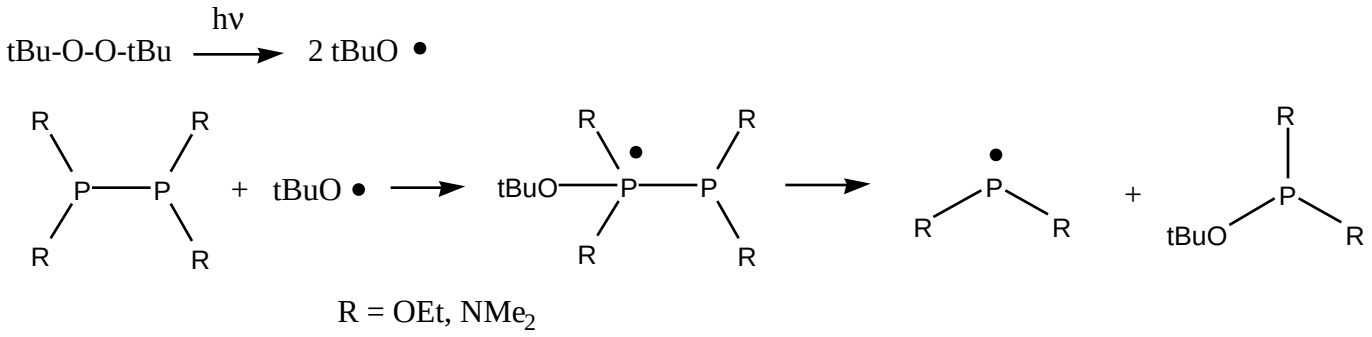


R = H, iPr, OMe, SMe, Ph, Cl, SPr, SEt

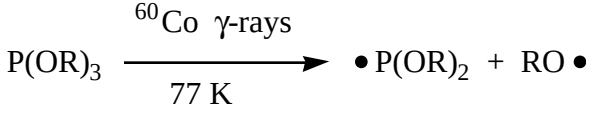
Fullam, B.W.; Mishra, S.P.; Symons, M.C.R. *J. Chem. Soc. Dalton Trans.* **1974**, 2145
Fullam, B.W.; Symons, M.C.R. *J. Chem. Soc. Dalton Trans.* **1975**, 861



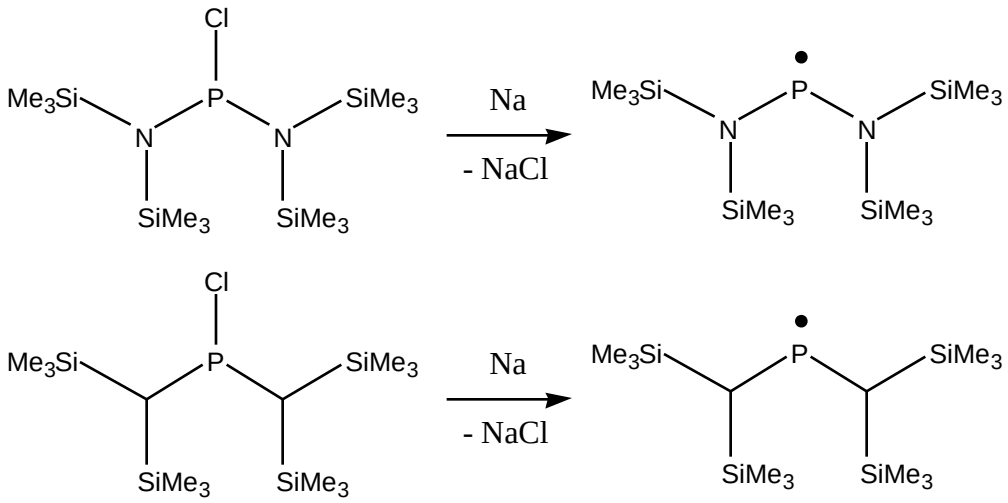
Cook, W.T.; Vincent, J.S.; Bernal, I.; Ramirez, F. *J. Chem. Phys.* **1974**, 61, 3479



Griller, D.; Roberts, B.P.; Davies, A.G.; Ingold, K.U. *J. Am. Chem. Soc.* **1974**, 96, 554

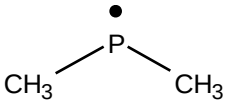


Kerr, C.M.L.; Webster, K.; Williams, F. *J. Phys. Chem.* **1975**, 79, 2650

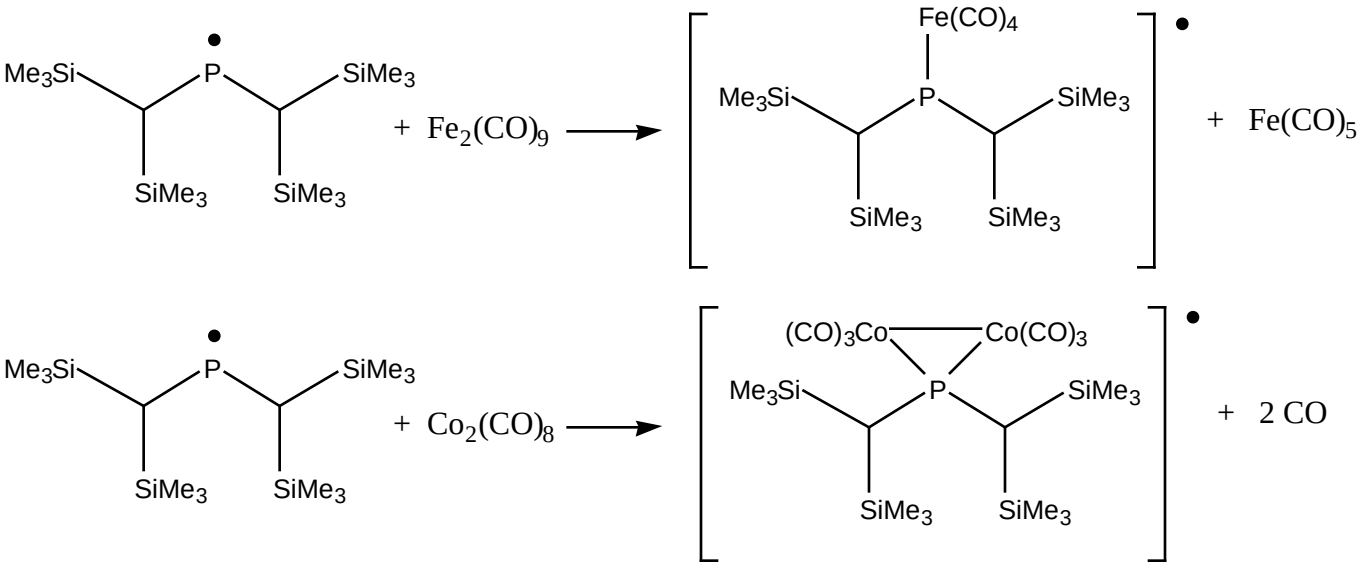


Gynane, M.J.S.; Hudson, A.; Lappert, M.F.; Power, P.P. *Chem. Commun.* **1976**, 623

Gynane, M.J.S.; Hudson, A.; Lappert, M.F.; Power, P.P.; Goldwhite, H. *J. Chem. Soc. Dalton Trans.* **1980**, 2428
Cowley, A.H.; Kemp, R.A. *Inorg. Chem.* **1983**, 22, 547

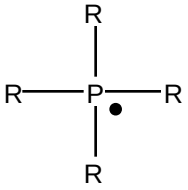


Roberts, B.P.; Singh, K. *J. Organometallic Chem.* **1978**, 159, 31 (ESR spectrum)

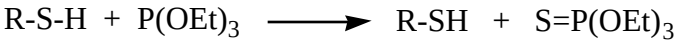


Cowley, A.H.; Kemp, R.A.; Wilburn, J.C. *J. Am. Chem. Soc.* **1982**, 104, 331

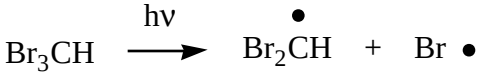
(iii) Phosphoranyl radicals

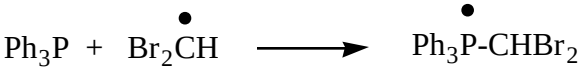


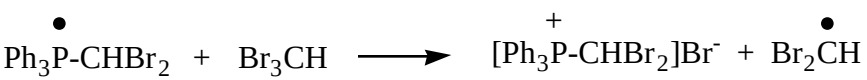
Reviews:
Bentrude, W.G. *ACS Symp. Ser.* **1978**, 69, 321
Roberts, B.P. *Adv. Free Radical Chem.* **1980**, 6, 225
Bentrude, W.G. *Acc. Chem. Res.* **1982**, 15, 117
Bentrude, W.G. *Reactive Intermediates* **1983**, 3, 199



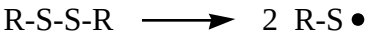
Hoffman, F.W.; Ess, R.J.; Simmons, T.C.; Hanzel, R.S. *J. Am. Chem. Soc.* **1956**, 78, 6414



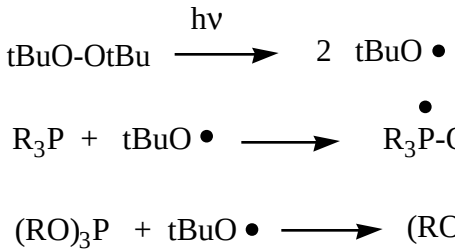




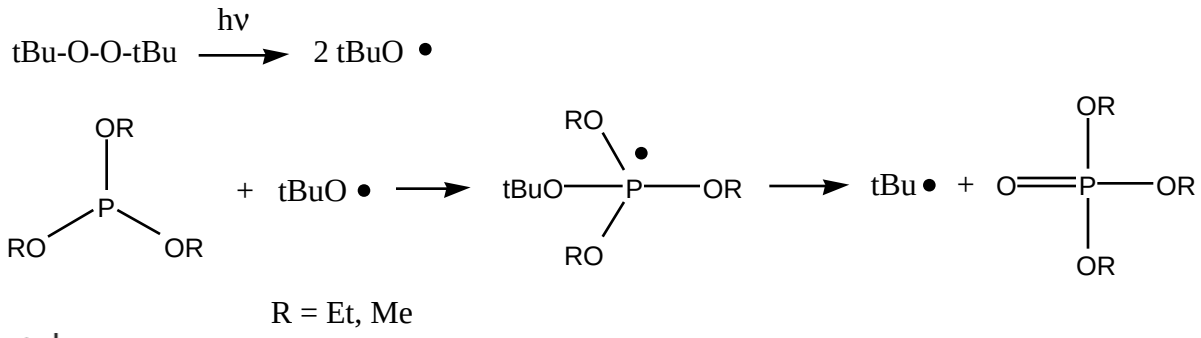
Ramirez, F.; McElvie, N. *J. Am. Chem. Soc.* **1957**, 79, 5829



Walling, C.; Rabinowitz, R. *J. Am. Chem. Soc.* **1957**, 79, 5326
Walling, C.; Rabinowitz, R. *J. Am. Chem. Soc.* **1959**, 81, 1243
Walling, C.; Basedow, O.H.; Savas, E.S. *J. Am. Chem. Soc.* **1960**, 82, 2181
Buckler, S.A. *J. Am. Chem. Soc.* **1962**, 84, 3093

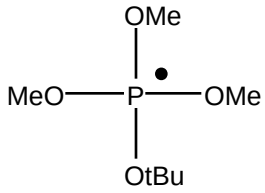


Krusic, P.J.; Mahler, W.; Kochi, J.K. *J. Am. Chem. Soc.* **1972**, 94, 6033



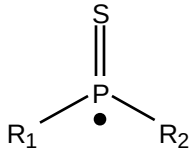
R = Et, Me

Griller, D.; Roberts, B.P.; Davies, A.G.; Ingold, K.U. *J. Am. Chem. Soc.* **1974**, 96, 554



Roberts, B.P.; Singh, K. *J. Organometallic Chem.* **1978**, 159, 31 (ESR spectrum)

(iv) Thiophosphinoyl (phosphinothioyl) radicals



Reviews:
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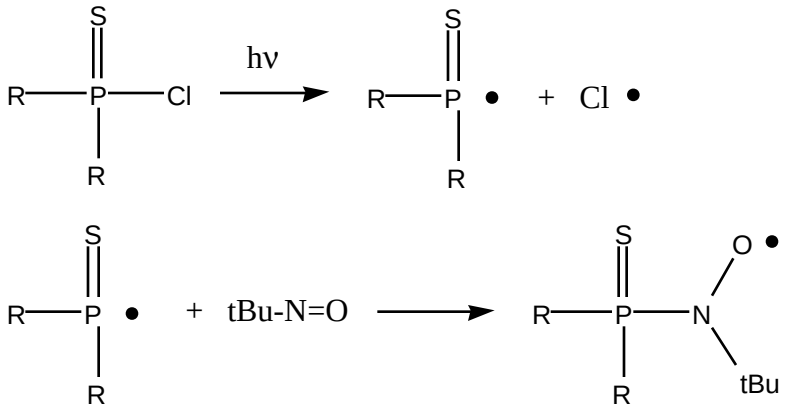
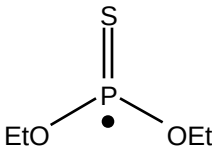


Karlsson, H.; Lagercrantz, C. *Acta Chem. Scand.* **1970**, 24, 3411

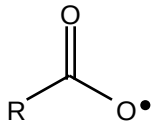


Davies, A.G.; Dennis, R.W.; Griller, D.; Ingold, K.U.; Roberts, B.P. *Molecular Physics* **1973**, 25, 989

Group VI centred radicals (O, S, Se)

Oxygen centred radicals:

(i) Acetoxy (acetoxyl) radicals



Reviews:

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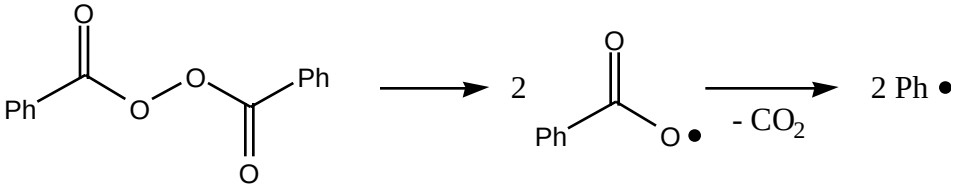
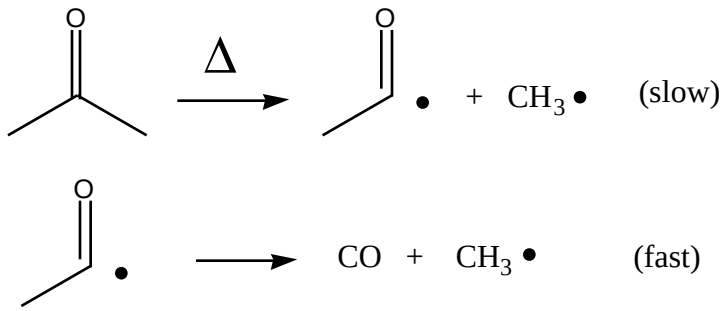
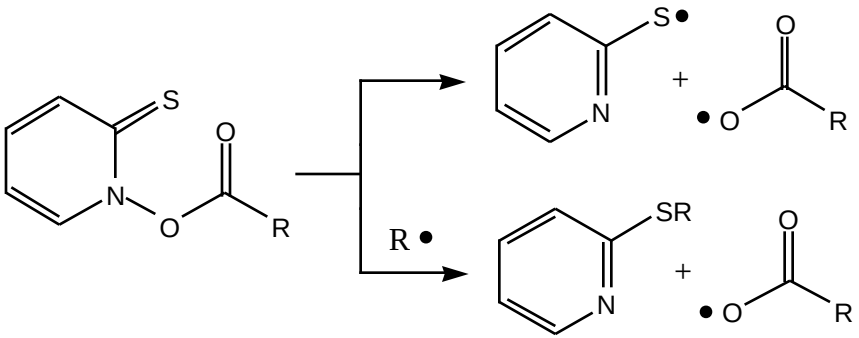


Brodie, B.C. *Ann. Chem.* **1858**, 108, 79
Hey, D.H. *J. Chem. Soc.* **1934**, 1966
Waters, W.A. *J. Chem. Soc.* **1937**, 113
Roberts, J.S.; Skinner, H.A. *Trans. Faraday Soc.* **1949**, 45, 339
McDowell, C.A.; Thomas, J.H. *J. Chem. Soc.* **1949**, 2208; 2217

Marcotte, F.B.; Noyes, W.A. Jr. *J. Am. Chem. Soc.* **1952**, 74, 783
Volman, D.H.; Graven, W.M. *J. Chem. Phys.* **1952**, 20, 919
Nicholson, A.J.C. *J. Chem. Phys.* **1952**, 20, 1811
Norrish, R.G.W. *Z. Elektrochem. Angew. Physik. Chem.* **1952**, 56, 705
Porter, G.B.; Benson, S.W. *J. Am. Chem. Soc.* **1953**, 75, 2773
Nicholson, G.R.; Szwarc, M.; Taylor, J.W. *J. Chem. Soc.* **1954**, 2767
Ausloos, P.; Steacie, E.W.R. *Can. J. Chem.* **1955**, 33, 47
Farmer, J.B.; Lossing, F.P.; Marsden, D.G.H.; Steacie, E.W.R. *J. Chem. Phys.* **1955**, 23, 1169

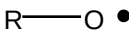


Szwarc, M.; Taylor, J.W. *J. Chem. Phys.* **1955**, 23, 2310

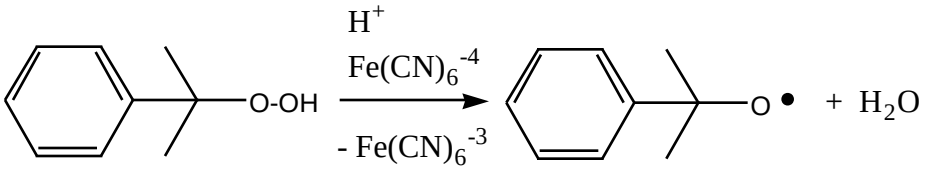


Barton, D.H.R.; Crich, D.; Motherwell, W.B. *Tetrahedron* **1985**, 41, 3901

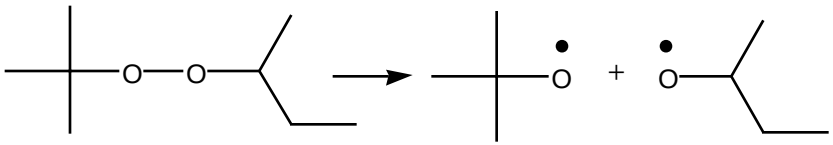
(ii) Alkoxy radicals

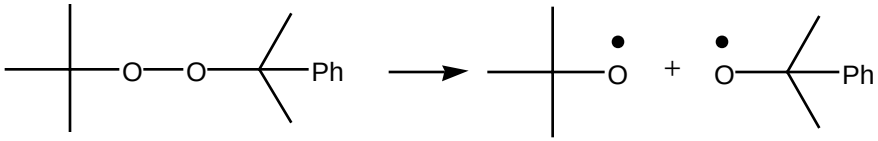


Reviews:
Walling, C. *Pure Appl. Chem.* **1967**, 15, 69
Griller, D.; Wayner, D.D.M. *Pure Appl. Chem.* **1989**, 61, 717
Orlando, J.J.; Tyndall, G.S.; Wallington, T.J. *Chem. Rev.* **2003**, 103, 4657

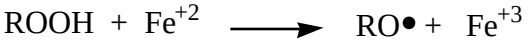


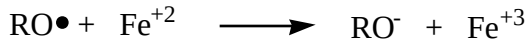
Fordham, J.W.L.; Williams, H.L. *J. Am. Chem. Soc.* **1950**, 72, 4465
Kharasch, M.S.; Fono, A.; Nudenberg, N. *J. Org. Chem.* **1950**, 15, 763



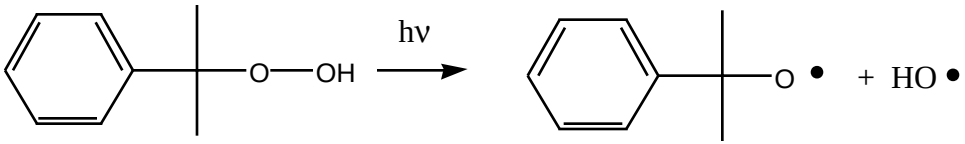


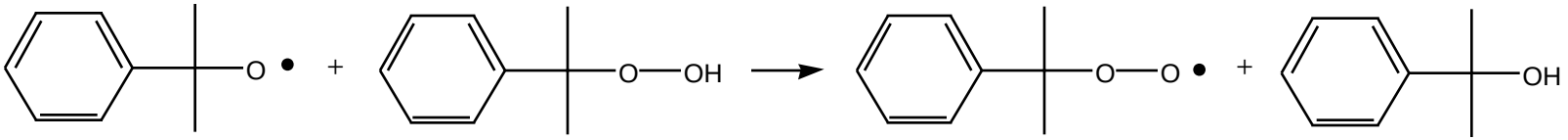
Kharasch, M.S.; Fono, A.; Nudenberg, W. *J. Org. Chem.* **1951**, 16, 105
Kharasch, M.S.; Nudenberg, N.; Arimoto, F.S. *Science* **1951**, 113, 392 (addition to olefins)
Boardman, H. *J. Am. Chem. Soc.* **1953**, 75, 4268



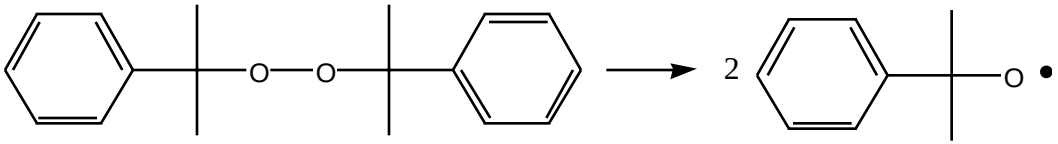


Orr, R.J.; Williams, H.L. *J. Am. Chem. Soc.* **1955**, 77, 3715

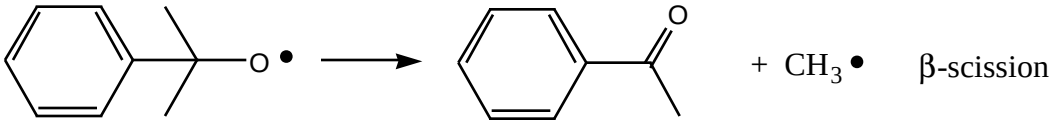




Zwolenik, J.J. *J. Phys. Chem.* **1967**, 71, 2464

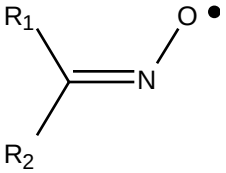


Niki, E.; Kamiya, Y.; Ohta, N. *Bull. Chem. Soc. Jpn* **1968**, 41, 1466

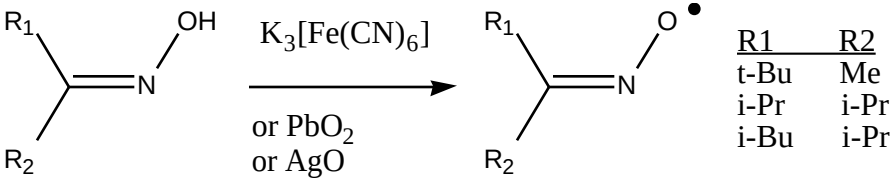


Howard, J.A.; Ingold, K.U. *Can. J. Chem.* **1969**, 47, 3797

(iii) Iminoxyl radicals

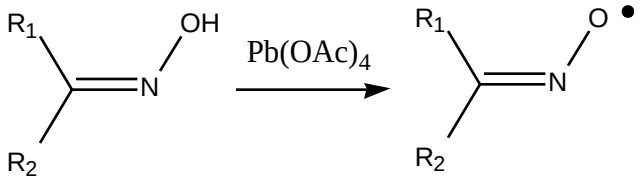


Reviews:
Rozantsev, E.G. *Usp. Khim.* **1966**, 35, 1549

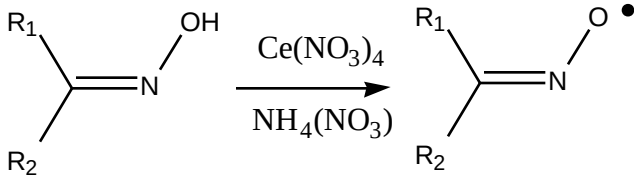


R1	R2
t-Bu	Me
i-Pr	i-Pr
i-Bu	i-Pr

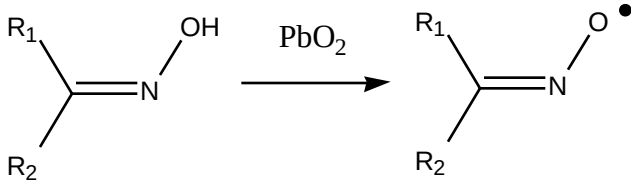
Fedtke, M.; Mitternacht, H. *Z. Chem.* **1964**, 4, 389



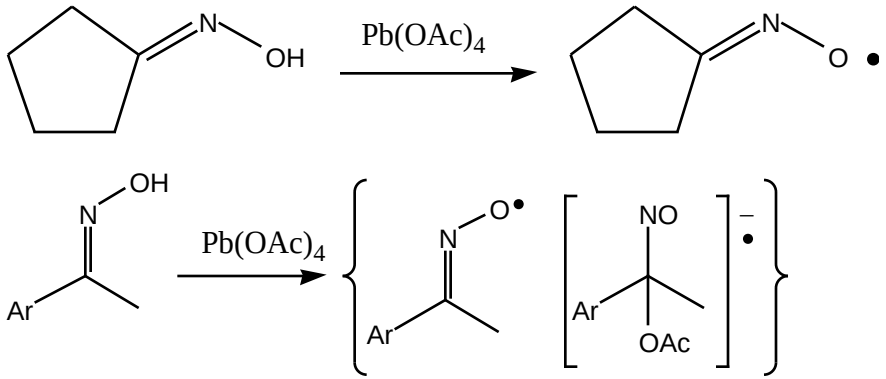
Lemaire, H.; Rassat, A. *Tetrahedron Lett.* **1964**, 2245



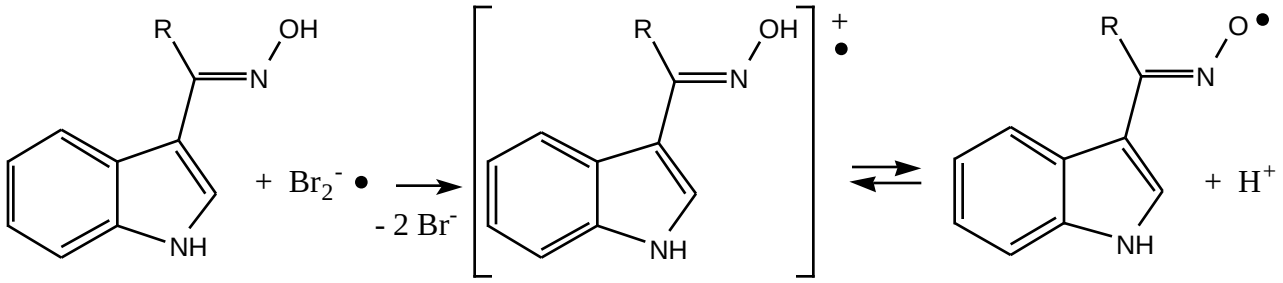
Thomas, J.R. *J. Am. Chem. Soc.* **1964**, 86, 1446



Gilbert, B.C.; Norman, R.O.C. *J. Chem. Soc. (Phys. Org.)* **1966**, 86

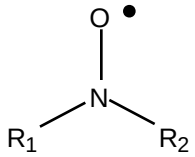


Lown, J.W. *J. Chem. Soc. B* **1966**, 441

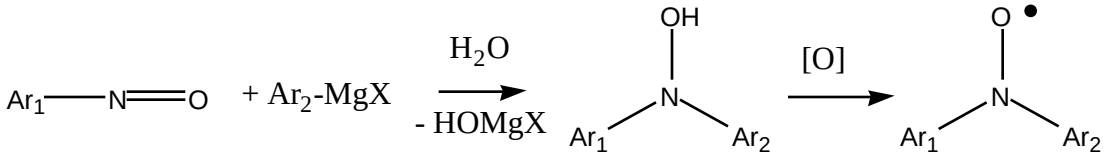


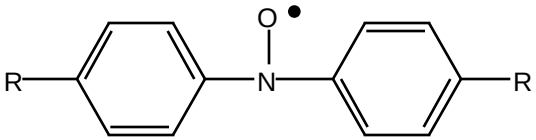
Everett, S.A.; Naylor, M.A.; Stratford, M.R.L.; Patel, K.B.; Ford. E.; Mortensen, A.; Ferguson, A.C.; Vojnovic, B.; Wardman, P. *J. Chem. Soc. Perkin Trans. 2* **2001**, 1989

(iv) Nitroxyl radicals

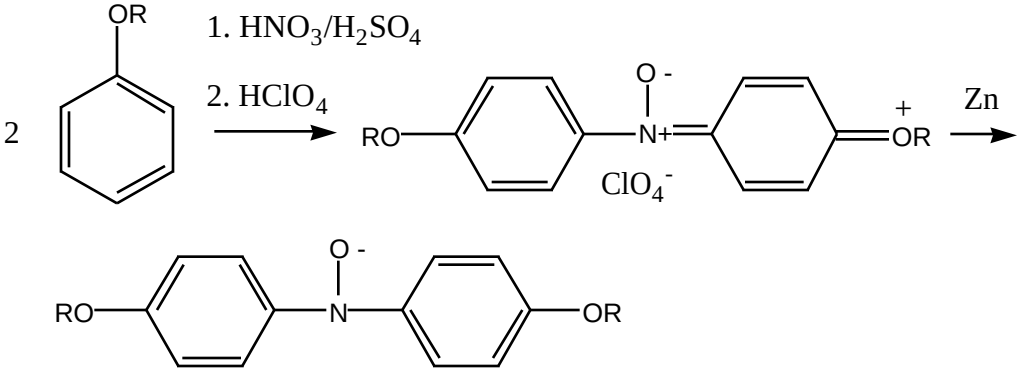


<u>Reviews:</u>
Rozentsev, E.G. *Free Nitroxyl Radicals*, (translated by B.J. Hazzard) Plenum: New York, 1970
Rozantsev, E.G.; Sholle, V.D. *Synthesis* **1971**, 190
Rozantsev, E.G.; Sholle, V.D. *Synthesis* **1971**, 401
Volodarsky, L.B.; Reznikov, V.A.; Ovcharenko, V.I. *Synthetic Chemistry of Stable Nitroxides*, CRC Press: Boca Raton, FL, 1994

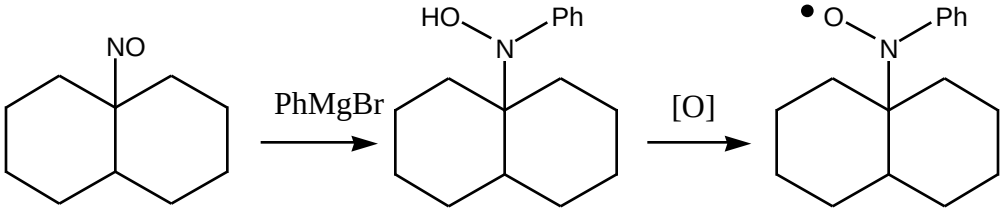




Wieland, H.; Roseeu, A. *Chem. Ber.* **1912**, 45, 494
Wieland, H.; Offenbächer, M. *Chem. Ber.* **1914**, 47, 2111
Wieland, H.; Roseeu, A. *Chem. Ber.* **1915**, 48, 1117
Wieland, H.; Roth, K. *Chem. Ber.* **1920**, 53, 210
Wieland, H.; Kögel, F. *Chem. Ber.* **1922**, 55, 1798

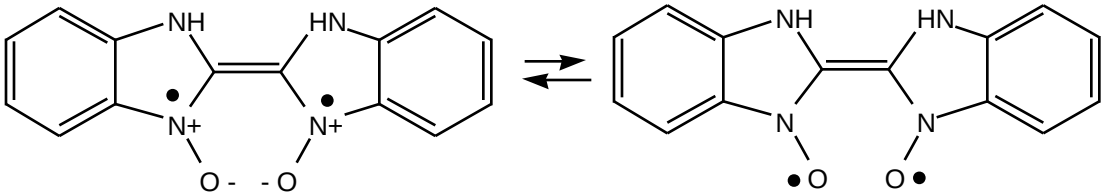


Meyer, K.H.; Gottlieb-Billroth, H. *Chem. Ber.* **1919**, 52, 1476
Meyer, K.H.; Reppe, W. *Chem. Ber.* **1921**, 54, 327

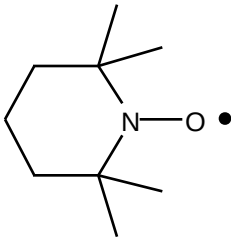


Hückel, W.; Liegel, W. *Chem. Ber.* **1938**, 71, 1442

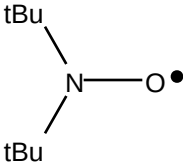
Johnson, D.; Rogers, M.; Trappe, G. *J. Chem. Soc.* **1956**, 1093 (postulated existence of free nitroxyl radicals)
Rogers, M. *J. Chem. Soc.* **1956**, 2784

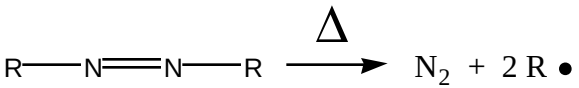


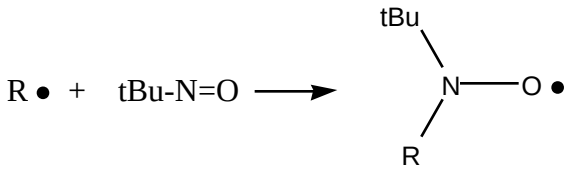
Niementowski, S. *Chem. Ber.* **1910**, 43, 3012
Kuhn, R.; Blau, W. *Ann. Chem.* **1958**, 615, 99



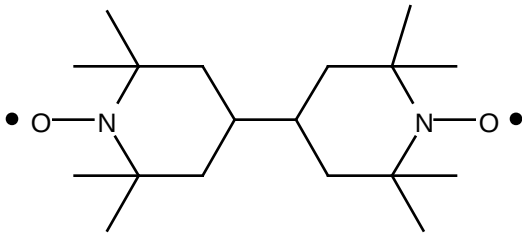
Lebedev, O.L.; Kazarnovskii, S.N. *Treatises on Chemistry and Chemical Technology*, Gorky, **1959**, 3, 649
Il'yasov, A.V. *Zh. Strukt. Khim.* **1962**, 3, 95
Garif'yasov, I.S.; Il'yasov, A.V.; Yablokov, Yu. V. *Dokl. Akad. Nauk SSSR* **1963**, 149, 876



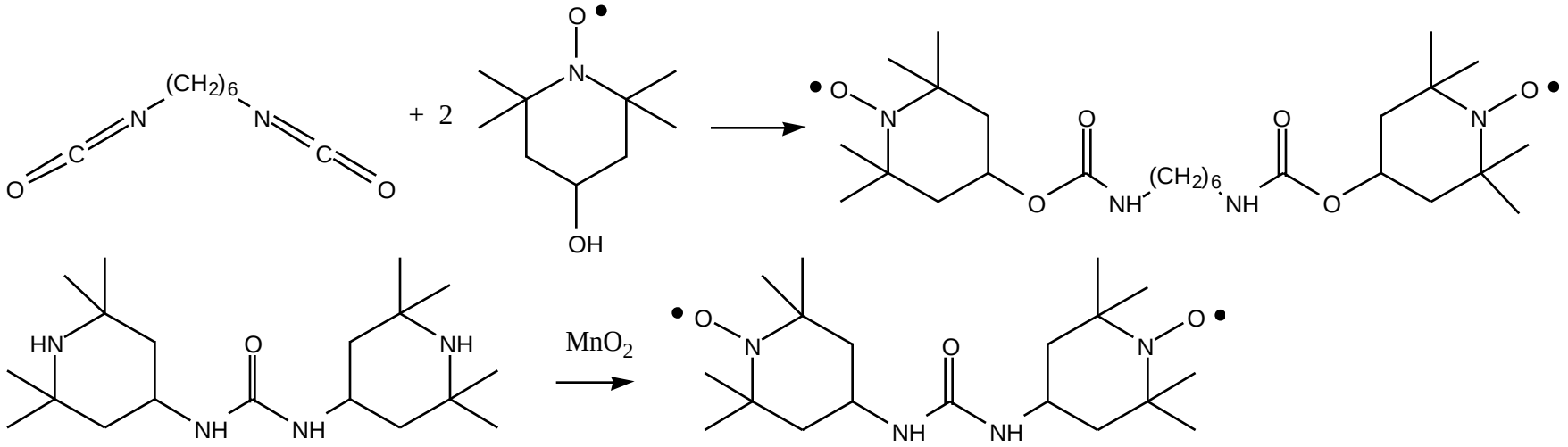




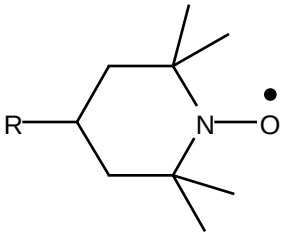
Hoffmann, A.K.; Henderson, A.T. *J. Am. Chem. Soc.* **1961**, 83, 4671
Hoffmann, A.K.; Hodgson, W. *J. Am. Chem. Soc.* **1961**, 83, 4675
Hoffmann, A.K.; Hodgson, W.; Maricle, D.; Jura, W. *J. Am. Chem. Soc.* **1964**, 86, 631
Hoffmann, A.K.; Feldman, A.; Gelblum, E.; Hodgson, W. *J. Am. Chem. Soc.* **1964**, 86, 639
Hoffmann, A.K. FR 1,357,477 (1964)
Hoffmann, A.K. US 3,253,015 (1966)



Rozantsev, E.G.; Golubev, V.A.; Neiman, M.B. *Izv. Akad. Nauk SSSR, Ser. Khim.* **1965**, 393

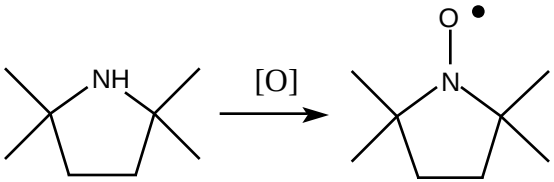


Rozantsev, E.G.; Golubev, V.A.; Neiman, M.B.; Kokhanov, Yu.V. *Izv. Akad. Nauk SSSR, Ser. Khim.* **1965**, 572

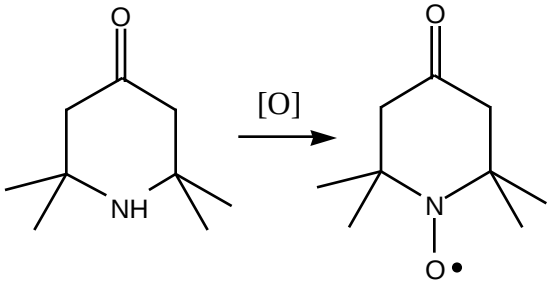


R = H, OH, O=, =NOH, OAc

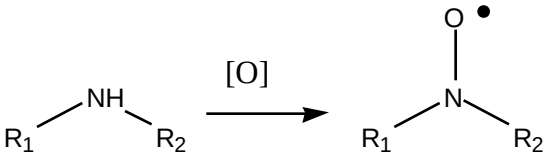
Briere, R.; Lemaire, H.; Rassat, A. *Bull. Soc. Chim. Fr.* **1965**, 3273



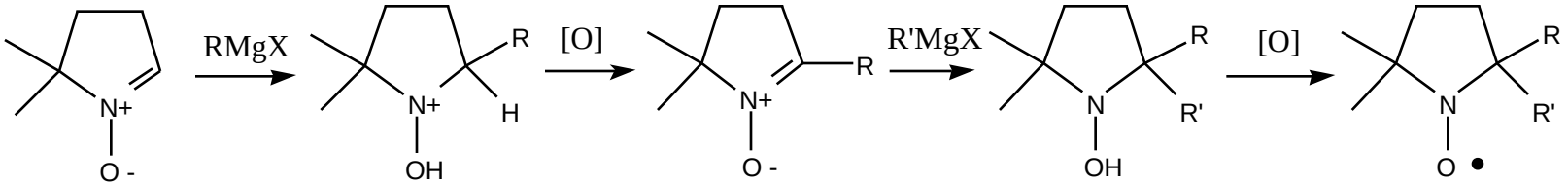
Rozantsev, E.G. *Usp. Khim.* **1966**, 35, 1549



Rozantsev, E.G. *Izv. Akad. Nauk SSSR, Ser. Khim.* **1966**, 770
Rozantsev, E.G.; Neiman, M.B. *Tetrahedron* **1964**, 20, 131

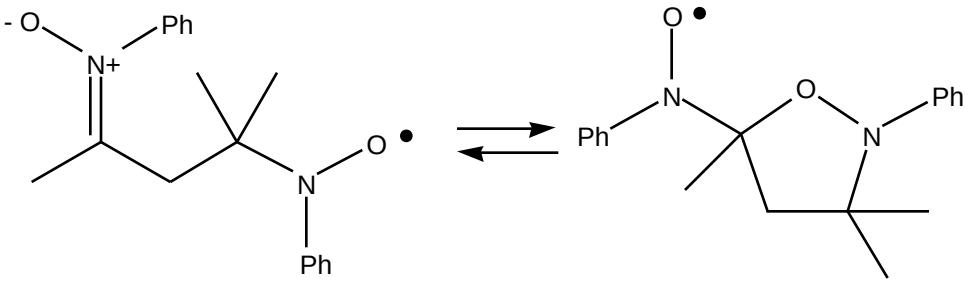


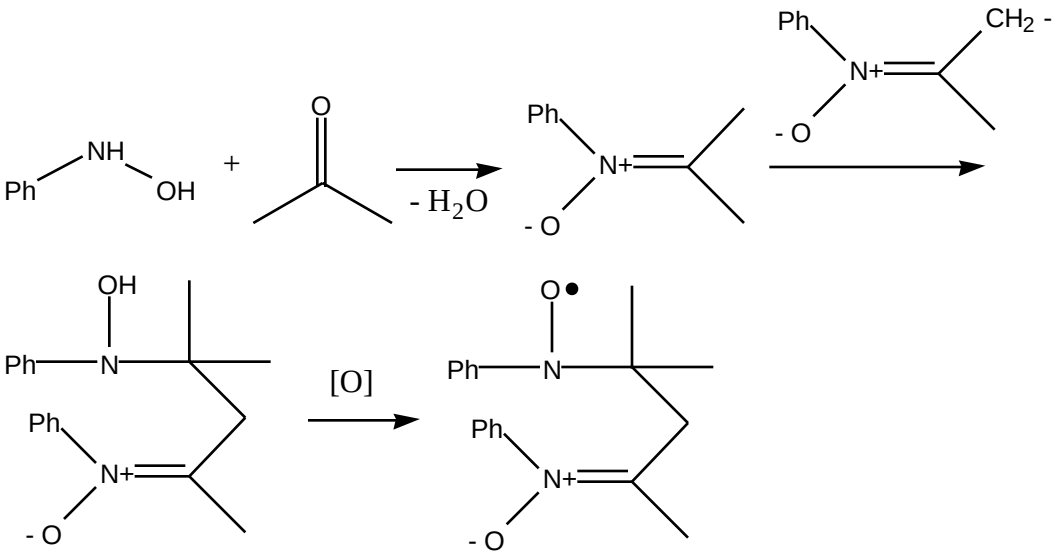
Lebedev, O.L.; Khidekel, M.L.; Razuvaev, G.A. *Dokl. Akad. Nauk SSSR* **1961**, 140, 1327
Rozantsev, E.G.; Neiman, M.B. *Tetrahedron* **1964**, 20, 131
Rozantsev, E.G.; Krinitzkaya, L.A. *Tetrahedron* **1965**, 21, 491
Rozantsev, E.G.; Burmistrova, R.M. *Dokl. Chem.* **1966**, 166, 38
Rozantsev, E.G.; Kokhanov, Yu.V. *Bull. Acad. Sci. USSR* **1966**, 1422



Bonnett, R.; Brown, R.F.C.; Clark, V.M.; Sutherland, I.O.; Todd, A. *J. Chem. Soc.* **1959**, 2094
Brown, R.F.C.; Clark, V.M.; Lamchen, M.; Todd, A. *J. Chem. Soc.* **1959**, 2116
Keanu, J.F.W.; Lee, T.D.; Bernard, E.M. *J. Am. Chem. Soc.* **1976**, 98, 3052

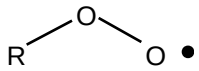
(v) Kenyon-Banfield radical





Banfield, F.H.; Kenyon, J. *J. Chem. Soc.* **1926**, 1612
Baldry, P.J.; Forrester, A.R.; Thomson, R.H. *J. Chem. Soc. Perkin Trans. 2* **1976**, 76

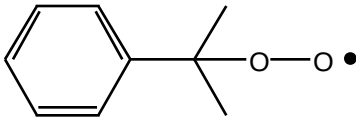
(vi) Peroxy radicals



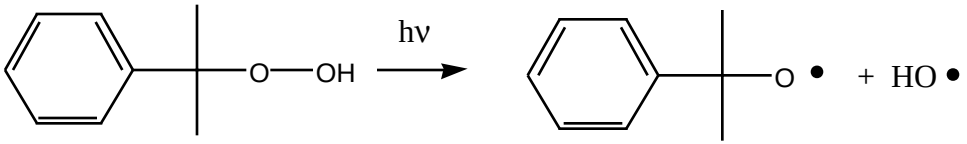
Reviews:

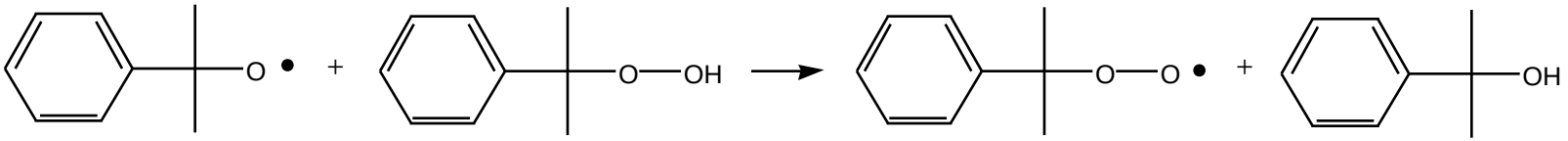
Ingold, K.U. *Acc. Chem. Res.* **1969**, 2, 1
Swern, D. (ed.) *Organic Peroxides*, Wiley-Interscience: New York, Vol. 1 - 3, 1970 - 1981
Ando, W. (ed.) *Organic Peroxides*, Wiley: New York, 1992
Alfassi, Z.B. (ed.) *Peroxyl Radicals*, Wiley: New York, 1997

Foner, S.N.; Hudson, R.L. *J. Chem. Phys.* **1953**, 21, 1608 (detection of hydroperoxide radical)



Bersohn, M.; Thomas, J.R. *J. Am. Chem. Soc.* **1964**, 86, 959 (detection by ESR)

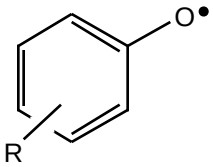




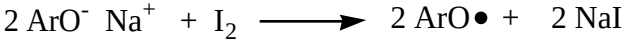
Zwolenik, J.J. *J. Phys. Chem.* **1967**, 71, 2464

Howard, J.A.; Ingold, K.U. *Can. J. Chem.* **1969**, 47, 3797

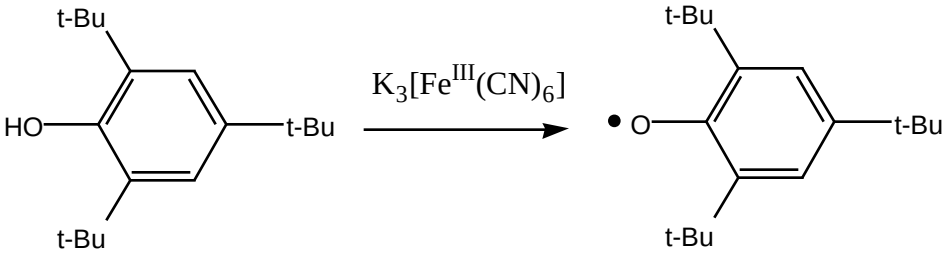
(vii) Phenoxy (phenoxyl) radicals



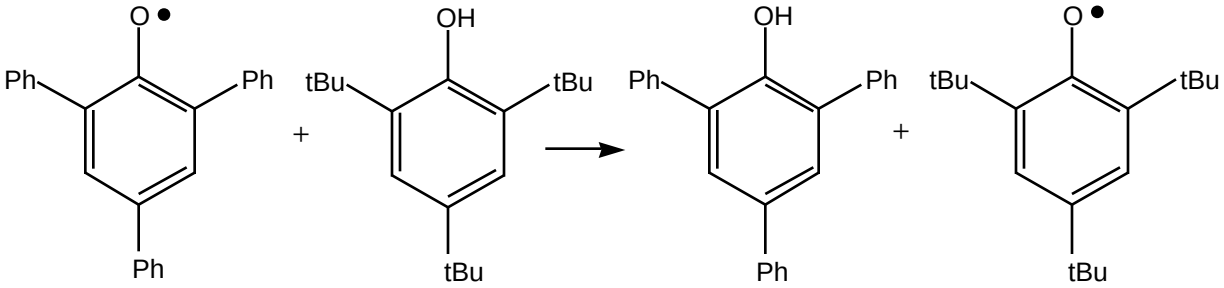
Reviews:
Becconsall, J.K.; Clough, S.; Scott, G. *Trans. Faraday Soc.* **1960**, 56, 459 (ESR of phenoxy radicals)
Müller, E. *Revista Portuguesa de Quimica* **1972**, 14, 129
Iley, J.; Taylor, P.G. in *The Chemistry of Hydroxyl, Ether Peroxide Groups*, (S. Patai, ed.) Wiley: Chichester, 1993, p. 241
Prokof'ev, A.I. *Russ. Chem. Rev.* **1999**, 68, 727



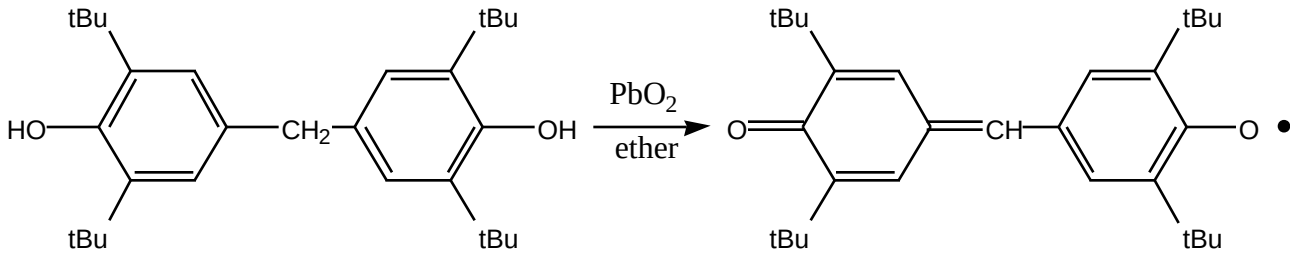
Müller, E.; Ley, K.; Kiedaisch, W. *Chem. Ber.* **1954**, 87, 1605
Hunter, W.H.; Seyfried, L.M. *J. Am. Chem. Soc.* **1921**, 43, 151



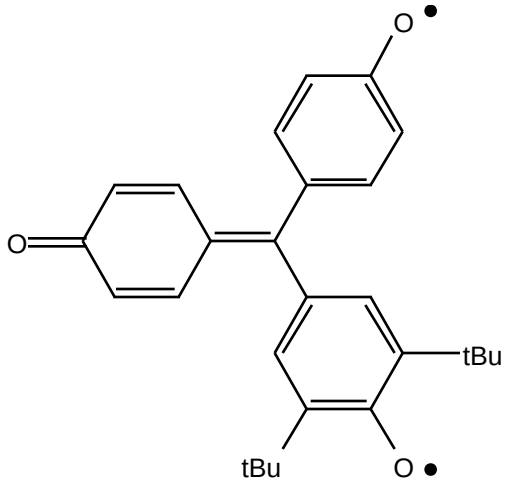
Müller, E.; Ley, K. *Z. Naturforsch.* **1953**, 8B, 694
Müller, E.; Ley, K. *Chem. Ber.* **1954**, 87, 922
Müller, E.; Ley, K.; Kiedaisch, W. *Chem. Ber.* **1954**, 87, 1605
Müller, E.; Ley, K. *Chem. Ber.* **1955**, 88, 601
Cook, C.D. *J. Am. Chem. Soc.* **1953**, 18, 261
Cook, C.D.; Kuhn, D.A.; Fianu, P. *J. Am. Chem. Soc.* **1956**, 78, 2002
Blanchard, H.S. *J. Org. Chem.* **1960**, 25, 264



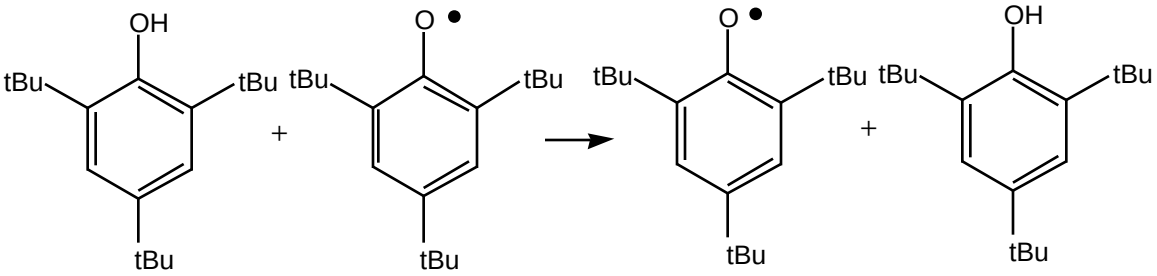
Dimroth, K.; Kalk, F.; Sell, R.; Schlömer, K. *Ann. Chem.* **1959**, 624, 51



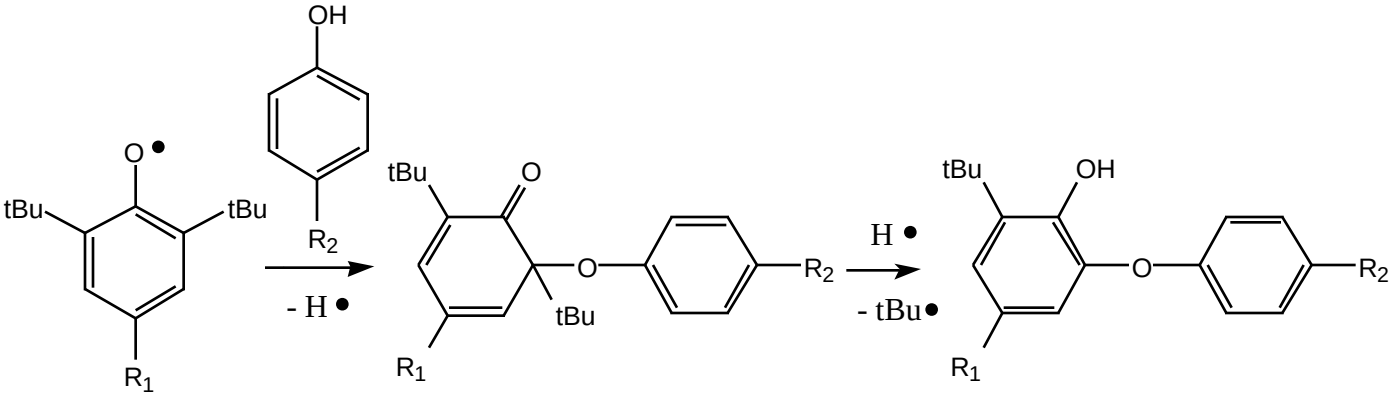
Coppinger, G.M. *J. Am. Chem. Soc.* **1957**, 79, 501
Joshi, B.S. *Chem. Ind.* **1957**, 525
Bartlett, P.D.; Funahashi, T. *J. Am. Chem. Soc.* **1962**, 84, 1605
ESR:
Besev, C.; Lund, A.; Vanngard, T.; Hakansson, R. *Acta Chem. Scand.* **1963**, 17, 2281
Hyde, J.S. *J. Chem. Phys.* **1965**, 43, 1806
Hausser, K.H.; Brunner, H.; Jochims, J.C. *Mol. Phys.* **1966**, 10, 253



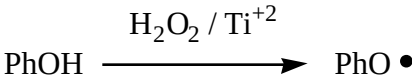
Yang, N.; Kastro, A. *J. Am. Chem. Soc.* **1960**, 82, 6208



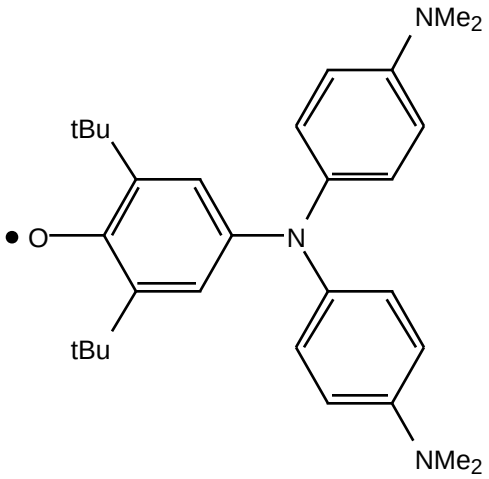
Kreilick, R.W.; Weissman, S.I. *J. Am. Chem. Soc.* **1962**, 84, 306



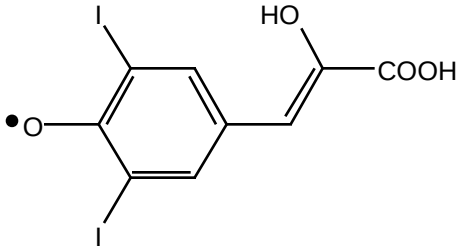
Matsuura, T.; Nishinaga, A.; Cahnmann, H.J. *J. Org. Chem.* **1962**, 27, 3620



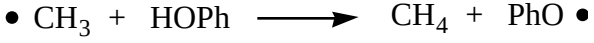
Dixon, W.T.; Norman, R.O.C. *Proc. Chem. Soc.* **1963**, 97 (ESR of phenoxy radical)



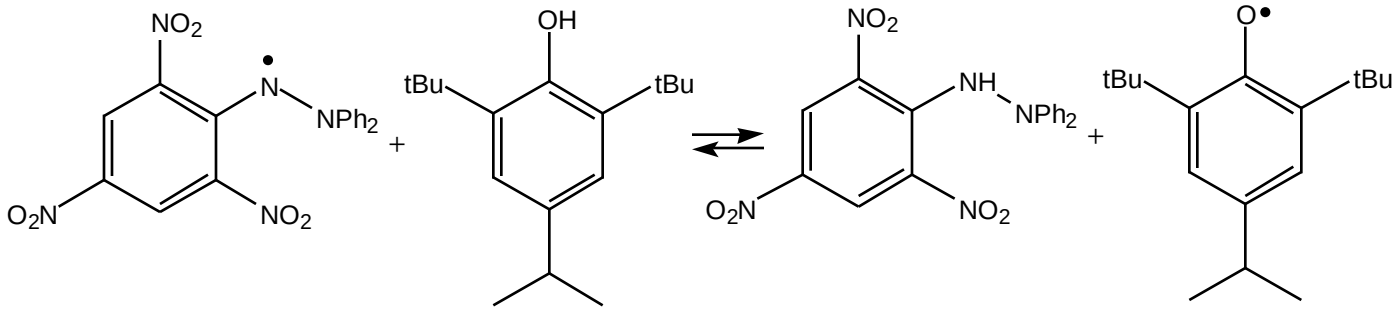
Neuhoeffer, O.; Heitmann, P. *Chem. Ber.* **1963**, 96, 1027



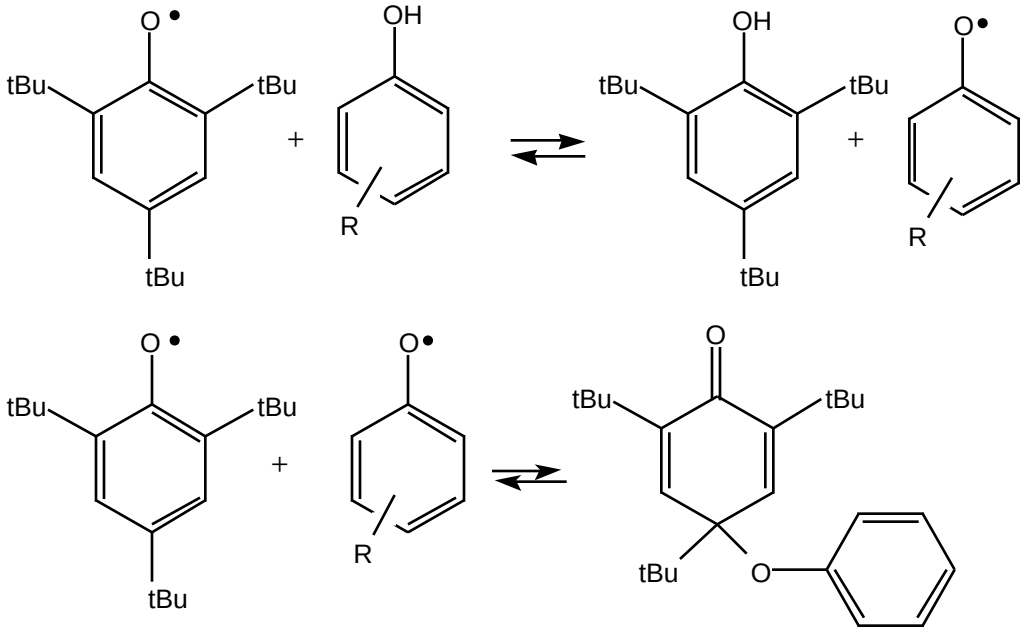
Matsuura, T.; Kon, H.; Cahnmann, H.J. *J. Org. Chem.* **1964**, 29, 3058



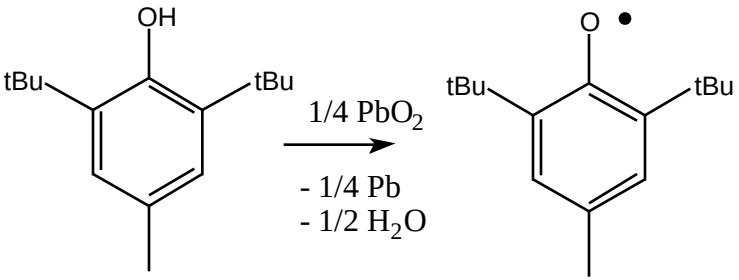
Mulcahy, M.F.R.; Williams, D.J. *Austr. J. Chem.* **1965**, 18, 20



Ayscough, P.B.; Russell, K.E. *Can. J. Chem.* **1967**, 45, 3019



Mahoney, L.R.; DaRooge, M.A. *J. Am. Chem. Soc.* **1970**, 92, 890



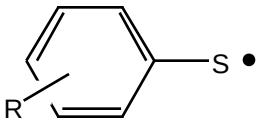
Stebbins, R.; Silicio, F. *Tetrahedron* **1970**, 26, 291

Sulfur centred radicals:

Reviews:
Kice, J.L. in *Free Radicals*, (J.K. Kochi, ed.) Wiley: New York, 1973, Vol. 2, p. 711
Davies, D.L.; Parrott, M.J. in *Int. Rev. Sci.: Org. Chem. Ser. 2* Butterworth: London, 1975, Vol. 10, p. 47
Asmus, K.D. *NATO ASI Ser. A* **1990**, 197, 155
Griller, D.; Simoes, J.A.M. *NATO ASI Ser. A* **1990**, 197, 327
Alfassi, Z.B. (ed.) *S-Centered Radicals*, Wiley: New York, 1999

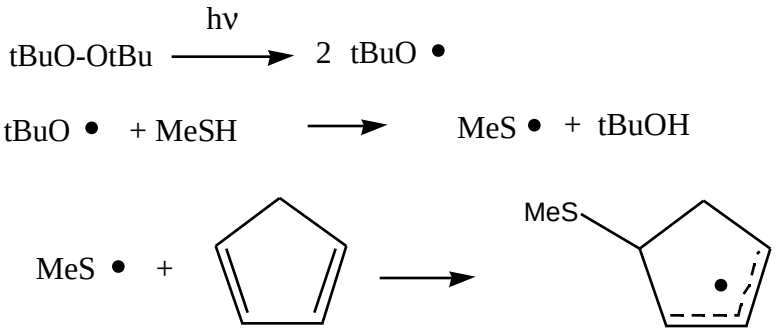
(i) Sulfanyl (mercapto, thiyl) radicals

Reviews:
Kooijman, E.C. *Pure Appl. Chem.* **1967**, 15, 81
Kellogg, R.M. *Methods in Free Radical Chem.* **1969**, 2, 1
Ito, O. *Trends Phys. Chem.* **1992**, 3, 245
Chatgilialglu, C.; Guerra, M. *The Chemistry of Sulphur Containing Functional Groups*, (Z. Rappoport, ed.) Wiley: Chichester, 1993, p. 363
Ito, O. *Res. Chem. Intermediates* **1995**, 21, 69

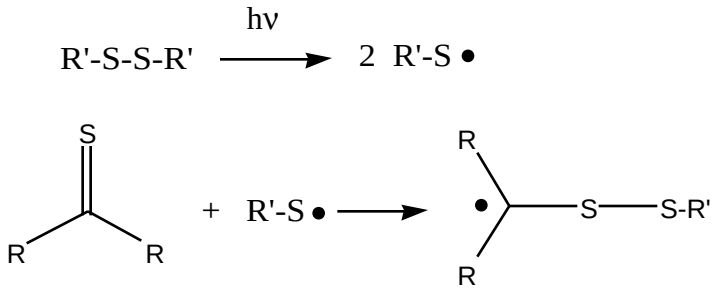


R = H, p-MeO, p-Me_2N, p-COOEt, p-Ph, o-OH

Schmidt, U.; Müller, A.; Markau, K. *Tetrahedron Lett.* **1963**, 1091

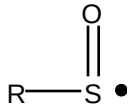


Kawamura, T.; Kochi, J.K. *J. Organometallic Chem.* **1973**, 47, 79

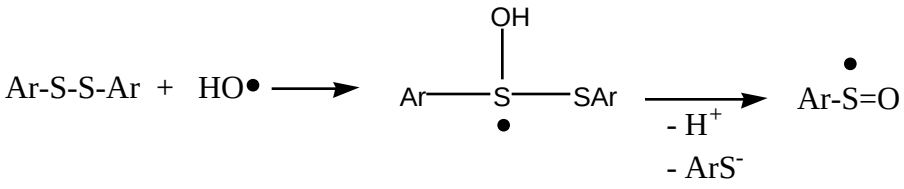


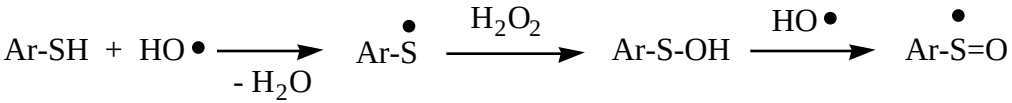
Alberti, A.; Bonini, B.F.; Pedulli, G.F. *Tetrahedron Lett.* **1987**, 28, 3737

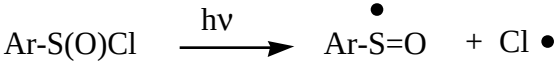
(ii) Sulfinyl radicals



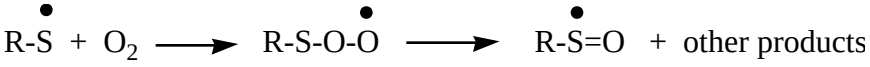
Reviews:
Chatgilialoglu, C. in *Chemistry of Sulphones and Sulfoxides*, (S. Patai, Z. Rappoport, C. Stirling, eds.) Wiley: New York, 1988, p. 1081 - 1087

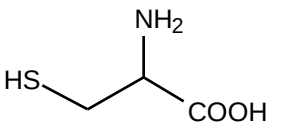




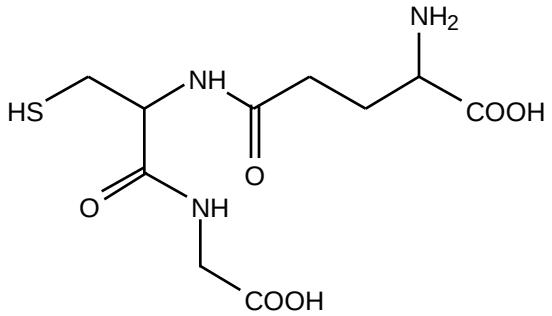


Gilbert, B.C.; Kirk, C.M.; Norman, R.O.C.; Laue, H.A.H. *J. Chem. Soc. Perkin Trans. 2* **1977**, 497



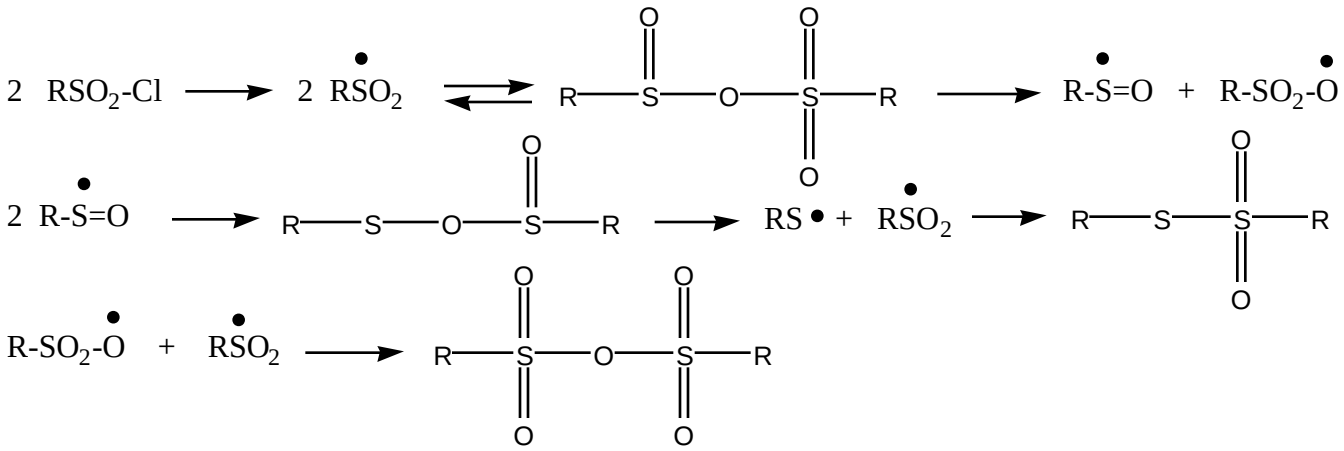


cysteine



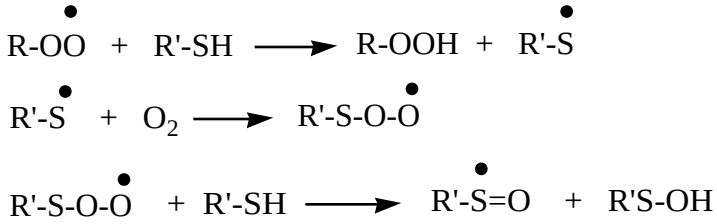
glutathione

Sevilla, M.D.; Becker, D.; Swarts, S.; Herrington, J. *Biochem. Biophys. Res. Commun.* **1987**, 144, 1037
Becker, D.; Swarts, S.; Champagne, M.; Sevilla, M.D. *Int. J. Radiat. Biol.* **1988**, 53, 767



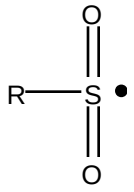
R = Ph

Bennett, J.E.; Brunton, G.; Gilbert, B.C.; Whittall, P.E. *J. Chem. Soc. Perkin Trans. 2* **1988**, 1359



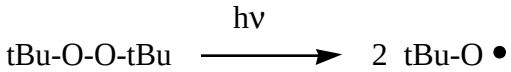
Swarts, S.G.; Becker, D.; De Bolt, S.; Sevilla, M.D. *J. Phys. Chem.* **1989**, 93, 155 (gamma irradiation in $Cl_2FC\text{-}CF_2Cl$ at 77 K; ESR of radicals)

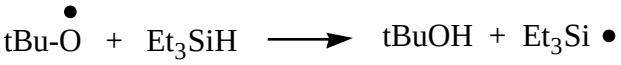
(iii) Sulfonyl radicals

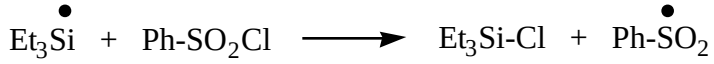


Reviews:

Freeman, F.; Keindl, M.C. *Sulfur Reports* **1985**, 4, 231
Chatgilialoglu, C. in *The Chemistry of Sulphones and Sulphoxides*, (S. Patai, Z. Rappoport, C. Stirling, eds.) Wiley: Chichester, 1988, p. 1089
Bertrand, M.P. *Org. Prep. Proced. Inter.* **1994**, 26, 257
Crich, D. in *Organosulfur Chemistry*, (P. Page, ed.) Academic Press: London, 1995, p. 49

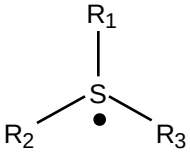




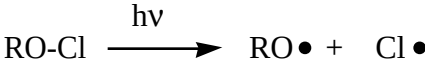


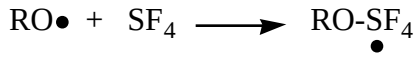
Chatgilialglu, C.; Gilbert, B.C.; Norman, R.O.C. *J. Chem. Soc. Perkin Trans. 2* **1979**, 770
Chatgilialglu, C.; Gilbert, B.C.; Norman, R.O.C. *J. Chem. Soc. Perkin Trans. 2* **1980**, 1429
Bennett, J.E.; Brunton, G.; Gilbert, B.C.; Whittall, P.E. *J. Chem. Soc. Perkin Trans. 2* **1988**, 1359

(iv) Sulfuranyl radicals

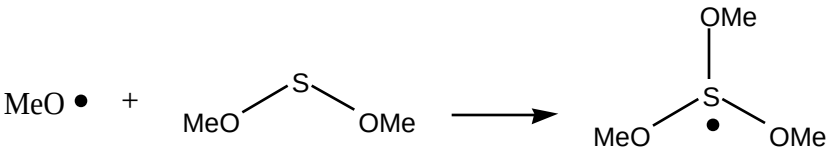


Reviews:
Anklam, E.; Margaretha, P. *Res. Chem. Intermed.* **1989**, 11, 127
Chatgilialoglu, C. in *Chemistry of Sulphenic Acids and Their Derivatives* (S. Patai, ed.) Wiley: Chichester, 1990, p. 549 - 569
Margaretha, P. in *S-Centered Radicals* (Z.B. Alfassi, ed.) Wiley: Chichester, 1999, p. 277 - 288

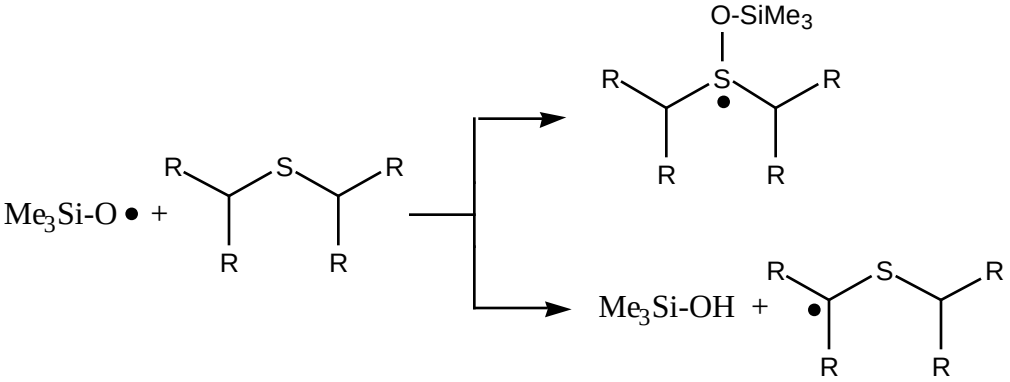




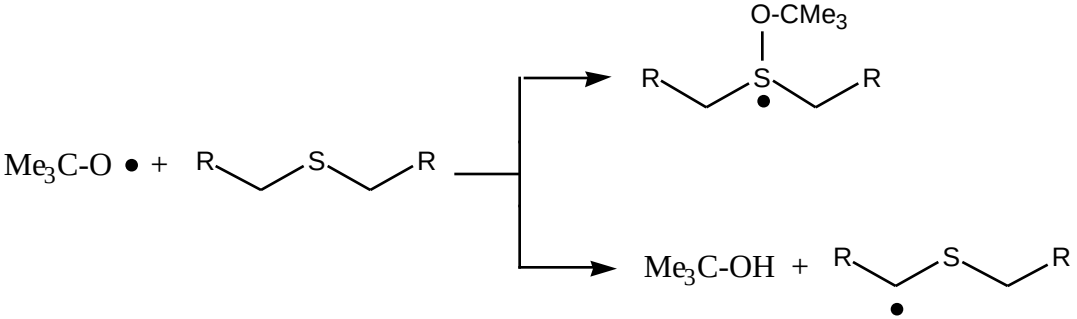
Gregory, A.R.; Karavelas, S.E.; Morton, J.R.; Preston, K.F. *J. Am. Chem. Soc.* **1975**, 97, 2206



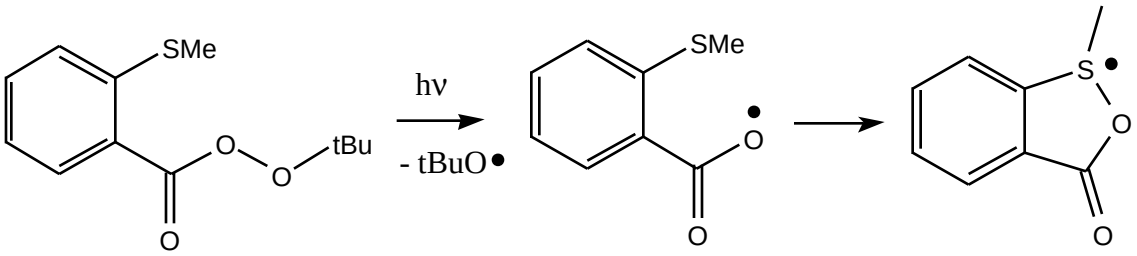
Cooper, J.W.; Roberts, B.P. *Chem. Commun.* **1977**, 228



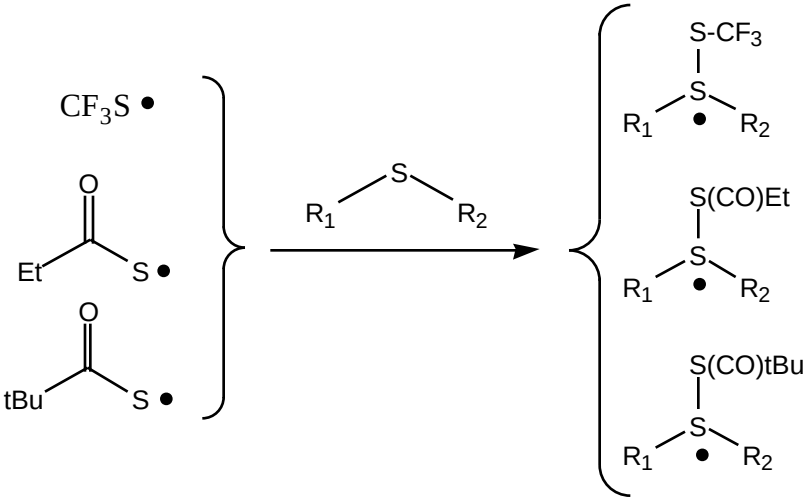
Gara, W.B.; Roberts, B.P. *J. Organometallic Chem.* **1977**, 135, C20



Gara, W.B.; Giles, J.R.M.; Roberts, B.P. *J. Chem. Soc. Trans. Perkin 2* **1979**, 1444

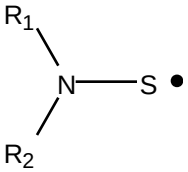


Perkins, C.W.; Martin, J.C.; Arduengo, A.J.; Lau, W.; Alegria, A.; Kochi, J.K. *J. Am. Chem. Soc.* **1980**, 102, 7753
Nakanishi, W.; Kusuyama, Y.; Ikeda, Y.; Iwamura, H. *Bull. Chem. Soc. Jpn.* **1983**, 56, 3123

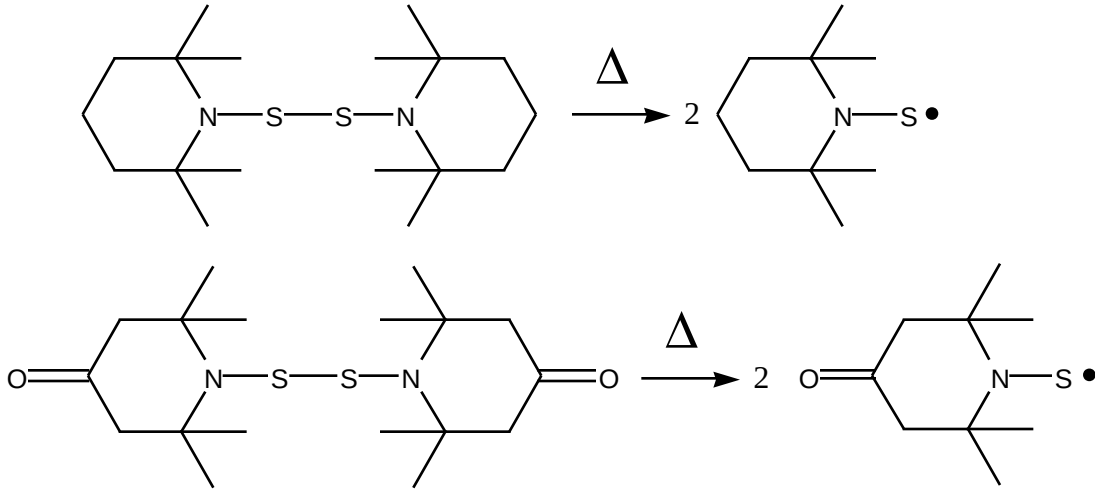


Giles, J.R.M.; Roberts, B.P. *J. Chem. Soc. Perkin Trans. 2* **1980**, 1497

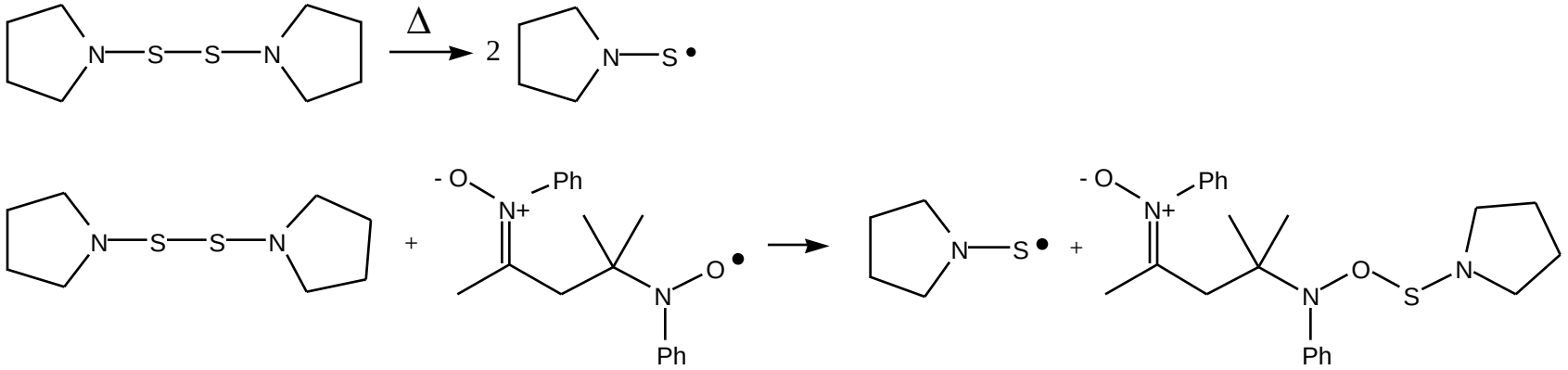
(v) Thionitroxide radicals



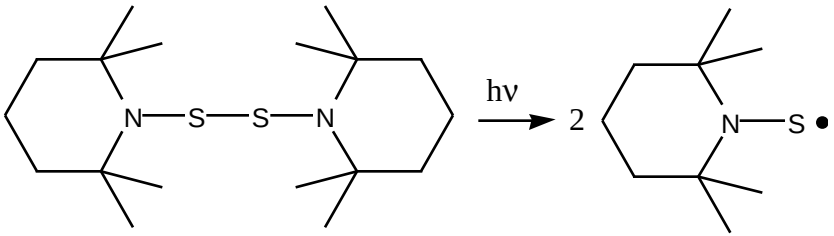
Reviews:
None.



Bennett, J.E.; Sieper, H.; Tavs, P. *Tetrahedron* **1967**, 23, 1697

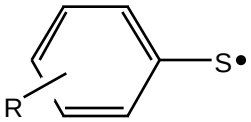


Danen, W.C.; Newkirk, D.D. *J. Am. Chem. Soc.* **1976**, 98, 516

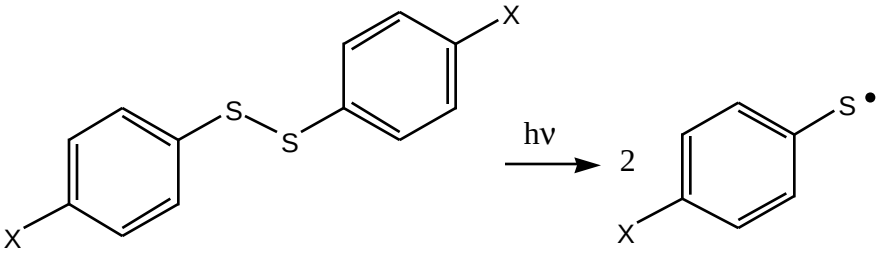


Maillard, B.; Ingold, K.U. *J. Am. Chem. Soc.* **1976**, 98, 520

(vi) Thiophenoxy (phenylthio, phenylthiyl, benzenethiyl) radicals



Reviews:
None.



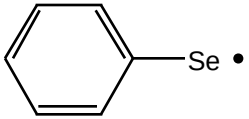
X = H, MeO, Me_2N, OH, EtOOC, Ph

Schmidt, U.; Müller, A.; Markau, K. *Chem. Ber.* **1964**, 97, 405

Selenium centred radicals:

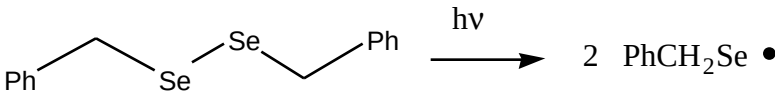
Reviews:
Deryagina, E.N.; Voronkov, M.G.; Korchevin, N.A. *Usp. Khim.* **1993**, 62, 1173
Deryagina, E.N.; Voronkov, M.G. *Sulfur Reports* **1995**, 17, 89

(i) Phenylselanyl (phenylseleno) radical

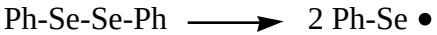


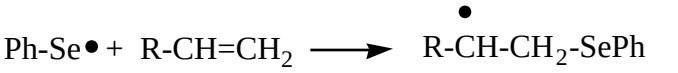
Reviews:
None.

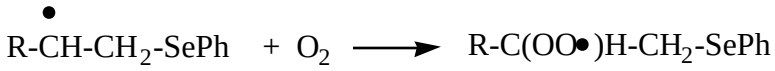
Schmidt, U.; Müller, A.; Markau, K. *Tetrahedron Lett.* **1963**, 1091 (ESR)



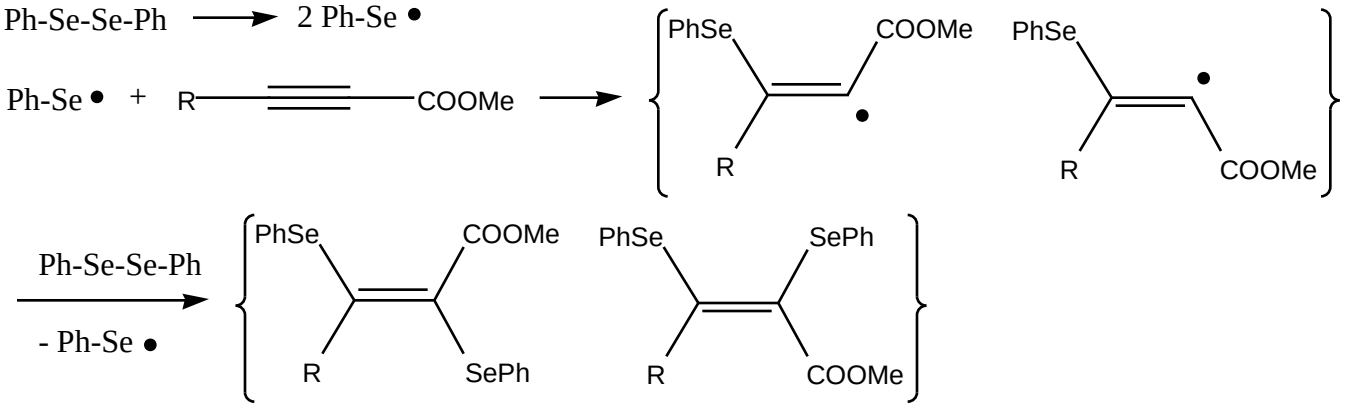
Schmidt, U.; Müller, A.; Markau, K. *Chem. Ber.* **1964**, 97, 405





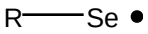


Ito, O. *J. Am. Chem. Soc.* **1983**, 105, 850



Back, T.G.; Krishna, M.V. *J. Org. Chem.* **1988**, 53, 2533

(ii) Selanyl



Reviews:
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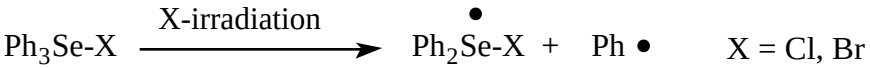
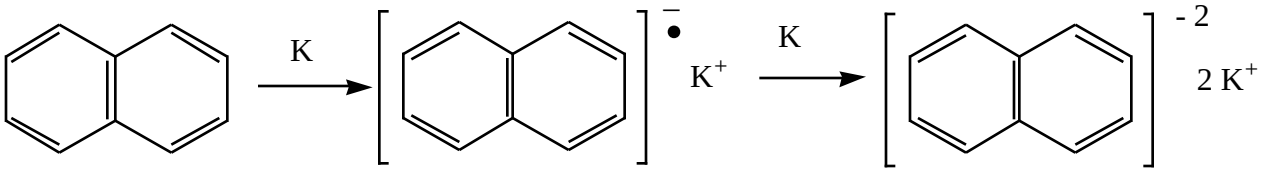


Franzi, R.; Geoffroy, M.; Ginet, L.; Leray, N. *J. Phys. Chem.* **1979**, 83, 2898

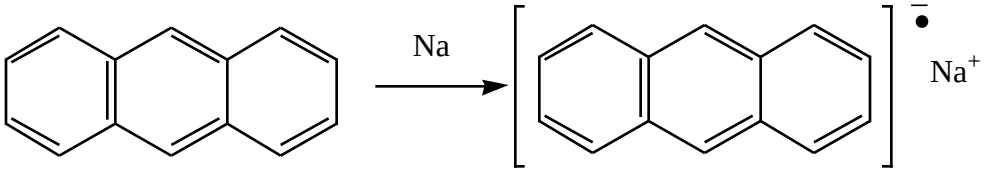
Radical Anions

Reviews:
Kaiser, E.T.; Kevan, L. (eds.) *Radical Anions*, Interscience Publishers: New York, 1968
Szwarc, M. *Prog. Phys. Org. Chem.* **1968**, 6, 323
Melby, L.R. in *The Chemistry of the Cyano Group* (Z. Rappoport, ed.) Wiley-Interscience: London, 1970. Vol. 2, p. 639
Russell, G.A.; Norris, R.K. in *Organic Reactive Intermediates*, (S.P. McManus, ed.) Academic Press: New York, 1973, p. 423
Rossi, R.A. *Acc. Chem. Res.* **1982**, 15, 164
Hertler, W.R.; Mahler, W.; Melby, L.R.; Miller, J.S.; Putscher, R.E.; Webster, O.W. *Molecular Crystals & Liquid Crystals* **1988**, 171, 205
Saveant, J.M. *Adv. Phys. Org. Chem.* **2000**, 35, 117

Rathore, R.; Kochi, J.K. *Adv. Phys. Org. Chem.* **1998**, 31, 193
Webster, O.W. *J. Polym. Sci. A* **2002**, 40, 210 (tetracyanoethylene radical anion)
Todres, Z.V. *Organic Ion Radicals*, Marcel Dekker, Inc.: New York, 2003

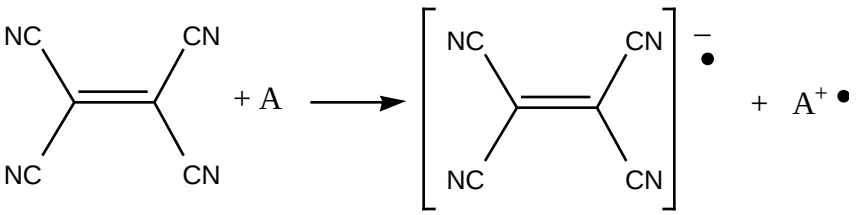


Berthelot, M. *Compt. Rend.* **1866**, 63, 836
Berthelot, M. *Ann. Chim. Phys.* **1867**, 12, 1955

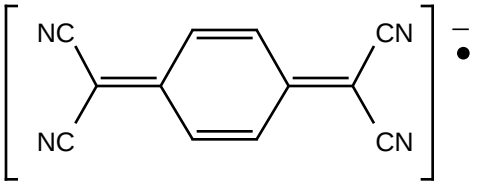


Schlenk, W.; Appenrodt, J.; Michael, A.; Thal, A. *Chem. Ber.* **1914**, 47, 473

Weitz, E.Z. *Z. Elektrochem.* **1928**, 34, 538
Willstätter, R.; Seitz, F.; Bumm, E. *Chem. Ber.* **1928**, 61, 871
Schlenk, W.; Bergmann, E. *Ann. Chem.* **1928**, 463, 1; **1928**, 464, 1
Scott, N.D.; Walker, J.F.; Hansley, V.L. *J. Am. Chem. Soc.* **1936**, 58, 2442
Walker, J.F.; Scott, N.D. *J. Am. Chem. Soc.* **1938**, 60, 951
Hueckel, W.; Bretschneider, H. *Ann. Chem.* **1939**, 540, 157
Lipkin, D.; Paul, D.E.; Townsend, J.; Weissman, S.I. *Science* **1953**, 117, 534
Weissman, S.I.; Townsend, J.; Paul, D.E.; Pake, G.E. *J. Chem. Phys.* **1953**, 21, 2227
Wertz, J.E.; Vivo, J.L. *J. Chem. Phys.* **1955**, 23, 2441



Webster, O.W.; Mahler, W.; Benson, R.E. *J. Org. Chem.* **1960**, 25, 1470
Webster, O.W.; Mahler, W.; Benson, R.E. *J. Am. Chem. Soc.* **1962**, 84, 3678
Phillips, W.D.; Rowell, J.C.; Weissman, S.I. *J. Chem. Phys.* **1960**, 33, 626 (ESR spectrum)



Acker, D.S.; Hertler, W.R. *J. Am. Chem. Soc.* **1962**, 84, 3770

$tBu\text{-}NO_2 + e^- \longrightarrow tBu\text{-}NO_2^{\bullet -}$

$tBu\text{-}NO_2^{\bullet -} \longrightarrow NO_2^- + tBu^{\bullet}$

$tBu\text{-}NO_2^{\bullet -} + tBu^{\bullet} \longrightarrow tBu\text{-}N{=}O + tBuO^-$

$tBu\text{-}N{=}O + tBu^{\bullet} \longrightarrow (tBu)_2N\text{-}O^{\bullet}$

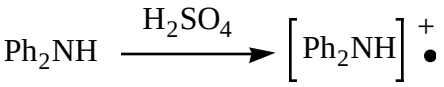
$(tBu)_2N\text{-}O^{\bullet} + tBu^{\bullet} \longrightarrow (tBu)_2N\text{-}OtBu$

Hoffmann, A.K.; Hodgson, W.G.; Jura, W.H. *J. Am. Chem. Soc.* **1961**, 83, 4675

Radical Cations

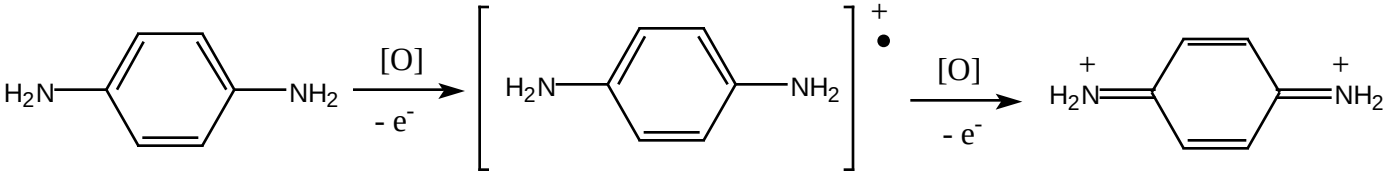
Reviews:
Michaelis, L. *Chem. Rev.* **1935**, 16, 243
Kaiser, E.T.; Kevan, L. (eds.) *Radical Ions*, Interscience Publishers: New York, 1968
Szwarc, M. *Prog. Phys. Org. Chem.* **1968**, 6, 323
Ledwith, A. *Acc. Chem. Res.* **1972**, 5, 133
Russell, G.A.; Norris, R.K. in *Organic Reactive Intermediates*, (S.P. McManus, ed.) Academic Press: New York, 1973, p. 423
Bard, A.J.; Ledwith, A.; Shine, H.J. *Adv. Phys. Org. Chem.* **1976**, 13, 156
Bard, A.J.; Faulkner, L.R. *Electrochemical Methods*, Wiley: New York, 1980
Mattes, S.L.; Farid, S. *Org. Photochem.* **1983**, 6, 233

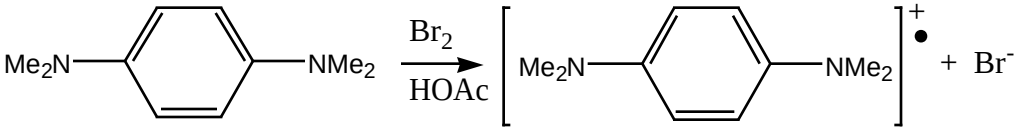
Yoshida, K. *Electro-oxidation in Organic Chemistry*, Wiley: New York, 1984
Hammerich, O.; Parker, V.D. *Adv. Phys. Org. Chem.* **1984**, 20, 55
Mattay, J. *Angew. Chem. Int. Ed.* **1987**, 26, 825
Roth, H.D. *Top. Curr. Chem.* **1992**, 163, 131
Eberson, L. *Adv. Phys. Org. Chem.* **1998**, 31, 91
Saveant, J.M. *Adv. Phys. Org. Chem.* **2000**, 35, 117
Rathore, R.; Kochi, J.K. *Adv. Phys. Org. Chem.* **1998**, 31, 193
Werst, D.W.; Trifunac, A.D. *Acc. Chem. Res.* **1998**, 31, 651
Todres, Z.V. *Organic Ion Radicals*, Marcel Dekker, Inc.: New York, 2003
Wiest, O.; Oxgaard, J.; Saettel, N.J. *Adv. Phys. Org. Chem.* **2003**, 38, 87



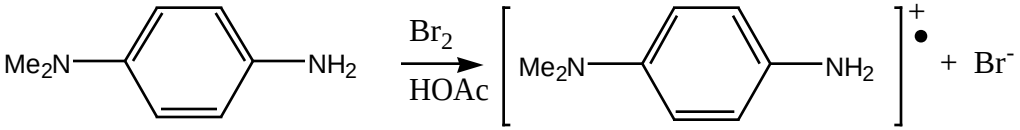
Laurent, A. *Ann. Chim. Phys.* **1835**, 59, 367
Laurent, A. *Ann. Chem. Phys.* **1836**, 17, 89

Wurster salts



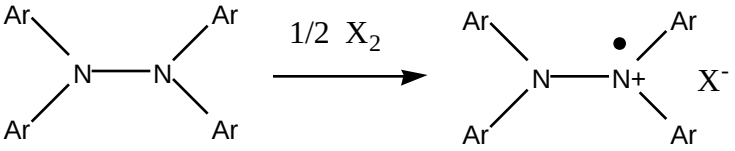


Wurster's blue

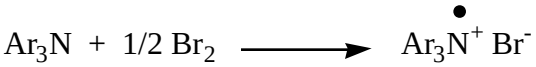


Wurster's red

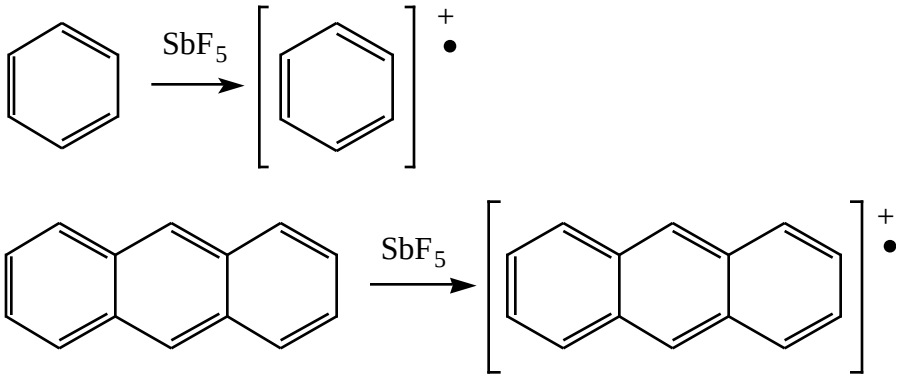
Baeyer, A. *Chem. Ber.* **1875**, 8, 614
Wurster, C. *Chem. Ber.* **1879**, 12, 522
Wurster, C.; Sendtner, R. *Chem. Ber.* **1879**, 12, 1803
Wurster, C.; Schobig, E. *Chem. Ber.* **1879**, 12, 1807
Wurster, C. *Chem. Ber.* **1879**, 12, 2071
Wurster, C., *Chem. Ber.* **1886**, 19, 3195
Willstätter, R.; Piccard, J. *Chem. Ber.* **1908**, 41, 1458
Piccard, J. *Chem. Ber.* **1911**, 46, 1843
Michaelis, L. *J. Am. Chem. Soc.* **1931**, 53, 2953
Katz, H. *Z. Physik* **1933**, 87, 238
Michaelis, L.; Schubert, M.P.; Granick, S. *J. Am. Chem. Soc.* **1939**, 61, 1981



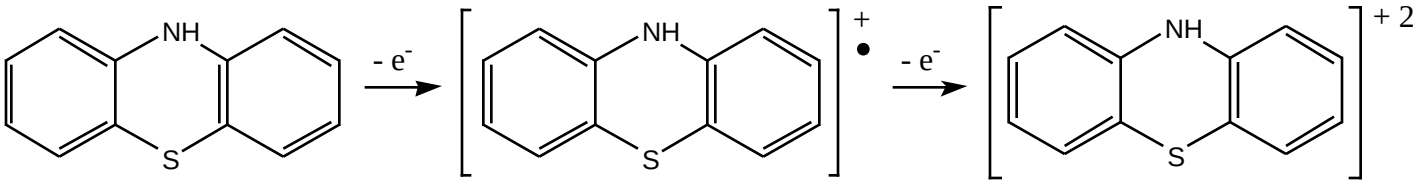
Wieland, H. *Chem. Ber.* **1907**, 40, 4260; 4263



Wieland, H.; Wecker, E. *Chem. Ber.* **1910**, 43, 699

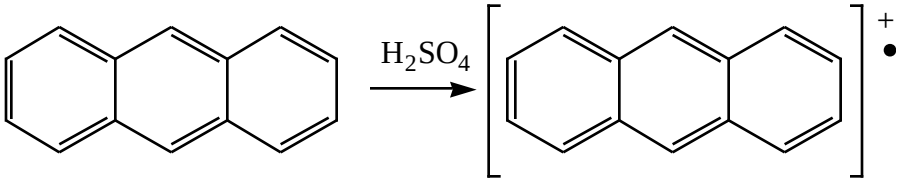


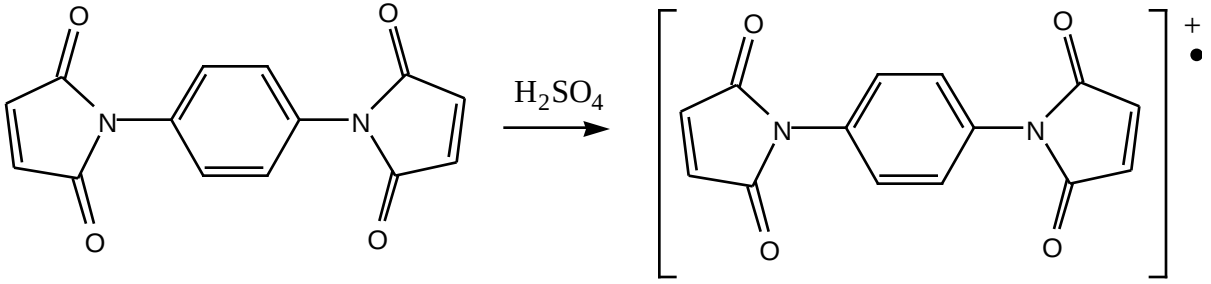
Meyer, K.H. *Chem. Ber.* **1910**, 43, 161
Hilpert, S.; Wolf, L. *Chem. Ber.* **1913**, 46, 2215



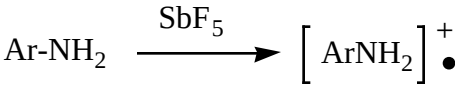
Kehrmann, F.; Speitel, J.; Grandmougin, E. *Chem. Ber.* **1914**, 47, 2976
Kehrmann, F.; Diserens, L. *Chem. Ber.* **1915**, 48, 318

Weitz, E.Z. *Z. Elektrochem.* **1928**, 34, 538
Weitz, E.; Meitzner, E. *Chem. Ber.* **1931**, 64B, 2909
Giusa, R. *Gazz. Chim. Ital.* **1945**, 75, 162
Hughes, G.K.; Hush, N.S. *J. Proc. Roy. Soc. New South Wales* **1947**, 81, 48
Holden, A.N.; Yager, W.A.; Merritt, F.R. *J. Chem. Phys.* **1951**, 19, 1319

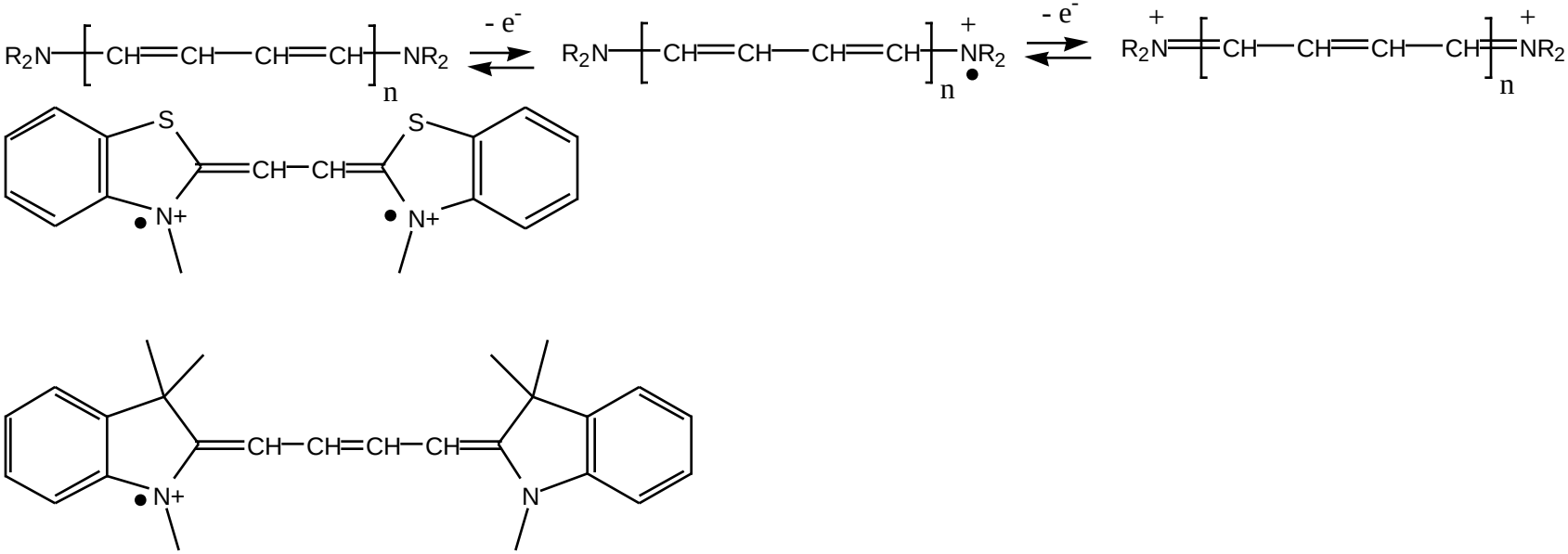




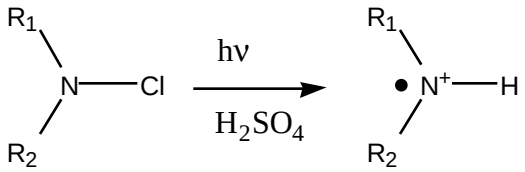
Hirschon, G.M.; Gardner, D.M.; Fraenkel, G.K. *J. Am. Chem. Soc.* **1953**, 75, 4115
Hoijtink, G.J.; Weijland, W.P. *Rec. Trav. Chim. Pays-Bas* **1957**, 76, 836
Kon, H.; Blois, M.S. *J. Chem. Phys.* **1958**, 28, 743



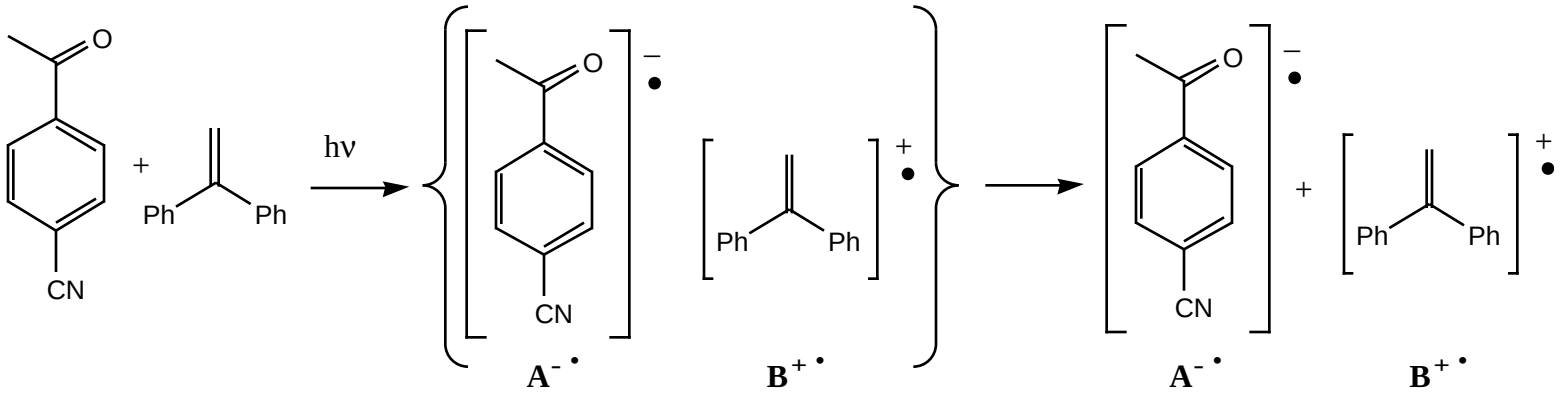
Kainer, H.; Hausser, K.H. *Chem. Ber.* **1957**, 86, 1563
Lewis, I.C.; Singer, L.S. *J. Chem. Phys.* **1965**, 43, 2712
Lewis, I.C.; Singer, L.S. *J. Chem. Phys.* **1966**, 44, 2082

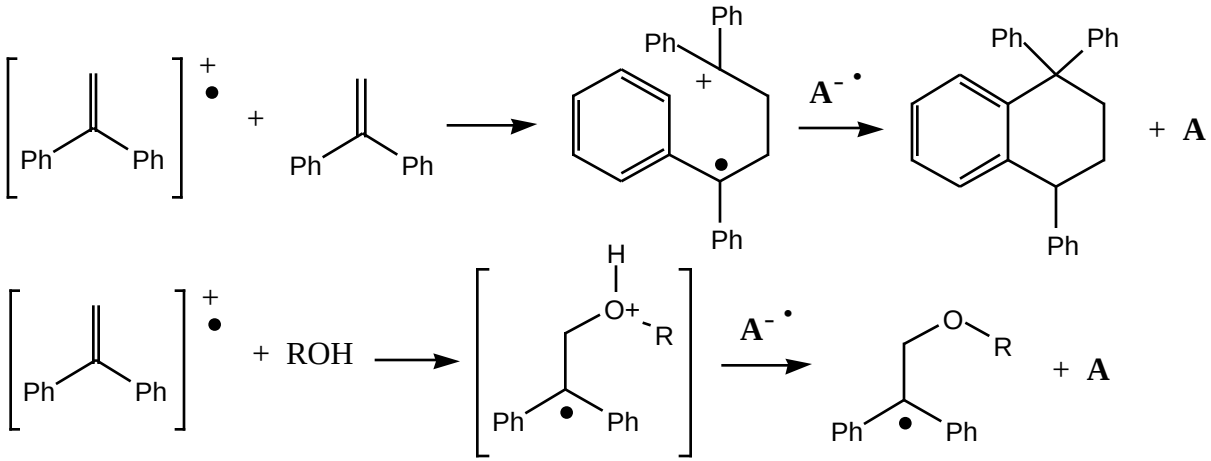


Hünig, S. *Ann. Chem.* **1964**, 676, 32
Hünig, S.; Balli, H.; Conrad, H.; Schott, A. *Ann. Chem.* **1964**, 676, 36; 52
Hünig, S. *Chem. Eng. News* **1966**, 44, 102
Hünig, S.; Geiger, H.; Kaupp, G.; Kniese, W. *Ann. Chem.* **1966**, 697, 116

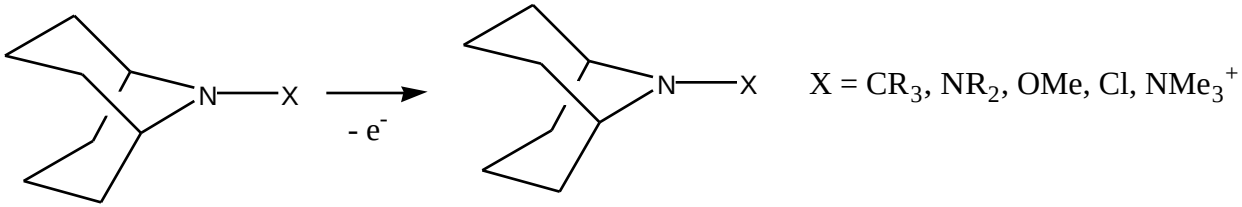


Danen, W.C.; Rickard, R.C. *J. Am. Chem. Soc.* **1972**, 94, 3254

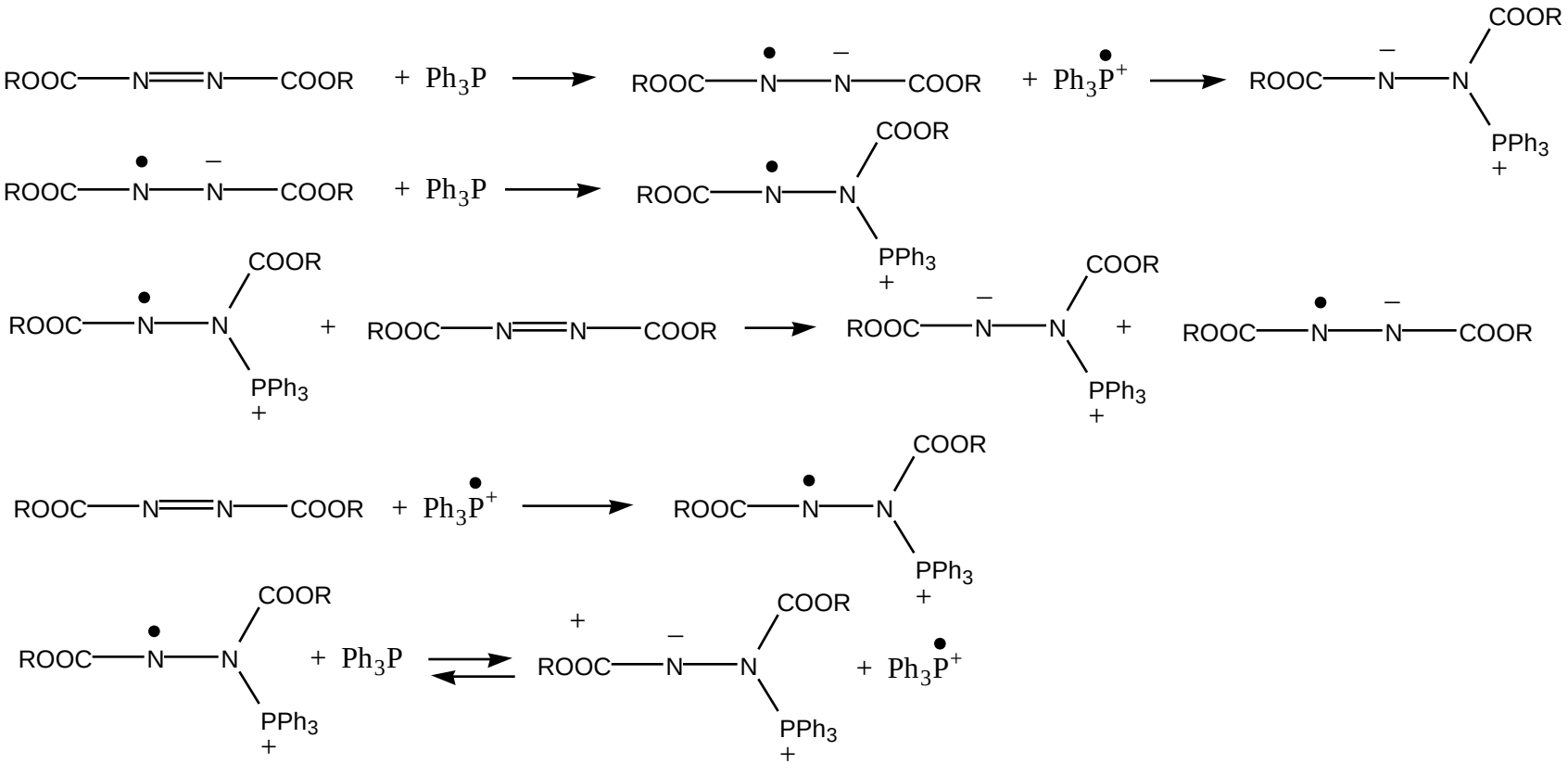




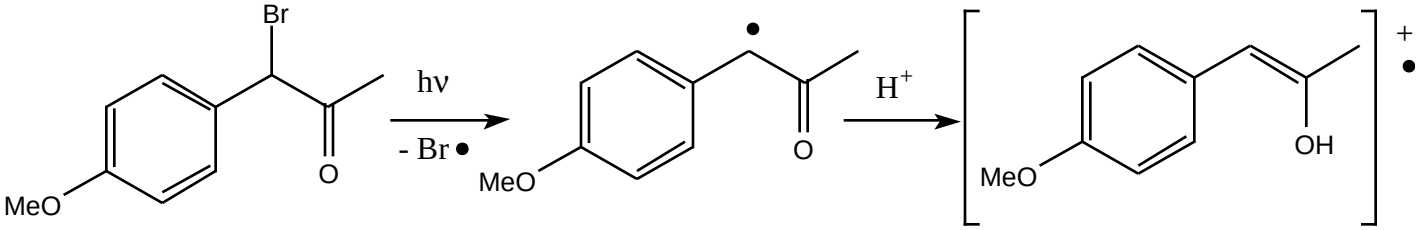
Neutefel, R.A.; Arnold, D.R. *J. Am. Chem. Soc.* **1973**, 95, 4080
Pincock, J.A. *Can. J. Chem.* **2003**, 81, 413



Nelsen, S.F.; Kessel, C.R.; Brien, D.J. *J. Am. Chem. Soc.* **1980**, 102, 702



Camp, D.; Hanson, G.R.; Jenkins, I.D. *J. Org. Chem.* **1995**, 60, 2977

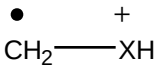


Schepp, N.P. *J. Org. Chem.* **2004**, 69, 4931

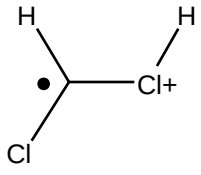
Distonic radical cations

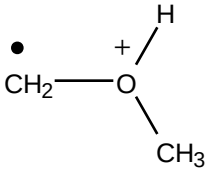
Reviews:
Radom, L.; Bouma, W.J.; Nobes, R.H. *Pure Appl. Chem.* **1984**, 56, 1831
Yates, B.F.; Bouma, W.J.; Radom, L. *Tetrahedron* **1986**, 42, 6225
Westwood, N.P.C. *J. Molecular Struct.* **1988**, 173, 227
Bouchoux, G. *Mass Spectrometry Rev.* **1988**, 7, 1
Hammerum, S. *Mass Spectrometry Rev.* **1988**, 7, 123
Bouchoux, G. *Mass Spectrometry Rev.* **1988**, 7, 203
Stirk, K.M.; Kiminikenen, L.K.M.; Kenttaemaa, H.I. *Chem. Rev.* **1992**, 92, 1649
Bouchoux, G. *Trends in Org. Chem.* **1993**, 4, 161
Kenttaemaa, H.I. *Org. Mass Spectrometry* **1994**, 29, 1
Smith, R.L.; Chou, P.K.; Kenttaemaa, H. in *Structure, Energetics, and Dynamics of Organic Ions*, (T. Baer, C.Y. Ng, I. Powis, eds.) Wiley: Chichester, 1996, p. 197
Audier, H.E.; Fossey, J.; Leblanc, D.; Mourgues, P.; Troude, V. *NATO ASI Ser., Ser. C* **1999**, 521, 27
Gebecki, J.; Marcinek, A. in *General Aspects of the Chemistry of Radicals*, (Z.B. Alfassi, ed.) Wiley: Chichester, 1999, p. 175

Golding, B.T.; Radom, L. *J. Am. Chem. Soc.* **1976**, 98, 6331 (prediction of stability in gas phase)
Bouma, W.J.; MacLeod, J.K.; Radom, L. *Nouv. J. Chim.* **1978**, 2, 439



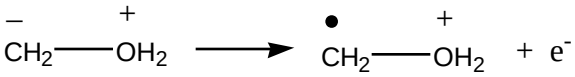
X = OH, NH_2, SH, Cl, Br



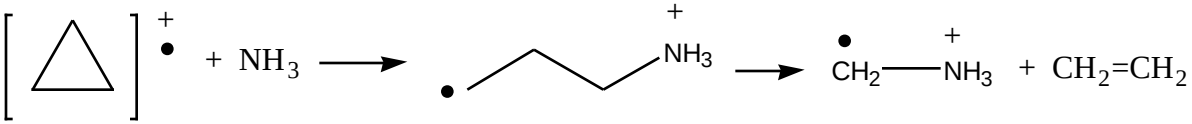


Holmes, J.L.; Lossing, F.P.; Terlouw, J.K.; Burgers, P.C. *J. Am. Chem. Soc.* **1982**, 104, 2931

Terlouw, J.K.; Heerma, W.; Dijkstra, G.; Holmes, J.L.; Burgers, P.C. *Int. J. Mass Spectrom. Ion Phys.* **1983**, 47, 147



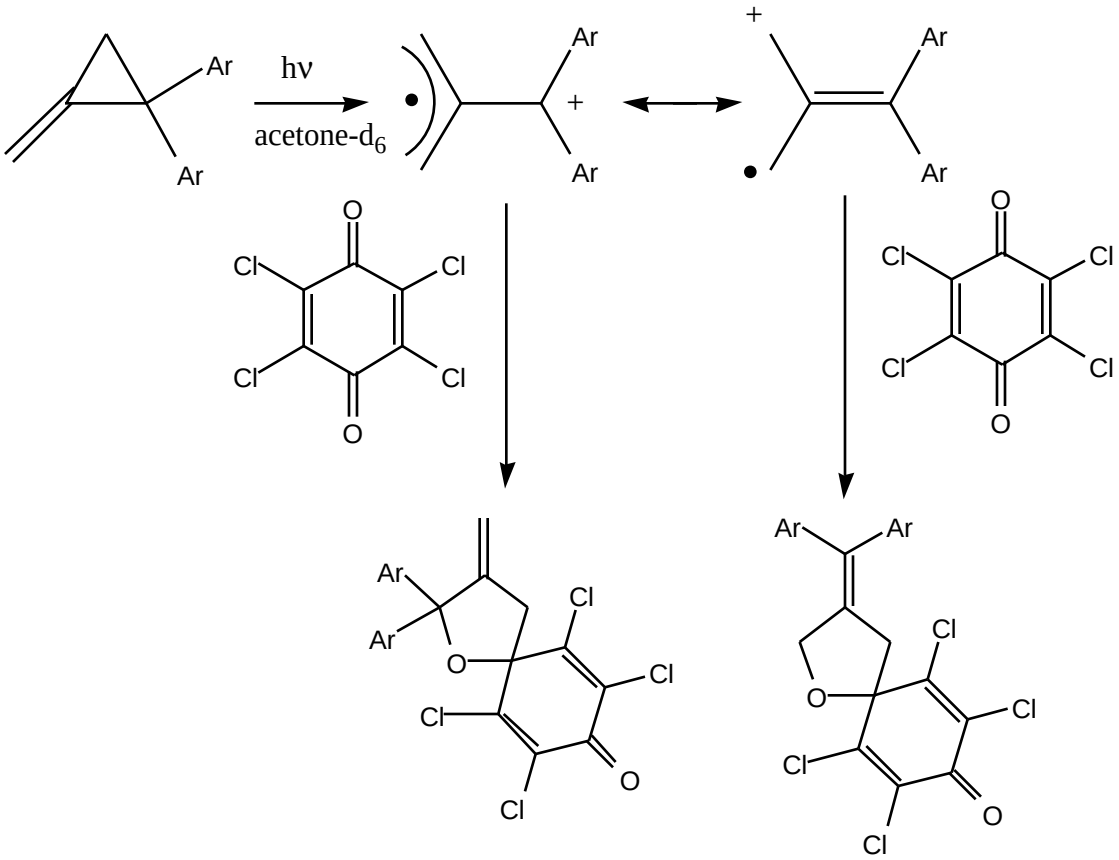
Yates, B.F.; Bouma, W.J.; Radom, L. *J. Am. Chem. Soc.* **1984**, 106, 5805



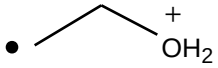
Sack, T.M.; Cerny, R.L.; Gross, M.L. *J. Am. Chem. Soc.* **1985**, 107, 4562

Z = bond, CH_2, CHMe, CH_2CH_2; X = OH, NH_2

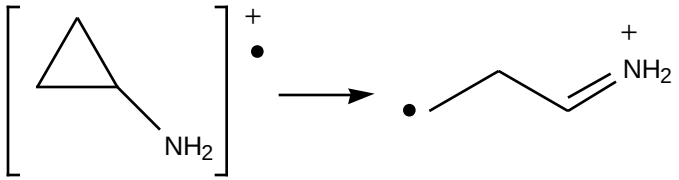
Wesdemiotis, C.; Danis, P.O.; Feng, R.; Tso, J.; McLafferty, F.W. *J. Am. Chem. Soc.* **1985**, 107, 8059



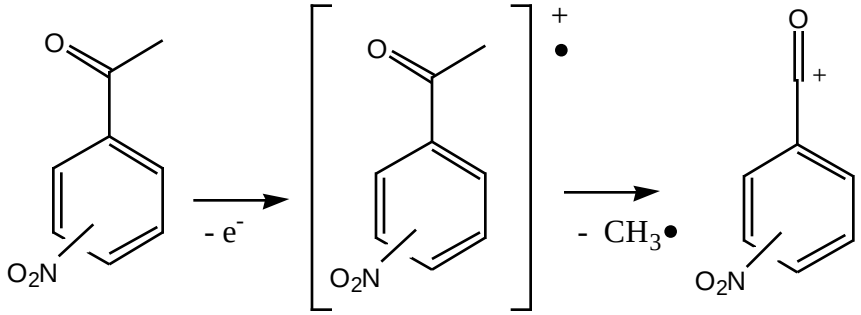
Miyashi, T.; Takahashi, Y.; Mukai, T.; Roth, H.D.; Schilling, M.L.M. *J. Am. Chem. Soc.* **1985**, 107, 1079



Postma, R.; Ruttink, P.J.A.; Van Baar, B.; Terlouw, J.K.; Holmes, J.L.; Burgers, P.C. *Chem. Phys. Lett.* **1986**, 123, 409

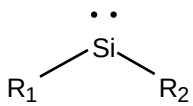


Qin, X.Z.; Williams, F. *J. Am. Chem. Soc.* **1987**, 109, 5957



Moraes, L.A.B.; Eberlin, M.N. *J. Am. Chem. Soc.* **1998**, 120, 11136

Silylenes and germylenes

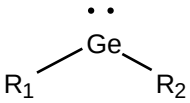


Reviews:

Denk, M.; West, R.; Hayashi, R. in *Organosilicon Chemistry II: from molecules to materials*, (N. Auner; J. Weis, eds.) VCH: Weinheim, 1994, p. 251
Weidenbruch, M. *Coord. Chem. Rev.* **1994**, 130, 275
Becerra, R.; Walsh, R. *Res. Chem. Intermediates* **1995**, 3, 263
Korolev, V.A.; Nefedov, O.M. *Adv. Phys. Org. Chem.* **1995**, 30, 1
West, R.; Denk, M. *Pure Appl. Chem.* **1996**, 68, 785
Gehrhus, B.; Lappert, M.F. *Phosphorus, Sulfur, Silicon and Related Elements* **1997**, 124-125, 537
Gaspar, P.P.; West, R. in *The Chemistry of Silicon Compounds*, (Z. Rappoport; Y. Apeloig, eds.) Wiley: Chichester, 1998, Vol. 2 (Pt. 3), p. 2463

Kira, M. *Pure Appl. Chem.* **2000**, 72, 2333
Veszpremi, T. *Adv. Molecular Structure Res.* **2000**, 6, 267
Haaf, M.; Schmedake, T.A.; West, R. *Acc. Chem. Res.* **2000**, 33, 704
Tokitoh, N.; Okazaki, R. *Coord. Chem. Rev.* **2000**, 210, 251 (silylenes, germylenes, stannylenes, plumbylenes)
Gehrhus, B.; Lappert, M.F. *J. Organometallic Chem.* **2001**, 617-618, 209 (stable bis(amino)silylenes)
Gaspar, P.P.; Xiao, M.; Pae, D.H.; Berger, D.J.; Haile, T.; Chen, T.; Lei, D.; Winchester, W.R.; Jiang, P. *J. Organometallic Chem.* **2002**, 646, 68

Gaspar, P.P.; Pate, B.D.; Eckelman, W. *J. Am. Chem. Soc.* **1966**, 88, 3878
Atwell, W.H.; Weyenberg, D.R. *J. Am. Chem. Soc.* **1968**, 90, 3438
Atwell, W.H.; Weyenberg, D.R. *Angew. Chem. Int. Ed. Engl.* **1969**, 8, 469
Atwell, W.H.; Mahone, L.G.; Hayes, S.F.; Uhlmann, J.G. *J. Organometal. Chem.* **1969**, 18, 69
Gaspar, P.P.; Hwang, R.J. *J. Am. Chem. Soc.* **1974**, 96, 6198
Henis, J.M.S.; Stewart, G.W.; Gaspar, P.P. *J. Chem. Phys.* **1974**, 61, 4860
Hwang, R.J.; Gaspar, P.P. *J. Am. Chem. Soc.* **1978**, 100, 6626
Gaspar, P.P. *React. Intermed.* **1978**, 1, 229

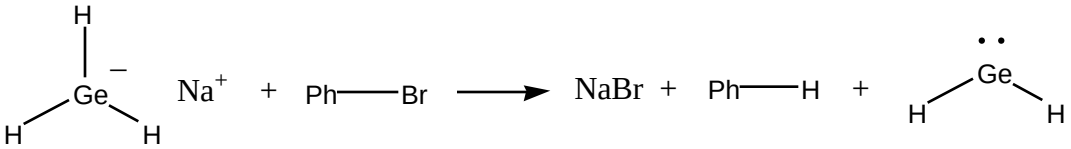


Reviews:

Lappert, M.F.; Rowe, R.S. *Coordin. Chem. Rev.* **1990**, 100, 267 (germylenes, stannylenes, plumbylenes)
Neumann, W.P. *Chem. Rev.* **1991**, 91, 311 (germylenes and stannylenes)
Neumann, W.P.; Weisbeck, M.P.; Wienken, S. *Main Group Metal Chem.* **1994**, 17, 151
Korolev, V.A.; Nefedov, O.M. *Adv. Phys. Org. Chem.* **1995**, 30, 1
Tokitoh, N.; Okazaki, R. *Coord. Chem. Rev.* **2000**, 210, 251 (silylenes, germylenes, stannylenes, plumbylenes)

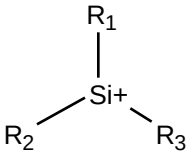
$$CaH_2 + Ge \xrightarrow[-\ H_2]{950\ C} CaGe \xrightarrow[-\ Ca(OH)_2]{2\ H_2O} GeH_2$$

Royen, P.; Schwarz, R. *Z. Anorg. Allgem. Chem.* **1933**, 211, 412 (first claim, later refuted)



Glarum, S.N.; Kraus, C.A. *J. Am. Chem. Soc.* **1950**, 72, 5398

Silylium ions (silylenium ions, silicenium ions, silyl cations, silicocations)



Reviews:
Lambert, J.B.; Kania, L.; Zhang, S. *Chem. Rev.* **1995**, 95, 1191
Corriu, R.J.P.; Henner, M. *J. Organometallic Chem.* **1974**, 74, 1
Reed, C.A. *Acc. Chem. Res.* **1998**, 31, 325

$(iPr)_3SiH + Ph_3C^+ [CB_{11}H_6X_6]^- \longrightarrow Ph_3CH + (iPr)_3Si^+ [CB_{11}H_6X_6]^-$

X = Cl, I

Xie, Z.; Manning, J.; Reed, R.W.; Mathur, R.; Boyd, P.D.W.; Benesi, A.; Reed, C.A. *J. Am. Chem. Soc.* **1996**, 118, 2922
Reed, C.A.; Xie, Z.; Bau, R.; Benesi, A. *Science* **1993**, 262, 402

$Ph_3C^+ X^- + R_3SiH \longrightarrow Ph_3CH + R_3Si^+ X^-$

$Me(iPr)_2Si^+ X^-$

$Et_3Si^+ X^-$ X = $[B(F_5Ph)_4]$

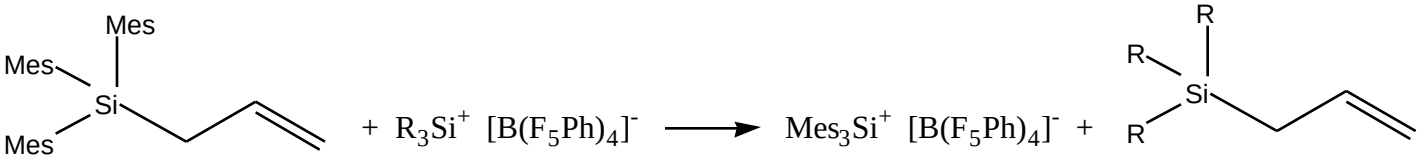
$(Me_3Si)_3Si^+ X^-$

Lambert, J.B.; Zhang, S.; Ciro, S.M. *Organometallics* **1994**, 13, 2430

R_3Si^+ $[Br_6\text{-}CB_{11}H_6]^-$ R = Et, iPr, tBu

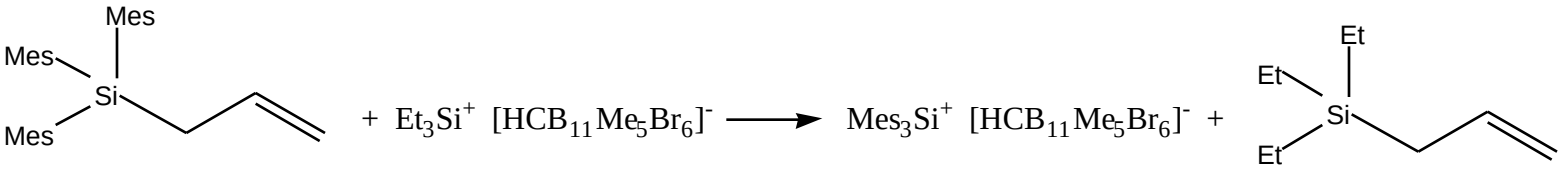
$(tBu)_2MeSi^+$ $[Br_6\text{-}CB_{11}H_6]^-$

Xie, Z.; Bau, R.; Benesi, A.; Reed, C.A. *Organometallics* **1995**, 14, 3933

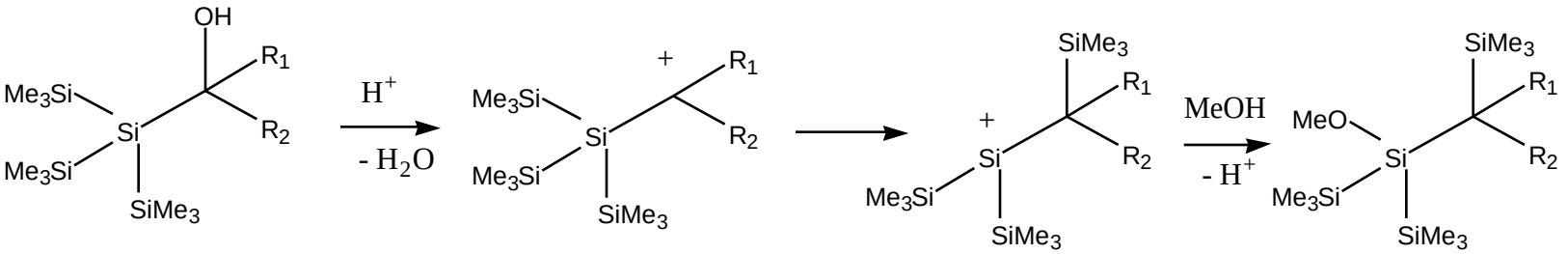


R = Ph, Et

Lambert, J.B.; Zhao, Y. *Angew. Chem. Int. Ed.* **1997**, 36, 400



Kim, K.C.; Reed, C.A.; Elliott, D.W.; Mueller, L.J.; Tham, F.; Lin, L.; Lambert, J.B. *Science* **2002**, 297, 825

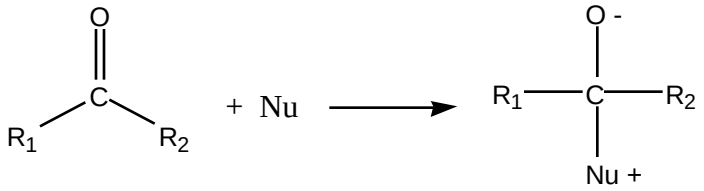


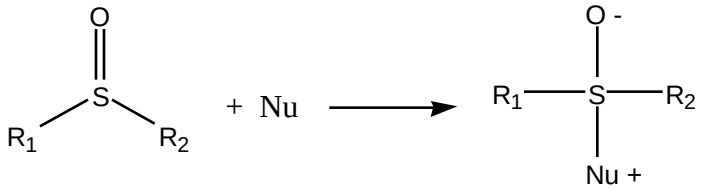
Sternberg, K.; Michalik, M.; Oehme, H. *J. Organometallic Chem.* **1997**, 533, 265

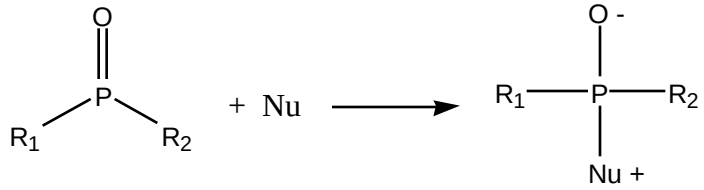
Tetrahedral Intermediates

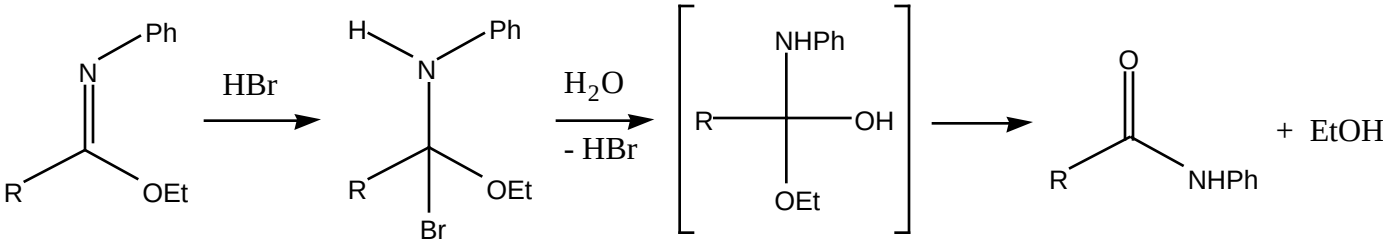
Reviews:

Jencks, W.P. *Prog. Phys. Org. Chem.* **1964**, 2, 63
Johnson, S.L. *Adv. Phys. Org. Chem.* **1967**, 5, 237
Jencks, W.P. *Catalysis in Chemistry and Enzymology*, McGraw-Hill: New York, 1969
Jencks, W.P. *Chem. Rev.* **1972**, 72, 705
Barnett, R.E. *Acc. Chem. Res.* **1973**, 6, 41
Capon, B.; Ghosh, A.K.; Grieve, D.M.A. *Acc. Chem. Res.* **1981**, 14, 306
McClelland, R.A.; Santry, L.J. *Acc. Chem. Res.* **1983**, 16, 394
Capon, B.; Dosunmu, M.I.; De Nazare, M.; Sanchez, M. *Adv. Phys. Org. Chem.* **1985**, 21, 37
Bowden, K. *Adv. Phys. Org. Chem.* **1993**, 28, 171
Perrin, C.L. *Acc. Chem. Res.* **2002**, 35, 28

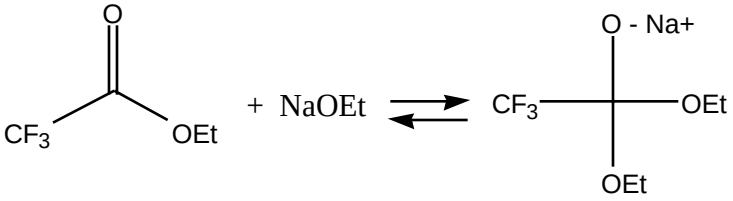






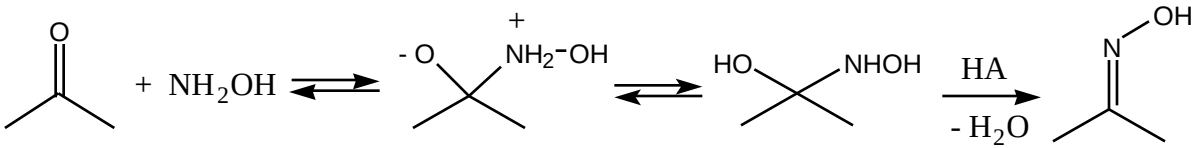


Stieglitz, J. *Am. Chem. J.* **1899**, 21, 101



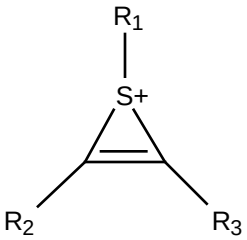
Swarts, F. *Bull. Soc. Chim. Belg.* **1926**, 35, 414
Helferich, B.; Muller, A. *Chem. Ber.* **1930**, 63B, 2142
Bender, M.L. *J. Am. Chem. Soc.* **1951**, 73, 1626
Bender, M.L. *J. Am. Chem. Soc.* **1953**, 75, 5986
Zaugg, H.E.; DeNet, R.W.; Michaels, R.J. Jr. *J. Org. Chem.* **1961**, 26, 4828
Cordes, E.H.; Childers, M. *J. Org. Chem.* **1964**, 29, 968
Bender, M.L.; Kezdy, F.J. *J. Am. Chem. Soc.* **1964**, 86, 3704
Martin, R.B.; Hedrick, R.I.; Parcell, A. *J. Org. Chem.* **1964**, 29, 3197

Jencks, W.P.; Gilchrist, M. *J. Am. Chem. Soc.* **1964**, 86, 5616
Fedor, L.R.; Bruice, T.C. *J. Am. Chem. Soc.* **1964**, 86, 5697
Kirby, A.J.; Jencks, W.P. *J. Am. Chem. Soc.* **1965**, 87, 3217
Fedor, L.R.; Bruice, T.C. *J. Am. Chem. Soc.* **1965**, 87, 4138
Caplow, M. *J. Am. Chem. Soc.* **1965**, 87, 5774
Biffin, M.E.C.; Crombie, L.; Elvidge, J.A. *J. Chem. Soc.* **1965**, 7500

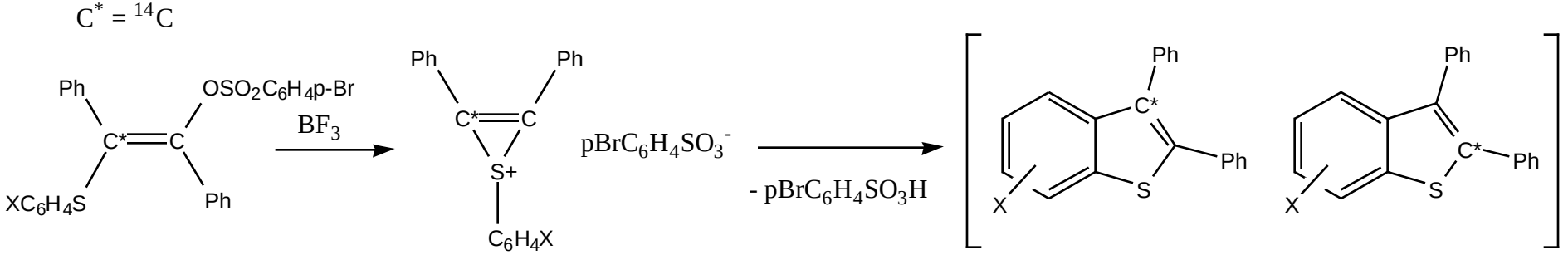


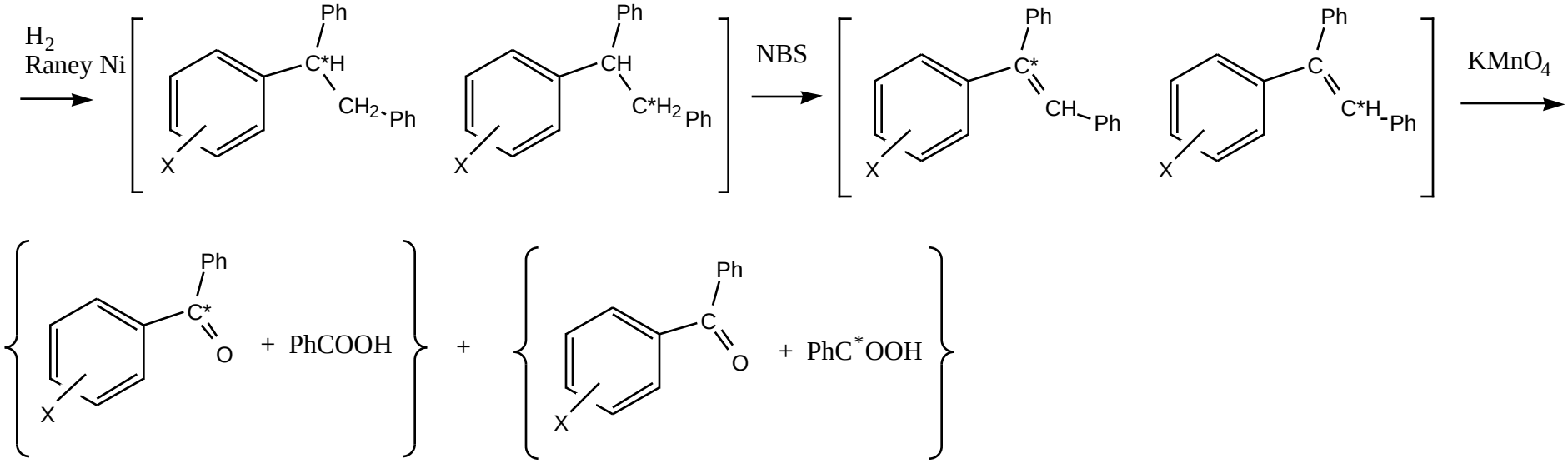
Reimann, J.E.; Jencks, W.P. *J. Am. Chem. Soc.* **1966**, 88, 3973
DeJersey, J.; Zerner, B. *Biochem. Biophys. Res. Commun.* **1967**, 28, 173
Robinson, D.R.; Jencks, W.P. *J. Am. Chem. Soc.* **1967**, 89, 7098
Robinson, D.R.; Jencks, W.P. *J. Am. Chem. Soc.* **1967**, 89, 7088

Thiirenium Ions

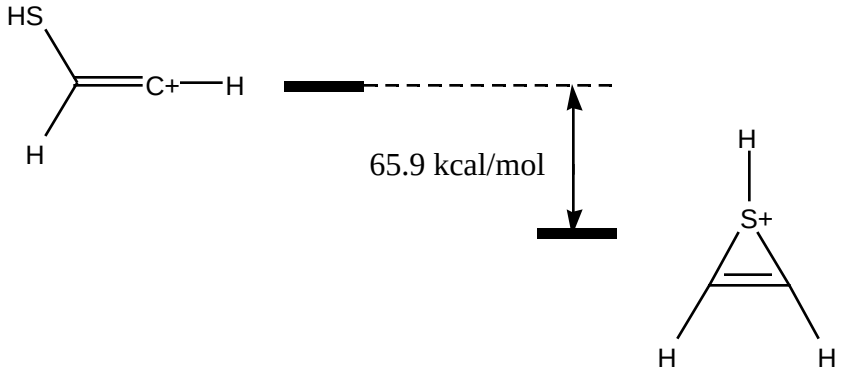


Reviews:
Pasquato, L.; Destro, R.; Lucchini, V.; Modena, G. *Phosphorus, Sulfur, and Silicon and the related elements* **1999**, 153-154, 235
Lucchini, V.; Modena, G.; Pasquato, L. *Gazz. Chim. Ital.* **1997**, 127, 177
Modena, G.; Pasquato, L.; Lucchini, V. *Phosphorus, Sulfur, and Silicon and the related elements* **1994**, 95-96, 265
Capozzi, G.; Lucchini, V.; Modena, G. *Rev. Chem. Intermediates* **1979**, 2, 347

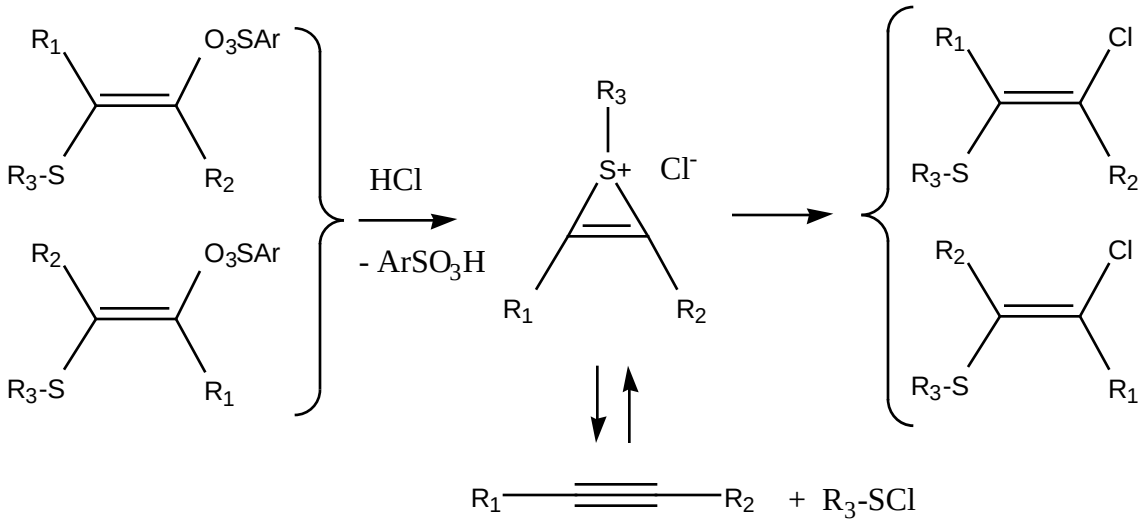




Capozzi, G.; Melloni, G.; Modena, G.; Tonellato, U. *Chem. Commun.* **1969**, 1520
Modena, G.; Tonellato, U. *J. Chem. Soc. B* **1971**, 381 (stereochemical evidence)
Modena, G.; Tonellato, U. *J. Chem. Soc. B* **1971**, 374 (kinetic evidence)
Burighel, A.; Modena, G.; Tonellato, U. *Chem. Commun.* **1971**, 1325

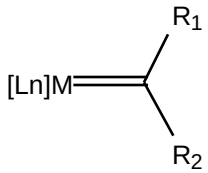


Denes, A.S.; Csizmadia, I.G.; Modena, G. *Chem. Commun.* **1972**, 8



Modena, G.; Scorrano, G.; Tonellato, U. *J. Chem. Soc. Perkin Trans. 2* **1973**, 493

Transition Metal Carbene Complexes



Reviews:

Fischer, E.O. in *Advances in Organometallic Chemistry*, (F.G.A. Stone, R. West, eds.), Academic Press: Orlando, FL, 1976; Vol. 14, p. 1 - 32 (carbene and carbyne complexes)

Schrock, R.R. *Acc. Chem. Res.* **1979**, 12, 98

Dötz, K.H.; Fischer, H.; Hofmann, P.; Kreissl, F.R.; Schubert, U.; Weiss, K. *Transition Metal Carbene Complexes*, Verlag Chemie: Weinheim, 1983

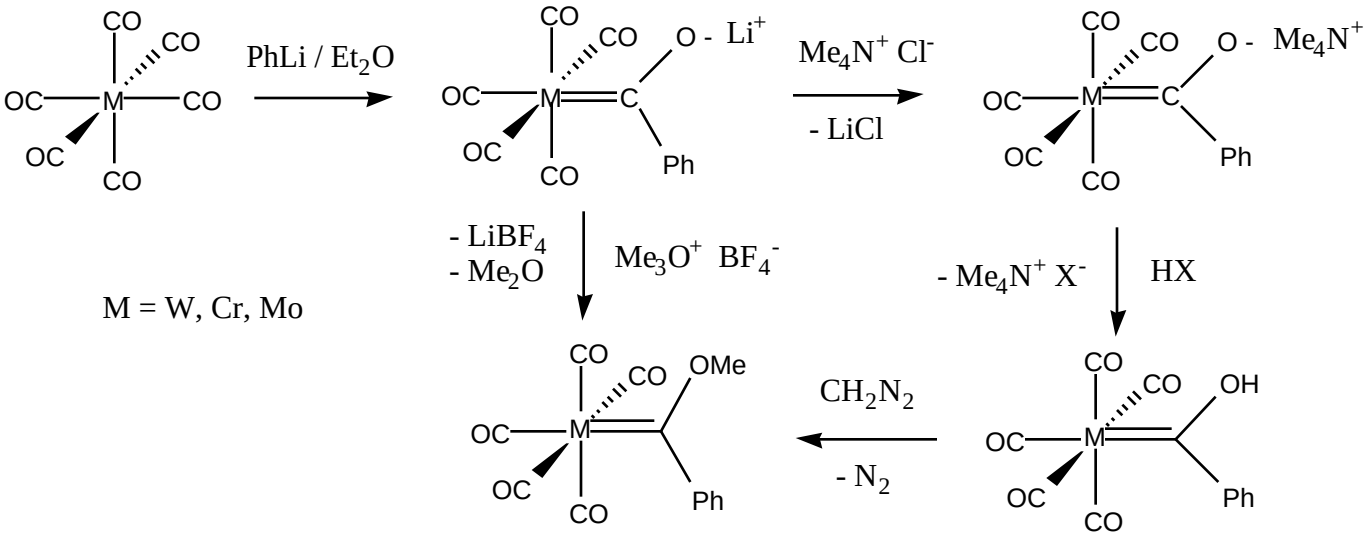
Dötz, K.H. *Angew. Chem. Int. Ed.* **1984**, 23, 587

Roper, W.R. *NATO ASI Series, Ser. C.* **1989**, 269, 27

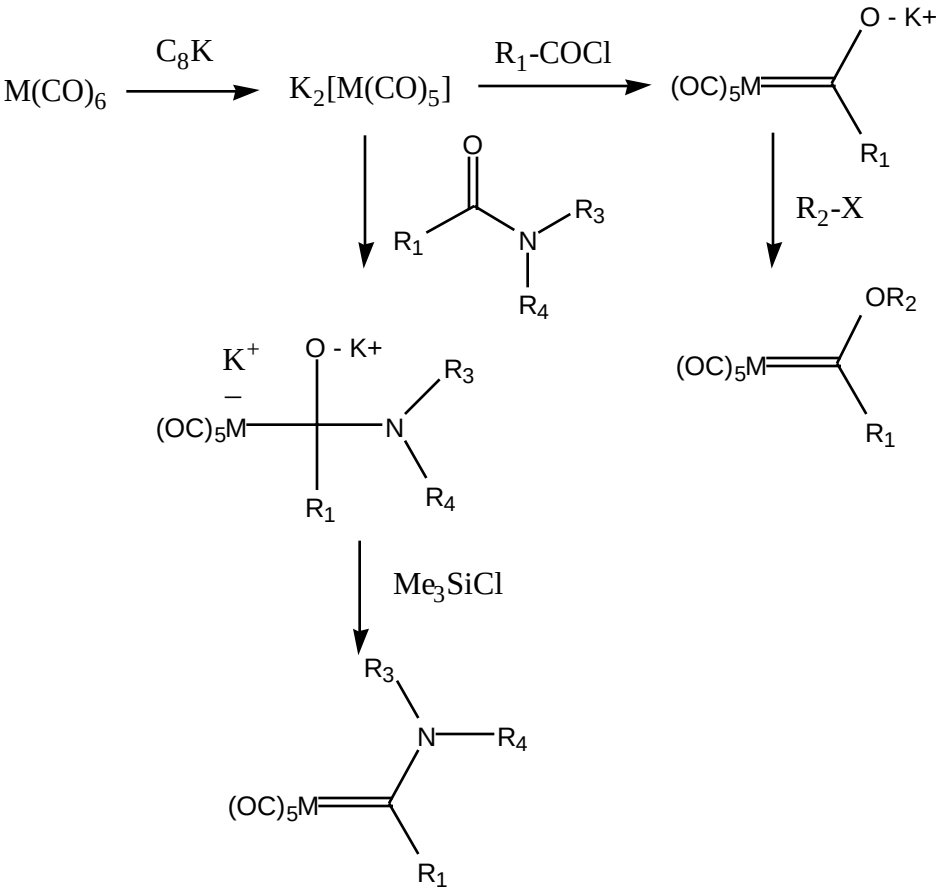
Harvey, D.F.; Sigano, D.M. *Chem. Rev.* **1996**, 96, 271

de Meijere, A. *Pure Appl. Chem.* **1996**, 68, 61
Barluenga, J. *Pure Appl. Chem.* **1996**, 68, 543
Hegedus, L.S. *Tetrahedron* **1997**, 53, 4105
Aumann, R.; Nienhaber, H. *Adv. Organometallic Chem.* **1997**, 41, 163
Barluenga, J. *Pure Appl. Chem.* **1999**, 71, 1385
Herndon, J.W. *Tetrahedron* **2000**, 56, 1257
de Meijere, A.; Schirmer, H.; Duetsch, M. *Angew. Chem. Int. Ed.* **2000**, 39, 3964
Barluenga, J.; Fananas, F.J. *Tetrahedron* **2000**, 56, 4597
Sierra, M.A. *Chem. Rev.* **2000**, 100, 3591
Bernasconi, C.F. *Adv. Phys. Org. Chem.* **2002**, 37, 137

Fischer carbene

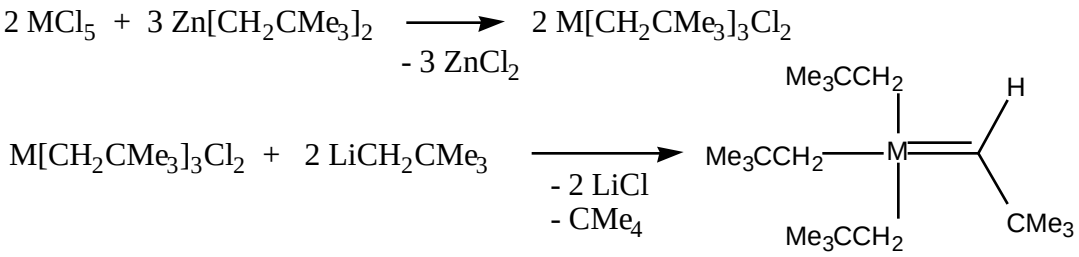


Fischer, E.O.; Maasbol, A. *Angew. Chem. Int. Engl. Ed.* **1964**, 3, 580
Fischer, E.O.; Maasbol, A. *Angew. Chem.* **1964**, 76, 645
Aumann, R.; Fischer, E.O. *Angew. Chem. Int. Ed.* **1967**, 6, 879
Fischer, E.O. *Adv. Organomet. Chem.* **1976**, 14, 1



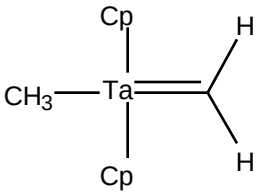
Semmelhack, M.F.; Lee, G.R. *Organometallics* **1987**, 6, 1839
Imwinkelried, R.; Hegedus, L.S. *Organometallics* **1988**, 7, 702

Schrock carbene



M = Ta, Nb

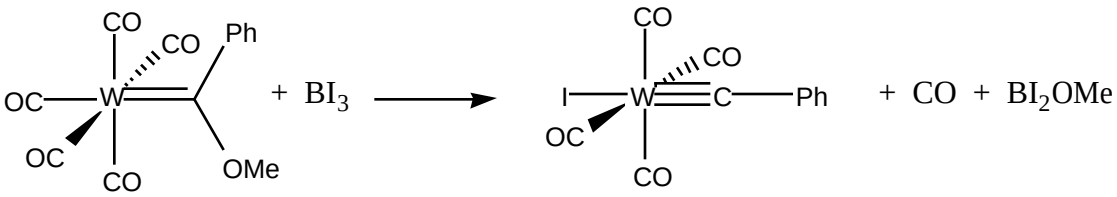
Schrock, R.R.; Meakin, P. *J. Am. Chem. Soc.* **1974**, 96, 5288
Schrock, R.R. *J. Am. Chem. Soc.* **1974**, 96, 6796
Schrock, R.R.; Fellmann, J.D. *J. Am. Chem. Soc.* **1978**, 100, 3359
Schrock, R.R. *J. Organometallic Chem.* **1976**, 122, 209



Schrock, R.R. *J. Am. Chem. Soc.* **1975**, 97, 6577
Schrock, R.R.; Guggenberger, L.J. *J. Am. Chem. Soc.* **1975**, 97, 6578

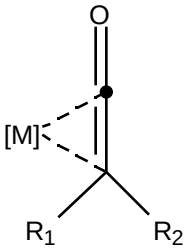
Transition Metal Carbyne Complexes

Reviews:
Fischer, E.O. in *Advances in Organometallic Chemistry*, (F.G.A. Stone, R. West, eds.), Academic Press: Orlando, FL, 1976; Vol. 14, p. 1 - 32 (carbene and carbyne complexes)

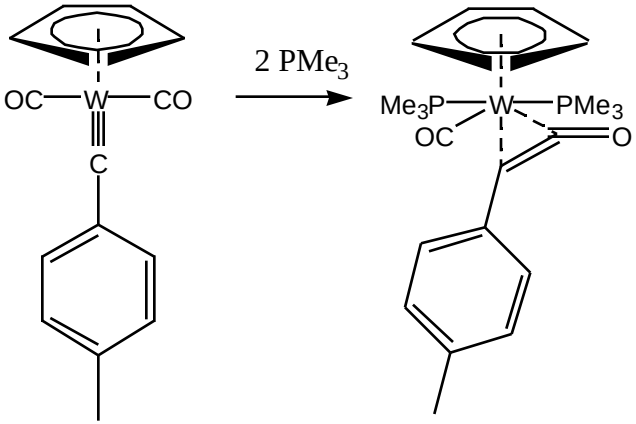


Fischer, E.O.; Kreis, G.; Kreiter, C.G..; Cornelius, G.; Müller, J.; Huttner, G.; Lorenz, H. *Angew. Chem.* **1973**, 85, 618
Fischer, E.O.; Kreiter, C.G.; Müller, J.; Huttner, G.; Lorenz, H. *Angew. Chem. Int. Ed.* **1973**, 12, 564
Fischer, E.O.; Kreis, G.; Kreissl, F.; Kalbfus, W.; Winkler, E. *J. Organometallic Chem.* **1974**, 65, C53

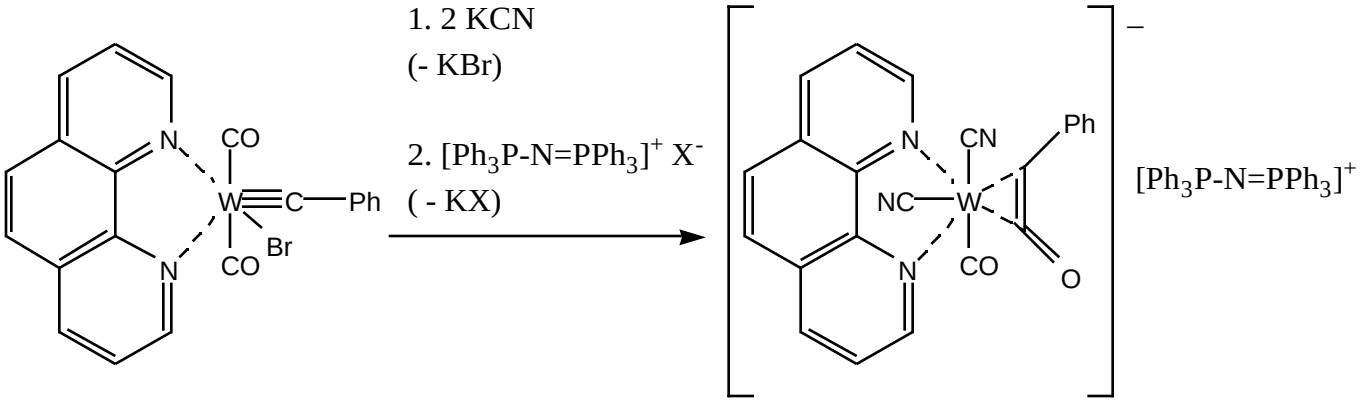
Transition Metal Ketenyl Complexes



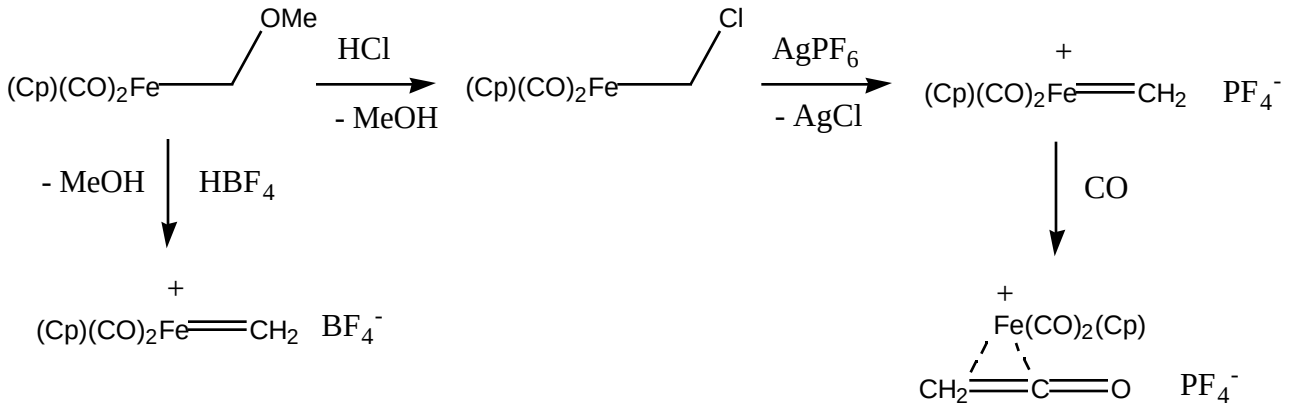
Reviews:
Geoffrey, G.L.; Bassner, S.L. *Adv. Organometallic Chem.* **1988**, 28, 1 (ketenyl complexes, heterovinylidene complexes)
Gibson, S.E.; Peplow, M.A. *Adv. Organometallic Chem.* **1999**, 44, 275 (vinylketenyl complexes)
Kirmse, W. *Eur. J. Org. Chem.* **2002**, 2193
Singh, G.S.; Mdee, L.K. *Curr. Org. Chem.* **2003**, 7, 1821



Kreissl, F.R.; Frank, A.; Schubert, U.; Lindner, T.L.; Hutner, G. *Angew. Chem.* **1976**, 88, 649
Kreissl, F.R.; Eberl, K.; Uedelhoven, W. *Chem. Ber.* **1977**, 110, 3782
Kreissl, F.R.; Uedelhoven, W.; Eberl, K. *Angew. Chem.* **1978**, 90, 908
Uedelhoven, W.; Eberl, K.; Kreissl, F.R. *Chem. Ber.* **1979**, 112, 3376
Eberl, K.; Uedelhoven, W.; Karsch, H.H.; Kreissl, F.R. *Chem. Ber.* **1980**, 113, 3377

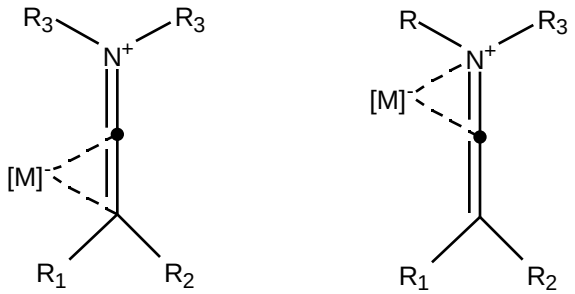


Fischer, E.O.; Filippou, A.C.; Alt, H.G.; Ackermann, K. *J. Organometallic Chem.* **1983**, 254, C21 (first anionic ketenyl transition metal complex)

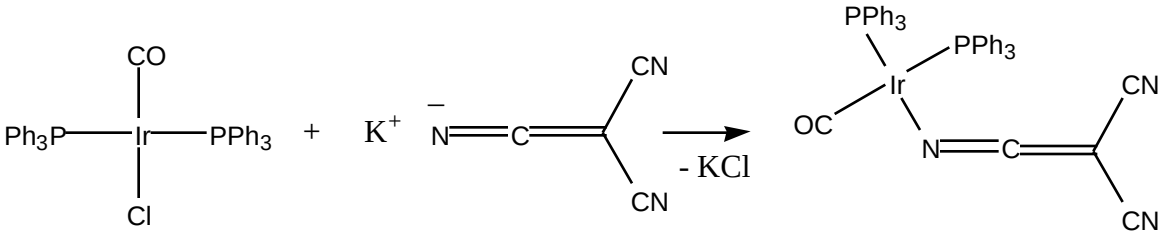


Bodnar, T.W.; Cutler, A.R. *J. Am. Chem. Soc.* **1983**, 105, 5926

Transition Metal Keteniminium Complexes

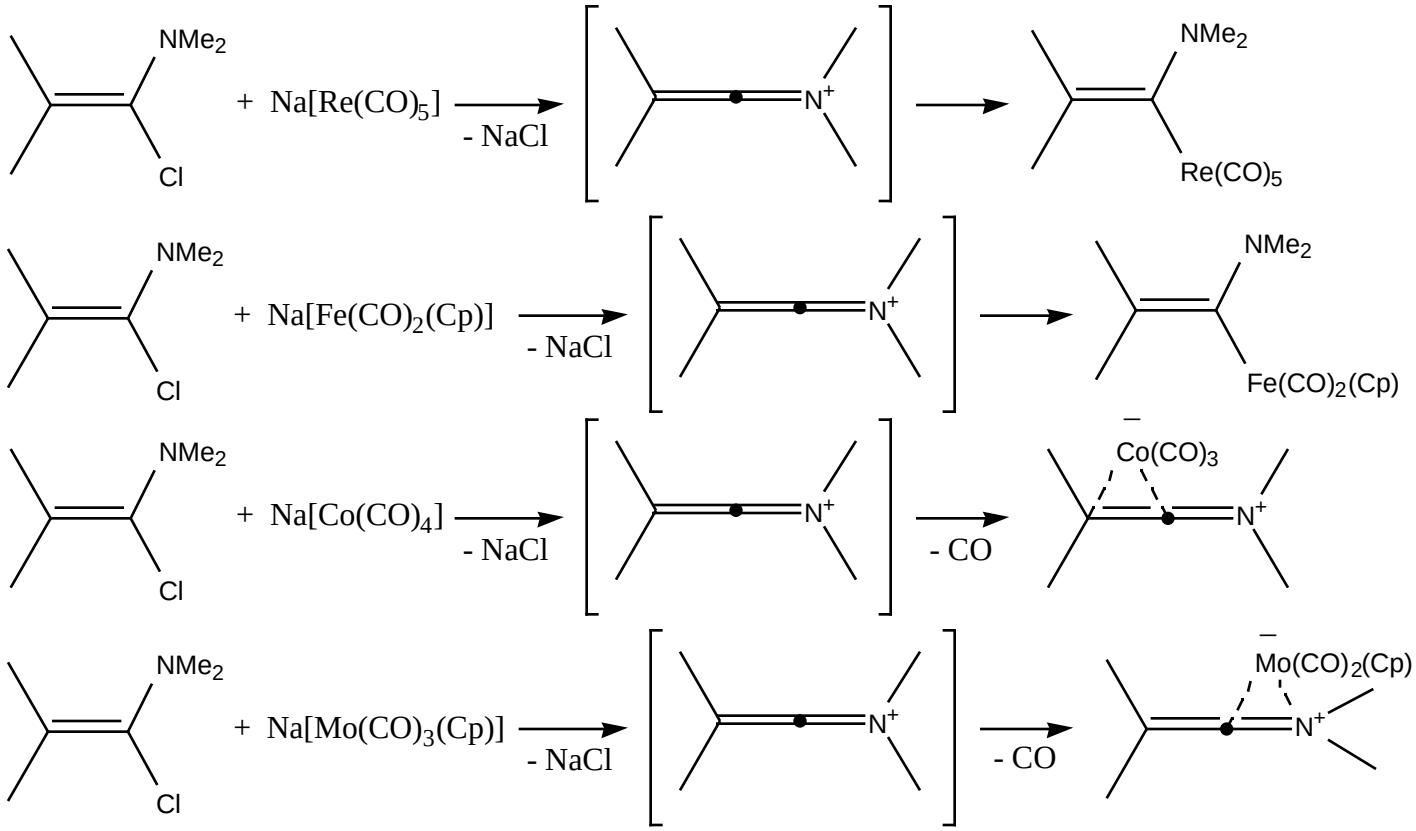


Reviews:
Aumann, R. *Angew. Chem.* **1988**, 100, 1512

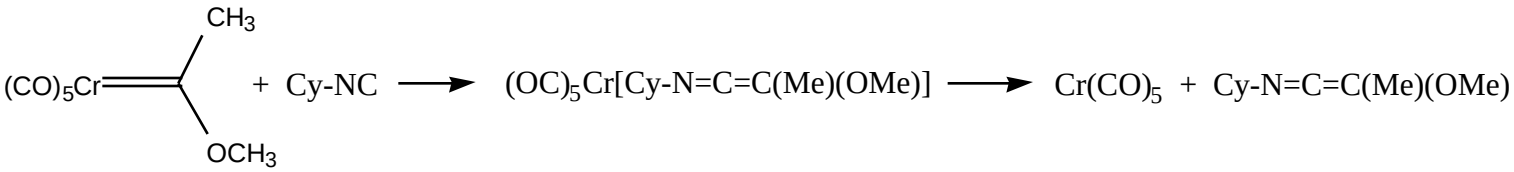


Lenarda, M.; Baddley, W.H. *J. Organometallic Chem.* **1972**, 39, 217

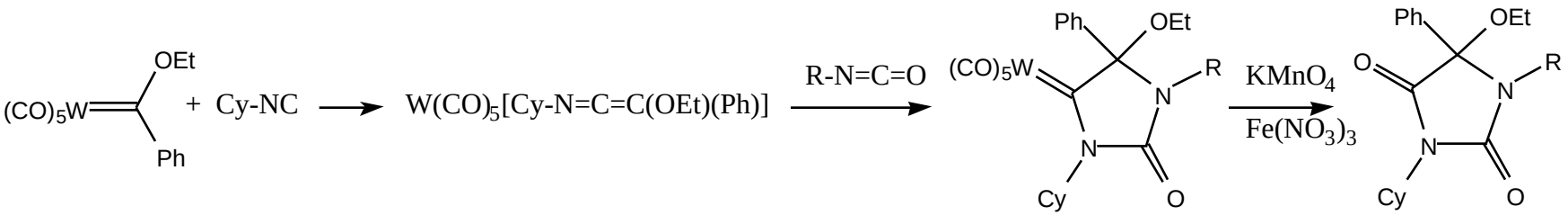
Marchand-Brynaert, J.; Ghosez, L. *J. Am. Chem. Soc.* **1972**, 94, 2869; 2870



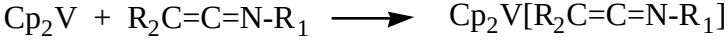
King, R.B.; Hodges, K.C. *J. Am. Chem. Soc.* **1974**, 96, 1263



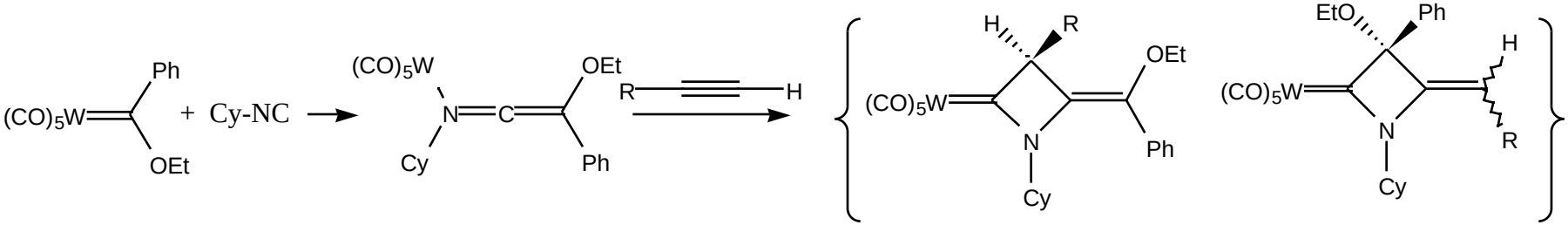
Kreiter, C.G.; Aumann, R. *Chem. Ber.* **1978**, 111, 1223



Aumann, R.; Kuckert, E. *Chem. Ber.* **1986**, 119, 156

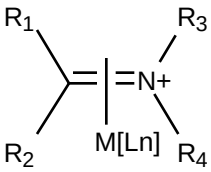


Sielisch, T.; Behrens, U. *J. Organometallic Chem.* **1986**, 310, 179



Aumann, R.; Kuckert, E. *Chem. Ber.* **1987**, 120, 1939

Transition Metal Iminium Complexes



Reviews:
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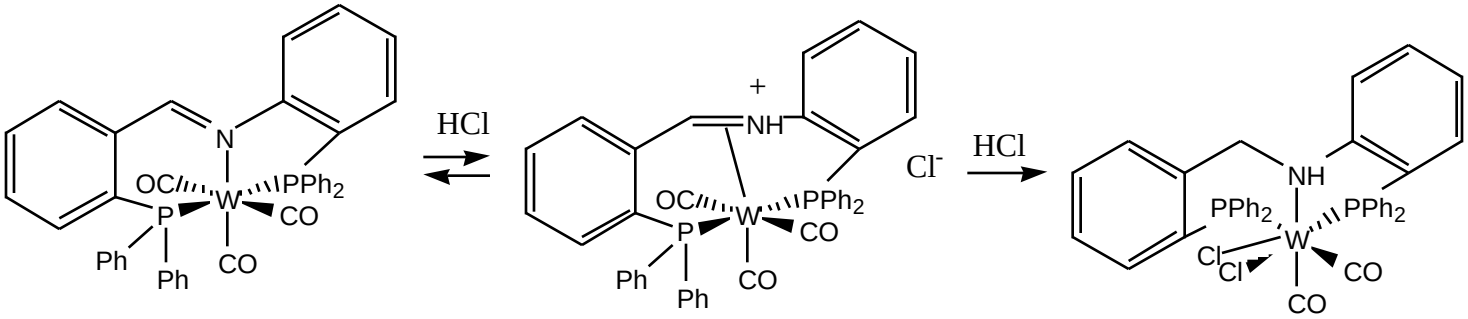
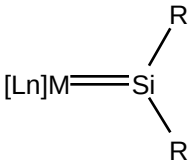
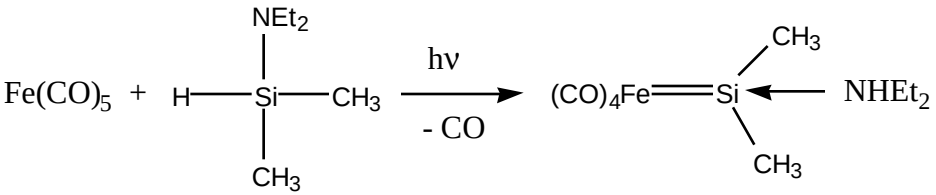


Ainscough, E.W.; Brodie, A.M.; Burrell, A.K.; Kennedy, S.M.F. *J. Am. Chem. Soc.* **2001**, 123, 10391

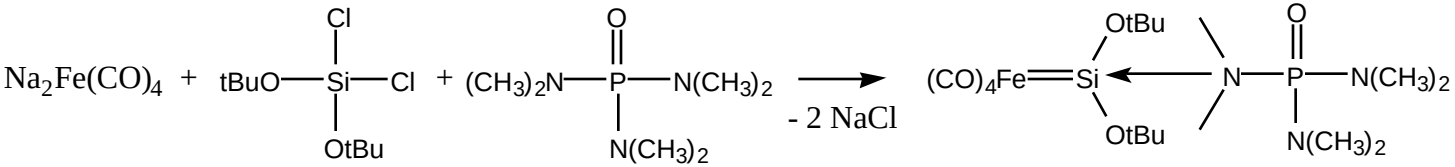
Transition Metal Silene Complexes



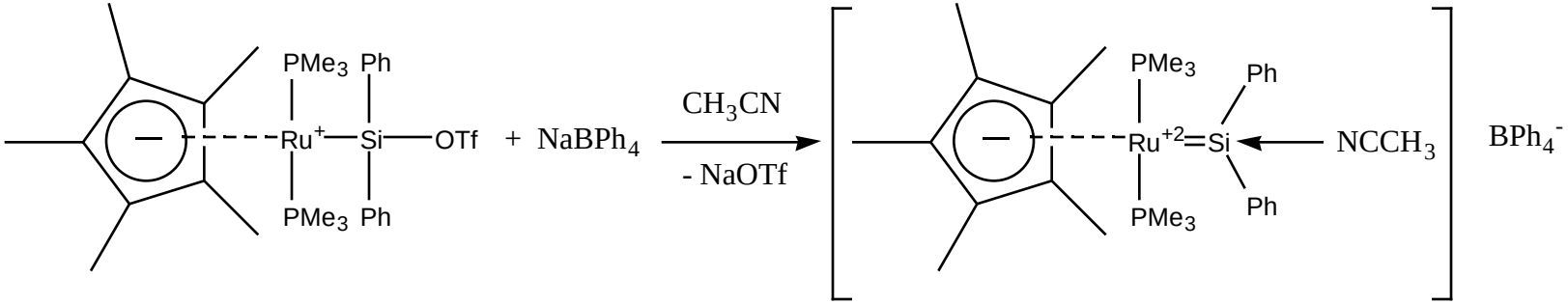
Reviews:
Lickliss, P.D. *Chem. Soc. Rev.* **1992**, 21, 271
Ogino, H. *The Chemical Record* **2002**, 2, 291



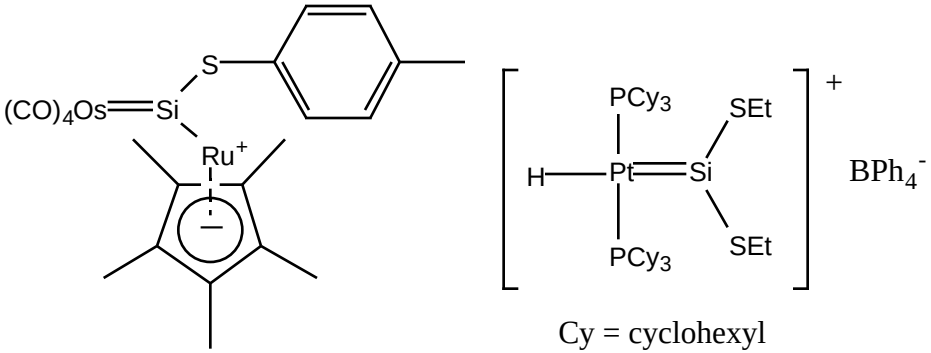
Schmid, G.; Welz, E. *Angew. Chem. Int. Ed.* **1977**, 16, 785



Zybill, C.; Muller, G. *Angew. Chem. Int. Ed.* **1987**, 26, 669

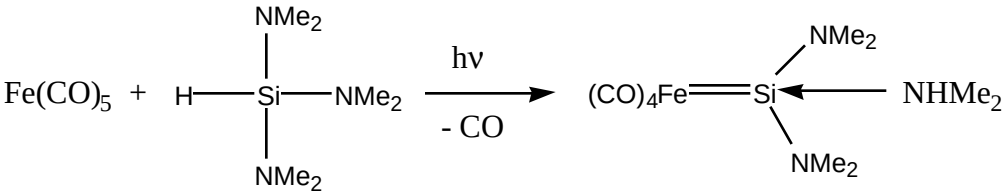


Straus, D.A.; Tilley, T.D.; Rheingold, A.L.; Geib, S.J. *J. Am. Chem. Soc.* **1987**, 109, 5872



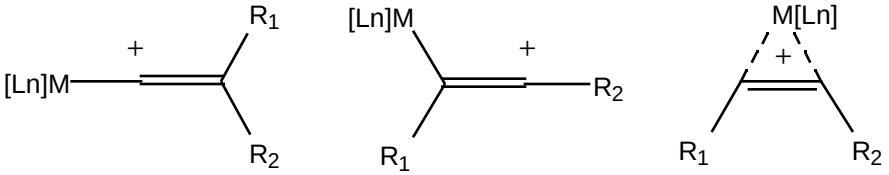
Cy = cyclohexyl

Grumbine, S.D.; Tilley, T.D.; Rheingold, A.L. *J. Am. Chem. Soc.* **1993**, 115, 358
Grumbine, S.D.; Tilley, T.D.; Arnold, E.P.; Rheingold, A.L. *J. Am. Chem. Soc.* **1993**, 115, 7884
Grumbine, S.D.; Tilley, T.D.; Arnold, E.P.; Rheingold, A.L. *J. Am. Chem. Soc.* **1994**, 116, 5495



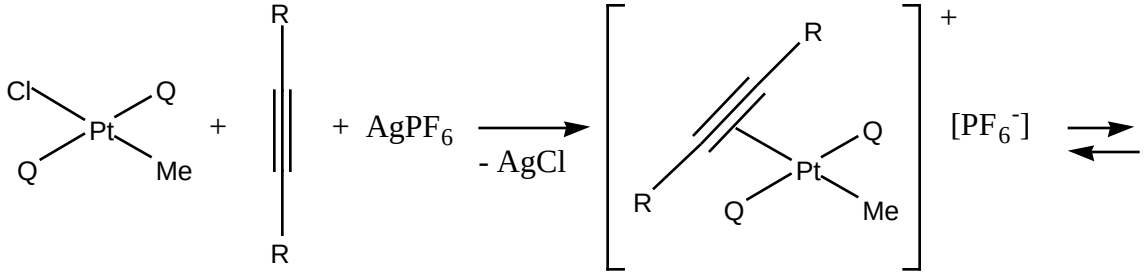
Bodensieck, U.; Braunstein, P.; Deck, W.; Faure, T.; Knorr, M.; Stern, C. *Angew. Chem. Int. Ed.* **1994**, 33, 2440

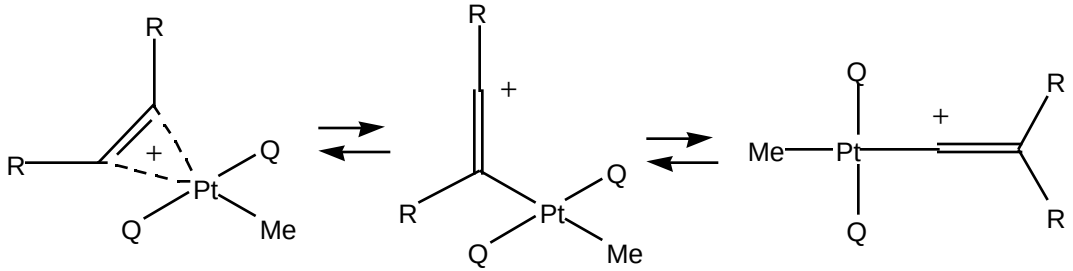
Transition metal vinyl cation complexes



Reviews:

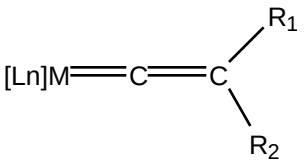
Chisholm, M.H.; Clark, H.C. *Acc. Chem. Res.* **1973**, 6, 202





- Clark, H.C.; Puddephatt, R.J. *Chem. Commun.* **1970**, 92
- Clark, H.C.; Puddephatt, R.J. *Inorg. Chem.* **1970**, 9, 2670
- Clark, H.C.; Ruddick, J.D. *Inorg. Chem.* **1970**, 9, 1226
- Chisholm, M.H.; Clark, H.C. *Chem. Commun.* **1970**, 763
- Clark, H.C.; Puddephatt, R.J. *Inorg. Chem.* **1971**, 10, 18
- Chisholm, M.H.; Clark, H.C. *Inorg. Chem.* **1971**, 10, 1711; 2557
- Chisholm, M.H.; Clark, H.C. *J. Am. Chem. Soc.* **1972**, 94, 1532

Transition Metal Vinylidene Complexes

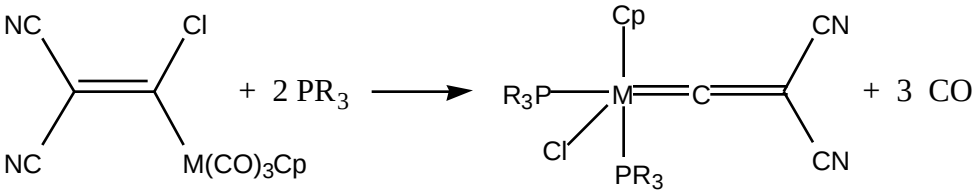


Reviews:

King, R.B. *Acc. Chem. Res.* **1970**, 3, 417
Herrmann, W.A. *Adv. Organometallic Chem.* **1982**, 20, 159
Bruce, M.I.; Swincer, A.G. *Adv. Organometallic Chem.* **1983**, 22, 59
Sailor, M.L.; Shriver, D.F. *Acc. Chem. Res.* **1988**, 21, 374 (heterovinylidene complexes)
Bruce, M.I. *Chem. Rev.* **1991**, 91, 197
Bruce, M.I. *Chem. Rev.* **1998**, 98, 2797
Puerta, M.C.; Valegra, P. *Coord. Chem. Rev.* **1999**, 193-195, 977
Lin, Y.C. *J. Organometallic Chem.* **2001**, 617-618, 141 (Ru)
Bruneau, C. *Topics Organometallic Chem.* **2004**, 11, 125 (Ru, Os)
King, R.B. *Coord. Chem. Rev.* **2004**, 248, 1533
Selegue, J.P. *Coord. Chem. Rev.* **2004**, 248, 1543
Watatsuki, Y. *J. Organometallic Chem.* **2004**, 689, 4092

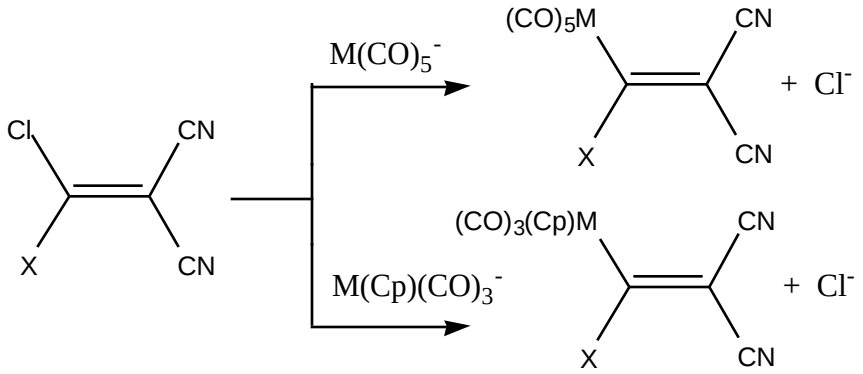
$Ph_2C{=}C{=}O + Fe_2(CO)_9 \longrightarrow Fe_2(\mu\text{-}C{=}CPh_2)(CO)_8 + CO_2$

Mills, O.S.; Redhouse, A.D. *Chem. Commun.* **1966**, 444
Mills, O.S.; Redhouse. A.D. *J. Chem. Soc. A* **1968**, 1282



M = W, Mo; R = PPh_3, $P(OMe)_3$, $P(OPh)_3$, $P(OEt)_3$, $AsPh_3$, $SbPh_3$

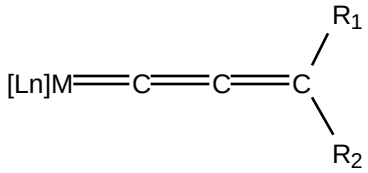
King, R.B.; Saran, M.S. *Chem. Commun.* **1972**, 1053



X = H, Cl, CN; M = Mo, W

King, R.B.; Saran, M.S. *J. Am. Chem. Soc.* **1972**, 94, 1784
King, R.B.; Saran, M.S. *J. Am. Chem. Soc.* **1973**, 95, 1811
King, R.B.; Saran, M.S. *J. Am. Chem. Soc.* **1973**, 95, 1817

Transition Metal Vinylidenecarbene (allenylidene) Complexes



Reviews:
Bruce, M.I.; Swincer, A.G. *Adv. Organometallic Chem.* **1983**, 22, 59
Bruce, M.I. *Chem. Rev.* **1991**, 91, 197
Werner, H. *J. Organometallic Chem.* **1994**, 475, 45
Werner, H. *Chem. Commun.* **1997**, 903
Bruce, M.I. *Coord. Chem. Rev.* **1997**, 166, 91
Cadiero, V.; Gamasa, M.P.; Gimeno, J. *Eur. J. Inorg. Chem.* **2001**, 571
Werner, H.; Ilg, K.; Lass, R.; Wolf, J. *J. Organometallic Chem.* **2002**, 661, 137
Winter, R.F.; Zalis, S. *Coord. Chem. Rev.* **2004**, 248, 1565
Rigaut, S.; Touchard, D.; Dixneuf, P.H. *Coord. Chem. Rev.* **2004**, 248, 1585

$M(CO)_5[=C(OEt)CH=C(Ph)(NEt_2)] + EX_3 \longrightarrow M(CO)_5[=C=C=C(Ph)(NEt_2)] + [EtOEX_3]^- H^+$

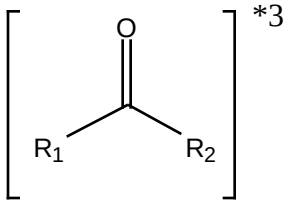
M = Cr, W $EX_3 = BF_3$ (when M = Cr), $AlEt_3$ (when M = W)

Berke, H. *Angew. Chem. Int. Ed. Engl.* **1976**, 15, 624
Fischer, E.O.; Kalder, H.J.; Frank, A.; Köhler, F.H.; Huttner, G. *Angew. Chem. Int. Ed.* **1976**, 15, 623

$[Ru(=C=C=CPh_2)(PMe_3)_2Cp]^+$

Selengue, J.P. *Organometallics* **1982**, 1, 217

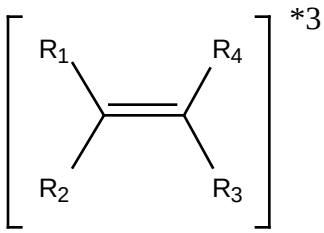
Triplet Ketones (excited state)



Reviews:
Brand, J.C.D.; Williamson, D.G. *Adv. Phys. Org. Chem.* **1963**, 1, 365
Yang, N.C. *Reactivity of the Photoexcited Organic Molecule, Proc. Conf. Chem.* **1965**, 145
Parker, C.A. *Ber. Bunsen-Gesell.* **1969**, 73, 764
Stephenson, L.M.; Hammond, G.S. *Angew. Chem. Int. Ed.* **1969**, 8, 261
Davidson, R.S. *Organic Reaction Mechanisms* **1971**, 467
Ireland, J.F.; Wyatt, P.A.H. *Adv. Phys. Org. Chem.* **1976**, 12, 132
Davidson, R.S. *Adv. Phys. Org. Chem.* **1983**, 19, 1
Pedulli, G.F. *Rev. Chem. Intermediates* **1986**, 7, 155
Chan, I.Y. *Rev. Chem. Intermediates* **1987**, 8, 339
Wan, J.K.S.; Depew, M.C. *Res. Chem. Intermediates* **1992**, 18, 227
Armesto, D.; Ortiz, M.J.; Agarrabeitia, A.R. in *CRC Handbook of Organic Photochemistry and Photobiology*, 2nd ed., (W. Horspool; F. Lenci, eds.) CRC Press: Boca Raton, FL, 2004, p. 77/1
Wagner, P.J.; Klan, P. in *CRC Handbook of Organic Photochemistry and Photobiology*, 2nd ed., (W. Horspool; F. Lenci, eds.) CRC Press: Boca Raton, FL, 2004, p. 52/1

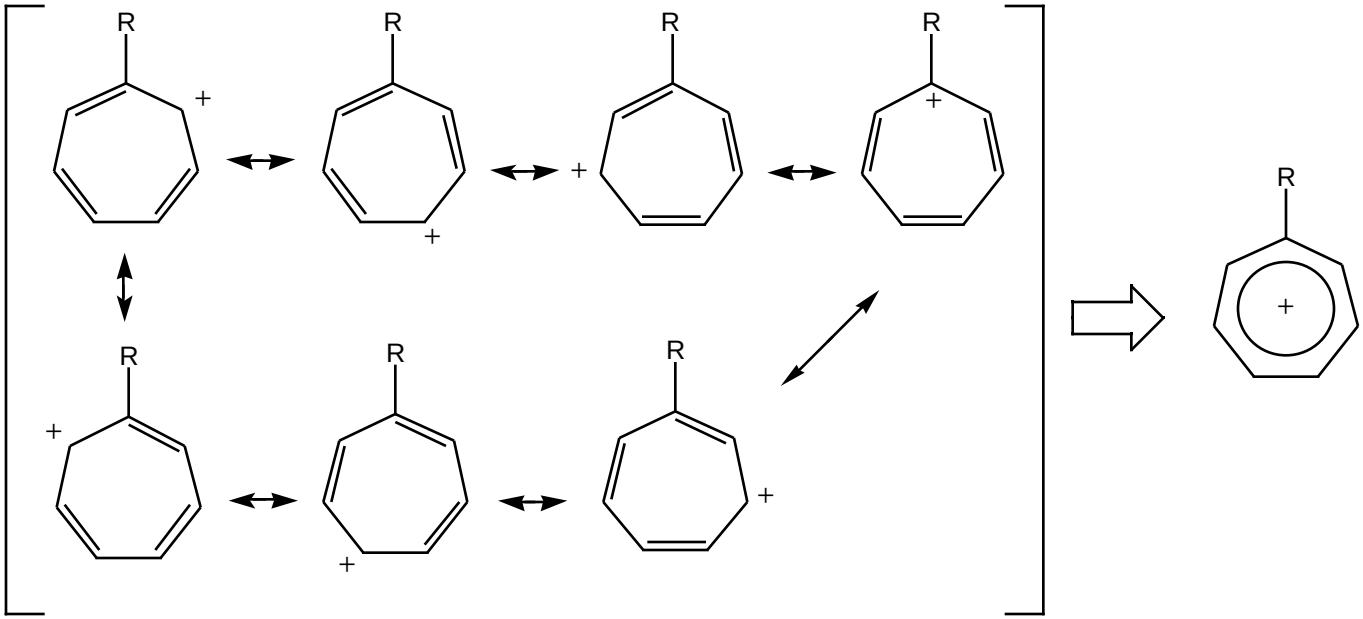
Lewis, G.N.; Kasha, M. *J. Am. Chem. Soc.* **1945**, 67, 994

Triplet olefins (excited state)

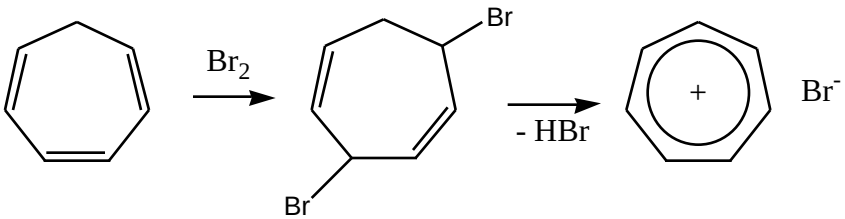


Reviews:
Brand, J.C.D.; Williamson, D.G. *Adv. Phys. Org. Chem.* **1963**, 1, 365
Stephenson, L.M.; Hammond, G.S. *Angew. Chem. Int. Ed.* **1969**, 8, 261
Caldwell, R.A. in *Kinetics and Spectroscopy of Carbenes and Biradicals*, (M.S. Platz, ed.) Plenum: New York, 1990, p. 77
Wilbrandt, R.; Langkilde, F.W. *NATO ASI Ser. Ser. C* **1973**, 410, 567
Ireland, J.F.; Wyatt, P.A.H. *Adv. Phys. Org. Chem.* **1976**, 12, 132
Davidson, R.S. *Adv. Phys. Org. Chem.* **1983**, 19, 1
Unett, D.J.; Caldwell, R.A. *Res. Chem. Intermediates* **1995**, 21, 665

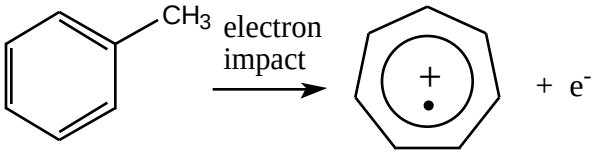
Tropylium ion



Reviews:
Harmon, K.M. in *Carbonium Ions* (G.A. Olah, ed.) Wiley: New York, 1973, Vol. 4, p. 1579
Lifshitz, C. *Acc. Chem. Res.* **1994**, 27, 138
Abraham, W.; Kharlanov, V. in *Handbook of Photochemistry and Photobiology*, (H.S. Nalwa, ed.) American Scientific Publishers: CA, 2003, Vol. 2, p. 299

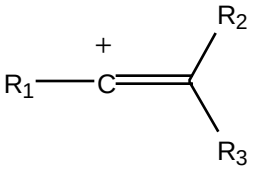


Doering, W.v.E.; Knox, L.H. *J. Am. Chem.Soc.* **1954**, 76, 3203 (also first use of inscribed circle to indicate aromaticity)

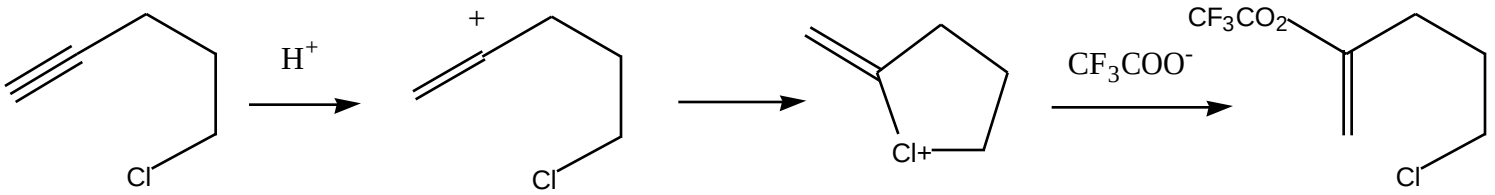


Rylander, P.N.; Meyerson, S.; Grubb, H.M. *J. Am. Chem. Soc.* **1957**, 79, 842

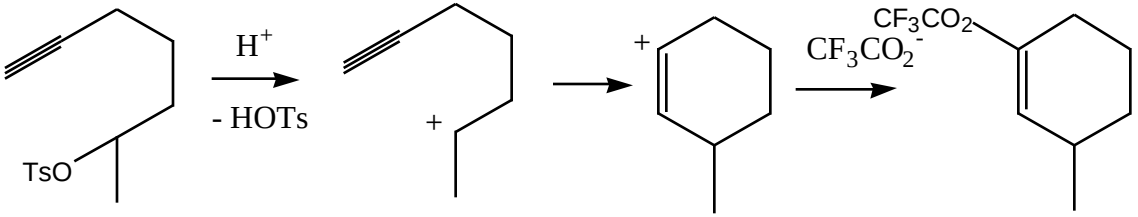
Vinyl cations



Reviews:
Hanack, M. *Acc. Chem. Res.* **1970**, 3, 209
Modena, G.; Tonellato, U. *Adv. Phys. Org. Chem.* **1971**, 9, 185
Stang, P.J. *Prog. Phys. Org. Chem.* **1973**, 10, 205
Grob, C.A. *Angew. Chem. Int. Ed.* **1972**, 11, 544
Stang, P.J. *Prog. Phys. Org. Chem.* **1973**, 10, 205
Subramanian, L.R.; Hanack, M. *J. Chem. Educ.* **1975**, 52, 80
Hanack, M. *Acc. Chem. Res.* **1976**, 9, 364
Rappoport, Z. *Acc. Chem. Res.* **1976**, 9, 265
Stang, P.J.; Rappoport, Z.; Hanack, M.; Subramanian, L.R. *Vinyl Cations*, Academic Press: New York, 1979
Rappoport, Z. *Reactive Intermediates* **1983**, 3, 427
Wan, P.; Yates, K. *Rev. Chem. Intermediates* **1984**, 5, 157
Rappoport, Z.; Stang, P.J. (eds.) *Dicoordinated Carbocations*, Wiley: Chichester, 1997
Okuyama, T.; Lodder, G. *Adv. Phys. Org. Chem.* **2002**, 37, 1
Okuyama, T. *Acc. Chem. Res.* **2002**, 35, 12

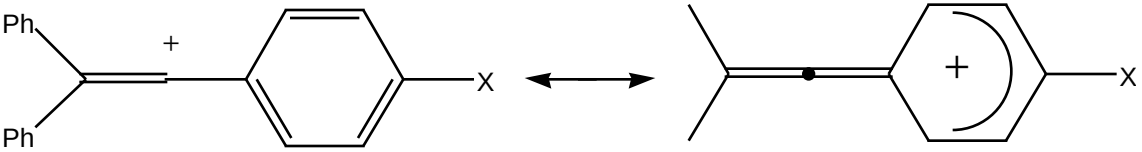


Peterson, P.E.; Duddey, J.E. *J. Am. Chem. Soc.* **1963**, 85, 2865

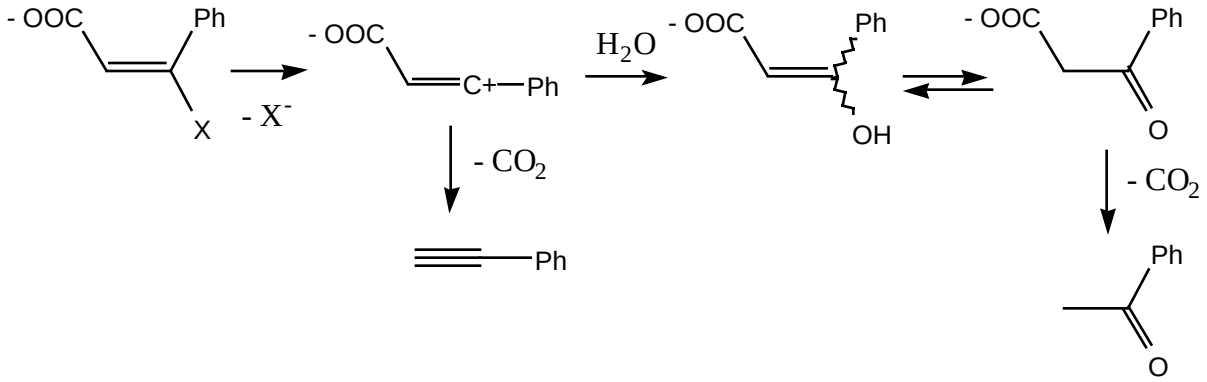


Peterson, P.E.; Kamat, R.J. *J. Am. Chem. Soc.* **1966**, 88, 3152
Peterson, P.E.; Duddey, J.E. *J. Am. Chem. Soc.* **1966**, 88, 4990

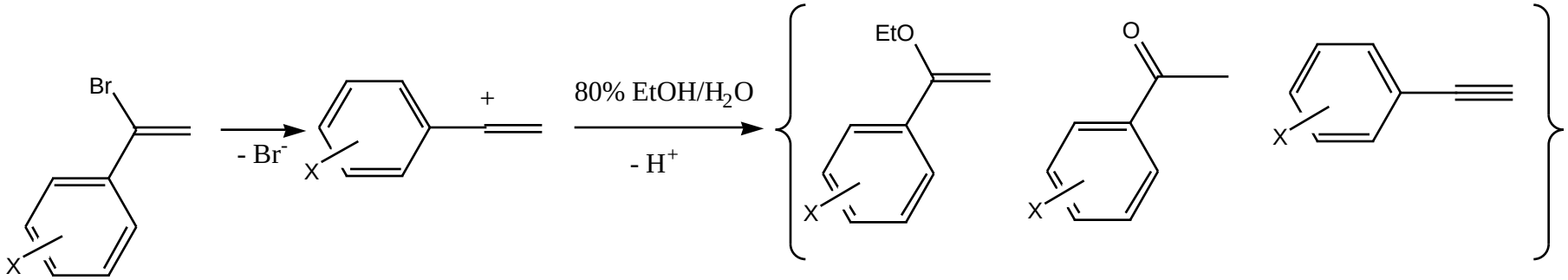
Jones, W.M.; Miller, F.W. *J. Am. Chem. Soc.* **1967**, 89, 1960
Fahey, R.C.; Lee, D.J. *J. Am. Chem. Soc.* **1967**, 89, 2780
Nishimura, A.; Kato, H.; Ohta, M. *J. Am. Chem. Soc.* **1967**, 89, 5083
Bly, R.S.; Ballentine, A.R.; Koock, S.U. *J. Am. Chem. Soc.* **1967**, 89, 6993
Noyce, D.S.; Matesich, M.A.; Peterson, P.E. *J. Am. Chem. Soc.* **1967**, 89, 6225



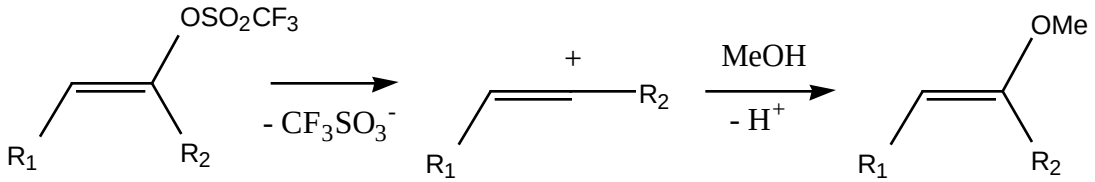
Miller, L.L.; Kaufman, D.A. *J. Am. Chem. Soc.* **1968**, 90, 7282



Grob, C.A. *Bull. Soc. Chim. Fr.* **1960**, 1360



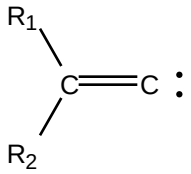
Grob, C.A.; Cseh, G. *Helv. Chim. Acta* **1964**, 47, 194
Grob, C.A.; Csapilla, J.; Cseh, G. *Helv. Chim. Acta* **1964**, 47, 1590
Huang, S.J.; Lessard, M.V. *J. Am. Chem. Soc.* **1968**, 90, 2432
Grob, C.A.; Spaar, R. *Helv. Chim. Acta* **1970**, 53, 2119
Grob, C.A.; Pfaendler, H.R. *Helv. Chim. Acta* **1971**, 54, 2060
Grob, C.A.; Nussbaumer, R. *Helv. Chim. Acta* **1971**, 54, 2528
Grob, C.A. *Chimia* **1971**, 25, 87



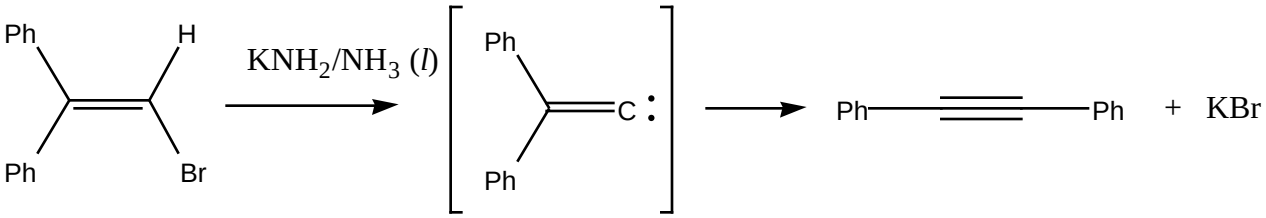
R_1, R_2 = alkyl

Summerville, R.H.; Senkler, C.A.; Schleyer, P.v.R.; Deuber, T.E.; Stang, P.J. *J. Am. Chem. Soc.* **1974**, 96, 1100
Stang, P.J.; Deuber, T.E. *Org. Synth.* **1974**, 54, 79

Vinylidenes (methylene carbenes, alkylidene carbenes)



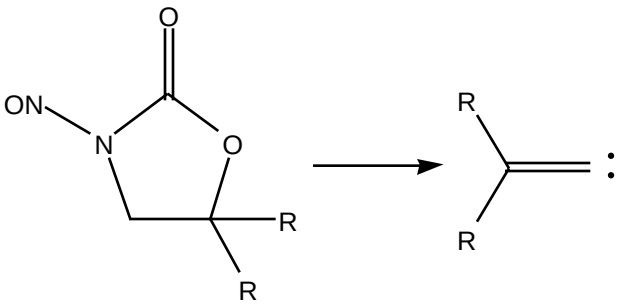
Reviews:
Hartzler, H.D. in *Carbenes*, (R. A. Moss, M. Jones Jr.; eds.) Wiley-Interscience: New York, 1975, Vol. 2
Stang, P.J. *Chem. Rev.* **1978**, 78, 383
Stang, P.J. *Acc. Chem. Res.* **1978**, 11, 107
Stang, P.J. *Acc. Chem. Res.* **1982**, 15, 348



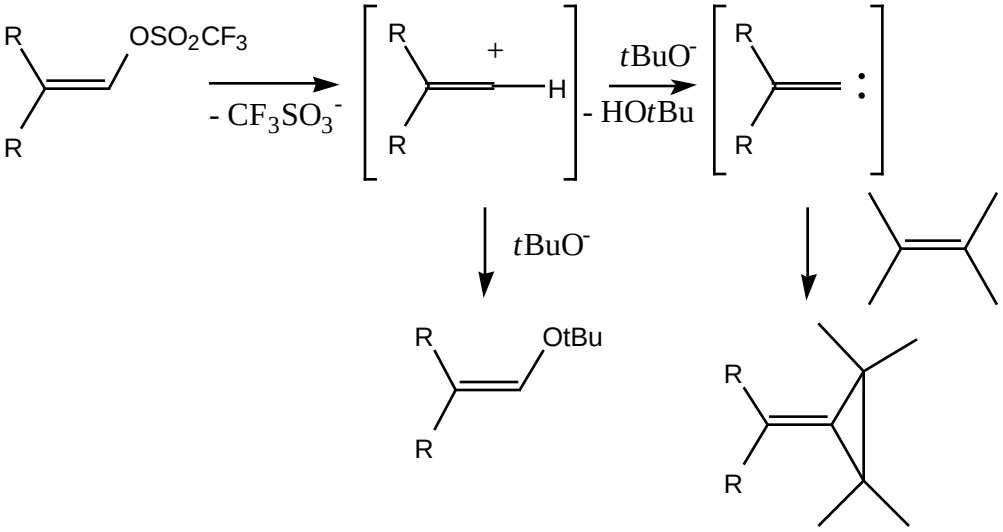
Coleman, G.H.; Maxwell, R.D. *J. Am. Chem. Soc.* **1934**, 56, 132

Emschwiller, G. *Bull. Soc. Chim. Fr.* **1935**, 2, 1625

Kobrich, G. *Angew. Chem. Int. Ed.* **1967**, 6, 41

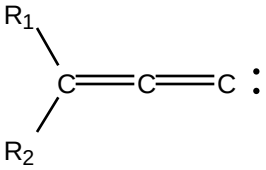


Newman, M.S.; Okorududu, A.O. *J. Am. Chem. Soc.* **1968**, 90, 4189
Newman, M.S.; Okorududu, A.O. *J. Org. Chem.* **1969**, 34, 1220
Newman, M.S.; Din, Z. *J. Org. Chem.* **1973**, 38, 547

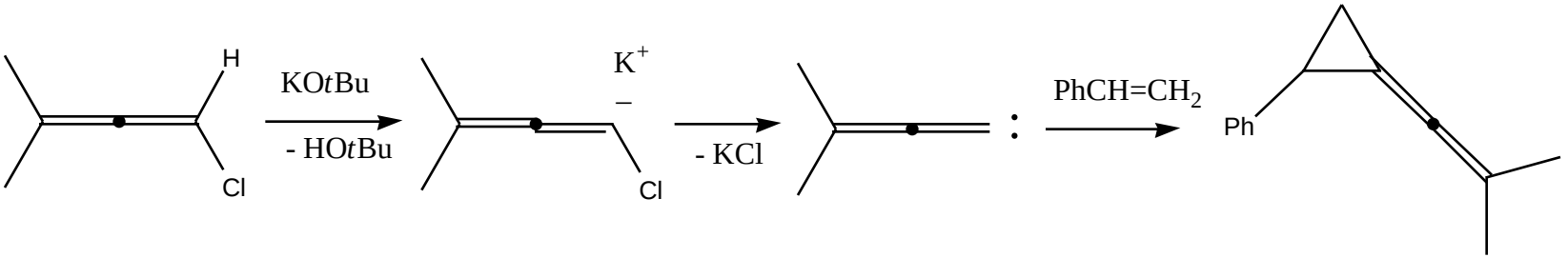


Stang, P.J.; Mangum, M.G.; Fox, D.P.; Haak, P. *J. Am. Chem. Soc.* **1974**, 96, 4562

Vinylidenecarbenes (allenylidenes, alkenylidene carbenes)



Reviews:
None.



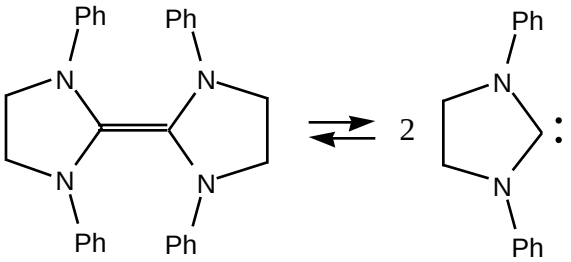
Hartzler, H.D. *J. Am. Chem. Soc.* **1961**, 83, 4990
Hartzler, H.D. *J. Org. Chem.* **1964**, 29, 1311

le Noble, W.J.; Chiou, D.M.; Okaya, Y. *J. Am. Chem. Soc.* **1979**, 101, 3244

Wallach intermediate (see Dications)

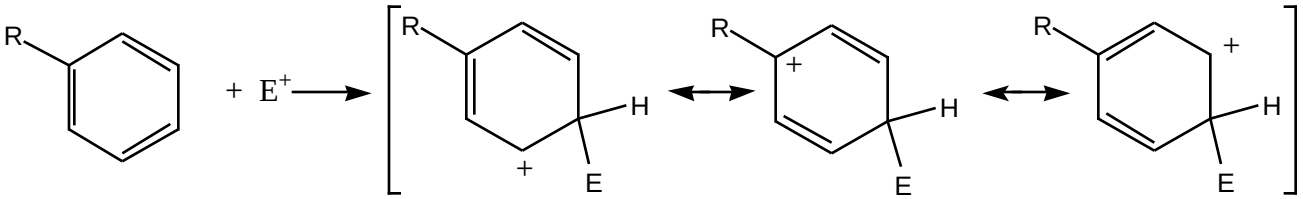
Wanzlich carbenes

Reviews:
Arduengo, A.J. III *Tetrahedron* **1999**, 55, 14523 (imidazolylidenes and imidazolinylidenes)

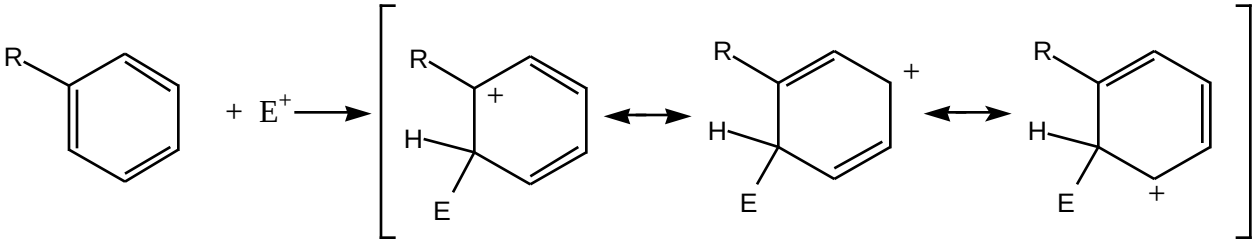


Wanzlich, H.W.; Schikora, E. *Angew. Chem.* **1960**, 72, 494
Wanzlich, H.W.; Schikora, E. *Chem. Ber.* **1961**, 94, 2389
Wanzlich, H.W. *Angew. Chem. Int. Ed.* **1962**, 1, 75
Wanzlich, H.W.; Schönherr, H.J. *Angew. Chem. Int. Ed.* **1968**, 80, 153

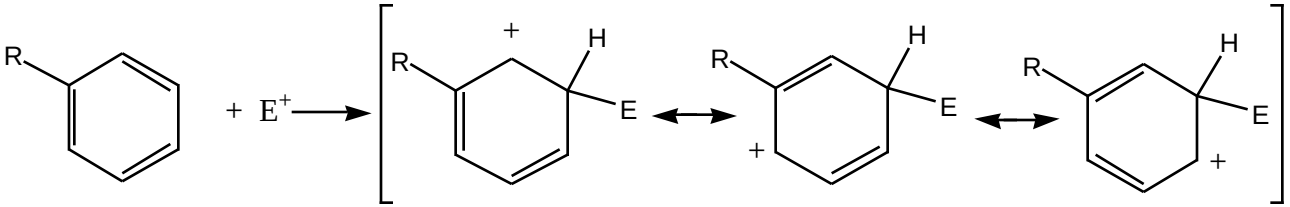
Wheland Intermediates (arenium ions, benzenium ions)



R = EDG, *para* substitution



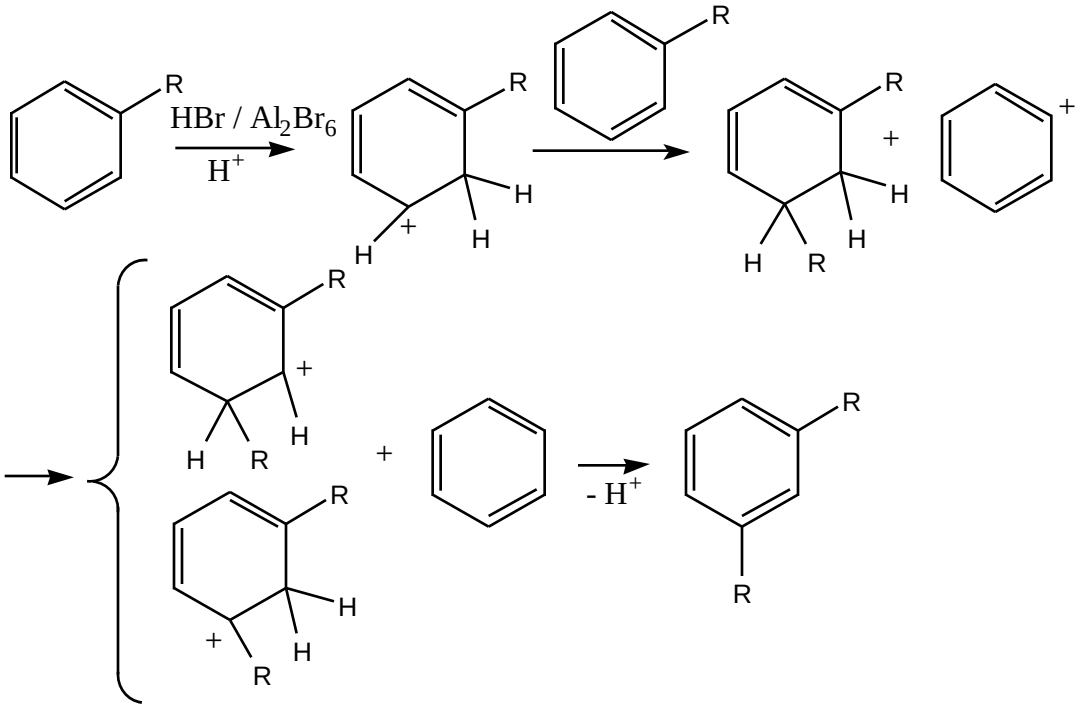
R = EDG, *ortho* substitution



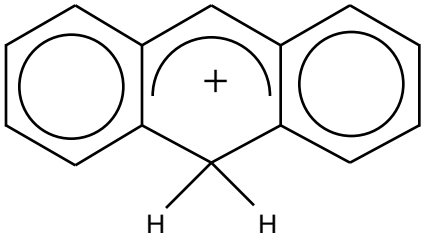
R = EWG, *meta* substitution

Reviews:
Olah, G.A. *Acc. Chem. Res.* **1970**, 4, 240

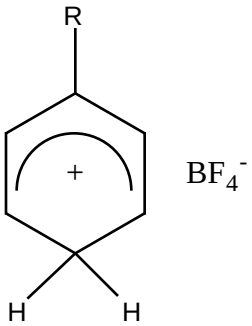
Wheland, G.W.; Pauling, L. *J. Am. Chem. Soc.* **1935**, 57, 2086
Wheland, G.W. *J. Am. Chem. Soc*. **1942**, 64, 900
Matlow, S.L.; Wheland, G.W. *J. Am. Chem. Soc.* **1955**, 77, 3653



Nightingale, D.V. *Chem. Rev.* **1939**, 25, 329
McCaulay, D.A.; Lien, A.P. *J. Am. Chem. Soc.* **1951**, 73, 2013
McCaulay, D.A.; Lien, A.P. *J. Am. Chem. Soc.* **1953**, 75, 2411
Brown, H.C.; Smoot, C.R. *J. Am. Chem. Soc.* **1956**, 78, 2176

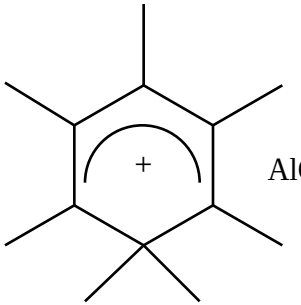


Gold, V.; Tye, F.L. *J. Chem. Soc.* **1952**, 2172 (first direct spectroscopic evidence for protonation of aromatics)
Reid, C. *J. Am. Chem. Soc.* **1954**, 76, 3264



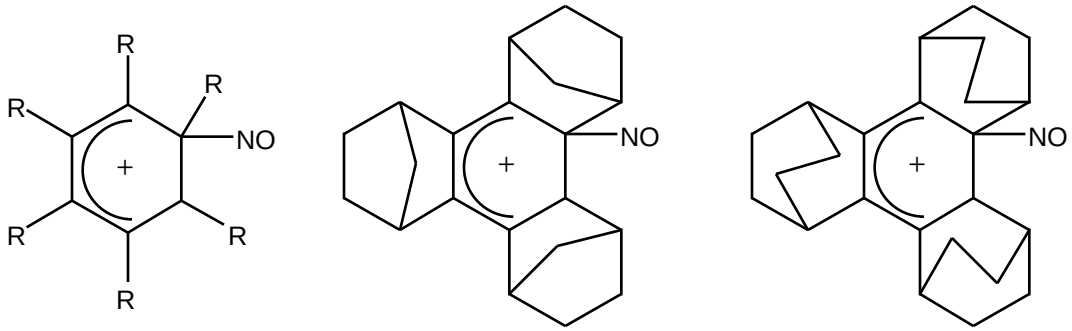
BF_4^-

Olah, G.A.; Kuhn, S.J. *Nature* **1956**, 178, 693
Olah, G.A.; Kuhn, S.J. *J. Am. Chem. Soc.* **1958**, 80, 6535



$AlCl_4^-$

Doering, W.v.E.; Saunders, M.; Boyton, H.G.; Earhart, H.W.; Wadley, E.F.; Edwards, W.R.; Laber, R. *Tetrahedron* **1958**, 4, 178



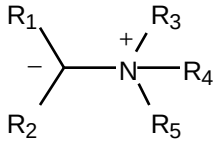
R = Me, Et, Ph

Hubig, S.M.; Kochi, J.K. *J. Am. Chem. Soc.* **2000**, 122, 8279

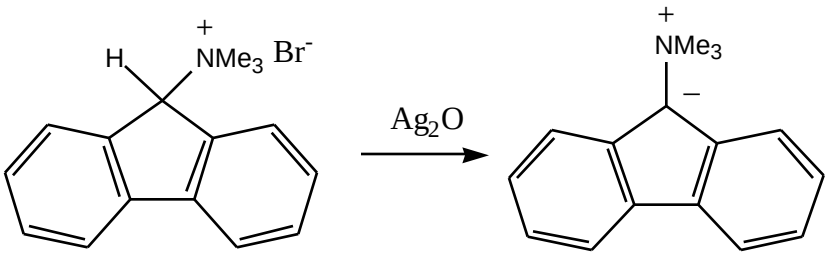
Ylides (1,2-Dipoles)

Reviews:
Johnson, A.W. *Ylid Chemistry*, Academic Press: New York, 1966
Nesmeyanov, N.A. *Mendeleev Chem.* **1967**, 12, 35
Lowe, P.A. *Chem. Ind.* **1970**, 1070
Wittig, G. *J. Organometallic Chem.* **1975**, 100, 279
Morris, D.G. in *Recent Advances in the Chemistry of Ylides*, (G.G. Wubbels, ed.) Butterworths: London, Vol. 10, 1983, p. 189
Lloyd, D. *Non-Benzenoid Conjugated Carbocyclic Compounds*, Elsevier Press: Amsterdam, 1984, p. 32
Johnson, A.W. *Ylides and Imines of Phosphorus*, Wiley: New York, 1993
Clark, J.S. (ed.) *Nitrogen, Oxygen, and Sulfur Ylide Chemistry*, Oxford University Press: Oxford, 2002

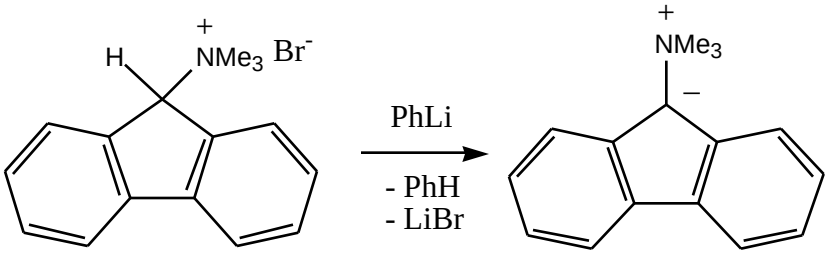
(i) Ammonium ylides



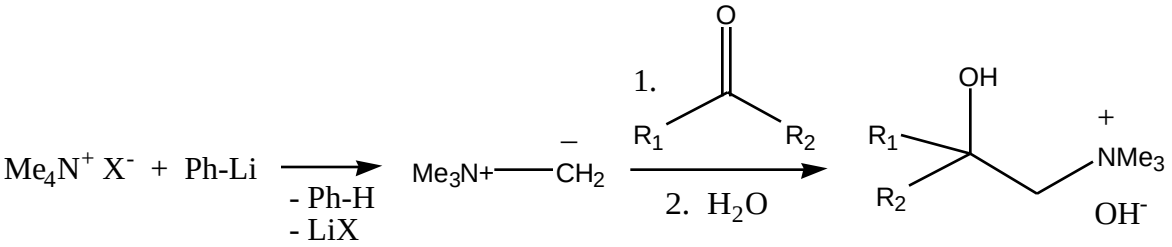
Reviews:
Zugravescu, I.; Petrovanu, M. *N-Ylid Chemistry*, (translated by C. Stoicescu) McGraw-Hill International Book Co.: New York, 1976
Clark, J.S. (ed.) *Nitrogen, Oxygen, and Sulfur Ylide Chemistry*, Oxford University Press: Oxford, 2002

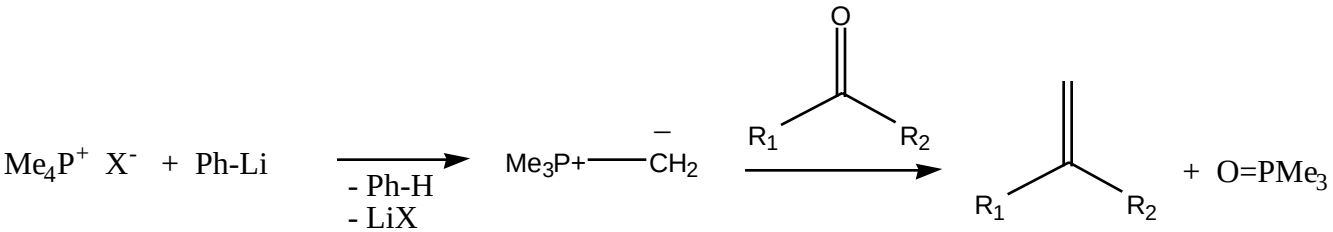


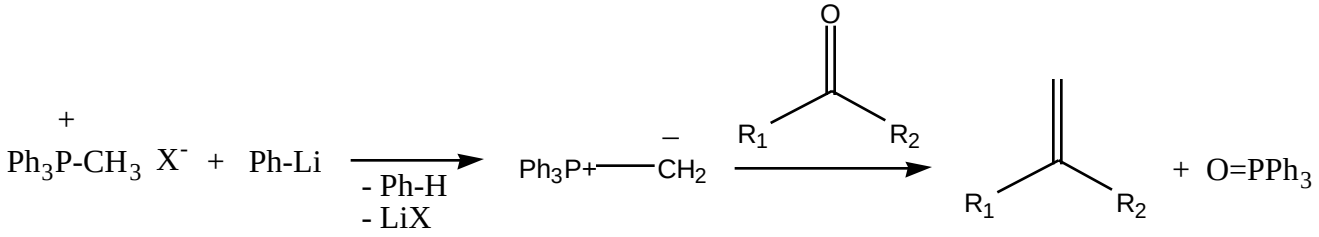
Ingold, C.K.; Jessop, A.J. *J. Chem. Soc.* **1929**, 2357



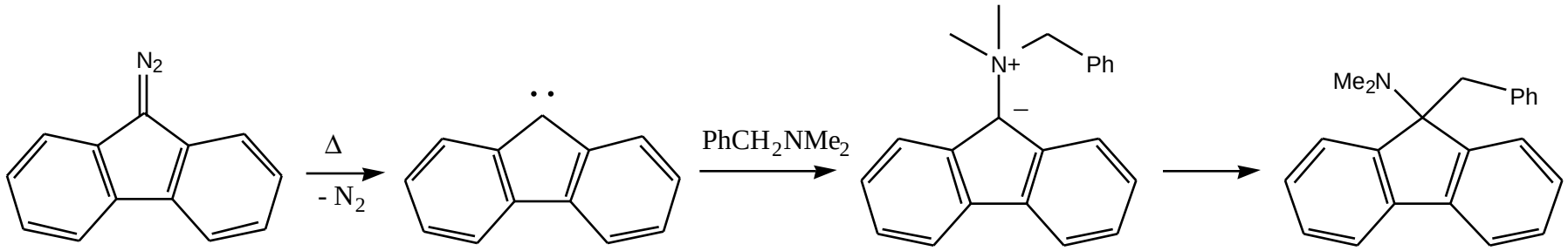
Wittig, G.; Felletschin, G. *Ann. Chem.* **1944**, 555, 133



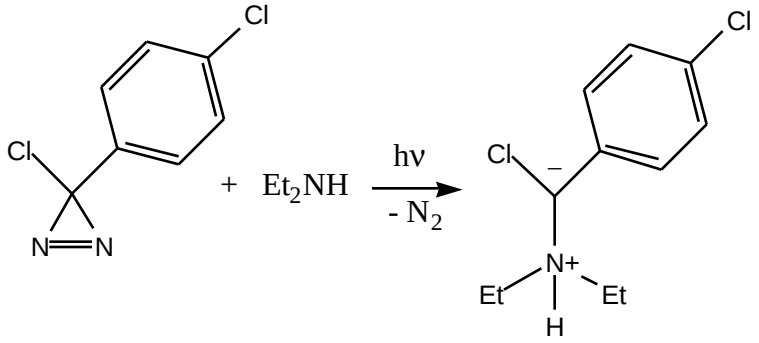




Wittig, G.; Wetterling, M.H. *Ann. Chem.* **1947**, 557, 193
Wittig, G.; Rieber, M. *Ann. Chem.* **1949**, 562, 177; 187
Wittig, G.; Geissler, G. *Ann. Chem.* **1953**, 580, 44

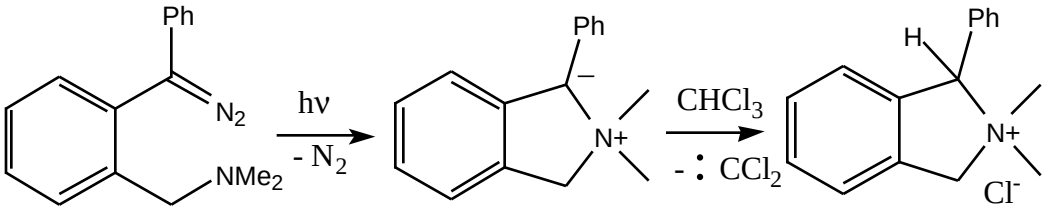


Bamford, W.R.; Stevens, T.S. *J. Chem. Soc.* **1952**, 1975



Bonneau, R.; Liu, M.T.H. *J. Am. Chem. Soc.* **1991**, 113, 9872

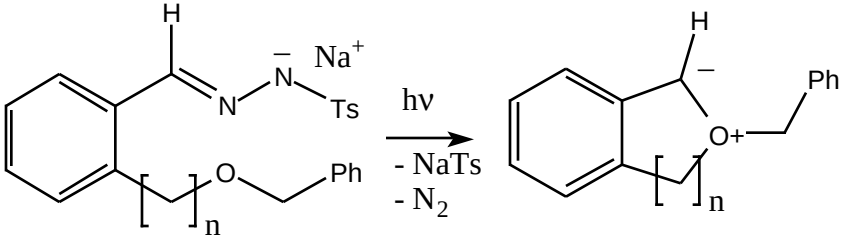
West, F.G.; Glaeske, K.W.; Kevin, W.; Naidu, B.N. *Synthesis* **1993**, 977



Tomioka, H.; Yamada, S.; Hirai, K. *J. Org. Chem.* **1995**, 60, 1298

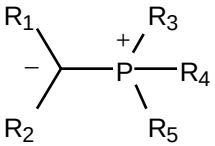
(ii) Oxonium ylides

Reviews:
West, F.G.; Clark, J.S. in *Nitrogen, Oxygen, and Sulfur Ylide Chemistry*, (J.S. Clark, ed.) Oxford University Press: Oxford, 2002, p. 115 - 134

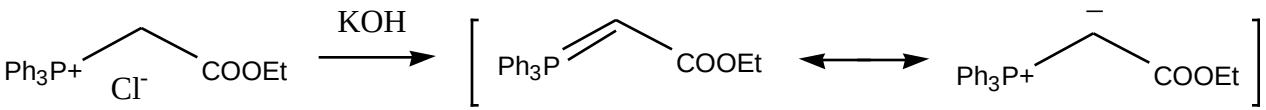


Kirmse, W.; Kund, K. *J. Am. Chem. Soc.* **1989**, 111, 1465

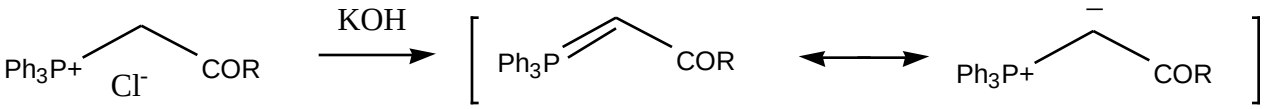
(iii) Phosphonium ylides



Reviews:
Gruetzmacher, H.; Heim, U.; Schoenberg, H.; Pritzkow, H. *Phosphorus, Sulfur, Silicon, and Related Elements* **1993**, 76, 281

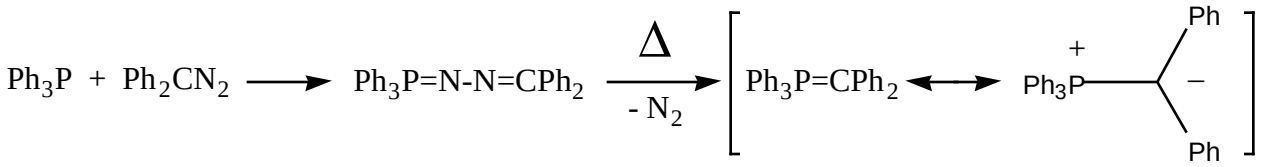


Michaelis, A.; Gimborn, H.V. *Chem. Ber.* **1894**, 27, 272
Aksnes, G. *Acta Chem. Scand.* **1961**, 15, 438

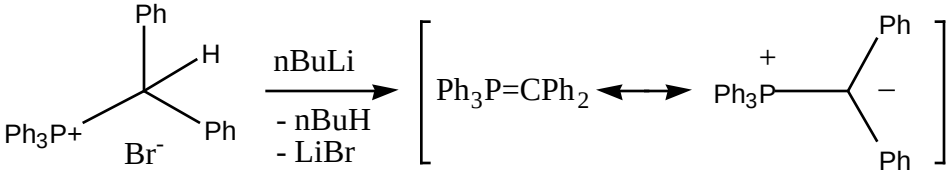


R = Me, Ph

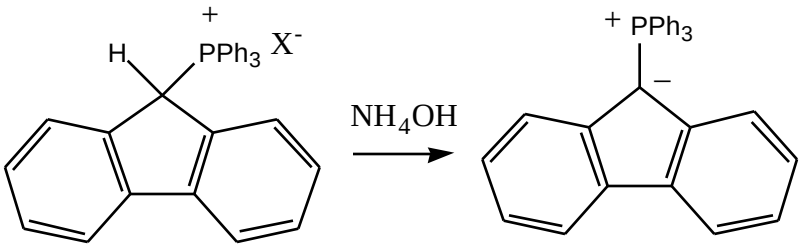
Michaelis, A.; Kohler, E. *Chem. Ber.* **1899**, 32, 1566
Ramirez, F.; Dershowitz, S. *J. Org. Chem.* **1957**, 22, 41



Staudinger, H.; Meyer, J. *Helv. Chim. Acta* **1919**, 2, 635



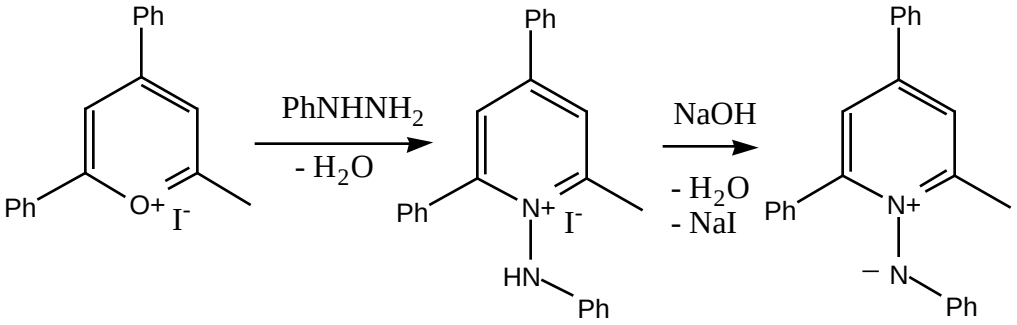
Coffmann, D.D.; Marvel, C.S. *J. Am. Chem. Soc.* **1929**, 51, 3496



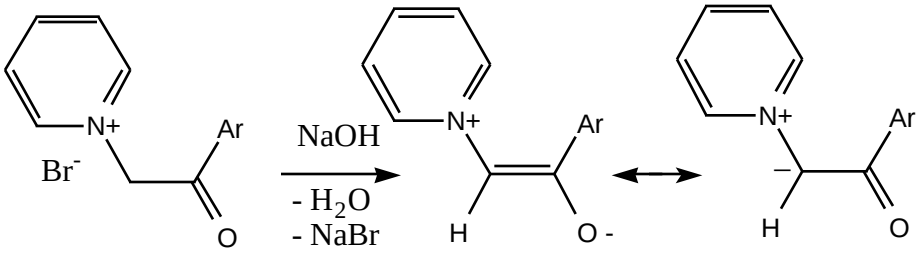
Pinck, L.A.; Hilbert, G.E. *J. Am. Chem. Soc.* **1947**, 69, 723

(iv) Pyridine ylides

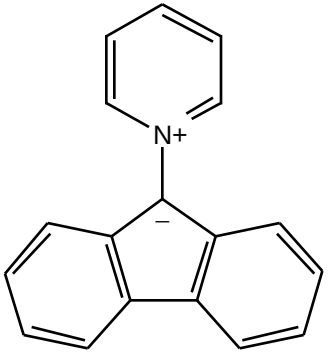
Reviews:
Zugravescu, I.; Petrovanu, M. *N-Ylid Chemistry*, (translated by C. Stoicescu) McGraw-Hill International Book Co.: New York, 1976
Platz, M.S.; White, W.R. III; Modarelli, D.A.; Celebi, S. *Res. Chem. Intermediates* **1994**, 20, 175



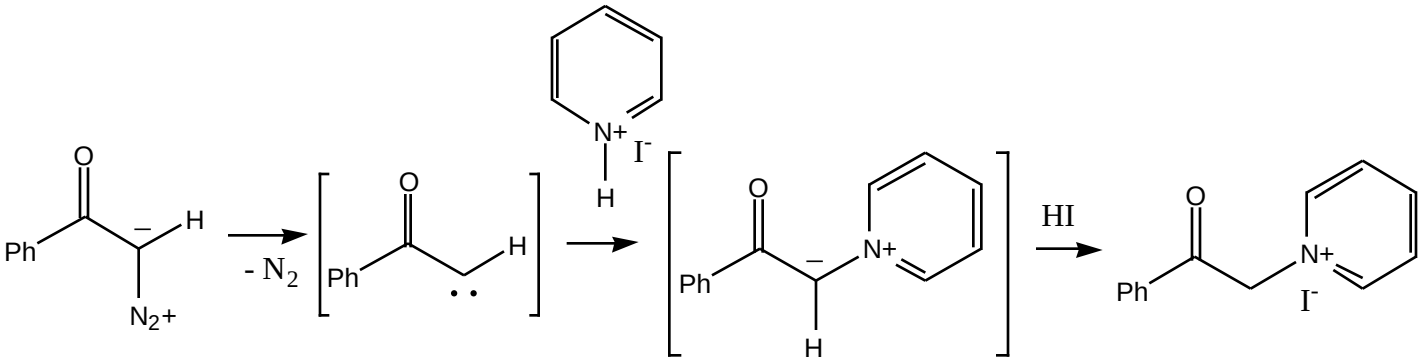
Scheider, W.; Seebach, F. *Chem. Ber.* **1921**, 54, 2285
Scheider, W. *Ann. Chem.* **1924**, 438, 115



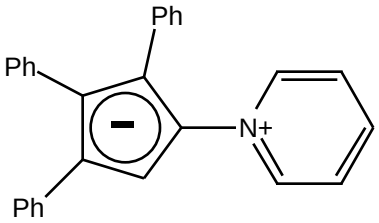
Krollpfeiffer, F.; Müller, A. *Chem. Ber.* **1933**, 66, 739
Krollpfeiffer, F.; Müller, A. *Chem. Ber.* **1935**, 68, 1169
Kröhnke, F. *Chem. Ber.* **1935**, 68, 1177
Kröhnke, F.; Heffe, W. *Chem. Ber.* **1967**, 70, 864
Kröhnke, F. *Angew. Chem.* **1953**, 65, 605



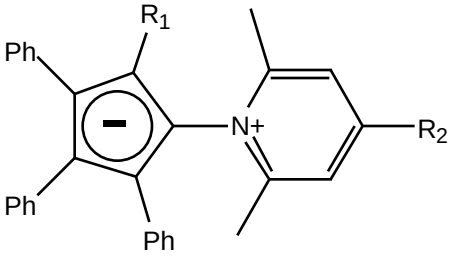
Pinck, L.A.; Hilbert, G.E. *J. Am. Chem. Soc.* **1946**, 68, 2011



King, L.C.; Miller, F.M. *J. Am. Chem. Soc.* **1948**, 70, 4154



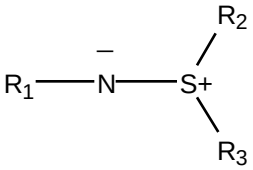
Lloyd, D.; Singer, M.I.C. *J. Chem. Soc. Sect. C* **1971**, 2941



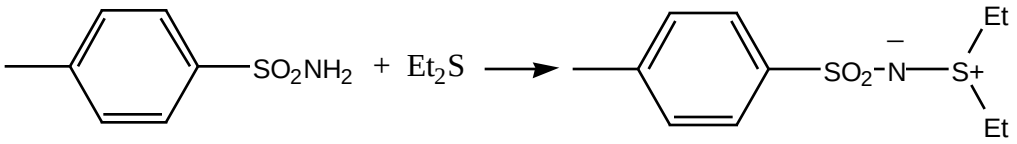
R_1 = H, Ph; R_2 = H, Me

Duerr, H.; Heu, B.; Ruge, B.; Scheppers, G. *Chem. Commun.* **1972**, 1257

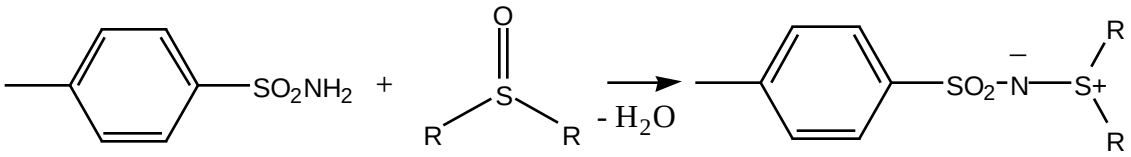
(v) Sulfimine ylides



Reviews:
None.

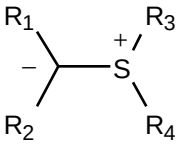


Mann, F.; Pope, W.J. *J. Chem. Soc.* **1922**, 121, 1052 (first sulfimine)



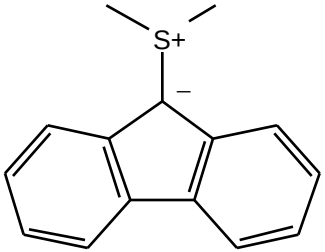
Tarbell, D.S.; Weaver, C. *J. Am. Chem. Soc.* **1941**, 63, 2939

(vi) Sulfonium ylides

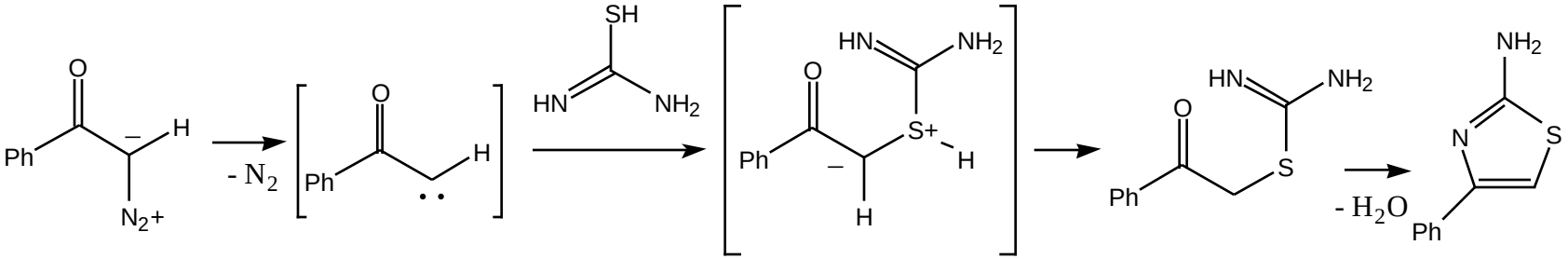


Reviews:
Trost, B.M.; Melvin, L.S. Jr. *Sulfur Ylides: emerging synthetic intermediates*, Academic Press: New York, 1975
Ando, W. *Acc. Chem. Res.* **1977**, 10, 179
Ando, W. in *The Chemistry of Diazonium and Diazo Groups*, (S. Patai, ed.) Wiley: New York, 1978, Chapter 9

Doyle, M.P. *Chem. Rev.* **1986**, 86, 919
Padwa, A.; Hornbuckle, S.F. *Chem. Rev.* **1991**, 91, 263
Padwa, A.; Weingarten, M.D. *Chem. Rev.* **1996**, 96, 223
Doyle, M.P. *Chem. Rev.* **1998**, 98, 911
Clark, J.S. (ed.) *Nitrogen, Oxygen, and Sulfur Ylide Chemistry*, Oxford University Press: Oxford, 2002



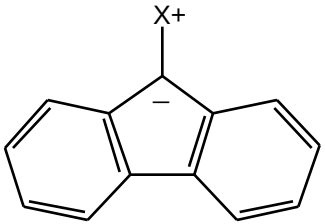
Ingold, C.K.; Jessop, J.A. *J. Chem. Soc.* **1930**, 713



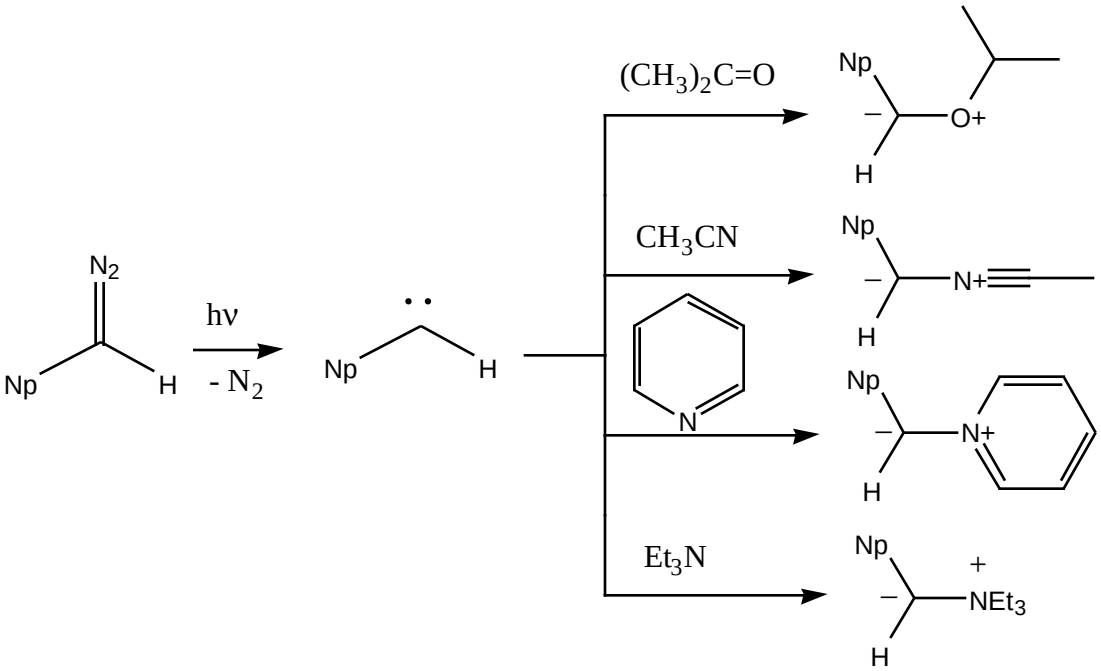
King, L.C.; Miller, F.M. *J. Am. Chem. Soc.* **1949**, 71, 367

(vii) Trapping of carbenes generated by flash photolysis

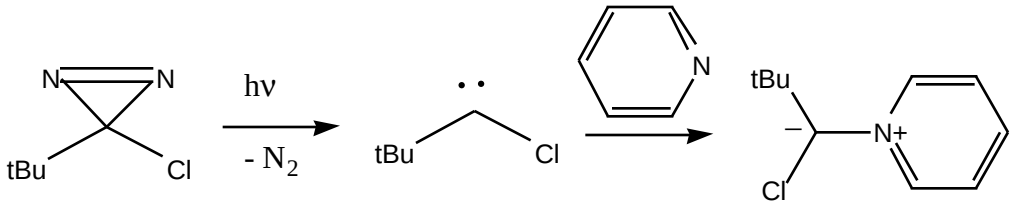
Reviews:
Jackson, J.E.; Platz, M.S. in *Adv. Carbene Chem.* (U. Brinker, ed.) JAI Press: Greenwich, CT, 1994, p. 89



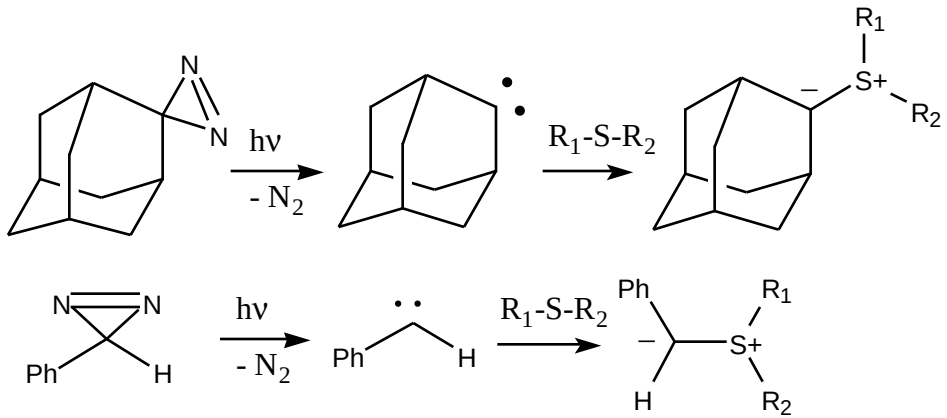
Griller, D.; Hadel, L.M.; Nazran, A.S.; Platz, M.S.; Wong, P.C.; Savino, T.G.; Scaiano, J.C. *J. Am. Chem. Soc.* **1984**, 106, 2227
(trapping of carbenes via ylide formation)



Barcus, R.L.; Hadel, L.M.; Johnston, L.J.; Platz, M.S.; Savino, T.G.; Scaiano, J.C. *J. Am. Chem. Soc.* **1986**, 108, 3928
(trapping of carbenes via ylide formation)

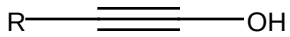


Jackson, J.E.; Soundarajan, N.; Platz, M.S.; Liu, M.T.H. *J. Am. Chem. Soc.* **1988**, 110, 5595



Romashin, Y.N.; Liu, M.T.H.; Hill, B.T.; Platz, M.S. *Tetrahedron Lett.* **2003**, 44, 6519

Ynols (hydroxyacetylenes)

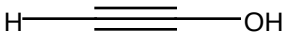


Reviews:

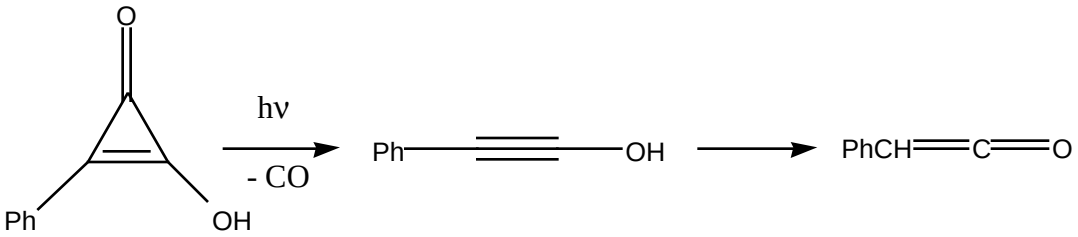
Kresge, A.J. *Acc. Chem. Res.* **1990**, 23, 43

Staudinger, H.; Klever, H.W. *Chem. Ber.* **1908**, 41, 594 (confirmation that ketene structure is not that of hydroxyacetylene)

Meinert, R.N.; Hurd, C.D. *J. Am. Chem. Soc.* **1930**, 52, 4540 (coining of names "ynol" and "keteno-ynol" isomerism akin to keto-enol isomerism)



von Baar, B.; Weiske, T.; Terlouw, J.K.; Schwarz, H. *Angew. Chem. Int. Ed.* **1986**, 25, 282
Hochstrasser, R.; Wirz, J. *Angew. Chem.* **1989**, 101, 183



Chiang, Y.; Kresge, A.J.; Hochstrasser, R.; Wirz, J. *J. Am. Chem. Soc.* **1989**, 111, 2355

Craig, D.; Regenass, F.A.; Fowler, R.B. *J. Org. Chem.* **1959**, 24, 240
Julia, M.; Descoins, C. *Bull. Soc. Chim. Fr.* **1962**, 1939
Eugster, C.H.; Kuser, P. *Chimia (Aarau)* **1964**, 18, 358
Baker, C.S.L.; Landor, P.D.; Landor, S.R.; Patel, A.N. *J. Chem. Soc.* **1965**, 4348

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