amine ${ }^{19}$ produced the silyl ether of cholesterol. Deprotection of the $3 \beta$-hydroxyl group yielded cholesterol which was spectroscopically identical with an authentic sample ( ${ }^{13} \mathrm{C}$ NMR, 360 $\mathrm{MHz}{ }^{1} \mathrm{H}$ NMR, and IR).

The alkylideneoxirane 5 provided the complementary proof for our methodology. Addition of lithium methylcyanocuprate to 5 resulted in the formation of equal amounts of 1,4 and 1,2 adducts, $7^{20}$ and $8,{ }^{21}$ respectively. The unanticipated 1,2 adduct (8) can only be rationalized this time by the differences in the steric bulk of the alkylidene substituents (i.e., methyl vs. isohexyl). Comparison of the $360-\mathrm{MHz}{ }^{1} \mathrm{H}$ NMR spectra of the enantiomeric adducts 6 and 7 revealed a clear distinction in the absorptions for the respective C-21 methyl groups ( 0.97 for 6 and 1.11 for 7 ). Intermediate 7 was then converted to the known isocholesterol ${ }^{22}$ by the same sequence of steps used for the preparation of cholesterol.

As a final check on the purity of the $\mathrm{C}-20$ epimers produced in this study, we subjected the dimethyl ethyl silyl (DMES) ethers of compounds $6,7,9,10$, cholesterol, and isocholesterol to GC analysis. ${ }^{23}$ While the retention times for the DMES ethers of 6 and 7 were very close, the ethers of compounds 9,10 , cholesterol, and isocholesterol separated well enough that it was possible to detect less than $1 \%$ epimeric contaminants. The GC analyses ${ }^{24}$ confirmed that our synthetic products, 6, 7, 9, 10, cholesterol, and isocholesterol were $>99.5 \%$ pure epimers at C-20.

In conclusion, the 1,4 -trans addition of alkyl cyanocuprates to alkylideneoxiranes of sterols provides the only stereospecific methodology for the concomitant introduction of the $\mathrm{C}-21$ asymmetric center and the $15 \beta$-hydroxyl group. This synthetic
(19) Ireland, R. E.; Muchmore, D. C.; Hengartner, U. J. Am. Chem. Soc. 1972, 94, 5098.
(20) 7: $[\alpha]^{27}{ }_{\mathrm{D}}-87.6^{\circ}\left(c 0.21, \mathrm{CHCl}_{3}\right) ;{ }^{1} \mathrm{H}$ NMR $(360 \mathrm{MHz}) \delta 1.06(\mathrm{~s}$, $3 \mathrm{H}, \mathrm{H}-18$ ) 1.11 (s, $3 \mathrm{H}, \mathrm{H}-19$ ), H-21 overlapped with $1.11,3.43-3.52$ (m, $1 \mathrm{H}, \mathrm{H}-3$ ), 4.44-4.48 (br, $1 \mathrm{H}, \mathrm{H}-15), 5.30-5.38$ (br, $1 \mathrm{H}, \mathrm{H}-6$ ), 5.53 (d, 1 $\mathrm{H}, J=2.20 \mathrm{~Hz}$ ).
strategy should be applicable to a wide variety of functionalized sterol side chains and functionalized D rings of steroids.

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Supplementary Material Available: Experimental details and characterization data for compounds 2-10 are available upon request (11 pages). Ordering information is given on any current masthead.
(21) 8: $[\alpha]^{27} \mathrm{D}-66.9^{\circ}\left({ }^{(c} 0.22, \mathrm{CHCl}_{3}\right)$; ${ }^{1} \mathrm{H}$ NMR $(360 \mathrm{MHz}) \delta 1.03(\mathrm{~s}$, $3 \mathrm{H}, \mathrm{H}-18), 1.05\left(\mathrm{~d}, 3 \mathrm{H}, J=7.32 \mathrm{~Hz}, \mathrm{H}-16 \mathrm{CH}_{3}\right), 1.18(\mathrm{~s}, 3 \mathrm{H}, \mathrm{H}-19)$, $3.42-3.52$ ( $\mathrm{m}, 1 \mathrm{H}, \mathrm{H}-3$ ), $3.80(\mathrm{~d}, 1 \mathrm{H}, J=4.39 \mathrm{~Hz}, \mathrm{H}-20$ ), $5.00-5.08$ (br, $1 \mathrm{H}, \mathrm{H}-20$ ), $5.28-5.36$ (br, $1 \mathrm{H}, \mathrm{H}-6$ ).
(22) Nes, W. E.; Varkey, T. E.; Krevitz, K. J. Am. Chem. Soc. 1977, 99, 260. Koreeda, M.; Koizumi, N. Tetrahedron Lett. 1978, 1641. See also 5a. Isocholesterol: mp $151-153^{\circ} \mathrm{C}$; ${ }^{1} \mathrm{H}$ NMR ( 360 MHz ) $\delta 0.66(\mathrm{~s}, 3 \mathrm{H}, \mathrm{H}-18$ ), $0.80(\mathrm{~d}, 3 \mathrm{H}, J=6.59 \mathrm{~Hz}, \mathrm{H}-21), 0.99(\mathrm{~s}, 3 \mathrm{H}, \mathrm{H}-19)$; ${ }^{13} \mathrm{C}$ NMR ( 90 MHz ) $140.83,121.70,71.86,56.90,55.91,50.32,42.43,39.81,39.53,37.37,36.62$, 35.82, 35.23, 32.05, 31.80, 28.10, 28.00, 24.27, 24.03, 22.75, 22.66, 21.21, 19.43, 18.72, 12.18.
(23) For GC analysis of $20 R$ and $20 S$ steroidal acetates, see: Schow, $S$. R.; McMorris, T. C. J. Org. Chem. 1979, 44, 3760.
(24) The DMES ethers of $6,7,9,10$, cholesterol, and isocholesterol were prepared at room temperature with neat (dimethylethylsily) imidazole (Miyazaki, H.; Ishibashi, M.; Itoh, M.; Nambura, T. Biomed. Mass Spectrom. 1977, 4, 23). GC analyses were carried out on a Shimadzu TP-MI gas chromatograph (FID) with a $1.8-\mathrm{m}$ ( $5-\mathrm{mm}$ o.d.) column of $3 \%$ SE-30.
 cholesterol and isocholesterol. Gas flow: nitrogen $40 \mathrm{~mL} / \mathrm{min}$; hydrogen 40 $\mathrm{mL} / \mathrm{min}$. Retention times relative to THF solvent: DMES ether of $6,9.6$ $\mathrm{min} ; 7,9.4 \mathrm{~min} ; \mathbf{9}, 8.2 \mathrm{~min} ; \mathbf{1 0}, 11.2 \mathrm{~min} ;$ cholesterol, 10.6 min ; isocholesterol, 9.8 min .

## Additions and Corrections

Studies on the Reaction Mechanism of the Photocyclization of $\boldsymbol{N}$-Aryl Enamines. Dependence of Quantum Yields on Back and Side Reactions. [J. Am. Chem. Soc. 1980, 102, 6098]. Thomas Wolff* and Reinhardt Waffenschmidt, Gesamthochschule Siegen, Physikalische Chemie, D-5900 Siegen 21, West Germany.

Page 6099, column 1, first paragraph: The NMR data for 1 -( $N$-methylanilino)-1-phenyl-1-propene (3) should read: ${ }^{1} \mathrm{H}$ NMR ( $\mathrm{CDCl}_{3}$ ) 1.7 ( 3 H , doublet), 3.1 ( 3 H , singlet), 6.1 ( 1 H , quartet), $6.6-7.4 \mathrm{ppm}(10 \mathrm{H}$, multiplet). The authors are indebted to Professor H. Ahlbrecht, Giessen, for detecting and communicating the error.

Synthesis of $\beta$-Lactams from Substituted Hydroxamic Acids [ $J$. Am. Chem. Soc. 1980, 102, 7026]. M. J. Miller,* P. G. Mattingly, M. A. Morrison, and J. F. Kerwin, Jr., Department of Chemistry, University of Notre Dame, Notre Dame, Indiana 46556.

The products from the intermolecular N -alkylation of O -benzyl hydroxamates ( $\mathrm{RCONHOCH} \mathrm{CO}_{2} \mathrm{Ph}$ ) with alcohols ( $\mathrm{R}^{2} \mathrm{OH}$ ) in the presence to $\mathrm{DEAD} / \mathrm{PPh}_{3}$ (last four entries in Table I) have been subsequently shown to be the $O$-alkyl isomers

$$
\begin{gathered}
\mathrm{O}-\mathrm{R}^{2} \\
\mathrm{R}-\stackrel{\mathrm{C}}{\mathrm{C}}=\mathrm{N} \sim \mathrm{OCH}_{2} \mathrm{Ph}
\end{gathered}
$$

and not the $N$-alkyl isomers

$$
\begin{array}{cc}
\mathrm{O} & \mathrm{R} \\
\| & \mathrm{l} \\
\mathrm{R}-\stackrel{\mathrm{C}}{\mathrm{C}}-\mathrm{N}-\mathrm{OCH}_{2} \mathrm{Ph}
\end{array}
$$

as reported. The products from the intermolecular alkylation of O -acylhydroxamates and the intramolecular alkylations to give $\beta$-lactams are correctly assigned.
${ }^{15} \mathrm{~N}$ Nuclear Magnetic Resonance Spectroscopy. Products and Rearrangements in the Reaction of $p$-Toluenesulfonyl Azide-3- ${ }^{15} \mathrm{~N}$ with the Sodium Salt of $\boldsymbol{p}$-Toluenesulfonamide. An in Situ ${ }^{15} \mathrm{~N}$ NMR Study [J. Am. Chem. Soc. 1980, 102, 2364]. Carla Casewit and J. D. Roberts,* Contribution No. 6112 from the Gates and Crellin Laboratories of Chemistry, California Institute of Technology, Pasadena, California 91125

Page 2365, column 2: Figure 1a should appear as shown below.


