$tyr_{1.1}glu_{1.1}his_{0.8}phe_{1.0}arg_{0.9}gly_{1.0}\epsilon\text{-}tosyls_{1.0}$. Met, val and pro present but not determined.

The final product and a number of intermediates were assayed for melanocyte expanding ability,[13,14] with the following results which are expressed in MSH units per gram: his.phe.arg.try.gly 1.5 × 10^4; his.phe.arg.try.gly.-ε-toslys.-pro.val. amide 0.5 × 10^6; cbzoser.tyr.ser.met.-gluta.his.phe.arg.try.gly.-ε-toslys.pro.val. amide 0.8 × 10^8.

From these results it is apparent that our blocked tridecapeptideamide possesses essentially the same MSH activity as the corticotropins, and that it is one per cent. as active as α-MSH.

(13) K. Shizume, A. B. Lerner and T. B. Fitzpatrick, *Endocrinol.*, **54**, 553 (1954).

(14) We wish to express our gratitude to Drs. A. B. Lerner and M. R. Wright of the Department of Medicine, Yale University School of Medicine, for these assays.

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RECEIVED OCTOBER 10, 1958

REACTION OF BIS-CYCLOPENTADIENYLCOBALT(II) WITH ORGANIC HALIDES

Sir:

Wilkinson[1] has reported that bis-cyclopentadienylcobalt(II) reacts with ethyl bromide to form bis-cyclopentadienylcobalt(III) bromide. We have observed that with certain halogenated hydrocarbons, new covalent cyclopentadienylcobalt compounds are formed as well as the bis-cyclopentadienylcobalt(III) halides. The formation of these new compounds may involve a rearrangement from π bonded cyclopentadienyl rings to σ bonded rings.

We wish to report some preliminary work on the reaction of bis-cyclopentadienylcobalt(II) with carbon tetrachloride.

On the addition of bis-cyclopentadienylcobalt(II) to carbon tetrachloride in an inert atmosphere, bis-cyclopentadienylcobalt(III) chloride precipitates leaving a cyclopentadienylcobalt compound in solution. Removal of the carbon tetrachloride by vacuum distillation leaves a residue which after sublimation and fractional crystallization from hexane has the composition $(C_5H_5)_2CoCCl_3$. Calcd. for $(C_5H_5)_2CoCCl_3$: C, 42.96; H, 3.28; Co, 19.17; Cl, 34.59. Found: C, 42.94; H, 3.46; Co, 19.34; Cl, 33.04. Molecular weight calcd.: 307.5. Found: 315. The yields of the trichloromethyl compound and the *bis*-cyclopentadienylcobalt(III) chloride are 90% and 100%, respectively, based on the equation

$$2(C_5H_5)_2Co + CCl_4 \longrightarrow (C_5H_5)_2CoCCl_3 + (C_5H_5)_2CoCl$$

The trichloromethyl compound, m.p. 79–80°, is orange to red depending on crystal size, decomposes over a period of hours above 40°, and is soluble in organic solvents and insoluble in water. In ethanol–water solutions it reacts slowly to form the bis-cyclopentadienylcobalt(III) cation in greater than 70% yield.

The infrared spectrum of the trichloromethyl compound shows two C–H stretching frequencies, at 3.25 μ and 3.45 μ. Similar frequencies are observed in compounds containing a cyclopentadienyl ring σ bonded to a metal.[2] Cyclopentadienyl rings that are π bonded are known to have only one C–H stretching frequency, in the region 3.20–3.25 μ.[3] The weak absorption at 6.2 μ characteristic of σ bonded cyclopentadienyl rings is also present.

The infrared spectrum indicates that at least one ring in the trichloromethyl compound is σ bonded to the cobalt. In this case, the formation of the compound involves a rearrangement from π to σ bonding. Other indications for σ bonding are that the compound reacts with maleic anhydride in warm benzene and also reacts with ferrous chloride in tetrahydrofuran to form small amounts (about one per cent. yield) of bis-cyclopentadienyliron(II). The other products of these reactions were not identified. Piper and Wilkinson[2] have shown that these two reactions can be used as qualitative tests for a σ bonded cyclopentadienyl group.

Assuming σ bonding for one ring, the reaction with ethanol-water involves a second rearrangement, from σ bonding back to π bonding. Herwig and Zeiss[4] have postulated a similar rearrangement involving $(C_6H_5)_3Cr$. The possibility that the trichloromethyl group is bonded to one of the rings has been considered but discarded as incompatible with this reaction.

Another possible explanation is the formation of a σ bond between the trichloromethyl group and the cobalt, the rings retaining their π character, but sufficiently distorted by the large σ bonded group to account for the infrared spectrum and the chemical reactivity. This would eliminate the necessity for π to σ and σ to π rearrangements.

Further work is at present being carried out to establish the structure and bonding in this compound and in the products of similar reactions with other organic halides. A detailed account of this work will be published in the near future.

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(2) T. S. Piper and G. Wilkinson, *ibid.*, **3**, 104 (1956).

(3) T. S. Piper, F. A. Cotton and G. Wilkinson, *ibid.*, **1**, 165 (1955).

(4) W. Herwig and H. H. Zeiss, THIS JOURNAL, **79**, 6561 (1957).

CONTRIBUTION NO. 672 FROM THE INSTITUTE FOR ATOMIC RESEARCH AND DEPARTMENT OF CHEMISTRY
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RECEIVED SEPTEMBER 26, 1958

5-BIS-(2-CHLOROETHYL)-AMINOURACIL, A NEW ANTITUMOR AGENT

Sir:

Since the discovery of the pharmacological properties of methyl-bis-(2-chloroethyl)-amine, HN2[1] and its therapeutic use in human malignancies,[2] a number of analogs and related alkylating agents have been developed which have clinical value.[3] Nevertheless, the need for compounds

(1) A. Gilman and F. S. Philips, *Science*, **103**, 409 (1946).

(2) L. S. Goodman, M. M. Wintrobe, W. Dameshek, M. J. Goodman, A. Gilman and M. J. McLennon, *J. Am. Med. Assoc.*, **132**, 126 (1946).

(3) S. Farber, R. Toch, E. M. Sears and D. Pinkel, in "Advances in Cancer Research," J. P. Greenstein and A. Haddow, editors, Academic Press, Inc., New York, N. Y., Vol. IV, 1956, pp. 20–33.