XXI.—*Molecular Rotatory Power in Normal Homologous Series. Part I. Optically Active Derivatives of the Higher Aliphatic Alcohols and Acids.*

By THOMAS PERCY HILDITCH.

THE values of a strictly additive physical property in successive members of a homologous series form an arithmetical progression the common difference of which represents the value of the property for the methylenic increment $\cdot\text{CH}_2\cdot$. Molecular mass is, however, the only physical characteristic which can be considered entirely

additive; in all other cases the influences of chemical constitution are sufficiently strong to interfere with the simple additive rule.

Nevertheless, in certain cases (such as specific heat, capillarity, or refractivity) the additive influence is stronger than the constitutive, so that, at all events after the earlier members of a homologous series are passed, a definite increment is added to the molecular value of the property for each addition of a methylene group.

In other properties, the constitutive effects outbalance any additive influence, and as an example the case of molecular magnetic rotatory power may be cited. Sir W. H. Perkin (*Trans.*, 1884, **45**, 574) showed that in this case each different homologous series possesses a characteristic "series constant" (which depends only on the chemical nature of the series in question), and, subsidiary to this, each methylene group present increases the molecular magnetic rotation by 1.023 units.

Finally, in still more constitutive properties (such as viscosity: compare Dunstan and Thole, *J. Chim. phys.*, 1909, **7**, 205; Getman, *Amer. Chem. J.*, 1908, **30**, 1077), the additive increment is almost or quite suppressed, and after the early members, the molecular value of the property becomes fairly constant for each member.

The extreme susceptibility of optical rotatory power (which, indeed, owes its existence to a specific type of constitution—molecular asymmetry) to the effects of chemical constitution has been frequently emphasised (compare Guye and Chavanne, *Bull. Soc. chim.*, 1896, [iii], **15**, 177; Frankland, *Trans.*, 1903, **83**, 1342, etc.; Forster, *ibid.*, 1909, **95**, 942; Pickard and Kenyon, *ibid.*, 1911, **99**, 45, etc.), and it is of some interest to observe the change in molecular rotatory power on ascending homologous series.

Tschugaëff (*Ber.*, 1898, **31**, 360) drew attention to the fact that the molecular rotatory powers of the active amyl and menthyl esters of the normal fatty acids became constant after the first few members, but apparently did not extend his generalisation to other types of optically active compounds. He pointed out, however, that the optically active esters of acids isomeric with the normal aliphatic acids do not in general possess the same rotatory power.

Walden (*Ber.*, 1905, **38**, 355) tabulated the evidence then available, and concluded that Tschugaëff's rule held in many cases, but was not universal, whilst Miss Homfray and Guye (*J. Chim. phys.*, 1903, **1**, 505) regard it as a particular case of the more general rule that a change of mass at a point sufficiently distant from the asymmetric system produces little alteration in the rotatory power.

On the other hand, the author has remarked (*Trans.*, 1908, **93**, 1; 1909, **95**, 1570) that changes in the rotatory power, due to alteration

in constitution of part of the molecule, can be best appreciated with reference to the molecular rotatory power of the nearest normal aliphatic derivative, and has suggested that the difference between these two values may be interpreted as a rough indication of the "anomaly" in optical activity introduced by the constitutive change.

The possibility of using such a "series constant" for optical activity has rendered desirable a more thorough revision of the data on which the Tschugaeff rule is based. A somewhat exhaustive survey of the existing data shows that some forty series of optically active homologous compounds have been described, but in about half the cases the members dealt with are only the first three, which renders them of little use for the present purpose.

In the remaining groups, many reach a constant molecular rotatory power almost at once, others after several members, and others, again, show no sign of attaining a constant value within the limits so far investigated. A few examples of each class may be given.

I.—*Series in which Approximate Constancy of $[M]_D$ is Rapidly Attained.*

(a) *Esters of Optically Active Alcohols.*

Acid.	Amyl. ¹	Bornyl. ²	Acid.	Amyl. ¹	Bornyl. ²
Formic	+2.3°	-89.2°	n-Valeric	+4.3°	-89.0°
Acetic	3.3	89.2	n-Hexoic	4.5	—
Propionic	4.0	89.9	n-Heptoic	4.4	—
n-Butyric	4.3	89.6	n-Octoic	4.5	—
			n-Nonoic	4.5	—

¹ Guye and Chavanne, *Bull. Soc. chim.*, 1896, [iii], 15, 177 (amyl alcohol, $[\alpha]_D - 4.5^\circ$).

² Minguin and Bollement, *Compt. rend.*, 1902, 134, 608.

(b) *Salts of Brucine and Cinchonine*¹ (compare p. 200).

(c) *Alkyl Derivatives of Ricinoleic Acid*² and of Bornylamine.³

(d) *Acyl Derivatives of Bornylamine*⁴ and *Menthylamine*,⁵ and of *Ethyl Malate*.⁶

¹ Hilditch, *Trans.*, 1909, 95, 1570.

² Walden, *Ber.*, 1903, 36, 781.

³ Forster, *Trans.*, 1899, 75, 934 (in alcohol).

⁴ Frankland and Barrow, *ibid.*, 1909, 95, 2017.

⁵ Birz, *Zeitsch. physikal. Chem.*, 1893, 12, 723.

⁶ Reitter, *ibid.*, 1901, 36, 129.

II.—Series in which Approximate Constancy of $[M]_D$ is only attained after several members.

(a) Alkyl Derivatives of Tartramide and Malamide.

Alcohol.	Tartaric diamides. ⁷	Malic diamides. ⁸	Alcohol.	Tartaric diamides. ⁷	Malic diamides. ⁸
Dimethyl.....	+262°	+109·6°	Di- <i>n</i> -butyl	+291°	+116·5°
Diethyl	282	111·8	Di- <i>n</i> -heptyl	303	118·4
Di- <i>n</i> -propyl...	290	114·7			

⁷ Frankland and Twiss, Trans., 1906, **89**, 1852.

⁸ Frankland and Done, *ibid.*, 1906, **89**, 1859.

(b) Normal Aliphatic Esters of Glyceric⁹ and Diacetylgllyceric Acids,⁹ and of Monomethoxy- and Monoethoxy-succinic Acids.¹⁰

III.—Series in which Constancy of $[M]_D$ is not reached.

(a) Esters of Diacetyltartaric Acids.¹¹

	Dimethyl.	Diethyl.	Di- <i>n</i> -propyl.	Di- <i>n</i> -butyl.
Diacetyltartrate	—	+14·5°	+42·6°	+27·7°
Dipropionyltartrate	—31·0°	+1·6	+19·4	+25·8
Di- <i>n</i> -butyryltartrate	—48·0	—2·8	+19·5	+24·1
Di- <i>n</i> -valeryl tartrate	—55·7	—7·9	+13·2	+20·6
Di- <i>n</i> -hexoyltartrate	—59·5	—12·6	+9·5	—

It is at once noticeable that all the series included in tables II and III (glycerates, malates, and tartrates) contain the asymmetric system :

and that in the tartrates (which are least of all in accord with the Tschugaeff rule) this system, which possesses the two unsaturated groups $\cdot\text{CO}_2\text{R}'$ and $\cdot\text{OR}''$ adjacent to the asymmetric carbon atom, is repeated symmetrically about the centre of the molecule.

The author has previously shown (Trans., 1909, **95**, 331, 1570; *Zeitsch. physikal. Chem.*, 1911, **77**, 482) that unsaturation, and especially symmetrically conjugated unsaturation, of this type leads to anomalous values of optical rotatory power, and therefore it appears very possible that the inconstant nature of the molecular rotatory power in the above-mentioned cases is caused by the disturbing influence of the unsaturated radicles directly united to the asymmetric atoms. This suggestion is supported by the series quoted in table II, inasmuch as the latter reach tolerable constancy after the first half-dozen or so members are passed.

⁹ Frankland and McGregor, Trans., 1893, **63**, 511, 1410, 1419; 1894, **65**, 750.

¹⁰ Purdie and co-workers, *ibid.*, 1893, **63**, 217, 229; 1895, **67**, 944, 957.

¹¹ Freundler, *Bull. Soc. chim.*, 1894, [iii], **11**, 305.

It is therefore intended to examine a number of derivatives of the tartrates, malates, etc., of very high molecular weights (such as cetyl esters, stearyl and palmityl derivatives, etc.) in order to test whether the suggested disturbing influences of unsaturation are overcome on ascending the various homologous series to a sufficient distance.

It appeared desirable, however, in the first place, to ensure that series of the normal type quoted in table I maintained their constant molecular rotatory power equally high in their respective groups, and this communication includes a description of this preliminary work, which, it may be said at the outset, confirms Tschugaeff's rule in these cases.

Before quoting the figures obtained in this investigation, it will be well to draw attention to the following points:

(a) The most appropriate constant for the quantitative study of optical activity.

(b) The comparability of different series when the latter contain varying numbers of asymmetric carbon atoms.

(a) *Specific rotatory power* $[\alpha]_D$ affords a comparison of equal masses of active substance, and whilst beyond this it possesses no precise physical meaning or substantiation, it is the only fundamental constant of optical activity which we at present possess. Of the two derived constants, *molecular rotatory power* $[M]_D$ and *molecular deviation* $[\delta]_D$ (Guye, *Compt. rend.*, 1893, 116, 1451), the latter has found little application; Tschugaeff (*loc. cit.*) pointed out that specific rotatory power has little meaning with respect to either the molecular hypothesis or from a stereochemical point of view, whereas molecular rotatory power gives a direct comparison of the rotation produced by the active molecules.

Although, as Forster (*Trans.*, 1909, 95, 942) has emphasised, there may be no absolute physical proof of the validity of the expression $[\alpha]_D$, it is the only one available, and it has stood the test of a century's practical use; and, for the same reasons as those given by Tschugaeff, it will be employed in the present investigation in its derived form of molecular rotatory power.

(b) Doubt has frequently been expressed (compare, for example, Pickard and Kenyon, *loc. cit.*) as to the possibility of comparing the results from series derived from different optically active substances containing varying numbers of asymmetric atoms (for example, amyl alcohol and menthol), and furthermore, in the case of substances containing more than one asymmetric atom, as to whether each asymmetric atom will be affected similarly by a given change of constitution, since the different atoms will be at varying distances from the group which has suffered alteration.

With regard to the second point, there is no direct evidence, so far as the author is aware, that the optical activity of a poly-asymmetric grouping is derived in any way additively from the activity of each asymmetric atom. Indeed, it would appear more probable that, although such atoms doubtless act each as a centre of asymmetry, the resultant rotation is due, as Pasteur (*Compt. rend.*, 1852, **35**, 180) originally suggested, to *molecular*, and not *atomic*, asymmetry. Two facts which seem to favour this distinction are (i) the absence of any simple relation between the rotation of a compound possessing n , and a nearly-related compound possessing $n-1$, asymmetric atoms (for example, *l*-menthol and *l*-menthone), and the absolute dissimilarity of the rotatory powers of isomerides possessing similar asymmetric systems (for example, menthol and borneol); and (ii) the well-established circumstance (Perkin, Pope, and Wallach, *Trans.*, 1909, **95**, 1789; Mills and Miss Bain, *ibid.*, 1910, **97**, 1866) that a compound may exhibit optical activity, owing to molecular asymmetry, in the absence of any asymmetric carbon atom at all.

Hence it appears to the author that the number of asymmetric atoms present in a given molecule has little bearing, according to the evidence at present existing, upon the changes induced in the rotatory power by constitutive influences, providing, of course, that no centres of asymmetry are destroyed or created by the alteration in chemical constitution.

With reference to the former question of drawing generalisations from series derived from varying asymmetric systems, it must be admitted that the existing results tend to show the validity of the comparison. For example, the following homologous series (table I, grouped according to the number of "asymmetric atoms" present) conform strictly to the Tschugaeff rule:

- 1 *asymmetric atom*.—Amyl esters, ricinoleic esters, acyl derivatives of ethyl malate.
 - 3 *asymmetric atoms*.—Bornyl and menthyl esters, alkyl bornylamines, acyl bornylamines, and menthylamines.
 - 4 *asymmetric atoms*.—Cinchonine salts.
- Unknown number of }
asymmetric atoms. } Brucine salts.

Moreover, apart from derivatives of the above types (esters and salts), in which the change in constitution takes place at a point relatively distant from the centres of asymmetry, series in which the increasing alkyl radicles are directly attached to an asymmetric atom show an exactly parallel behaviour. Two examples may be cited, in one of which there is but little unsaturation (methyl-*n*-alkylcarbinols, Pickard and Kenyon, *loc. cit.*), whilst in the second (alkylated malic acids, Purdie and co-workers, *loc. cit.*), unsaturation

and asymmetry of the $R\cdot CH(OH)\cdot CO_2H$ type (compare p. 195) is present. The first conforms to the constant molecular rotatory power rule almost at once, the second (of which only the first three members are available) does not reach a constant value for $[M]_D$.

Constancy of molecular rotatory power is thus a well-defined characteristic of many optically active homologous series, simple or complex, and comprising asymmetric systems with one, three, four, or more atomic centres of asymmetry.

The compounds the optical activity of which is about to be described include the higher aliphatic esters or salts of menthol, camphoric acid, camphor- β -sulphonic acid, brucine, and cinchonine.

The polarimetric measurements were made at 20° in a 2-dcm. tube in chloroform solution at two concentrations (5.0 and 2.5 per cent.), and, also, in the case of menthyl esters, in alcohol solution at the same concentrations. As usual, the alkaloid salts were made up from the requisite amounts of base and acid (accurately weighed), and subsequently recovered for characterisation. The optically active materials from which the various derivatives were prepared possessed the following rotations at 20° :

	Solvent.	Concentration per cent.	α_D .	$[\alpha]_D$.
Menthol	Chloroform.	5.0	-4.891°	-48.91°
Brucine	"	2.5	-6.049	-120.98
Cinchonine	Alcohol	0.5	+2.245	+224.5
Camphoric acid	"	5.0	+4.867	+48.67
Camphor- β -sulphonic acid ...	Chloroform.	5.0	+3.947	+39.47
Camphor- β -sulphonyl chloride ...	Water	5.0	+2.395	+23.95
	Chloroform.	5.0	+3.201	+32.01

The following tables comprise the result of the polarimetric determinations:

I.—*Menthyl Esters.*

(a) *In Chloroform.*

	5.0 per cent.			2.5 per cent.		
	α_D .	$[\alpha]_D$.	$[M]_D$.	α_D .	$[\alpha]_D$.	$[M]_D$.
Menthyl myristate...	-4.283°	-42.83°	-156.7°	-2.137°	-42.74°	-156.4°
Menthyl palmitate	3.979	39.79	156.8	1.967	39.34	155.0
Menthyl stearate ...	3.671	36.71	154.9	1.847	36.94	155.9

(b) *In Alcohol.*

	5.0 per cent.			2.5 per cent.		
	α_D .	$[\alpha]_D$.	$[M]_D$.	α_D .	$[\alpha]_D$.	$[M]_D$.
Menthyl myristate ...	-4.341°	-43.41°	-158.9°	-2.193°	-43.86°	-160.5°
Menthyl palmitate...	4.017	40.17	158.2	2.027	40.54	159.7
Menthyl stearate ...	3.773	37.73	159.2	1.885	37.70	159.1

II.—*Brucine Salts.*

	5.0 per cent.			2.5 per cent.		
	α_D .	$[\alpha]_D$.	$[M]_D$.	α_D .	$[\alpha]_D$.	$[M]_D$.
Brucine myristate ...	-3.967°	-39.67	-246.8°	-1.983°	-39.66°	-246.7°
Brucine palmitate ...	3.807	38.07	247.5	1.911	38.22	248.4
Brucine stearate	3.648	36.48	247.4	1.827	36.54	247.7

III.—*Cinchonine Salts.*

	5.0 per cent.			2.5 per cent.		
	α_D .	$[\alpha]_D$.	$[M]_D$.	α_D .	$[\alpha]_D$.	$[M]_D$.
Cinchonine myristate	+13.353°	-133.53°	+697.1°	+6.709°	+134.18°	+700.3
Cinchonine palmitate	12.779	127.79	703.1	6.317	126.34	695.0
Cinchonine stearate	12.221	122.27	706.6	6.071	121.42	702.5

IV.—*Alkyl Hydrogen Camphorates.*

	5.0 per cent.			2.5 per cent.		
	α_D .	$[\alpha]_D$.	$[M]_D$.	α_D .	$[\alpha]_D$.	$[M]_D$.
Cetyl hydrogen camphorate.....	+2.043°	+20.43°	+86.6°	+1.021°	+20.42°	+86.6°
Myricyl hydrogen camphorate	1.429	14.29	88.6	0.729	14.58	90.4°

V.—*Alkyl Camphor- β -sulphonates.*

	5.0 per cent.			2.5 per cent.		
	α_D .	$[\alpha]_D$.	$[M]_D$.	α_D .	$[\alpha]_D$.	$[M]_D$.
Cetyl camphor- β -sulphonate.....	+2.193°	+21.93°	+100.0°	+1.087°	+21.74°	+99.2°
Myricyl camphor- β -sulphonate.....	—	—	—	0.765	15.30	99.5

In the concluding table are collected the molecular rotatory powers of the complete series of these esters and salts; the values for the lower members are taken from the author's measurements (Trans., 1909, **95**, 331, 1570), with the exception of the alcohol solutions of menthyl acetate to *n*-hexoate (Rupe, *Annalen*, 1903, **327**, 157):

I.—*Esters and Salts of n-Aliphatic Acids.*

	Menthyl (chloroform).		Menthyl (alcohol.)	
	5.0.	2.5.	5.0.	2.5.
Concentration: per cent.	5.0.	2.5.	5.0.	2.5.
Acetate	-158.2°	-157.0°	-149.9°	—
Propionate.....	156.6	157.2	162.2	—
<i>n</i> -Butyrate.....	161.2	161.7	164.7	—
<i>n</i> -Valerate.....	161.9	162.1	165.7	—
<i>n</i> -Hexoate.....	164.4	168.1	164.7	—
<i>n</i> -Heptoate	—	—	165.9	—
<i>n</i> -Myristate	156.7	156.4	158.9	160.5°
Palmitate	156.8	155.0	158.2	159.7
Stearate.....	154.9	155.9	159.2	159.1

I.—*Esters and Salts of n-Aliphatic Acids (continued).*

Concentration : per cent.	Brucine.		Cinchonine.	
	5.0.	2.5.	5.0.	2.5.
Acetate	-258.0°	-260.6°	+691.9°	+706.7°
Propionate	248.1	252.3	690.7	707.9
<i>n</i> -Butyrate	247.4	251.2	692.6	714.1
<i>n</i> -Valerate	247.4	251.6	692.8	704.1
<i>n</i> -Hexoate	246.8	252.8	672.7	698.6
<i>n</i> -Heptoate	—	—	—	—
<i>n</i> -Myristate	246.8	246.7	697.1	700.3
Palmitate	247.5	248.4	703.1	695.0
Stearate	247.4	247.7	706.6	702.5

II.—*Esters of Optically Active Acids.*

Concentration : per cent.	Hydrogen camphorates.		Camphor- β -sulphonates.	
	5.0.	2.5.	5.0.	2.5.
Methyl	+123.5°	+125.2°	+107.3°	+106.8°
Ethyl	88.3	90.7	114.2	112.6
<i>n</i> -Propyl	93.8	93.3	—	—
<i>n</i> -Butyl	91.1	92.8	—	—
Cetyl	86.6	86.6	100.0	99.2
Myricyl	88.6	90.4	—	99.5

The approximate constancy is well maintained throughout, although there may possibly be a very slight diminution in the value of the constant after a certain point on passing up the series; it is also noticeable that the effect of concentration on the rotations of the alkaloid salts diminishes on ascending the series.

It is hoped to continue this line of research, both in the direction of the rotatory powers of the higher homologous derivatives of more unsaturated acids, and of the examination of certain substituted series of the higher fatty acids, such as the bromo- and hydroxy-derivatives.

EXPERIMENTAL.

The *menthyl* esters were prepared by warming the acids with a very slight excess of pure thionyl chloride for about twenty minutes, the excess being then removed by warming to 100° under diminished pressure; the theoretical quantity of menthol was then added, and the mixture heated at 100° under diminished pressure for two hours. The product was dissolved in chloroform, and extracted two or three times with aqueous potassium carbonate. The chloroform layer was finally separated, dried, and evaporated, and on boiling the residue with alcohol and setting aside for some time the ester slowly crystallised out, and was purified from a little hot alcohol. The table illustrates the properties and analyses of the esters used :

		Analysis.			Found.			Theory.		
		M. P.	Subst.	CO ₂ .	H ₂ O.	C%.	H%.	Formula.	C%.	H%.
<i>Myristate</i> ...	Thin, colourless prisms.	32°	0.0994	0.2858	0.1181	78.41	13.20	C ₂₄ H ₄₆ O ₂	78.68	12.57
<i>Palmitate</i> ..	Large, thin prisms.	36	0.1756	0.5082	0.2082	78.93	13.05	C ₂₆ H ₅₀ O ₂	79.20	12.69
<i>Stearate</i> ...	Small, colourless tablets.	39	0.1191	0.3459	0.1346	79.26	12.49	C ₂₈ H ₅₄ O ₂	79.62	12.80

The characteristics of the *brucine* and *cinchonine* salts examined are given below:

<i>Brucine myristate</i>	C ₃₇ H ₅₄ O ₆ N ₂ , ½H ₂ O	Cream, wax-like crystals, melting at 60–65°, and frothing at 125°.
<i>Brucine palmitate</i>	C ₃₉ H ₅₈ O ₆ N ₂ , 2H ₂ O	Soft, white, microcrystalline powder, which melts to a clear liquid at 70°, and froths at 100–105°.
<i>Brucine stearate</i>	C ₄₁ H ₆₂ O ₆ N ₂ , 1½H ₂ O	White, crystalline powder, melting at 70–72° to a clear liquid, which froths at 110–115°.
<i>Cinchonine myristate</i> ...	C ₃₃ H ₅₀ O ₃ N ₂	Tough, waxy crystals, melting and decomposing at 215°.
<i>Cinchonine palmitate</i> ...	C ₃₅ H ₅₄ O ₃ N ₂	Soft, white, crystalline powder, which melted and commenced to blacken at 230°.
<i>Cinchonine stearate</i>	C ₃₇ H ₅₈ O ₃ N ₂	Small, slender, white prisms, melting and decomposing at 248°.

The following analyses of these salts were made:

	Subst.	CO ₂ .	H ₂ O.	Found.		Calc.	
				C%.	H%.	C%.	H%.
<i>Brucine myristate</i>	0.1800	0.4640	0.1461	70.26	9.02	70.37	8.72(½H ₂ O)
<i>Brucine palmitate</i>	0.1284	0.3211	0.1069	68.19	9.25	68.22	9.04(2H ₂ O)
<i>Brucine stearate</i>	0.1500	0.3855	0.1281	70.08	9.49	69.79	9.22(1½H ₂ O)
<i>Cinchonine myristate</i> ...	0.1001	0.2784	0.0847	75.84	9.40	75.86	9.57
<i>Cinchonine palmitate</i> ..	0.1414	0.3963	0.1296	76.40	10.18	76.35	9.82
<i>Cinchonine stearate</i>	0.1013	0.2848	0.0940	76.68	10.31	76.83	10.03

Cetyl and *myricyl hydrogen camphorates* were obtained when equivalent amounts of camphoric anhydride and the alcohol were heated at 170° for eight hours in an oil-bath; the cooled product was dissolved in a considerable quantity of ether, and extracted twice with dilute aqueous potassium carbonate. The aqueous layer was separated and acidified with dilute sulphuric acid, and again extracted with ether. The ethereal extract, after being dried and the ether evaporated, was crystallised two or three times from chloroform.

<i>Cetyl hydrogen camphorate</i>	C ₂₆ H ₄₈ O ₄	White, waxy nodules, which melted at 35°.
<i>Myricyl hydrogen camphorate</i> ...	C ₄₀ H ₇₆ O ₄	Wax-like, crystalline powder, melting at 71–72°.

Analyses:

	Subst.	CO ₂ .	H ₂ O.	Found.		Calc.	
				C%.	H%.	C%.	H%.
<i>Cetyl ester</i>	0.0921	0.2474	0.0981	73.24	11.84	73.58	11.32
<i>Myricyl ester</i>	0.0975	0.2781	0.1058	77.78	12.06	77.41	12.26

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Cetyl camphor-β-sulphonate, $C_{26}H_{48}O_4S_2$, resulted when the alcohol was heated with a large excess of camphor-β-sulphonyl chloride in 50 per cent. aqueous pyridine at 100° for two hours.

Some cetyl alcohol still remained unattacked, but several recrystallisations from hot alcohol gave a sample of the pure sulphonic ester, melting at 52° .

Myricyl camphor-β-sulphonate, $C_{40}H_{76}O_4S$, was produced in good yield by heating the alcohol with excess of the sulphonyl chloride in pyridine at 100° for some hours. After several recrystallisations from ether, it melted at 78° .

Analyses:

	Subst.	CO ₂ .	H ₂ O.	Found.		Calc.	
				C%.	H%.	C%.	H%.
<i>Cetyl ester</i>	0.0929	0.2336	0.0955	68.58	11.42	68.42	10.52
<i>Myricyl ester</i>	0.1086	0.2968	0.1129	74.52	11.57	73.62	11.45

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