

TABLE I
 C^{13} -PROTON COUPLING CONSTANTS OF METHYL PROTONS
 IN CH_3X AND CALCULATED COUPLING COMPONENTS

Substituent	J_{CH} (cps.)	ζ_x (cps.) (av. value)
—H	125 ^a	41.7
—F	149 ^a	65.6
—Cl	150 ^a	68.6 ^a
—Br	152 ^a	68.6
—I	151 ^{a,4}	67.6
—OC ₆ H ₅	143 ^a	59.6
—OH	141 ¹ , 144 ¹	59.6
—S(O)CH ₃	138 ^a	54.6
—NH ₂	133 ^a	49.6
—NHCH ₃	132 ^a	48.6
—N(CH ₃) ₂	131 ^a	47.6
—CN	136 ^{a,3}	52.6
—CCl ₃	134 ^a	50.6
—CH ₂ I	132 ⁶	48.6
—C≡CH	132 ^a	48.6
—CHCl ₂	131 ⁵	47.6
—COOH	103 ³ , 131 ¹	47.1
—CH ₂ Br	128 ⁶	44.6
—CH ₂ Cl	128 ⁵	44.6
—CHO	127 ^a	43.6
—CH ₃	126 ^a	42.6
—C ₆ H ₅	126 ^a	42.6
—CHCH ₃ Br	126 ⁶	42.6
—C(O)CH ₃	126 ² , 122 ⁸	40.6
—C(CH ₃) ₃	124 ² , 120 ⁸	38.6

^a Based on 152 cps. instead of 150 cps. for better correspondence with data of Table II.

TABLE II
 COMPARISON OF PREDICTED AND OBSERVED C^{13} -PROTON
 COUPLING CONSTANTS

Compound	J_{CH} (calcd.)	J_{CH} (exp.)	Diff.
C ₆ H ₅ CH ₂ C ₆ H ₅	127	127 ⁶	0
(CH ₃) ₂ CCH ₂ OH	139	132 ⁷	+7
CH ₃ CH ₂ I	152	149 ⁶	+3
CH ₃ CH ₂ Br	153	151 ⁶	+2
C ₆ H ₅ CH ₂ Cl	153	152 ⁶	+1
C ₆ H ₅ CH ₂ Br	153	153 ⁶	0
(CH ₃) ₂ CHBr	154	151 ⁶	+3
BrCH ₂ CH ₂ Br	155	157 ^{5,6}	-2
ClCH ₂ CH ₂ Cl	155	154 ^{5,6}	+1
CH ₂ ClCN	163	161 ⁶	+2
CH ₂ I ₂	177	173 ^a	+4
CH ₂ Br ₂	179	178 ⁶	+1
CH ₂ Cl ₂	179	178 ^{3,4}	+1
Cl ₂ CHCHCl ₂	185	182 ⁵	+3
CHCl ₂ CN	190	189 ⁶	+1
CHCl ₃	206	209 ^{2,4}	-3

can be evaluated from the data of methane² ($J_{CH} = 125$ cps.). According to the equation $J_{CH}(CH_3) = 3\zeta_H$; thus we find $\zeta_H = 41.7$ cps.

Zeta values for various substituents now can be calculated from C^{13} -proton coupling constants of methyl protons in CH_3X type compounds, since $\zeta_x = J_{CH}(CH_3X) - 2\zeta_H$. Spectral data and the results of such calculations are presented in Table

(3) P. C. Lauterbur, *ibid.*, **26**, 217 (1957).

(4) G. V. D. Tiers, *J. Phys. Chem.*, **64**, 373 (1960).

(5) N. Sheppard and J. J. Turner, *Proc. Roy. Soc. (London)* **A252**, 506 (1959).

(6) Observed in this laboratory by Richard Magee, National Science Foundation Undergraduate Research Participant, 1961.

(7) G. J. Karabatsos, *J. Am. Chem. Soc.*, **83**, 1230 (1961).

I. The accuracy of this simple additive scheme in predicting J_{CH} values for methylene and methine protons is shown in Table II. The differences between calculated and experimental values are within the range of experimental error, that is, approximately ± 2 cps.

Upon further examination of Table I we notice that the zeta values seem to be primarily dependent upon the first atom of the substituent (the atom by which the substituent is bonded to the rest of the molecule); halogens $> O > N > C$. This variation parallels the order which these elements occupy in the Periodic Table.

Besides its utility in spectral analysis, the present scheme should have a significant bearing on general theories of nuclear spin-spin coupling. The additivity and variations of zeta values probably are the result of independent, anisotropic, electron-orbital currents localized in the substituents. Consequently, we should expect the zeta values to be angular dependent.

Further work along these lines is being conducted in this laboratory.

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SOME TRIMETHYLSILOXYTRIALKYL TIN COMPOUNDS¹

Sir:

It is worth while to add some further results of our own studies to a recent note² in the field of trimethylsiloxytrialkyltin compounds.

Trimethylsiloxytrialkyltin compounds, $Me_3SiO-SnR_3$, ($R = n$ -Pr, and n -Bu) are prepared easily by cohydrolysis, as previously reported,³ of a mixture of trimethylchlorosilane (3-5 mole) and trialkyltin chloride (1 mole) in benzene solution with a slight excess of aqueous ammonia over that necessary to neutralize the mixture. The properties of the products, after rigorous fractionation, are as shown in the table.

TABLE I
 PROPERTIES OF TRIMETHYLSILOXYTRIALKYL TIN COMPOUNDS:

	$Me_3SiOSnR_3$			
	n -Pr		n -Bu	
B.p., °C. at mm.	126	20	142	2
n_D^{20}	1.4575		1.4582	
d_4^{20}	1.093		1.059	
Sn, %, calcd., found	35.21	35.29	31.30	31.28
C, %, calcd., found ^a	42.75	42.70	47.51	47.51
H, %, calcd., found ^a	8.97	8.89	9.57	9.81
Mol. wt., calcd., found ^b	337.2	336	379.2	382

^a Carbon and hydrogen analyses were performed by the Schwarzkopf Microanalytical Laboratory, Woodside, N. Y.
^b Cryoscopic measurement in benzene.

These two transparent oils have an irritating smell and are fairly stable in a laboratory atmos-

(1) This work was presented at The Chemical Society Symposium on Inorganic Polymers at Nottingham University, England, July, 1961.

(2) H. Schmidbaur and M. Schmidt, *J. Am. Chem. Soc.*, **83**, 2963 (1961).

(3) R. Okawara, D. G. White, K. Fujitani and H. Sato, *ibid.*, **83**, 1342 (1961).

phere; the refractive indices of the compounds do not change over 50 days. Contrary to this, trimethylsiloxytriethyltin (b.p. 99° (20 mm.)) synthesized by the same method seemed to absorb carbon dioxide easily from air to form a crystalline solid during the distillation or on standing. By bubbling carbon dioxide into trimethylsiloxytriethyltin in acetone, a white precipitate of bis-(triethyltin) carbonate is formed immediately. Thus it is clear that the stability of a trimethylsiloxytrialkyltin compound depends upon the nature of the alkyl groups attached to the tin atom.

It is also worth noting that the two compounds shown in the table are monomeric in benzene solution, while the tetraalkyl-1,3-bis-(trimethylsiloxy)-distannoxanes, $(\text{Me}_3\text{SiOSnR}_2)_2\text{O}$ ($\text{R} = \text{Me}, \text{Et}, n\text{-Pr}, n\text{-Bu}$), are dimeric, as has been reported.⁴

The infrared spectra of the two compounds show a strong absorption associated with the stretching vibration of the Si-O-Sn group near 980 cm^{-1} ; that of tetraalkyl-1,3-bis-(trimethylsiloxy)-distannoxanes has been reported³ to have two strong absorptions near 980 and 910 cm^{-1} .

(4) R. Okawara, *Proc. Chem. Soc.*, in press.

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PROCESS FOR BIOSYNTHESIS OF 7-CHLORO-6-DEMETHYLTETRACYCLINE

Sir:

The biosynthesis of 7-chloro-6-demethyltetracycline and the related 6-demethyltetracycline by mutant strains of *Streptomyces aureofaciens* has been described by McCormick, *et al.*^{1,2} These mutants apparently lack the enzyme system which inserts the methyl group derived from methionine (as shown by Miller, *et al.*³) into the molecule. We have found that "normal" strains of *S. aureofaciens* form 6-demethyltetracyclines when grown in sulfonamide containing media. Among the organisms used in our experiments were these strains of *S. aureofaciens*: NRRL B-2209, NRRL B-1286, NRRL B-1287, NRRL B-1288, ATCC 12416a, ATCC 12416b, and ATCC 12416c.

These strains were grown in shaken Erlenmeyer flasks and in aerated fermenters in a medium containing extraction process soybean meal, glucose, sodium chloride and powdered calcium carbonate. Sulfaguanidine was added to the autoclaved medium to give a final concentration of 1 g. per l. Both the powdered form and a hydrochloric acid solution of the sulfonamide were used. After 5 days incubation at 25°, samples were removed from the fermentations and prepared for chromatographic analysis by acidification to pH 2.5 with sulfuric acid. The cell-free liquid obtained after acidification and centrifuging was analyzed for the presence of members of the tetracycline group of antibiotics by the paper chromatographic systems mentioned earlier.⁴

(1) J. R. D. McCormick, N. O. Sjolander, U. Hirsch, E. R. Jensen, and A. P. Doerschuk, *J. Am. Chem. Soc.*, **79**, 4561 (1957).

(2) J. R. D. McCormick, N. O. Sjolander, U. Hirsch, and E. R. Jensen, U. S. Patent 2,878,289 (1959).

(3) P. A. Miller, J. R. D. McCormick and A. P. Doerschuk, *Science*, **123**, 1030 (1956).

The samples taken from the sulfaguanidine-supplemented fermentations contained substantial amounts of 7-chloro-6-demethyltetracycline and 7-chlorotetracycline, as well as traces of tetracycline and 6-demethyltetracycline. The crystalline 7-chloro-6-demethyltetracycline hydrochloride isolated from a 30-l. fermentation was compared with the material prepared by the McCormick processes.^{1,2} There were no significant differences in infrared and ultraviolet spectra, rotation, and melting point, and a Kuhn-Roth degradation showed the absence of the C-methyl moiety. Chemical stability studies using 2 *N* HCl and 0.2 *N* NaOH showed that the material from the sulfaguanidine supplemented fermentations had the same stability in these reagents as 7-chloro-6-demethyltetracycline.^{1,2} Other sulfonamides found effective in shifting these fermentations from the production of 7-chlorotetracycline to the formation of 7-chloro-6-demethyltetracycline included sulfanilamide, sulfadiazine, sulfathiazole, sulfapyridine, sulfasuxidine, sulfamerazine, and sulfisoxazole. Further experiments which showed that this diversionary effect was reversed in part by addition to the fermentation of methionine provide additional support to the hypothesis that the sulfonamides interfere with methionine metabolism of *S. aureofaciens*.

(4) D. Perlman, L. J. Heuser, J. M. Barrett, and J. A. Boska, *J. Bacteriol.*, **80**, 419 (1960).

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A NOVEL REARRANGEMENT OF THE STEROID NUCLEUS. SYNTHESIS OF 18-NOR-D-HOMOSTEROIDS¹

Sir:

Recent work on the photolysis of steroid nitrite esters² has demonstrated the utility of this reaction in the synthesis of structures only difficultly obtainable by other methods.

We now wish to report the photolytic conversion of steroid 11 β -hydroxy-17-keto nitrite esters to 18-nor-D-homo- $\Delta^{13(17a)}$ -11 β -hydroxy-17-keto steroids.

When 4-androstene-11 β -ol-3,17-dione³ was converted to the 11 β -nitrite (partial structure A; m.p. 157–159°; $[\alpha]_D^{25} +249^\circ$ $\lambda_{\text{max}}^{\text{Nujol}}$ 5.76, 5.96, 6.07, 6.18, 12.90, 13.25 μ)⁴ and the latter irradiated in toluene,⁵ a compound was isolated by crystallization which was shown to be 18-nor-D-homo-4,13-(17a)-androstadiene-11 β -ol-3,17-dione (I; partial

(1) Part IV in the series "Photolysis of Organic Nitrites"; part III, A. L. Nussbaum, C. H. Robinson, E. P. Oliveto and D. H. R. Barton, *J. Am. Chem. Soc.*, **83**, 2400 (1961).

(2) D. H. R. Barton, J. M. Beaton, L. E. Geller and M. M. Pechet, *ibid.*, **82**, 2640 (1960); D. H. R. Barton and J. M. Beaton, *ibid.*, **82**, 2641 (1960); A. L. Nussbaum, F. E. Carlson, E. P. Oliveto, E. Townley, P. Kabasakalian and D. H. R. Barton, *ibid.*, **82**, 2973 (1960); C. H. Robinson, O. Gnoj, A. Mitchell, R. Wayne, E. Townley, P. Kabasakalian, E. P. Oliveto and D. H. R. Barton, *ibid.*, **83**, 1771 (1961).

(3) T. Reichstein, *Helv. Chim. Acta*, **20**, 978 (1937).

(4) Rotations are in chloroform unless otherwise noted. Satisfactory analyses have been obtained for all new compounds.

(5) We thank Mr. R. Armswood for technical assistance.