## PERFLUORO $\alpha, \omega$ -DIOLEFINS AND SOME OF THEIR REACTIONS

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The telomerization reaction, which has been applied extensively in recent years, opens up wide possibilities for the preparation of polyfluoro hydrocarbons of high molecular weight and their various derivatives, differing in the terminal groups of the telomer. Numerous different telomers of fluoro olefins have now been prepared. In 1951 Haszeldine [1] reported the telomerization of tetrafluoroethylene with iodine with formation of polyfluoro- $\alpha, \omega$ -diiodoalkanes of general formula  $I(CF_2CF_2)_{nl}I$  in which  $\underline{n} = 4-18$ , but the author does not give the experimental conditions. Our experiments in this direction gave very low yields of a mixture of telomers. Moreover, the inability of the CF<sub>2</sub>I group to undergo heterolytic reactions greatly limits the possibility of passing from diiodo compounds to derivatives of other types. In the thermal telomerization of tetrafluoroethylene with 1,2-dichlorotrifluoroiodoethane Hauptschein and others [2] obtained only a solid product which did not contain iodine and was probably polyfluoroethylene.

By the telomerization of tetrafluoroethylene with 1,2-dichlorotrifluoroiodoethane in presence of benzoyl peroxide as initiator we succeeded in obtaining, in good yields, the lower telomer-homologs and the higher telomers, which were waxlike substances  $CF_2CI \cdot CFCII + nCF_2 = CF_2 \rightarrow CF_2CICFC1(CF_2CF_2)_{II}$  in which  $\underline{n} = 1, 2, 3$ , and 4 (Tables 1 and 2). As in all cases of telomerization the proportions of the telomers in the reaction products depends on the reaction conditions and the amount of telogen used. In all experiments the amount of benzoyl peroxide was 1% on the weight of dichlorotrifluoroiodoethane taken for reaction.

By the action of zinc on solutions of telomers in methylene chloride in presence of acetic anhydride [3] we obtained  $\alpha$ ,  $\beta$ ,  $\psi$ ,  $\omega$ -tetrachloropolyfluoroalkanes (Table 3), which by dechlorination with zinc in acetic acid were converted into perfluoro  $\alpha$ ,  $\omega$ -dienes (Table 4).

$$2CF_{2}CICFC1 (CF_{2}CF_{2})_{n} I \xrightarrow{CH_{2}CI_{2}} CF_{2}CICFC1 (CF_{2}CF_{2})_{2n}CFCICF_{2}CI$$

$$Zn \qquad in CH_{3}COOF_{2}$$

$$CF_{2}=CF (CF_{2}CF_{2})_{2n}CF=CF_{2}$$

In this way we obtained perfluoro-1,7-octadiene, perfluoro-1,11-dodecadiene, and perfluoro-1,15-hexadecadiene. Moreover, by coupling together a mixture of different telomers we obtained tetrachloro compounds from which we isolated 1,2,5,6-tetrachlorodecafluorohexane and 1,2,9,10-tetrachlorooctadecafluorodecane (see Table 3).

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CF_CICECUL+ CF_CICECICF_CF_J															
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								U	F12	UI 2					
CF <sub>2</sub> CICFCICFCICF <sub>2</sub> CI															21,1%
CF_CICECICE_CF_CFCICE_CI															24 3%
	•	•	•	•		•	•	•	•	•		•	•	•	21,070
CF <sub>2</sub> ClCFCl (CF <sub>2</sub> CF <sub>2</sub> ) <sub>2</sub> CFClCF <sub>2</sub> Cl	•	•	•		•	٠								٠	22,1%
											Z	l n			
$CF_{2}CICFCICF_{2}CF_{2}J + C$	F,	CI	CI	FC	1 (	CF	7,0	CF	$_{2})_{2}$	J.				<b>*</b>	
,	-	•					-			(	CH	2C	12		
CF <sub>2</sub> ClCFCl (CF <sub>2</sub> CF <sub>2</sub> ) <sub>2</sub> CFClCF <sub>2</sub> Cl		•	•	•					•		•	•			20,0%
CF <sub>2</sub> CICFCI (CF <sub>2</sub> CF <sub>2</sub> ) <sub>3</sub> CFCICF <sub>2</sub> CI		•													38,2%
CE CICECHOE CEN CECICE CI															

By the dechlorination of 1,2,9,10-tetrachlorooctadecafluorodecane we obtained perfluoro-1,9-decadiene (see Table 4).

TABLE 1. Reaction Conditions and Yields of Telomer-Homologs

Ratio of	Reaction	Reaction	Yield	of telomers	(%*)
$CF_2CICFCII$ to $CF_2 = CF_2$	temp. (°C)	time (hr)	<i>n</i> =1	n=2	<i>n</i> ≥3
2:1 1:1 1:2	135 130 130	4 5 4	62,4 57,0 39,2	19,8 24,0 23,0	4,5 25

\* On the 1,2-dichlorotrifluoroiodoethane that reacted. The benzoyl peroxide bringing about the radical telomerization was converted to a considerable extent into iodobenzene.

TABLE 2

					М	R	М		Found	(%)	Calc	. (%)
n	b.p. in C (p in mm)	м.р. (°С)	d <sup>20</sup>	n20 D	found	calc.	found	calc.	с	F	с	F
-					1			1				
1	66 (67)		2,135	1,4040	43,47	44,18	374	379	12,44	[36, 21]	12,68	35,11
2	83 (35)	-	2.095	1.3840	53.34	53.98	3479.5	479	14.72	43.28	15,05	43,64
-			$d_{4}^{30}$	$n_{D}^{30}$							ŕ	
3	82 (3)	22 - 24	2.078	11.3710	63.17	63.76	61569	579	16.69	49.11	16,58	49.22
4	110-111 (7)	70-71							17,99	52,67	17,67	53,17

TABLE 3

						N	IR	Found	l (%)	Calc	. (%)
n	Yield (%)	B.p. in C (p in mm)	м.р. (°С)	$d^{20}_{4}$	$n_{D}^{20}$	found	calc.	с	F	С	F
1 2	$\left \begin{array}{c}24,3\\80\end{array}\right $	80 (34) 67 (3)		1,7215 1,838 $d_{*}^{35}$	1,3704 1,3604 $n_D^{35}$	49,84 60,58	50,76 60,56	18,08 18,89	$46,84 \\ 53,22$	17,82 19,06	47,01 52,79
3 4 6 8	38,2 77 91,5 85	94 (5) 116 (5)	29—30 68 126—128 160	1,858	1,3496	69,88	70,34	19,80 20,82 21,18 21,52	$57,56 \\ 59,33 \\ 63,63 \\ 66,01$	19,86 20,46 21,05 21,74	56,62 59,37 63,05 65,40

By oxidation with potassium permanganate in aqueous-acetone solution, all the perfluoro  $\alpha, \omega$ -diolefins obtained were converted in good yield into the corresponding perfluoro dicarboxylic acids HOOC(CF<sub>2</sub>CF<sub>2</sub>)<sub>n</sub>COOH, in which n = 2, 3, 4, and 6 (Table 5).

Until now only a few fluorinated dicarboxylic acids have been obtained in very low yields by the electrochemical fluorination of the corresponding dicarboxylic acids [4] or by the oxidation of unsaturated fluoro hydrocarbons [5, 6]. From perfluorodipic and perfluorosebacic acids acid chlorides were prepared for the first time by the action of thionyl chlorine in presence of catalytic amounts of KCl or KOH, and from these dianilides and diamides were prepared. The use of KCl as catalyst in the preparation of the acid chlorides of strong acids was reported earlier by Kraft and co-workers [7]. By the polycondensation of perfluoroadipoyl and of perfluorosebacoyl chlorides with 1,6-hexanediamine at the interface of two media (water  $-CCl_4$ ), fluorinated polyamides have been prepared.

· (%)	٢L	73, 47 74, 03 74, 38 74, 80
Calc	υ	26,54 25,97 25,62 25,20
(o/o)	ĩL,	$\begin{array}{c} 73,24\\74,55\\74,38\\74,45\end{array}$
Found	U	26,72 25,97 25,80 25,31
8	calc.	40,18 43,98 59,78
IW	found	40,52 49,56 59,99 -
	$n_D^{20}$	1,3020 1,3100 
	d <sup>20</sup> 4	1,695 1,796 1,826
	B.p. (°C)	106 148 181-182 147-149 (33 mm) M.P. 73-74
	11e1d (%)	72,5 67,8 60 72,9
	Perfluoro diolefins	Perfluoro-1,7-octadiene Perfluoro-1,9-decadiene Perfluoro-1,11-dodecadiene Perfluoro-1,15-hexadecadiene
	u	cl co 4 co

**TABLE 4** 

TABLE 5

	1			Neutral	ization		Found. 0			alculated	1. %	
Acid Yield, % M.	Yield.% M.	Z	p. (°C)	equival	ent		in the second second		,		2	Literature
				Found	calc.	J	Н	<u>د</u>	ç	Н	Ŀ,	Ici.
Perfluoroadipic 86 134-	86 134-	134	135	144,5	145,0	24,88	0,75	52,42	24,83	0,69	52,41	[2]
Perfluorosuberic 95   143-14	95 143-14	143-14	44	198	195	24,52	0,46		24,62	0,51	58,46	•
Perfluorosebacic 92 160-16	92 160-16	160-16	*	244	245	24,83	0, 49	62, 13	24,50	0,41	62,04	[1]
Perfluorotetradecanedioic 71,8 191-19	71,8 191-193	191-193	**	337	345	24,66	0,37		24,36	0,29	66,09	

\* From water. \* \* From dioxane.

## EXPERIMENTAL

Telomerization of tetrafluoroethylene with 1,2-dichlorotrifluoroiodoethane. A 250 ml rotating steel autoclave was charged with 200 g (0.72 mole) of dichlorotrifluoroiodoethane and 2 g of freshly precipitated benzoyl peroxide. The autoclave was purged with dry nitrogen, cooled to  $-60^{\circ}$ , and evacuated; 14 liters (0.7 mole) of tetrafluoroethylene was then condensed in the autoclave, which was heated with shaking for four hours at 130°. When the autoclave, which was heated with shaking for four hours at 130°. When the autoclave was cool, unchanged tetrafluoro-

TABLE 6. Fractionation Results

Fraction	B.p. (°C)	₩t. (g)	Yield (%)	Formula
I II IV V VI Residue	до 133 133—135 135—170 170—172 172—201 75—76 (4mm)	6 40,1 7,5. 58,8 9,0 67,0 2,0	22,1 24,3 22,1	C4F6Cl4 C6F10Cl4 C8F14Cl4

ethylene was transferred from the autoclave to a gas holder (5 liters), and the reaction mixture was distilled through a column of 17-plate efficiency. We collected the following fractions: 1) Unchanged dichlorotrifluoroiodoethane, 108 g, b.p. 53° (150 mm) and 99-102° (760 mm). 2) 1,2-Dichloroheptafluoro-4-iodobutane, 72 g (57% on the dichlorotrifluoroiodoethane that reacted); b.p. 66° (67 mm);  $n_D^{20}$  1.4046;  $d_4^{20}$  2.135. Found MR 43.47; M 374; calculated MR C<sub>4</sub>F<sub>7</sub>Cl<sub>2</sub>I MR 44.18; M 379. Found: C 12.44, 12.68; F 36.21, 35.69%. Calculated: C 12.68; F 35.11%. 3) A mixture of iodobenzene and 1,2-dichloroundecafluoro-6-iodohexane, b.p. 81° (35 mm). 4) 1,2-Dichloroundecafluoro-6-iodo-hexane, 37.5 g (24% on the dichlorotrifluoroiodoethane that reacted); b.p. 83-84° (35 mm);  $n_D^{20}$  1.3830;  $d_4^{20}$  2.095. Found MR 53.34; M 479.5; calculated MR C<sub>6</sub>F<sub>11</sub>Cl<sub>2</sub>I

MR 53.98, M 479. Found: C 14.49, 14.72; F 44.07, 43.28%. C<sub>6</sub>F<sub>11</sub>Cl<sub>2</sub>I. Calculated: C 15.05; F 43.64%.

The residue was 5 g of a thick crystallizing mass (mixture of higher telomers).

Under the same conditions from 93 g (0.33 mole) of 1,2-dichlorotrifluoroiodoethane, 1 g of benzoyl peroxide, and 14 liters (0.7 mole) of tetrafluoroethylene we obtained: 1) Unchanged dichlorotrifluoroiodoethane, 53 g. 2) 1,2-Dichloroheptafluoro-4-iodobutane, 21 g (39% on the dichlorotrifluoroiodoethane that reacted). 3) 1,2-Dichloroundecafluoro-6-iodohexane, 15.8 g (23%). 4) 1,2-Dichloropentadecafluoro-8-iodooctane, 20 g (24%); b. p. 82° (3 mm); m.p. 22-24°;  $n_D^{30}$  1.3710;  $d_4^{30}$  2.078. Found M 569; MR 63.17; calculated MR C<sub>8</sub>F<sub>15</sub>Cl<sub>2</sub>I M 579; MR 63.76. Found: C 16.69; F 49.11%. Calculated: C 16.58; F 49.22%.

For the mixture of higher telomers by fractionation through a column we isolated 1,2-dichlorononadecafluoro-10-iododecane; b.p. 110-111° (7 mm); m.p. 70-71°. Found: C 17.99; F 52.67%. C<sub>10</sub>F<sub>19</sub>Cl<sub>2</sub>I. Calculated: C 17.67; F 53.17%.

1,2,7,8-Tetrachlorotetradecafluorooctane. Gradual addition was made of 56.9 g (0.15 mole) of 1,2-dichloroheptafluoro-4-iodobutane to a stirred mixture of 10.0 g (0.15 mole) of granulated zinc, 31.0 g (0.3 mole) of acetic anhydride, and 50 ml of dry methylene chloride. Spontaneous evolution of heat occurred. Addition of the iodo compound was regulated in such a way that the temperature of the reaction mixture remained about 40°. When the addition was complete, the reaction mixture was stirred for six hours at 40°, after which 100 ml of water wqs added with cooling and stirring; the lower layer was separated, washed with water, dried with magnesium sulfate, and distilled through a column. We obtained 29.9 g (80%) of 1,2,7,8-tetrachlorotetradecafluorooctane; b.p. 67-68° (3 mm);  $n_D^{20}$  1.3604;  $d_4^{20}$  1.838. Found MR 60.58; M 505; calculated MR C<sub>8</sub>F<sub>14</sub>Cl<sub>4</sub> MR 60.56; M 504.00. Found: C 18.89; F 53.22%. Calculated: C 19.06; F 52.79%.

<u>1,2,11,12-Tetrachlorodocosafluorododecane</u>. Gradual addition was made of 96 g (0.2 mole) of 1,2-dichloroundecafluoro-6-iodohexane in 50 ml of methylene chloride to a stirred mixture of 13.5 g (0.2 mole) of granulated zinc, 41 g (0.4 mole) of acetic anhydride, and 150 ml of dry methylene chloride. The reaction conditions were as described for the preceding experiment. The reaction product was filtered off together with zinc, dried, and distilled. We obtained 54 g (77%) of 1,2,11,12-tetrachlorodocosafluorododecane; b.p.  $68-68.5^{\circ}$  (from CC1<sub>4</sub>). Found: C 20.82; F 59.33%. C<sub>12</sub>F<sub>22</sub>Cl<sub>4</sub>. Calculated: C 20.46; F 59.37%.

<u>1,2,15,16-Tetrachlorotriacontafluorohexadecane</u>. Gradual addition was made of 126 g (0.216 mole) of 1,2dichloropentadecafluoro-8-iodooctane in 50 ml of methylene chloride to a stirred mixture of 26 g (0.4 mole) of granulated zinc, 40 g of acetic anhydride, and 220 ml of dry methylene chloride. When the addition of the iodo compound was complete, the reaction mixture was stirred for nine hours at 40°; 250 ml of water was then added with cooling. The insoluble white precipitate was filtered off together with zinc, washed with water, and dried in air. The product was extracted with hot carbon tetrachloride. The carbon tetrachloride was distilled off and we obtained 90 g (91.5%) of 1,2,15,16-tetrachlorotriacontafluorohexadecane, m.p. 126-128° (from CCl<sub>4</sub>). Found: C 21.18; F 63.63%. C<sub>16</sub>F<sub>30</sub>Cl<sub>4</sub>. Calculated: C 21.05; F 63.05%.

1.2.19.20-Tetrachlorooctatriacontafluoroeicosane. Under the same conditions from 1,2-dichlorononadecafluoro-10-iododecane we obtained an 86% yield of 1,2,19,20-tetrachlorooctatriacontafluoroeicosane, b.p. 206-210° (8 mm) and m.p. 160-161° (from CCl<sub>4</sub>). Found: C 21.52; F 66.01. C<sub>20</sub>F<sub>38</sub>Cl<sub>4</sub>. Calculated: C 21.74; F 65.40%.

1.2.5.6-Tetrachlorodecafluorohexane. A mixture of 168 g (0.6 mole) of 1.2-dichlorotrifluoroiodoethane and 228 g (0.6 mole) of 1.2-dichloroheptafluoro-4-iodobutane was added gradually with stirring to a mixture of 120 g of granulated zinc, 240 ml of acetic anhydride, and 500 ml of dry methylene chloride. When the addition of the iodo compounds was complete, the reaction mixture was stirred for nine hours at 40°, after which 300 ml of water was added with cooling and stirring the layer was separated, and to complete the hydrolysis of the acetic anhydride

TABLE 7. Fractionation Results

Fraction	B.p. in °C (p in mm)	Wt. (g)	Yield (%)	Formula
I II	(8(5)) 69-93(5)	60,5 8,0	20,0	$C_8F_{14}Cl_4$
IV Residue	96—110 (5) 96—110 (5)	$138.3 \\ 6,5 \\ 100,0$	38,2 23,7	$C_{10}F_{18}C_{14}$ $C_{12}F_{22}C_{14}$

it was added with stirring to 200 ml of boiling 5% sulfuric acid. The reaction mixture was stirred further with heating for one hour. The lower layer was separated, washed, first with water, then with sodium bicarbonate solution, and then again with water, and dried over magnesium sulfate. Fractionation through a column gave 58.8 g of 1,2,5,6tetrachlorodecafluorohexane (Table 6).

Constants of 1,2,5,6-tetrachlorodecafluorohexane; b.p. 170.5°; 80° (34 mm);  $n_D^{20}$  1.3704;  $d_4^{20}$  1.7215. Found MR 49.84; MR calculated MR C<sub>6</sub>F<sub>10</sub>Cl<sub>4</sub> 50.76. Found: C 18.02; F 46.84%. Calculated: C 17.82; F 47.01%.

<u>1.2.9.10-Tetrachlorooctadecafluorodecane</u>. Under the same conditions from 228 g (0.6 mole) of 1,2-dichloroheptafluoro-4-iodobutane and 288 g (0.6 mole) of 1,2-dichloroundecafluoro-6-iodohexane we obtained 1,2,9,10tetrachlorooctadecafluorodecane in 38.2% yield. The results of the experiment are shown in Table 7.

Constants of 1,2,9,10-tetrachlorooctadecafluorodecane; b.p. 94° (5 mm); m.p. 29-30°;  $n_D^{35}$  1.3496;  $d_4^{35}$  1.858. Found MR 69.88; calculated MR 70.34. Found: C 19.80; F 57.56%. C<sub>10</sub>F<sub>18</sub>Cl<sub>4</sub>. Calculated: C 19.85; F 56.62%.

Perfluoro  $\alpha, \omega$ -diolefins. Gradual addition was made of 0.1 mole of the  $\alpha, \beta, \psi, \omega$ -tetrachloroalkane (fully fluorinated) to a mixture of 180 ml of acetic acid, 60 ml of acetic anhydride, and 40 g of granulated zinc at 118° with stirring. The reaction mixture was heated at the boiling point for 12 hours, cooled, and diluted with water. The lower layer was separated, washed, first with water, then with sodium bicarbonate solution, and finally again with water, dried over magnesium sulfate, and distilled through a column. In the preparation of perfluoro-1,7- octadiene the boiling point of the reaction mixture gradually fell to 103-107°, and the reaction product was distilled off. The distillate was washed in the usual way and fractionated through a column. In the preparation of perfluoro-1,15-hexadecadiene, after dilution of the reaction mixture with water the reaction product was extracted with trichlorotrifluoroethane (Freon 113). The Freon was distilled off, and then the perfluoro-1,15-hexadecadiene. The residues remaining after the distillation of the olefins were treated again with zinc and acetic acid, and further amounts of perfluoro diolefins were obtained. The yield and properties of the perfluoro diolefins are given in Table 4.

Perfluoro dicarboxylic acid. A three-necked flask fitted with stirrer, dropping funnel, and thermometer was charged with 75 ml of water, 75 ml of chemically pure acetone, and 19 g (0.12 mole) of potassium permanganate. A solution of 0.03 mole of the perfluoro diolefin in acetone was added dropwise to the mixture with stirring at 15-20°. Stirring was continued for five hours. The reaction mixture was left overnight. The precipitate was filtered off and washed with hot water. The solution was decolorized with sulfur dioxide and acidified with 50% sulfuric acid. Water and acetone were vacuum-distilled off down to a volume of 70 ml. The residue was extracted with ether in an extractor for five hours. The ether extract was dried over magnesium sulfate, and ether was vacuumdistilled off. The residue was recrystallized from toluene and dried in an Abderhalden pistol over  $P_2O_5$  at 100°. In the preparation of perfluorotetradecanedioic acid 2 g of the diolefin was dissolved in 100 ml of acetone and the reaction was carried out at 40-50°. Because of the low solubility of both the acid itself and its potassium salt in water, at the end of the reaction the mixture was not filtered, but sulfur dioxide was passed through it until the MnO<sub>2</sub> had dissolved completely. Water and acetone were distilled off until the volume was 70 ml, and the mixture was acidified with sulfuric acid to Congo red; the acid was extracted with ether. The results of the experiments are given in Table 5. Perfluoroadipoyl chloride. A mixture of 3.4 g (0,0117 mole) of perfluoroadipic acid, 5 ml of thionyl chloride, and 0.05 g of potassium hydroxide was placed in a flask fitted with reflux condenser. The mixture was heated in a water bath for eight hours and then distilled. We obtained 3.0 g (78.3%) of perfluoroadipoyl chloride; b.p. 131-132°;  $n_D^{20}$  1.3488;  $d_4^{20}$  1.679. Found MR 41.70; calculated MR 40.77. Found MR 84.1; calculated MR 81.8. Found: C 21.90; F 46.83; Cl 12.50%. C<sub>6</sub>H<sub>8</sub>Cl<sub>2</sub>O<sub>2</sub>. Calculated: C 21.38; F 46.48; Cl 13.46%.

Dianilide of perfluoroadipic acid. M.p. 196-196.5° (from ethanol). Found: C 49.10; H 2.72; F 35.15%. C<sub>18</sub>H<sub>12</sub>F<sub>8</sub>N<sub>2</sub>O<sub>2</sub>. Calculated: C 49.09; H 2.73; F 34.54%.

Perfluorosebacoyl chloride. By the same method we prepared perfluorosebacoyl chloride; b.p. 101-103° (23 mm); m.p. 29-30°; yield 80%;  $n_D^{37}$  1.3336;  $d_4^{37}$  1.771. Found MR 61.30; calculated MR 60.38. Found MR 130.0; calculated MR 131.8. Found: C 22.75; F 57.76; Cl 12.50%. C<sub>10</sub>F<sub>16</sub>Cl<sub>2</sub>O<sub>2</sub>. Calculated: C 22.77; F 57.68; Cl 13.47%.

Dianilide of perfluorosebacic acid, M.p. 199.5-200° (from ethanol). Found: C 41.30; H 1.86; F 47.33%.  $C_{22}H_{12}F_{16}N_2O_2$ . Calculated: C 41.25; H 1.88; F 47.50%.

Diamide of perfluorosebacic acid. M.p. 239-241° (from acetic acid). Found: C 24.76; H 0.68; F 61.13%.  $C_{10}H_{4}F_{16}N_{2}O_{2}$ . Calculated: C 24.59; H 0.83; F 62.30%.

Polyamide from perfluoroadipic acid. A solution of 0.93 g (0.008 mole) of 1.6-hexanediamine and 1.0 g (0.018 mole) of potassium hydroxide in 80 ml of water was added at 0-10° with vigorous stirring to a solution of 2.6 g (0.008 mole) of perfluoroadipoyl chloride in 80 ml of carbon tetrachloride. The precipitate was filtered off, washed by decantation four times with methanol and then five times with water, and then dried in an Abderhalden pistol over  $P_2O_5$  at 100°. We obtained 1.5 g (44.8%) of polyamide. Found: C 38.65; H 3.79; F 40.91%.  $C_{12}H_{14}F_8N_2O_2$ . Calculated: C 38.95; H 3.79; F 41.08%.

Polyamide from perfluorosebacic acid. In a similar way we prepared the polyamide formed by perfluorosebacic acid with 1,6-hexanediamine; yield 60.7%. Found: C 33.00; H 2.51; F 50.08%.  $C_{16}H_{14}F_{16}N_2O_2$ . Calculated: C 33.68; H 2.45; F 53.33%.

## SUMMARY

1. By the telomerization of tetrafluoroethylene with 1,2-dichlorotrifluoroiodoethane a series of dichloropolyfluoroiodoalkanes  $CF_2CICFCI(CF_2CF_2)_{\Pi}I$  (n = 1, 2, 3, and 4) were prepared.

2. Under the action of zinc the resulting dichloropolyfluoroiodoalkanes were converted into the corresponding tetrachloropolyfluoroalkanes and further into perfluoro  $\alpha, \omega$ -diolefins CF<sub>2</sub> = CF(CF<sub>2</sub>)<sub>II</sub>CF = CF<sub>2</sub> (n = 2, 3, 4, and 6).

3. Oxidation of the perfluoro  $\alpha, \omega$ -diolefins gave perfluoro dicarboxylic acids HOOC(CF<sub>2</sub>CF<sub>2</sub>)<sub>n</sub>COOH (<u>n</u> = 2, 3, 4, and 6).

4. By the heterophase condensation of perfluoroadipoyl and of perfluorosebacoyl chloride with 1,6-hexanediamine, fluorinated polyamides were prepared.

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