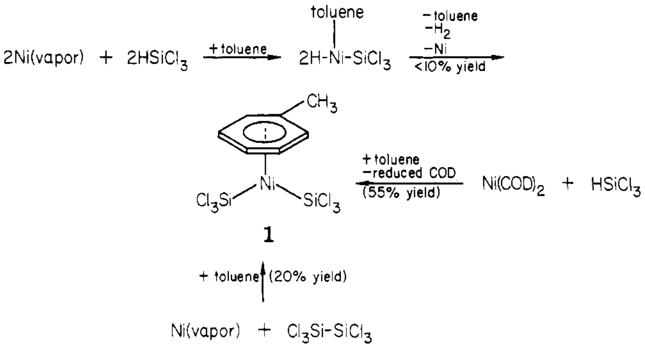
when C_6F_5 σ-bonding ligands were present, even though the π-arene could be varied at will, and (2) the π-arene lability is very high, probably higher than any other π-arene complex known.[4]

After considerable effort we have now found another σ-bonding ligand, $SiCl_3$, that imparts good thermal stability to the (π-arene)NiX_2 system. The impetus for using $SiCl_3$ as a σ-bonding ligand comes from the interesting work of Pomeroy and co-workers in (π-arene)Ru chemistry,[5] Lappert and co-workers on the reactivity of metal atoms and silanes,[6] and Uhlig and co-workers on the studies of Ni complexes with anionic ligands.[7] Of course, the method of introduction of the $SiCl_3$ groups into a Ni system was the most critical problem, and we report herein the first examples of oxidative addition of Si–H and Si–Si bonds to Ni atoms.[8] We also report that bis(1,5-cyclooctadiene)nickel(0), [Ni(COD)$_2$],[9] can be used for the preparation of π-arene complexes containing $SiCl_3$ ligands.

Codeposition of the vapors of Ni, toluene, and $HSiCl_3$ at −196 °C, followed by slow warming to room temperature, led to the production of H_2 and (π-toluene)Ni($SiCl_3$)$_2$ (1). In the absence of toluene as a stabilizing ligand (Ni vapor + $HSiCl_3$) hydrogen was produced but no stable complex was isolable. Preparation of a Ni atom–toluene matrix (toluene-solvated Ni atoms) followed by $HSiCl_3$ addition did not lead to 1, which suggests that Ni atoms first attack the Si–H bond. Stabilization of the initially formed Si–Ni–H species by toluene seems likely, and upon warming and meltdown, two such molecules could combine (or another $HSiCl_3$ molecule could react) to release H_2 and form the product.



A more direct route to 1 is by oxidative addition of Cl_3Si–$SiCl_3$ to Ni atoms in the presence of toluene. This reaction is more efficient and even small amounts of Cl_3Si–$SiCl_3$ are utilized well.

A third method to obtain 1 can be used, not employing Ni vapor, but Ni(COD)$_2$ instead. The success of this method is dependent on at least one COD ligand being converted to reduced and/or silylated derivatives. (About 50% of the COD is converted to cyclooctene during the reaction.) Furthermore, addition of COD to 1 causes the displacement of toluene, showing that 1 cannot exist in the presence of an excess of COD. Lastly, Ni(COD)$_2$ + Cl_3Si–$SiCl_3$ does not yield 1. Therefore, by ensuring that COD will be simultaneously destroyed during the reaction by adding adequate amounts of $HSiCl_3$, we can obtain convenient yields of 1 from Ni(COD)$_2$.

The ^1H NMR spectrum of 1 has absorptions at δ 2.7 (s, CH_3) and 6.7 (m, aromatic H), indicating a substantial upfield shift for the aromatic protons and a slight downfield shift for the CH_3 group. The toluene ligand is highly labile: addition of C_6D_6 to the NMR sample caused the immediate release of toluene (as detected by NMR). In addition, pure (η^6-benzene)Ni($SiCl_3$)$_2$ was synthesized by exhaustive arene displacement exchange.

Further studies of the exchange process, arene displacement reactions, and catalysis studies of 1 will be reported later.

Procedure. I. Nickel vapor (0.532 g, 9.06 mmol) was cocondensed with a mixture of 10 mL of Cl_3Si–$SiCl_3$ in 10 mL of toluene at −196 °C over a 1-h period.[9] The resulting dark red-brown matrix turned black with some gold areas on warming. The excess ligand was recovered by trap-to-trap distillation in vacuo. The residue was flushed with nitrogen and washed three times with 10-mL portions of toluene, and the washings were filtered under nitrogen through a medium porosity glass frit. The dark red filtrate was reduced to 5 mL in vacuo and 20 mL of purified, deoxygenated pentane was added to precipitate a yellow-orange powder (1). The solid was washed three times with 3.5-mL portions of pentane and dried under vacuum (17% yield based on Ni vaporized), mp 140 °C; the solubility of 1 is high in toluene and CH_2Cl_2 but low in CCl_4 and pentane; it has long term stability in the solid or dissolved state (slight decomposition of the solid in a 4-week period while under nitrogen at room temperature) and is moderately air sensitive. NMR (CCl_4): δ 2.70 (CH_3, s), 6.70 (C_6H_5, m).

Anal. Calcd for ($C_7H_8Cl_6NiSi_2$): C, 20.03; H, 1.92; Cl, 50.68; Si, 13.38. Found: C, 20.14; H, 2.03; Cl, 50.25; Si, 12.90.

II. Addition of a solution of 15 mL of $HSiCl_3$ in 20 mL of purified, deoxygenated toluene at −95 °C to a solution of 1 g of Ni(COD)$_2$ (3.6 mmol) in 80 mL of toluene at −95 °C under nitrogen resulted in no color change. The mixture was allowed to warm slowly, and at about −65 °C it started to turn red-brown. At −45 °C it was red-black. The mixture was filtered under nitrogen at room temperature, the filtrate was concentrated under vacuum, and pentane was added as in procedure I. The yield of pure 1 was 0.84 g (55% based on Ni(COD)$_2$).[11]

Registry No. 1, 80410-01-1; Ni(COD)$_2$, 1295-35-8; $Cl_3SiSiCl_3$, 13465-77-5; $HSiCl_3$, 10025-78-2; Ni, 7440-02-0.

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(4) For a review of π-arene complexes of the group 8 metals see: Gastinger, R. G.; Klabunde, K. J. *Transition Met. Chem. (Weinheim, Ger.)* **1979**, *4*, 1.

(5) Pomeroy, R. K.; Harrison, D. J. *J. Chem. Soc., Chem. Commun.* **1980**, 661.

(6) Cornish, A. J.; Lappert, M. F.; Macquitty, J. J.; Maskell, R. K. *J. Organomet. Chem.* **1979**, *177*, 153.

(7) Uhlig, V. E.; Hipler, B.; Müller, P. *Z. Anorg. Allg. Chem.* **1978**, *442*, 11.

(8) See: Klabunde, K. J. "Chemistry of Free Atoms and Particles"; Academic Press: New York, 1980, p 86 for a discussion of oxidative addition of group 8 metal atoms.

(9) Jolly, P. W.; Wilke, G. "The Organic Chemistry of Nickel"; Academic Press: New York, 1974; Vol. 1, p 257.

(10) Klabunde, K. J.; Timms, P. L.; Skell, P. S.; Ittel, S. D. *Inorg. Synth.* **1979**, *19*, 59.

(11) We thank Dr. Thomas Murdock for a pure sample of Ni(COD)$_2$.

Reactivity of Bridged Dinuclear Transition-Metal Complexes of the Type $Me_2Si[C_5H_4Fe(CO)(L)I]_2$, L = PPh_3 and $P(OPh)_3$. Synthesis and Characterization of the Mixed Iodo-Alkyl Complex $Me_2Si[C_5H_4Fe(CO)(PPh_3)(\eta^1\text{-butyl})]$–$[C_5H_4Fe(CO)(PPh_3)I]$

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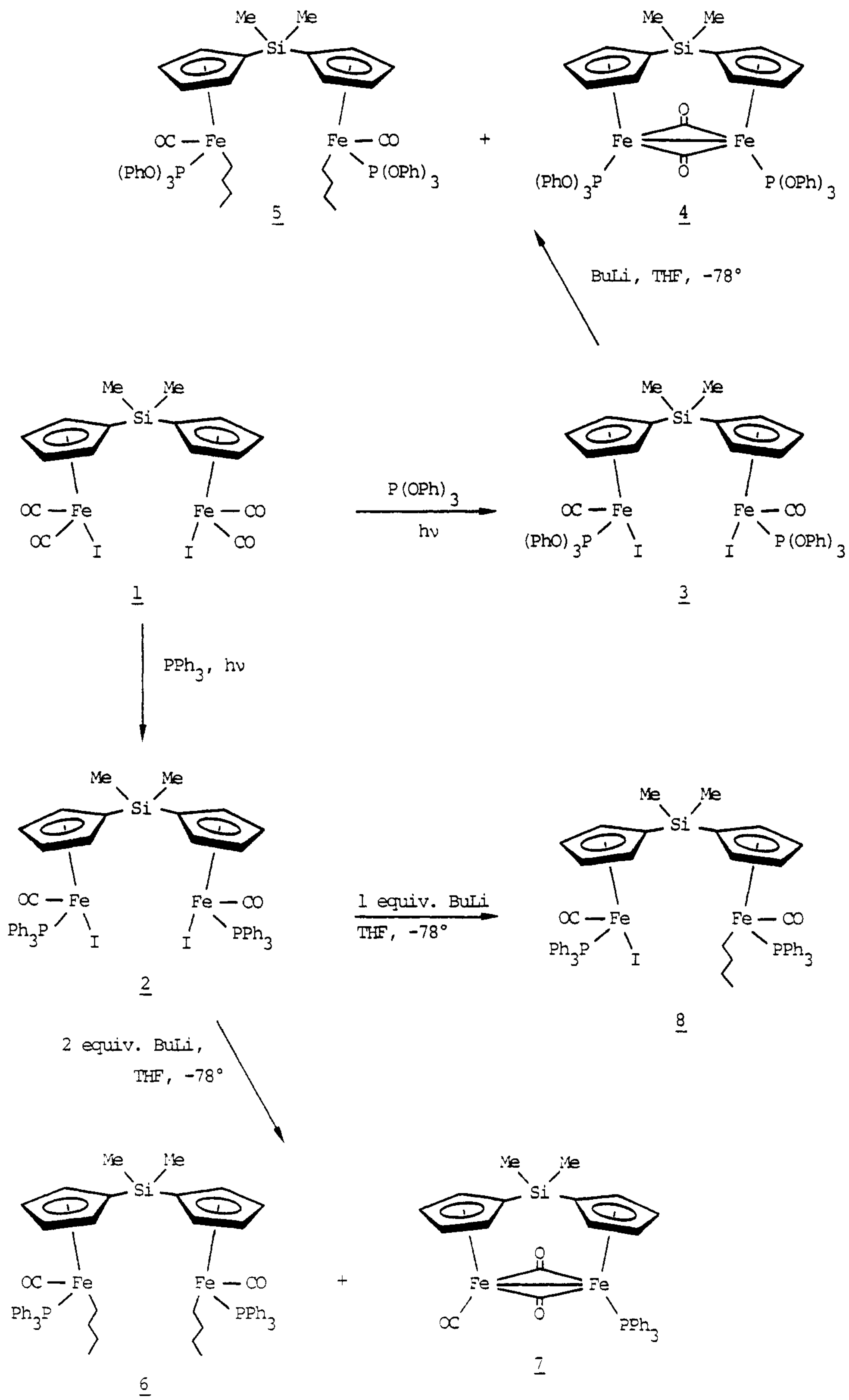
Summary: Dinuclear diiron transition-metal complexes of the type $Me_2Si[C_5H_4Fe(CO)(L)I]_2$, L = Ph_3P and $(PhO)_3P$, have been synthesized and characterized. Alkylation of



these compounds with 2 equiv of n-BuLi produces a variety of products including the di-n-butyl complexes $Me_2Si[C_5H_4Fe(CO)(L)(\eta^1\text{-}C_4H_9)]_2$, L = Ph_3P and $(PhO)_3P$ and the Fe–Fe bonded compounds $Me_2Si[C_5H_4Fe(CO)[P(OPh)_3]]_2$ and $Me_2Si[C_5H_4Fe(CO)_2][C_5H_4Fe(CO)(PPh_3)]$. Treatment of the Ph_3P-substituted diiodide with 1 equiv of n-BuLi results in isolation of the mixed iodo–alkyl complex $Me_2Si[C_5H_4Fe(CO)(PPh_3)I][C_5H_4Fe(CO)(PPh_3)(\eta^1\text{-}C_4H_9)]$.

We are actively involved in a program which is looking at the possibility of interaction between organic groups attached to metal centers linked through noninteractive ligands. Our initial work has been concerned with derivatives of the dimethylsilyl-bridged complex $Me_2Si[C_5H_4Fe(CO)_2]_2$.[1,2] We describe here the synthesis and

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[1] Weaver, J.; Woodward, P. *J. Chem. Soc., Dalton Trans.* **1973**, 1439. Wegner, P. A.; Uski, V. A.; Kiester, R. P.; Dabestani, S.; Day, V. W. *J. Am. Chem. Soc.* **1977**, *99*, 4846–4848.

[2] Nelson, G. O.; Wright, M. E. *J. Organomet. Chem.* **1981**, *206*, C21–23.

characterization of the substituted diiodides $Me_2Si[C_5H_4Fe(CO)(L)I]_2$ ($L = PPh_3$, **2**; $L = P(OPh)_3$, **3**) and their reactivity under various conditions. Most significantly we report here a difference in the alkylation of **3** as compared to it's mononuclear analogue and the ability to monoalkylate **2** producing the mixed iodo–alkyl complex **8**.

Complexes **2** and **3** are readily available through photolytic displacement of carbonyl in $Me_2Si[C_5H_4Fe(CO)_2I]_2$ (**1**)[3,4] by the appropriate ligand. For instance, photolysis of a brown solution of **1** (1.0 g, 1.5 mmol) and triphenylphosphine (PPh_3) (1.2 g, 4.4 mmol) in benzene (50 mL) with a 450-W mercury lamp (Pyrex filter) for 2 h results in formation of a deep green solution from which $Me_2Si[C_5H_4Fe(CO)(PPh_3)I]_2$ (**2**) can be isolated in a 90% yield.[5] By employing the analogous photolytic conditions with $(PhO)_3P$, the bis(triphenyl phosphite) derivative $Me_2Si[C_5H_4Fe(CO)[P(OPh)_3]I]_2$ (**3**) is obtained as a golden brown oil in a 90% yield.[6]

Complexes **2** and **3** exhibit different chemistry in their reactions with lithium anions such as *n*-butyllithium (*n*-BuLi).[7] For instance, when a solution of **3** (0.50 g, 0.4 mmol) in THF (10 mL) is allowed to react with 2.5 equiv of η-BuLi (2.4 M in hexane) at −78 °C, a green solution results from which $Me_2Si[C_5H_4Fe(CO)[P(OPh)_3]]_2$ (**4**) and $Me_2Si[C_5H_4Fe(CO)[P(OPh)_3](\eta^1-C_4H_9)]_2$ (**5**) can be isolated in 60% and ca. 10% yields, respectively. Complex **5** is obtained as a gold oil showing ^1H NMR signals in $CDCl_3$ at δ 7.22 (m, 30, OPh), 4.27 (s, 2, C_5H_4), 4.20 (s, 2, C_5H_4), 3.93 (s, 2, C_5H_4), 3.29 (s, 2, C_5H_4), 1.5–0.8 (m, 18, $CH_2CH_2CH_2CH_3$), and 0.41, 0.32, 0.22 (s, s, s, 6, $SiCH_3$).[8] The unique disubstituted iron complex **4**[9] has been fully characterized and must arise by reduction of the diiodo complex, a reaction that is not unexpected in these systems.[7] The bis(triphenylphosphine) complex **2**, on the other hand, alkylates quite nicely under the same conditions to produce a 60% yield of $Me_2Si[C_5H_4Fe(CO)(PPh_3)(\eta^1-C_4H_9)]_2$ (**6**).[16] Column chromatography of the crude material from this latter reaction (alumina (III), hexane/benzene, v/v, 4/1) results in the formation of a relatively rapidly moving red-orange band which corresponds to **6** and a slower moving green band which was identified as a Fe–Fe bonded product $Me_2Si[C_5H_4Fe(CO)_2][C_5H_4Fe(CO)(PPh_3)]$ (**7**),[10] indicating the lack of formation of the bis(triphenylphosphine)-substituted complex analogous to **4**. Complex **6** is a red oil which shows ^1H NMR signals in $CDCl_3$ at δ 7.2–7.5 (m, 30, Ph), 4.50 (b s, 2, C_5H_4), 4.27 (b s, 2, C_5H_4), 4.12 (b s, 2, C_5H_4), 3.98 (b s, 2, C_5H_4), 0.95–1.4 (m, 12, $CH_2CH_2CH_2CH_3$), and 0.6–0.75 (m, 12, $CH_2CH_2CH_2CH_3$, $SiCH_3$).[11] In addition, careful treatment of **2** with 1 equiv of η-BuLi at −78 °C gives a 30% isolated yield of the unsymmetrical iodo–alkyl complex $Me_2Si[C_5H_4Fe(CO)(PPh_3)I][C_5H_4Fe(CO)(PPh_3)(\eta^1-C_4H_9)]$ (**8**).[12] This complex displays ^1H NMR signals in $CDCl_3$ at δ 7.1–7.8 (m, 30, Ph), 5.52 (b s, 1, C_5H_4), 4.62 (b s, 1, C_5H_4), 4.49 (b s, 1, C_5H_4), 4.30 (b s, 1, C_5H_4), 4.13 (b s, 1, C_5H_4), 3.99 (b s, 2, C_5H_4), 3.79 (b s, 2, C_5H_4), 0.65–1.25 (m, 9, η-butyl), and 0.55–0.65 (m, 6, $SiCH_3$).

The fact that **4** is formed in the reaction of **3** with BuLi whereas **7** is isolated from the same reaction with **2** suggests that steric hinderance probably plays an important role in the formation of mono- and disubstituted analogues of these Fe–Fe bonded complexes. In the reaction of **3** with BuLi the disubstituted complex **4** is isolable and is the major product. Perhaps when **2** is reacted with BuLi the $[Ph_3P]_2$ complex is initially formed but rapidly disproportionates to **7**. These results could be related to a mechanistic study by Gray,[13] who has shown that PPh_3 and $P(O\text{-}i\text{-}Pr)_3$ only monosubstitute when photolytically reacted with $[CpFe(CO)_2]_2$ to give $Cp_2Fe_2(CO)_3PPh_3$ and $Cp_2Fe_2(CO)_3P(O\text{-}i\text{-}Pr)_3$, respectively, whereas $P(OMe)_3$ disubstitutes to give $Cp_2Fe_2(CO)_2[P(OMe)_3]_2$. In the dinuclear mechanism suggested by Gray's data, steric hinderance could prevent disubstitution of the complex if the ligand is too bulky. We believe that such steric interaction could cause the $[Ph_3P]_2$ complex if formed to be unstable in our system. We should point out that the bis(triphenyl phosphite) complex **4** itself is relativley labile[14] and decomposes upon slight heating or extended exposure to air. Since $P(OPh)_3$ has a cone angle only slightly smaller than $P(O\text{-}i\text{-}Pr)_3$, this lability could again be due to steric strain in the molecule. Finally, the fact that **4** is the major product of the reaction mixture might indicate its relative ease of formation as compared to the more sterically hindered disubstituted $[Ph_3P]_2$ complex.[15]

In summary, this synthetic study reveals at least one important parallel of the chemistry between the mononuclear and bridged dinuclear iron complexes, e.g., the result that **2** can be alkylated with *n*-BuLi. However, there are also significant differences in reactivity. For instance, reaction of **3** with *n*-BuLi at −78 °C gave the Fe–Fe bonded compound **4** as the major product and only minor amounts of alkylation.[18] This is in contrast to the mononuclear

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(3) Synthesis of this compound has been reported by Wegner: Wegner, P. A.; Kiester, R. P.; Speckman, D.; Sterling, G., Pacific Conference on Chemistry and Spectroscopy, Anaheim, CA, Oct 1977.

(4) We have completed an X-ray structural analysis of **1** and the related complex $[CpFe(CO)I]_2(PhO)_2PC_2H_4P(OPh)_2$. Details will be published shortly: Nelson, G. O.; Wright, M. E., in preparation.

(5) Anal. Calcd for $C_{50}H_{44}Fe_2I_2O_2P_2Si$: C, 53.13; H, 3.92; I, 22.45. Found: C, 52.97; H, 3.97; I, 22.39. IR for **2** (CH_2Cl_2): 1952 cm^{-1}. Complex **2** is isolated as a pair of separable diastereomers. The diastereomeric mixture can be obtained in analytically pure form by simply washing the crude reaction solid (benzene evaporated in vacuo) with acetonitrile to remove excess ligand. ^1H NMR ($CDCl_3$, one diastereomer): δ 7.39 (m, 30, Ph), 5.61 (m, 2, C_5H_4), 4.61 (m, 2, C_5H_4), 4.0 (s, 2, C_5H_4), 3.73 (m, 2, C_5H_4), 0.93 (s, 6, $SiCH_3$). Further details will be reported later.

(6) Anal. Calcd for $C_{50}H_{44}Fe_2I_2O_8P_2Si$: C, 48.89; H, 3.61; I, 20.66. Found: C, 49.01; H, 3.65; I, 20.53. IR for **3** (CH_2Cl_2): 1981 cm^{-1}. The mixture of diastereomers in $CDCl_3$ show ^1H NMR signals at δ 7.36 (m, 30, Ph), 5.04, 5.00 (s, s, 2, C_5H_4), 4.35 (s, 2, C_5H_4), 3.98 (s, 2, C_5H_4), 3.14, 3.12 (s, s, 2, C_5H_4), and 0.64, 0.62, 0.58 (s, s, s, 6, $SiCH_3$). This complex is obtained in analytically pure form by chromatography on silica gel (benzene) in the absence of air.

(7) The reaction of **1** with BuLi gives almost entirely the Fe–Fe bonded product $Me_2Si[C_5H_4Fe(CO)_2]_2$.

(8) Anal. Calcd for $C_{58}H_{62}Fe_2O_8P_2Si$: C, 63.98; H, 5.74. Found: C, 63.79; H, 5.83. IR for **5** (CH_2Cl_2): 1936 cm^{-1}. It should be noted that all reactions with BuLi were done with mixtures of the diastereomeric diiodides and thus diastereomeric products were formed. The question of whether each diastereomer (diiodide) behaves differently under these conditions has not yet been addressed.

(9) ^1H NMR for **4** ($CDCl_3$): δ 7.0–7.5 (m, 30, Ph's), 4.53 (b s, 4, C_5H_4), 4.45 (b s, 4, C_5H_4), 0.34 (s, 6, $SiCH_3$). IR (CH_2Cl_2): 1722 cm^{-1}. Anal. Calcd for $C_{50}H_{44}Fe_2O_8P_2Si$: C, 61.62; H, 4.55. Found: C, 61.52; H, 4.59.

(10) This compound has already been synthesized by Wegner through another route.[3] We obtained analytically pure samples with comparable IR and NMR data.

(11) Anal. Calcd for $C_{58}H_{62}Fe_2O_2P_2Si$: C, 70.31; H, 6.31. Found: C, 70.45; H, 6.28. IR for **6** (CH_2Cl_2): 1903 cm^{-1}.

(12) Anal. Calcd for $C_{54}H_{53}Fe_2IO_2P_2Si$: C, 61.15; H, 5.04; I, 11.96. Found: C, 61.26; H, 5.07; I, 11.83. IR for **8** (CH_2Cl_2): 1952 and 1903 cm^{-1}.

(13) Tyler, D. R.; Schmidt, M. A.; Gray, H. B. *J. Am. Chem. Soc.* **1979**, *101*, 2753–2755.

(14) Other related Fe–Fe bonded complexes such as $[CpFe(CO)]_2(PhO)_2PC_2H_4P(OPh)_2$[4] are extremely stable in comparison with compound **4**.

(15) However, one reviewer has correctly pointed out that the formation of Fe–Fe bonded products probably arises via an electron-transfer mechanism, and the appearance of less of this product in the reaction of **2** with BuLi could be related to the poorer ability of the Ph_3P-substituted metal center to stabilize extra electron density.

(16) It is noteworthy that thermal decomposition of **6** results in isolation of the dihydride $Me_3Si[C_5H_4Fe(CO)\ (PPh_3)H]_2$. An ^1H NMR of this complex (benzene-d_6) shows the characteristic hydride signal as a doublet ($J_{P-H} = 75$ Hz) at δ −12.82. Attempts to produce a mixed hydride–iodo system from **8** are currently under investigation.

(17) Reger, D. L.; Culbertson, E. C. *J. Am. Chem. Soc.* **1976**, *98*, 2789–2794.

complex where only the *n*-butyl-substituted complex has been isolated in the alkylation reaction.[20] Finally, the ability to monoalkylate 2 to produce the mixed iodo–alkyl complex 8 opens the pathway to investigate the interactions of different types of reactive groups attached to these dinuclear compounds. Further studies directed toward exploring the reactivity of complexes 2 and 3 and their derivatives are subjects of a continuing investigation.

Acknowledgment. We gratefully acknowledge partial support of this research by the Research Corp., the Camille and Henry Dreyfus Foundation, and the donors of Petroleum Research Fund, administered by the American Chemical Society. Our thanks also goes to funds obtained from NSF (Grant CHE - 8102918). We also would like to thank M. Donohue for technical assistance.

Registry No. **1**, 80399-47-9; **2**, 80409-36-5; **3**, 80409-37-6; **4**, 80409-38-7; **5**, 80399-48-0; **6**, 80399-49-1; **7**, 80409-39-8; **8**, 80399-50-4; PPh_3, 603-35-0; $(PhO)_3P$, 101-02-0; $Me_2Si[C_5H_4Fe(CO)(PPh_3)H]_2$, 80399-51-5.

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(18) Other differences are currently being studied. For instance, preliminary results indicate that the reaction of 8 with $AgBF_4$ in the presence of olefin does not give an alkyl–olefin complex as would be expected.[19] A full account will be reported later.

(19) Reger, D. L.; Coleman, C. J.; McElligott, P. J. *J. Organomet. Chem.* **1979**, *171*, 73–84.

(20) Reger, D. L.; Coleman, C. J. *Inorg. Chem.* **1979**, *18*, 3155–3160.

(21) Camille and Henry Dreyfus Award for Newly Appointed Faculty, 1980.

Book Reviews

Gmelin Handbook of Inorganic Chemistry, 8th Edition, Au, Organogold Compounds. H. Schmidbaur, volume author, A. Slawisch, volume editor. Gmelin Institut für Anorganische Chemie der Max-Planck-Gesellschaft zur Förderung der Wissenschaften and Springer-Verlag, Berlin/Heidelberg/New York. 1980. vi + 351 pages. DM 789. $465.60.

We have in this new Gmelin volume a comprehensive treatment of organogold chemistry: 296 pages of text packed with everything that is known about gold compounds in which there is a gold–carbon bonding interaction. The compounds which the reader will encounter range in stability from the elusive matrix-isolated gold carbonyls to the very stable phosphorus ylide complexes of gold. Although organogold chemistry, until recent years, has not been investigated by many research groups at any one time, the accumulated results, dating back to the preparation of the first organogold compound in 1907 by Pope and Gibson, are impressive indeed: the empirical formula index for this volume requires 19 pages, with 50–60 compounds listed per page!

The organization of the material in this book follows the rules which have been established for the Gmelin volumes on organometallic compounds. The book begins with a discussion of mononuclear organogold compounds and continues with dinuclear compounds (regardless of how the two gold atoms in the molecule are connected) and then with compounds of higher gold nuclearity, to the last chapter, which covers polymeric organogold compounds. Within each of these chapters the compounds are presented first of all according to organic ligand hapticity, then according to organic ligand type and number and gold oxidation state (I or III). Included among the organic ligands bonded via one C atom are alkyl, aryl, alkenyl, and carbene groups; among those of higher hapticity are olefins and polyolefins, acetylenes, carboranyl groups, and chelating alkylene and dienyl groups. Of special interest are the gold compounds with trialkylphosphonium methylide and dialkylphosphonium bismethylide ligands which were discovered and studied with great vigor by the author of this book and the intriguing salts of 1,1-bis(triorganophosphinegold(I))-substituted olefins, arenes, ferrocenes, and cymantrenes discovered by Nesmeyanov, Perevalova, and their co-workers, who have contributed so much to other aspects of modern organogold chemistry.

The coverage of organogold chemistry in this book is as exhaustive as "Chemical Abstracts" allows, with references to original research papers, theses, and conference reports and to the review literature through the end of 1979. All known details about the compounds covered are provided in text and tables: preparation, physical, and spectroscopic properties, theoretical studies, chemical studies, and applications.

As mentioned, a formula index is provided. There also is a ligand formula index, and the long and very detailed table of contents will quickly guide the reader to the section he wants.

This book is one of the new-style "Gmelins" in that it is written in English. It is a welcome addition to the Gmelin Handbook series on organometallic chemistry, and it will be the definitive treatment of the organic compounds of gold for some years to come.

Dietmar Seyferth, *Massachusetts Institute of Technology.*

The Chemistry of Catalytic Hydrocarbon Conversions. Edited by H. Pines. Academic Press, New York. 1981. xiii + 305 pages. $35.00

The first chapter of this eight-chapter book describes "Acid-Catalyzed Reactions", including a discussion of zeolite-catalyzed cracking, and comprises more than 40% of the entire treatise. In considering nomenclature a better case than the author admits to can be made for the use of the term "carbenium ion" to describe the carbocations, R_3C^+ (R may be hydrogen, alkyl, or aryl). Enium and onium are generic terms. Carbenium ion thus refers to an enium ion having a positively charged carbon atom possessing six valence electrons. Carbonium logically refers to an ion having a charged carbon with a coordination number greater than three. Other chapters in the book are, in order: Base-Catalyzed Reactions: Heterogeneous Hydrogenation; Dehydrogenation and Cyclodehydrogenation (Aromatization); Oxidation; Homogeneous Catalysis by Transition Metal Organometallic Compounds; Metathesis of Unsaturated Hydrocarbons; and Synthesis of Liquid Hydrocarbons (Synthetic Fuels). The first, second, and fourth chapters describe work to which the author has made substantial contributions; these contain many fascinating nuggets of information. The last three chapters are rather cursory treatments of important current topics that are discussed in more complete and sophisticated detail in other books and reviews.

It is difficult to determine exactly what kind of audience this book is intended for and the preface provides little guidance. However, students with a good undergraduate course in organic chemistry should have no trouble understanding most of it. It is disappointing not to find in a book dealing with catalysis clear definitions of terms such as selectivity and turnover number.

As the author points out, the chemistry of catalytic hydrocarbon conversions is of enormous practical importance to all industrialized nations and is at the core of the petroleum and associated industries. The preeminence of the United States in this field during the period 1945–1960 was due in no small measure to a small group of talented chemists and chemical engineers. It would have been a treat if the history of this exciting achievement could have been worked into this book by one of the major contributors to this effort.

Milton Orchin, *University of Cincinnati.*