($M^+ - CH_3COOH$) m/z 368.3443, found 368.3427.

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Registry No. **1a**, 54278-89-6; **1b**, 64783-84-2; **1c**, 57637-02-2; **1d**, 54165-73-0; **2a**, 58514-32-2; **2b**, 81520-53-8; **2c**, 58514-33-3; **2d**, 81520-54-9; **3a**, 81477-12-5; **3b**, 81520-55-0; **3c**, 81477-13-6; **3d**, 81520-56-1; **6**, 25819-77-6; **7a**, 81477-14-7; **7b**, 81477-15-8; **8a**, 81477-16-9; **8b**, 81477-17-0; **8c**, 81477-18-1; **9a**, 81477-19-2; **9b**, 81477-20-5; **9c**, 81477-21-6; **9d**, 81477-22-7; **10a**, 81477-23-8; **10b**, 81477-24-9; **11a**, 81477-25-0; **11b**, 81477-26-1; **12a**, 81477-27-2; **12b**, 81520-57-2; **13a**, 81477-28-3; **13b**, 81570-09-4; **13c**, 81477-29-4; **13d**, 81520-58-3; **14a**, 81477-30-7; **14b**, 81520-59-4; **15a**, 81477-31-8; **15b**, 81520-60-7; **16a**, 81477-32-9; **16b**, 81520-61-8; propyne, 74-99-7; 1-bromopropane, 106-94-5.

Stereoselectivities in Methylcyclopropanations of Cycloalken-3-ols with Ethylidene Iodide Using Zinc Dust–Cuprous Chloride or Diethylzinc Reagents

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A study of stereoselectivity differences in methylcyclopropanations of cycloalken-3-ols with ethylidene iodide using zinc dust–cuprous chloride or diethylzinc reagents has been carried out for the entire cyclopenten-3-ol to cycloocten-3-ol series. For each of the systems, both reagents afforded the same products and in very similar ratios. Also, with either reagent the stereoselectivities for endo/exo alcohol formation with ethylidene iodide paralleled those observed on using a zinc–copper couple with methylene iodide. The [3.1.0] and [4.1.0] alcohol products were exclusively endo, the [5.1.0] products were predominantly endo, and the [6.1.0] products were exclusively exo. Furthermore, endo alcohol formation was associated with preferential *anti*-methyl stereochemistry, and exo alcohol formation with preferential *syn*-methyl stereochemistry.

We recently reported[1] our discovery that methylcyclopropanations of allylic alcohols with ethylidene iodide do not require use of diethylzinc[2] or ethylzinc iodide[3] reagents as previously believed. Instead, they may be accomplished readily and in high yields by using the more convenient zinc dust–cuprous chloride reagent.[4] In a continuation of our investigations into this procedural variation, the yields and stereoselectivity differences in the reactions of ethylidene iodide with the entire cyclopenten-3-ol to cycloocten-3-ol series using either the zinc dust–cuprous chloride or the diethylzinc reagent were examined. The results of this study are described below.

Results and Discussion

Stereoselectivities in Reactions of Cycloalken-3-ols with Ethylidene Iodide. In earlier work we[1] had determined the zinc dust–cuprous chloride promoted methylcyclopropanation products of cyclopenten-3-ol and cycloocten-3-ol with ethylidene iodide, and Kawabata and co-workers[5] had determined the diethylzinc-promoted methylcyclopropanation products of cyclohexen-3-ol, cycloheptenol-3-ol, and cycloocten-3-ol with ethylidene iodide. Thus, for completion of the series, only the zinc dust–cuprous chloride promoted reactions of cyclohexen-3-ol and cycloheptenol-3-ol and the diethylzinc-promoted reaction of cyclopenten-3-ol with ethylidene iodide needed to be carried out. However, as initial studies revealed conflicting results in the zinc dust–cuprous chloride and in the literature[5] diethylzinc-promoted reactions of ethylidene iodide with cycloheptenol-3-ol, a diethylzinc-promoted reaction of cycloheptenol-3-ol with ethylidene iodide was also run. The results are summarized in Table I.

The methylcyclopropanation stereoselectivities for both the zinc dust–cuprous chloride and diethylzinc-promoted reactions of cycloalken-3-ols with ethylidene iodide were found with all of the systems to be almost identical. This indicates that in these reactions either the same reactive intermediates are involved with both zinc reagents or that it is unimportant to the reaction stereochemistries whether an ethyl group or an iodo group is present on zinc.

Comparison of the results summarized in Table I with published data[6,7] reveals that with a given cycloalken-3-ol, the endo/exo alcohol product stereochemistries are the same for cyclopropanations with either ethylidene iodide or with methylene iodide. Thus, both reagents give exclusively endo alcohol products in the [3.1.0] and [4.1.0] systems, a mixture predominating in endo of endo and exo alcohol products in the [5.1.0] system, and exclusively exo alcohol products in the [6.1.0] system.

The results in Table I also indicate that for the [3.1.0] and [4.1.0] systems where endo alcohol stereochemistry predominates, *anti*-methyl stereochemistry predominates. On the other hand, exo alcohol stereochemistry in the [6.1.0] system is associated with predominant *syn*-methyl stereochemistry. The product mixture in the 8-methyl-2-bicyclo[5.1.0]octanol system is rather complex. However, predominance of the endo,anti over the endo,syn and the exo,syn over the exo,anti products appears to follow the

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Table I. Stereospecificities in Methylcyclopropanations of Some Cycloalken-3-ols with Ethylidene Iodide and Zinc Dust-Cuprous Chloride[a] or Diethylzinc[b] in Diethyl Ether

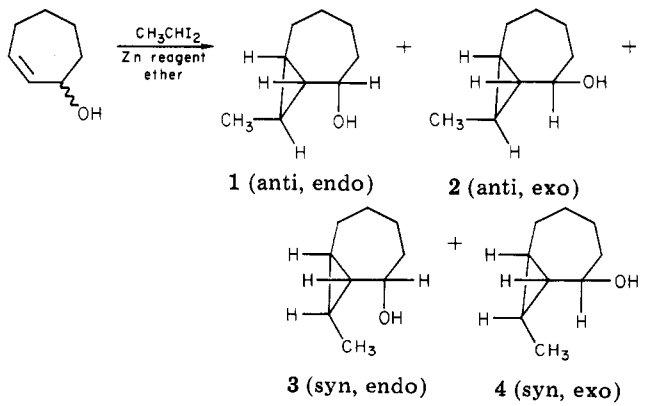
cycloalken-3-ol	zinc reagent	reaction time, h	total yield,[c] %	% 2-bicyclo[n.1.0]alkanols: anti-methyl endo	anti-methyl exo	syn-methyl endo	syn-methyl exo	ref
c-C_5H_7OH	Zn-CuCl	10	71	76 ± 2		24 ± 2		*d*
	Et_2Zn	20	60	76 ± 2		24 ± 2		this work
c-C_6H_9OH	Zn-CuCl	11	84	72 ± 2		28 ± 2		this work
	Et_2Zn	15	60	63		37		*e*
c-$C_7H_{11}OH$	Zn-CuCl	11	74	59 ± 1	2 ± 1	19 ± 3	20 ± 3	this work
	Et_2Zn	15	79[f]		52		48	*e*
	Et_2Zn	17	72	49 ± 2	10 ± 2	20 ± 3	21 ± 3	this work
c-$C_8H_{13}OH$	Zn-CuCl	20	88		28 ± 2		72 ± 2	*d*
	Et_2Zn	15	76[f]		29		71	*e*

[a] The reactions were all carried out at reflux approximately in the ratio 0.05 mol of cycloalken-3-ol/0.11 mol of ethylidene iodide/0.20 mol of zinc dust/0.02 mol of cuprous chloride/25 mL of ether. [b] The reactions were all carried out at room temperature by using approximately 0.010 mol of cycloalken-3-ol, 0.020 mol of diethylzinc, 0.015 mol of ethylidene iodide, and 10 mL of ether. [c] Distilled yield based on reacted allylic alcohol except where noted. [d] Friedrich, E. C.; Biresaw, G. *J. Org. Chem.*, in press. [e] Kawabata, N.; Nakagawa, T.; Nakao, T.; Yamashita, S. *J. Org. Chem.* **1977**, *42*, 3031. [f] GLPC yield based on starting allylic alcohol.

same pattern observed in the other [*n*.1.0] systems. These stereoselectivity differences all must have steric origins and illustrate the major effects which small changes in allylic alcohol conformational preferences can have on the cyclopropanation product stereochemistries.

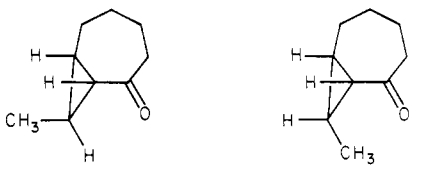
In connection with the *syn*/*anti*-methyl group stereoselectivity preferences observed in the present work, it should be pointed out that methylcyclopropanations of simple cycloalkenes have been found to be "syn selective".[8] For example, the reaction of cyclohexene with ethylidene iodide and diethylzinc[2] gives a *syn*/*anti*-7-methylnorcarane mixture in which the syn isomer predominates. Thus, the *syn*-methyl preference observed in the present work in the [5.1.0] and [6.1.0] systems where *exo*-cyclopropylcarbinols are formed would appear to be the normal behavior. On the other hand, the *anti*-methyl preference when *endo*-cyclopropylcarbinols are formed must be due to steric hindrance[8] to *syn*-methyl formation.

Proof of the Stereochemistries of the Cyclohepten-3-ol Methylcyclopropanation Products. The precise reason the present results for diethylzinc-promoted methylcyclopropanation of cyclohepten-3-ol with ethylidene iodide differ from those reported earlier[5] is unknown. However, it is conceivable that the discrepancy may have resulted because of difficulties associated with GLC separations of the exo and endo isomers 1–4 for both the *syn*- and *anti*-8-methyl-2-bicyclo[5.1.0]octanols. Thus, on a Carbowax 20M packed column GLC system in our laboratory, only two poorly resolved peaks were observed for the four-component mixture of 8-methyl-2-bicyclo-[5.1.0]octanols. Both syn alcohols were eluted under one peak, and both anti alcohols under the other.



Proof of the structure of the 8-methyl-2-bicyclo[5.1.0]-octanols was accomplished in the present study as follows. Chromium trioxide in acetone oxidation[9] of the 59:20:19:2 mixture of isomeric 8-methyl-2-bicyclo[5.1.0]octanols obtained from zinc dust–cuprous chloride promoted methylcyclopropanation of cyclohepten-3-ol with ethylidene iodide gave approximately a 60:40 mixture of isomeric ketones. Pure samples of each of the ketones were separated by GLC and reduced with lithium aluminum hydride in ether.

It was anticipated that reduction of the *anti*-8-methyl ketone **5** should give a stereoisomerically similar ratio of



5 **6**

endo to exo alcohol products as does the unsubstituted ketone. On the other hand, reduction of the *syn*-8-methyl ketone **6** was expected to give a very different stereoisomeric mixture of alcohols from that of the unsubstituted ketone and also one in which the endo alcohol product **3** resulting from preferential hydride attack from the less hindered exo side of the carbonyl group would strongly predominate.

Accordingly, the major ketone product separated from the oxidation mixture gave a 51:49 mixture of two alcohol products on lithium aluminum hydride reduction. This is similar to the 54:46 endo/exo alcohol mixture reported[10] from lithium aluminum hydride reduction of the unsubstituted 2-bicyclo[5.1.0]octanone. However, lithium aluminum hydride reduction of the minor ketone product gave an 84:16 mixture of alcohols. Thus, the minor ketone must have been the *syn*-8-methyl derivative **6** which on reduction gives an 84:16 mixture of endo and exo alcohols **3** and **4**, respectively, and the major ketone must be the *anti*-8-methyl derivative **5**. However, which of the two isomeric alcohol products obtained by reduction of **5** is the

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Table II. ^{1}H NMR Spectral Characteristics of the 2-Proton Absorptions for Some 2-Bicyclo[5.1.0]octanols in CCl_4 Solvent with a Me_2Si Internal Standard

2-bicyclo[5.1.0]-octanol	δ CHOH ($W_{1/2}$[a])	
	endo-OH	*exo*-OH
unsubstituted	4.2 (15)	3.3 (18)
anti-8-methyl	4.2 (15)	3.3 (18)[b]
syn-8-methyl	4.6 (14)	3.4 (21)[b]

[a] $W_{1/2}$ corresponds to the width of the multiplet in hertz at half-height. [b] Kawabata and co-workers (*J. Org. Chem.* **1977**, *42*, 3031) reported NMR shifts and widths at half-height in CCl_4 of δ 3.2 (18 Hz) and 3.3 (18 Hz) for the 8-methyl-2-bicyclo[5.1.0]octanol isomers they assigned as being the syn-exo and anti-exo, respectively.

Table III. Comparison of Aluminum Isopropoxide Alcohol Equilibration and Lithium Aluminum Hydride Ketone Reduction Results for Some 2-Bicyclo[5.1.0]octanols

2-bicyclo[5.1.0]-octyl system	$Al(OiPr)_3$ equilibration		$LiAlH_4$ reduction	
	% endo	% exo	% endo	% exo
unsubstituted[a]	20	80	54	46
anti-8-methyl	15 ± 1	85 ± 1	51 ± 1	49 ± 1
syn-8-methyl	0.03 ± 0.03	99.97 ± 0.03	84 ± 1	16 ± 1

[a] Unpublished work of F. R. Wight, M.S. Dissertation, University of Rochester, Rochester, NY, 1969.

endo **1** and which is the exo **2** was not obvious from the oxidation-reduction data alone.

Assignment of structures for the *anti*-8-methyl-*endo*- and -*exo*-2-bicyclo[5.1.0]alcohols (**1** and **2**) could be readily made from their ^{1}H NMR spectra. Thus, the data in Table II show that the 2-proton absorptions of the endo [5.1.0] alcohols, whether unsubstituted, *anti*-8-methyl substituted, or *syn*-8-methyl subsituted, all have chemical shifts of between 4.2 and 4.6 ppm. However, for the exo [5.1.0] alcohols, the chemical shifts all lie between 3.3 and 3.4 ppm. Also, it should be noted that the widths at half height for the 2-proton absorptions, which provide a measure of the magnitudes of the vicinal coupling constants for the 2-protons, are diagnostic for the alcohol stereochemistries.

As further confirmation of the structural assignments made above by using chromium trioxide oxidation–lithium aluminum hydride reduction and ^{1}H NMR techniques, aluminum isopropoxide in 2-propanol endo/exo alcohol equilibrations of samples of the *anti*- and *syn*-8-methyl-2-bicyclo[5.1.0]octanols were carried out. The data obtained, together with that reported[10] in the literature for the corresponding unsubstituted 2-bicyclo[5.1.0]octanols, are summarized in Table III. The results complement the lithium aluminum hydride ketone reduction data obtained earlier and are in complete agreement with the stereochemical assignments made for the isomeric 2-bicyclo-[5.1.0]octanols **1**–**4**.

Experimental Section

General Methods. Melting points and boiling points are uncorrected. Infrared spectra were obtained by using a Beckman Model IR-8 spectrophotometer. NMR spectra were measured by using Varian A60A, EM-360, and EM-390 instruments with chemical shifts measured in parts per million downfield from Me_4Si as an internal standard. For quantitative NMR analyses at least three integrations were run for each absorption of interest and the average value was used in calculations. Preparative-scale GLC separations were carried out by using an Aerograph A90P3 instrument equipped with a Pyrex injector insert. Relevant GLC conditions, including column phases, are described briefly in the following sections where appropriate. A 46-m Carbowax 20M glass capillary column heated at 135 °C in a Varian Series 1400 instrument was used for most of the quantitative GLC analyses. Microanalyses were performed by Galbraith Laboratories, Inc., Knoxville TN.

Reaction of Cyclohexen-3-ol with Ethylidene Iodide Using Zinc Dust–Cuprous Chloride. Into a 50-mL, three-necked, round-bottomed flask fitted with a Friedrich condenser and a dropping funnel and equipped for magnetic stirring were placed 6.5 g (0.10 mol) of zinc dust, 1.0 g (0.010 mol) of cuprous chloride, and 15 mL of anhydrous ether. Then, 2.5 g (0.025 mol) of cyclohexen-3-ol[11] was added, and the resulting mixture was stirred and heated to reflux. Ethylidene iodide[12] (16 g, 0.056 mol) was added dropwise over a period of 1 h. The rate of addition and heating were controlled so that a normal but not excessive rate of reflux was maintained. After the ethylidene iodide addition was completed, the reaction mixture was heated at reflux for an additional 10 h before the workup. The workup consisted of pouring the reaction mixture into about 50 mL of ether and adding dropwise about 50 mL of saturated aqueous NH_4Cl. The aqueous layer was separated and extracted with three 25-mL portions of ether. The combined ethereal layers were washed with four 25-mL portions of saturated aqueous Na_2CO_3 and 4–10-mL portions of saturated aqueous NaCl and dried over $MgSO_4$. The ether was removed on a rotary vacuum evaporator. Vacuum distillation of the resulting crude product through a small-scale, short-path apparatus gave 2.6 g (84% yield) of a 72:28 anti/syn mixture of 7-methyl-*endo*-2-bicyclo[4.1.0]heptanols, bp 78–81 °C (9 mm) [lit.[5] bp 44 °C (5 mm)]. The syn/anti analysis was done by GLC on a 46-m Carbowax 20M glass capillary column. The structures of the products were verified by coinjection with known samples prepared earlier in this laboratory[13] by using a different procedure. Also, ^{1}H NMR spectra of samples of the individual isomers separated on a 3-m, 10% DEGS on 60/80-mesh NAW Chromosorb W column were compared with known spectra.[13]

Reaction of Cyclohepten-3-ol with Ethylidene Iodide Using Zinc Dust–Cuprous Chloride. In a manner similar to that employed for the analogous reaction of cyclohexen-3-ol above but on twice the scale, 13 g (0.20 mol) of zinc dust, 2 g (0.02 mol) of cuprous chloride, 5.6 g (0.050 mol) of cyclohepten-3-ol[11] and 31 g (0.11 mol) of ethylidene iodide[12] in 25 mL of anhydrous ether were allowed to react at reflux for 11.5 h. After the workup and distillation, 5.2 g (74% yield) of a 59% anti,endo, 2% anti,exo, 19% syn,endo, and 20% syn,exo mixture of 8-methyl-2-bicyclo-[5.1.0]octanols was obtained: bp 100–110 °C (17 mm); NMR (CCl_4) δ 0.4–2.5 (m, 15 H), 3.4, 4.2, 4.6 (m, m, t, 1 H, CHOH) for the *syn-exo* and anti,exo together, the anti,endo, and the syn,endo isomers, respectively.

Anal. Calcd for $C_9H_{16}O$: C, 77.14; H, 11.43. Found: C, 77.28; H, 11.42.

Proof of structure for the various isomeric 8-methyl-2-bicyclo[5.1.0]octanols was accomplished as follows. Oxidation of a 2.0-g sample of the isomeric alcohol mixture with chromium trioxide in acetone gave 1.2 g (62% yield) of a 60:40 mixture of 8-methyl-2-bicyclo[5.1.0]octanones: bp 80–88 °C (10 mm); IR (neat) 1700 cm^{-1} (C=O str). These two ketones, later assigned as being the *anti*- and *syn*-8-methyl isomers, respectively, were separately collected from a 20% Carbowax 20M on 60/80-mesh NAW Chromosorb W column and reduced at room temperature with $LiAlH_4$ in ether. The minor (syn) ketone isomer gave an 84:16 mixture of alcohols later assigned as being the syn,endo and syn,exo isomers, respectively. The NMR spectrum (CCl_4) of this mixture exhibited the following diagnostic absorptions: δ 1.1 (d, 3 H, CH_3) and 3.4 (m, $W_{1/2}$ = 21 Hz, 1 H, CHOH) for the syn,exo alcohol and δ 1.3 (d, 3 H, CH_3) and 4.6 (t, $W_{1/2}$ = 14 Hz, 1 H, CHOH) for the syn,endo alcohol. The major (anti) ketone on $LiAlH_4$ reduction gave a 51:49 mixture of alcohols, later identified as being the anti,endo and anti,exo isomers, respectively. The NMR spectrum (CCl_4) of the mixture indicated the following

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diagnostic absorptions: δ 1.1 (d, 3 H, CH_3) and 3.3 (m, $W_{1/2}$ = 18 Hz, 1 H, CHOH) for the anti,exo alcohol and δ 1.1 (d, 3 H, CH_3) and 4.2 (m, $W_{1/2}$ = 15 Hz, 1 H, CHOH) for the anti,endo isomer.

Aluminum Isopropoxide Equilibrations of 8-Methyl-2-bicyclo[5.1.0]octanols. A 0.2-g sample of 97% *anti,endo*- and 3% *anti,exo*-8-methyl-2-bicyclo[5.1.0]octanols, 0.5 g of freshly distilled $Al(OiPr)_3$, and 0.1 mL of anhydrous acetone were dissolved in 25 mL of dry isopropyl alcohol, separated into four Pyrex ampules, sealed, and heated at 100 °C. Periodically an ampule was opened, the contents were poured into 50 mL of ether, and the ether solution was washed successively with three 10-mL portions of saturated aqueous NH_4Cl and three 10-mL portions of saturated aqueous NaCl. After being dried over $MgSO_4$, the solution was concentrated by distillation and analyzed by using both NMR and GLC techniques. The composition of the equilibrating mixture gradually changed until after 57 h an equilibrium position of 15% anti,endo and 85% anti,exo was reached which remained unchanged on further heating for a total of 130 h.

In a similar manner, a sample initially composed of 50% *syn,endo*- and 50% *syn,exo*-8-methyl-2-bicyclo[5.1.0]octanols was converted completely to the syn,exo alcohol after 57 h. As little as 0.03% of the syn,endo isomer could have been detected in the mixture were it present.

Reaction of Cyclopenten-3-ol with Ethylidene Iodide Using Diethylzinc. A three-necked, round-bottomed, 100-mL flask was oven dried, purged with nitrogen, and introduced into a drybox. Degassed anhydrous ether (30 mL) was added to the flask, a magnetic stirring bar was inserted, and the necks were closed with rubber septums which were securely wired on. Then, 10 mL (0.098 mol) of diethylzinc, which had been earlier transferred into a single-necked, round-bottomed flask from a lecture bottle, was removed with a syringe and added into the ether in the reaction flask. The flask containing the diethylzinc in ether was removed from the drybox, and the contents were stirred under a slow stream of nitrogen while cooling in an ice bath. Cyclopenten-3-ol (4.2 g, 0.050 mol) was added dropwise with a syringe over a period of 30 min, taking care that no excessive foaming occurred. Ethylidene iodide (7.4 mL, 0.065 mol) was also added dropwise with similar caution. After the additions were completed, the mixture was allowed to stir in the ice bath for 30 min more and then at room temperature for 20 h. The reaction mixture was worked up by adding it dropwise into 100 mL of a cooled (ice–water bath), stirred solution of saturated aqueous NH_4Cl. At the end of the addition, the mixture was allowed to stand at room temperature with stirring for several hours. The solids formed were filtered on a Büchner funnel and washed with about 50 mL of ether. The combined ether solutions were washed with four 25-mL portions of saturated aqueous Na_2CO_3 and two 15-mL portions of saturated aqueous NaCl and dried over $MgSO_4$. The ether was removed and the resulting oil distilled through a short-path, semimicro apparatus to give 3.7 g of material, bp 60–95 °C (16 mm). Examination by NMR revealed that the distillate contained 45% by weight of unreacted cyclopenten-3-ol. Thus, the yield of 6-methyl-2-bicyclo[3.1.0]hexanols based on reacted cyclopenten-3-ol was 60%. Analysis on a 46-m Carbowax 20M glass capillary column revealed that the ratio of the isomeric bicyclohexanols in the mixture was 76% anti,endo and 24% syn,endo.

Reaction of Cyclohepten-3-ol with Ethylidene Iodide Using Diethylzinc. In a manner similar to that for the analogous reaction with cyclopenten-3-ol, the reaction of cyclohepten-3-ol[11] (7.2 g, 0.064 mol), ethylidene iodide[12] (9.6 mL, 0.098 mol), and diethylzinc (10 mL, 0.096 mol) in 30 mL of ether for 17 h at room temperature gave after the workup and distillation 6.7 g of material, bp 90–95 °C (12 mm). By NMR, this was found to contain 28% by weight of unreacted cyclohepten-3-ol. Thus, the yield of 8-methyl-2-bicyclo[5.1.0]octanols based on reacted cyclohepten-3-ol was 72%. Analysis on a 46-m Carbowax 20M glass capillary column showed that the isomeric composition of the methylbicyclooctanols was 49% anti,endo, 10% anti,exo, 20% syn,endo, and 21% syn,exo.

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Registry No. Cyclopenten-3-ol, 3212-60-0; cyclohexen-3-ol, 822-67-3; cyclohepten-3-ol, 4096-38-2; *anti*-6-methyl,*endo*-2-bicyclo[3.1.0]hexanol, 80865-50-5; *syn*-6-methyl,*endo*-2-bicyclo[3.1.0]hexanol, 80865-51-6; *anti*-7-methyl,*endo*-2-bicyclo[4.1.0]heptanol, 62862-03-7; *syn*-7-methyl,*endo*-2-bicyclo[4.1.0]heptanol, 62862-02-6; *anti*-8-methyl,*endo*-2-bicyclo[5.1.0]octanol, 81520-65-2; *anti*-8-methyl,*exo*-2-bicyclo[5.1.0]octanol, 62929-22-0; *syn*-8-methyl,*endo*-2-bicyclo[5.1.0]octanol, 81520-66-3; *syn*-8-methyl,*exo*-2-bicyclo[5.1.0]octanol, 62862-00-4; ethylidene iodide, 594-02-5; zinc, 7440-66-6; cuprous chloride, 7758-89-6; diethylzinc, 557-20-0; *anti*-8-methyl,2-bicyclo[5.1.0]octanone, 62929-23-1; *syn*-8-methyl,2-bicyclo[5.1.0]octanone, 62862-01-5; *endo*-2-bicyclo[5.1.0]octanol, 6202-97-7; *exo*-2-bicyclo[5.1.0]octanol, 6142-49-0.

Synthesis of Stereoisomeric Crown Ethers Composed of *cis*- and *trans*-2,5-Bis(hydroxymethyl)tetrahydrofuran Units and Their Selective Transport of Alkali Metal Cations through Liquid Membranes

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Optical resolution of *trans*-tetrahydrofuran-2,5-dicarboxylic acid (**13**) was carried out via the (+)-2-(1-aminoethyl)naphthalene salt, and conversion of the (+) enantiomer **13** into (+)-2,5-dimethyltetrahydrofuran (**17**) of known configuration established its 2*R*,5*R* configuration. Condensation of (+)- and (−)-*trans*-ditosylates **15** and *cis*-ditosylate **20** with pyrocatechol afforded (−)-D_2-*trans,trans*-**8**, (−)-C_1-*cis,trans*-**9**. *meso*-C_{2h}-*trans,trans*-**10**, and a mixture of *meso*-C_{2h}-**11** and meso-C_{2v}-cis,cis crown ethers **12**. Their selective transport of alkali metal cations is reported.

From the culture solutions of various *Streptomyces* strains there have been isolated quite a variety of antibiotics[1] which possess potent physiological activity by virtue of their ionophoric properties, e.g., the uncoupling

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