## Ferrocene Derivatives

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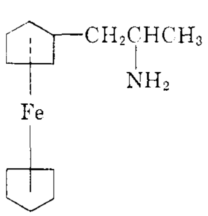
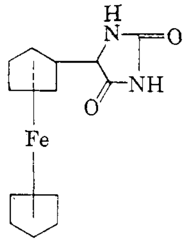
As part of an investigation dealing with the preparation of ferrocene analogues of pharmacologically active substances, we have prepared ferrocene derivatives related to amphetamine and diphenylhydantoin.

The amphetamine analogue was prepared by condensation of ferrocenecarboxyaldehyde[1] with nitroethane, followed by reduction of the crude condensation product with lithium aluminum hydride to give 2-aminopropylferrocene (I). The intermediate nitroolefin was very heat-sensitive, being thereby converted to a tar.



I



II

Ferrocenecarboxyaldehyde was converted to 5-ferrocenylhydantoin (II) on heating with ammonium carbonate and potassium cyanide under pressure. Attempts to convert benzoylferrocene[2] to the corresponding hydantoin (as a more exact analogue of diphenylhydantoin) under the same conditions were unsuccessful.

Compound I showed very weak anorexic and central nervous system stimulant activity; compound II showed virtually no central nervous system depressant activity in mice.

### EXPERIMENTAL

*2-Amino-1-ferrocenylpropane hydrobromide* (I). A solution containing 10.2 g. (0.05 mole) of ferrocenecarboxaldehyde, 11.25 g. (0.15 mole) of nitroethane, and 7 g. of ammonium acetate in 50 ml. of acetic acid was refluxed for 2 hr. The solution was then diluted with ice water and extracted with ether. The ethereal extract was dried and concentrated to give 10.7 g. (79%) of 1-ferrocenyl-2-nitropropene as a dark purple oil. An ethereal solution of 6.8 g. (0.025 mole) of 1-ferrocenyl-2-nitropropene was added to a suspension of 6 g. of lithium aluminum hydride in ether. The resulting yellow mixture was refluxed for 5 hr. and then treated with 30 ml. of water. The suspension was filtered and the filtrate was concentrated to give a dark oil which crystallized to a semisolid on standing. Attempts to purify the free base by recrystallization were unsuccessful. The hydrobromide salt was prepared and recrystallized from methanol–ethyl acetate–ether, m.p. 198–200° dec.

*Anal.* Calcd. for $C_{13}H_{18}NBrFe$: C, 48.18; H, 5.60. Found: C, 48.21, 48.22; H, 5.78, 6.00.

*5-Ferrocenylhydantoin* (II). A mixture of 4.28 g. (0.02 mole) of ferrocenylcarboxaldehyde[1], 2.09 g. (0.03 mole) of potassium cyanide, and 5.76 g. (0.06 mole) of ammonium carbonate in 50% ethanol was heated at 110° for 20 hr. in a pressure bottle. At the end of this period more cyanide (0.03 mole) and carbonate (0.06 mole) were added and heating continued for 48 hr. A dark yellow solid separated and was filtered. Recrystallization from ethanol yielded 3.3 g. (58%) of 5-ferrocenylhydantoin, m.p. 250–252°.

*Anal.* Calcd. for $C_{13}H_{12}N_2O_2Fe$: C, 54.96; H, 4.26; N, 9.85. Found: C, 54.60, 54.68; H, 4.69, 4.68; N, 9.81.

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[1] G. D. Broadhead, J. M. Osgerby, and P. L. Pauson, *J. Chem. Soc.*, 650 (1958).

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## Debrominations with Trialkyl Phosphites

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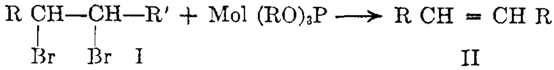
The reaction of vicinal dihalides with trialkyl phosphites has been reported to proceed *via* the normal Arbuzov Reaction to yield the corresponding mono- and diphosphonates.[1,2a,b] The formation of an olefin, as the major product, has been reported only in cases involving polyhalogenated compounds.[3,4]

We have found that a vicinal dihalide, where one or both of the halogens is contiguous to a carbonyl function, is converted smoothly and in good yield, with *one* mole equivalent of trialkyl phosphite, to the olefin.



$$\underset{\text{Br}}{\text{R CH}}\text{—}\underset{\text{Br}}{\text{CH}}\text{—R}' + \text{Mol }(\text{RO})_3\text{P} \longrightarrow \text{R CH} = \text{CH R}'$$

I II

a. $R = R' = C_6H_5CO$
b. $R = C_6H_5$; $R' = C_6H_5CO$ (1)
c. $R = C_6H_5$; $R' = CO_2H$

Attempts at debromination in the usual manner led to: a) reduction of the double bond when zinc was employed; b) tars when sodium iodide was used.

With two or more moles of trialkyl phosphite, the diphosphonate III is formed

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