3. Benzyl cyanide and the benzalacetylacetone were found not to react with the formamidine, though the free CH_2 derivatives did.

4. With benzalacetophenone and the formamidine the anil resulted—a product that was obtained in 80% yield on heating the ketone with aniline and sodium acetate.

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[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY, UNIVERSITY OF ILLINOIS]

DI-(CYCLOHEXYLALKYL) ACETIC ACIDS. XIV[1]

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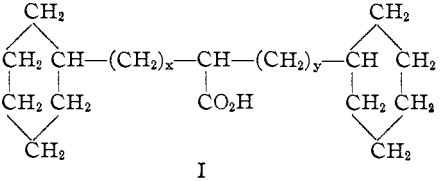
RECEIVED JUNE 4, 1928 PUBLISHED AUGUST 4, 1928

In previous papers it has been demonstrated that when a cyclohexyl group is substituted at the end of a straight-chained aliphatic acid of certain molecular weight, the product is an effective bactericide *in vitro* toward *B. leprae*, whereas the corresponding straight-chained acid with the same number of carbon atoms is ineffective. It has been shown further that if the carboxyl group is removed from the end of the chain to a position nearer to the ring, the effectiveness of the isomeric acid is increased. As a consequence it seemed advisable to prepare a few di-(cyclohexylalkyl) acetic acids for testing, in which the carboxyl group is in the favored position. It is thus possible to determine whether a second ring structure would enhance the bactericidal properties. The compounds prepared are of the general formula represented by I where "x" is 1, 2, 3 or 4 and where "y" is 0, 1, 2 or 3. They were made in the usual way by introducing first one cyclohexylalkyl group into malonic ester and then a second, followed by saponification and heating of the malonic acid.



I

The bacteriological results in Table I indicate that no particular ad-

[1] For previous articles in this field see (a) Shriner and Adams, THIS JOURNAL, **47**, 2727 (1925); (b) Noller with Adams, *ibid.*, **48**, 1080 (1926); (c) Hiers with Adams, *ibid.*, **48**, 1089 (1926); (d) *ibid.*, **48**, 2385 (1926); (e) Van Dyke and Adams, *ibid.*, **48**, 2393 (1926); (f) Sacks with Adams, *ibid.*, **48**, 2395 (1926); (g) Noller and Adams, *ibid.*, **48**, 2444 (1926); (h) Adams, Stanley, Ford and Peterson, *ibid.*, **49**, 2934 (1927); (i) Arvin with Adams, *ibid.*, **49**, 2940 (1927); (j) Adams, Stanley and Stearns, *ibid.*, **50**, 1475 (1928); (k) Yohe and Adams, *ibid.*, **50**, 1503 (1928); (l) Arvin and Adams, *ibid.*, **50**, 1983 (1928).

[2] This communication is an abstract of a portion of a thesis submitted by Letha A. Davies in partial fulfilment of the requirements for the Degree of Doctor of Philosophy in Chemistry at the University of Illinois.

vantage is gained by the introduction of the second ring. In fact, the two compounds which have 20 carbon atoms are, like most of the other molecules studied which contain that number of carbon atoms, comparatively inactive.

TABLE I

BACTERIOLOGICAL ACTION OF THE ACIDS

$C_6H_{11}(CH_2)_x—\underset{\underset{CO_2H}{|}}{CH}—(CH_2)_yC_6H_{11}$

			Dilution of sodium salts in thousands									
			25	50	62	74	85	100	125	155	180	230
1	x = 0	y = 2	−	−	+	+	+	+	+	+	+	+
2	x = 1	y = 2	−	−	−	−	−	−	±	+	+	+
3	x = 2	y = 2	−	−	−	−	−	−	−	−	−	+
4	x = 2	y = 3	−	−	−	±	−	−	−	−	−	±
5	x = 3	y = 3	−	+	+	+	+	+	+	+	+	+
6	x = 2	y = 4	−	+	+	+	+	+	+	+	+	+

Experimental Part

The general procedures for the preparation of all of the intermediate and final compounds have been given in previous articles in this series.[1d,h]

TABLE II

DIETHYL-DI-(ω-CYCLOHEXYLALKYL) MALONATES

$C_6H_{11}(CH_2)_x—C(CO_2C_2H_5)_2—(CH_2)_yC_6H_{11}$	B. p., °C.	n_D^{20}	d_4^{20}	Analysis Calcd. C	Calcd. H	Found C	Found H
1 x = 0 y = 2	192 (4.5 mm.)	1.4747	1.016	71.53	10.30	71.14	10.20
2 x = 1 y = 2	186–188 (3 mm.)	1.4725	1.003	72.06	10.46	71.96	10.24
3 x = 2 y = 2	200–202 (1.5 mm.)	1.4722	0.9931	72.57	10.60	72.45	10.49
4 x = 2 y = 3	210–211 (3.5 mm.)	1.4713	.9928	73.05	10.73	72.18	10.76
5 x = 3 y = 3	216–218 (3 mm.)	1.4710	.9811	73.45	10.86	73.43	10.82
6 x = 2 y = 4	208–210 (2.5 mm.)	1.4710	.9817	73.45	10.86	73.30	10.76

TABLE III

DI-(ω-CYCLOHEXYLALKYL) ACETIC ACIDS

$C_6H_{11}(CH_2)_x—CH(CO_2H)—(CH_2)_yC_6H_{11}$	B. p., °C.	M. p., °C.	n_D^{25}	d_4^{20}	Analysis Calcd. C	Calcd. H	Found C	Found H
1 x = 0 y = 2	182–186 (4 mm.)	.....	1.4852	0.9915	76.14	11.18	76.07	10.98
2 x = 1 y = 2	207–208 (5 mm.)	50–51	....	....	76.63	11.34	76.59	11.33
3[a] x = 2 y = 2	210–213 (1.5 mm.)	73–76	(Neut. equiv.:		280.3		279.8)	
4 x = 2 y = 3	213–214 (3 mm.)	46.5–47	....	....	77.49	11.65	77.14	11.52
5 x = 3 y = 3	216–218 (3 mm.)	42.5–45	....	....	77.91	11.79	78.00	11.73
6 x = 2 y = 4	221–223 (4 mm.)	.....	1.4831	0.9647	77.91	11.79	77.67	11.54

[a] This acid and the corresponding malonic ester have been described by G. H. Coleman in a Doctor's thesis, University of Illinois, 1928.

The bacteriological tests were kindly made by Mr. W. M. Stanley.

Summary

A number of di-(cyclohexylalkyl) acetic acids were prepared. They were no more effective bactericidally than those molecules containing the same number of carbon atoms which have only one ring present.

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