in benzene solution was achieved only with the coupling constants of opposite signs. The spacings between the lines shown in Fig. 1 at 241.7 and 243.7 cps. and 221.9 and 220.7 cps. (Fig. 1) were reduced to 1.4 and 0.1 cps., respectively, at 40 Mc. With coupling constants of the same sign, the computed spacings for these lines were 0.8 and 0.9 cps., respectively.

On the basis of these results, we believe that the relative signs of J_{AC} and J_{BC} must be taken as being indeed different from J_{AB}. Interestingly, this conclusion could only have been reached by treatment of the spin system as ABC_3, not as the ABX_3 approximation in which a change in the sign of J_{AB} relative to J_{AC} and J_{BC} does not affect the theoretical spectrum.

The results can be regarded as disquieting in two connections. First, the difference in sign between the geminal and vicinal H–H couplings runs counter to the theoretical predictions of Karplus and Gutowsky[10] for substances with normal bond angles. Second, in analogy with the findings of Castellano and Waugh[11] for ABC systems, rather different sets of spin-coupling and chemical-shift parameters were found to give nearly identical theoretical spectra for diethyl sulfite in benzene and each of these corresponds amazingly well to the experimental spectrum at 60 Mc. Indeed, the previously mentioned excellent agreement between theoretical and experimental spectra obtained for acetaldehyde diethyl acetal now has been duplicated with $\nu_B - \nu_A = 9.23$ cps., $\nu_C - \nu_A = 146.3$ cps., $J_{AC} = 9.30$ cps. and J_{AC} *equal to* $J_{BC} = 7.03$ cps. with J_{AB} opposite in sign to J_{AC} and J_{BC}.

Clearly, caution and judgment must be exercised in use of the iterative method of obtaining spin-spin coupling constants since there seems to be no assurance that a "final" solution is truly unique.[7b,11]

Acknowledgment.—We are deeply indebted to Dr. Stanley L. Manatt and the Computing Center of the Jet Propulsion Laboratory for the IBM 7090 calculations of the theoretical spectra.

(10) H. S. Gutowsky, M. Karplus and D. M. Grant, *J. Chem. Phys.*, **31**, 1278 (1959); M. Karplus, *ibid.*, **30**, 11 (1959).

(11) S. Castellano and J. S. Waugh, *ibid.*, **34**, 295 (1961).

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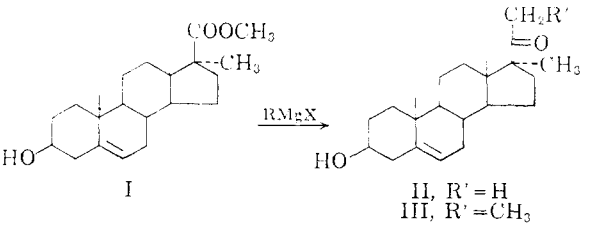
STERICALLY CONTROLLED GRIGNARD REACTIONS. A NEW SIMPLE ROUTE TO 17α-METHYLATED STEROID ANALOGS

Sir:

We wish to report a convenient new synthesis of 17α-methylated steroid derivatives which has made possible the preparation of highly active progesterone homologs. When the readily available methyl 3β-hydroxy-17α-methyl-5-etienate (I)[1] was refluxed in anisole for one hour in presence of *excess* methylmagnesium bromide, the corresponding sterically hindered *ketone*, 17α-methylpregnenolone II[1] was obtained in 70% yield. The latter substance was converted to the known[1] 17α-methylprogesterone by Oppenauer oxidation. Only about 20% of the "normal" product, the corresponding carbinol 17α,20-dimethyl-5-pregnene-3β,20-diol, was formed and conveniently separated by chromatography.



I

II, R' = H
III, R' = CH₃

Analogously, the 5α,6α epoxide obtained by peracetic acid treatment of I, m.p. 170–171°, $[\alpha]_D$ −67.2, gave in similar yields 3β,5α-dihydroxy-6β,-17α-dimethylpregnan-20-one, m.p. 188–192°, which was directly oxidized by chromic acid to the 3,20-dione, m.p. 230–233°, and converted by methanolic sodium hydroxide to 6α,17-dimethylprogesterone, m.p. 137–140°, $[\alpha]_D$ +90.5, λ_{max} 239 mμ, log ε 4.2. The latter substance, and the corresponding 6-dehydro derivative, m.p. 143–146°, $[\alpha]_D$ +87.1, λ_{max} 292 mμ, log ε 4.4, obtained by chloranil dehydrogenation, were orally at least as active, in the Clauberg test, as 19-nor-17α-ethynyltestosterone, and twenty times more active than 17α-methylprogesterone.

NOTE ADDED IN PROOF.—6,17-Dimethyl-6-dehydroprogesterone is as active orally as 6α-methyl-17-acetoxyprogesterone. It is devoid of any androgenic properties.

Treatment of I with ethylmagnesium iodide in anisole gave 17α,21-dimethylpregnenolone III, m.p. 145–148°, with no detectable amount of carbinol being formed. Oppenauer oxidation gave 17α,21-dimethylprogesterone, m.p. 157–159°, $[\alpha]_D$ +107.7, λ_{max} 241 mμ, log ε 4.2[2] in 70% over-all yield. Further transformations of these methylated steroids together with a report on their 6-halogenated derivatives[3] will be presented in a more detailed paper.

(1) Pl. A. Plattner, H. Heusser, P. Th. Herzig, *Helv. Chim. Acta*, **32**, 270 (1949).

(2) All rotations in 1% chloroform solution. All new compounds had satisfactory elemental analysis. We are indebted to Dr. G. Papineau-Couture and his associates for the analytical data and to Drs. C. Chappel and C. Revesz for the bioassays.

(3) Prepared by Dr. Y. Lefebvre of these laboratories.

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INERTIAL EFFECTS OF SUBSTITUENTS ON HOT ATOM CAPTURE[1]

Sir:

Hot hydrogen atoms can replace hydrogen and other atoms and groups with high collision efficiency.[2] The course of these reactions has been shown to be largely controlled by steric factors.[2] However certain results, particularly on alkyl replacement, have not found explanation. This letter reports a remarkable new effect in the hot hydrogen displacement of halogen atoms from

(1) Studies supported by the U. S. Atomic Energy Commission, Contribution No. 1681 from the Sterling Chemistry Laboratory.

(2) D. Urch and R. Wolfgang, *J. Am. Chem. Soc.*, **83**, 2982 (1961). This paper contains references to the earlier literature.