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Hydrogen Bonding in Potassium Hydrogen *meso*-Tartrate. A Low-Temperature X-ray Study

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A crystal-structure analysis of potassium hydrogen *meso*-tartrate was carried out at −160°C. The crystals are triclinic ($P\bar{1}$) with $Z=4$. Cell dimensions are $a=9{\cdot}33\pm0{\cdot}01$, $b=10{\cdot}29\pm0{\cdot}01$, $c=9{\cdot}09\pm0{\cdot}01$ Å, $\alpha=80{\cdot}71\pm0{\cdot}05$, $\beta=108{\cdot}77\pm0{\cdot}05$ and $\gamma=130{\cdot}95\pm0{\cdot}05°$. The crystal is in fact a racemate, since the *meso*-tartaric molecules themselves are disymmetric. The conformation of one of the carboxyl groups is quite unusual, as the OH bond is in the *anti* position with respect to the C=O bond. The hydrogen bond scheme is of a mixed *A*/*B* type with three short hydrogen bonds. One of the hydrogen atoms is found in an acentric position in an *A*-type bond, that is as a rule supposed to be symmetrical.

Introduction

In crystal structures of potassium *meso*-tartrate (Kroon, Peerdeman & Bijvoet, 1965), in several modifications of *meso*-tartaric acid (Bootsma & Schoone, 1967) and in the dimethyl ester of *meso*-tartaric acid (Kanters & Kroon, 1972) the same conformation of the *meso*-tartaric acid molecule is always found, *viz*. a skew ethane conformation around the central C–C bond. As one might expect the same disymmetric conformation in the acid salts of *meso*-tartaric acid, there is the problem how the non-equivalence of the carboxyl groups in *meso*-tartaric molecules will manifest itself in these salts. For that reason the structure determination of potassium hydrogen *meso*-tartrate was undertaken. Because of the importance of the hydrogen position the analysis was carried out at liquid-nitrogen temperature.

Experimental

Crystals of potassium hydrogen *meso*-tartrate were obtained from an aqueous solution at room temperature. The cell dimensions were determined on a Nonius diffractometer with Mo $K\alpha$ radiation ($\lambda=0{\cdot}7107$ Å) and found to be: $a=9{\cdot}33\pm0{\cdot}01$, $b=10{\cdot}29\pm0{\cdot}01$, $c=9{\cdot}09\pm0{\cdot}01$ Å, $\alpha=80{\cdot}71\pm0{\cdot}05$, $\beta=108{\cdot}77\pm0{\cdot}05$, $\gamma=130{\cdot}95\pm0{\cdot}05°$. The measurements were carried out at −160°C; the working temperature was maintained by immersion of the crystal in a stream of cold gaseous nitrogen surrounded by an envelope of dry nitrogen at room temperature. The *a* axis was chosen parallel to the direction of elongation of the crystal. The Delaunay-reduced cell can be obtained by the transformation matrix

$$S=\begin{pmatrix}1 & 1 & 0\\ 0 & \bar{1} & 0\\ 0 & 0 & 1\end{pmatrix}$$

and has cell dimensions $a'=8{\cdot}19$, $b'=10{\cdot}29$, $c'=9{\cdot}09$Å, $\alpha'=99{\cdot}29$, $\beta'=99{\cdot}42$ and $\gamma'=120{\cdot}65°$. With four molecules in the unit cell the calculated density (2·01 g.cm^{-3}) agrees well with the density determined by flotation (1·99 g.cm^{-3}). The space group was assumed to be $P\bar{1}$ and this choice was justified by the results of the structure determination.

The 5308 independent integrated intensities up to $\theta=34°$ were taken on a 3-circle Nonius automatic diffractometer with the θ–2θ scan technique, using zirconium-filtered Mo $K\alpha$ radiation. Corrections were made for Lorentz and polarization factors. An absorption correction was applied, taking into account the irregular shape of the crystal ($\mu=8{\cdot}3$ cm^{-1}; minimum and maximum dimensions were 0·2 and 0·5 mm respectively).

Table 1. *Final fractional positional parameters and their estimated standard deviations in parentheses*

	x	*y*	*z*
K(1)	0·22316 (4)	0·43397 (3)	0·12891 (3)
K(2)	0·25520 (4)	0·82925 (3)	0·27170 (3)
O(3)	−0·0747 (1)	−0·0928 (1)	0·7540 (1)
O(4)	0·0122 (1)	0·1267 (1)	0·8874 (1)
O(5)	0·0464 (1)	0·2216 (1)	0·5578 (1)
O(6)	0·3225 (1)	0·4131 (1)	0·4904 (1)
O(7)	0·3944 (1)	0·3293 (1)	0·8942 (1)
O(8)	0·4788 (1)	0·2618 (1)	0·6648 (1)
C(15)	0·0532 (2)	0·0647 (1)	0·8227 (1)
C(16)	0·2644 (2)	0·1615 (1)	0·8197 (1)
C(17)	0·2809 (2)	0·1802 (1)	0·6538 (1)
C(18)	0·2118 (2)	0·2780 (1)	0·5621 (1)
H(3)	−0·195 (4)	−0·147 (4)	0·765 (3)
H(6)	½ (0)	½ (0)	½ (0)
H(7)	0·414 (3)	0·323 (3)	0·982 (2)
H(8)	0·476 (3)	0·241 (3)	0·582 (2)
H(16)	0·300 (3)	0·094 (3)	0·871 (2)
H(17)	0·193 (3)	0·069 (3)	0·606 (2)
O(9)	0·4149 (1)	0·2724 (1)	0·2057 (1)
O(10)	0·5199 (1)	0·1805 (1)	0·4194 (1)
O(11)	0·8326 (1)	0·2704 (1)	0·0320 (1)
O(12)	0·5653 (1)	0·0873 (1)	0·1181 (1)
O(13)	0·7779 (1)	0·5094 (1)	0·1654 (1)
O(14)	1·0565 (1)	0·4664 (1)	0·3077 (1)
C(19)	0·5476 (2)	0·2745 (1)	0·3067 (1)
C(20)	0·7596 (2)	0·4083 (1)	0·2948 (1)
C(21)	0·8500 (2)	0·3299 (1)	0·2870 (1)
C(22)	0·7476 (2)	0·2256 (1)	0·1316 (1)
H(12)	½ (0)	0 (0)	0 (0)
H(13)	0·741 (3)	0·561 (3)	0·173 (2)
H(14)	1·116 (3)	0·440 (3)	0·365 (2)
H(20)	0·836 (3)	0·478 (3)	0·388 (2)
H(21)	0·832 (3)	0·256 (3)	0·366 (2)

Table 2. *Final anisotropic thermal parameters of the non-hydrogen atoms and the isotropic thermal parameters and peak heights of the hydrogen atoms*

The anisotropic temperature factor for an atom is of the form: $\exp\left[-(10^{-5}\sum_i\sum_j h_ih_j\beta_{ij})\right]$.

	β_{11}	β_{22}	β_{33}	$2\beta_{12}$	$2\beta_{23}$	$2\beta_{31}$
K(1)	418	505	344	441	55	368
O(3)	416	304	441	288	−14	381
O(4)	570	431	415	680	104	425
O(5)	550	506	419	711	160	189
O(6)	635	392	403	578	349	393
O(7)	432	326	224	346	−20	145
O(8)	469	508	312	628	94	354
C(15)	444	303	288	427	148	272
C(16)	401	284	234	382	96	225
C(17)	417	350	246	453	89	241
C(18)	539	323	221	468	31	145
K(2)	783	479	347	866	25	143
O(9)	410	465	328	530	124	241
O(10)	694	460	291	741	243	496
O(11)	540	652	383	446	−304	374
O(12)	453	361	392	250	−242	283
O(13)	623	384	325	722	240	447
O(14)	325	429	333	465	−105	−11
C(19)	456	320	242	450	−9	255
C(20)	427	305	225	428	13	183
C(21)	396	317	238	436	−32	98
C(22)	432	332	283	499	−81	148

Table 2 (*cont.*)

	B (Å^2)	ϱ (e.Å^{-3})
H(3)	2	0·42
H(6)	5	0·31*
H(7)	0	0·58
H(8)	0	0·52
H(16)	0	0·65
H(17)	0	0·69
H(12)	3	0·45
H(13)	0	0·46*
H(14)	0	0·46
H(20)	0	0·71
H(21)	0	0·69

* Value at special position.

Structure determination

On successful location of the potassium ions from a three-dimensional Patterson analysis followed by repeated cycles of structure-factor calculations and Fourier syntheses the positions of all the non-hydrogen atoms were found. The hydrogen atoms showed up in a difference Fourier synthesis (terms up to $\sin\theta/\lambda = 0{\cdot}4$ Å^{-1}); their peak heights are given in Table 1. Scaling factor, positional parameters, the anisotropic temperature factors of the non-hydrogen atoms and the isotropic temperature factors of the hydrogen atoms were submitted to a least-squares block-diagonal refinement. All structure factors were given unit weight. All the temperature factors of the hydrogen atoms except for those belonging to the carboxyl groups became slightly negative. For this reason they were put equal to zero and kept constant during the further refinement. No extinction correction was applied, but five strong reflexions suspected of being weakened by this effect were given zero weight. Scattering factors were in the form of the analytical expression given by Moore (1963).

Tables 1 and 2 show the final structural parameters. Table 3 compares the structure factors observed and calculated.

The final R value is 0·035. A difference Fourier synthesis with terms up to $\sin\theta/\lambda = 0{\cdot}4$ Å^{-1} and all atoms subtracted showed no peaks greater than 0·2 e.Å^{-3}. In the difference Fourier synthesis with all 5303 structure factors a systematic effect cropped up. Near the centres of the covalent bonds there was an appreciable residual electron density. The minimum and maximum values for carbon–oxygen bonds amounted to 0·2 e.Å^{-3} and 0·4 e.Å^{-3} respectively. For carbon–carbon bonds these values were 0·4 e.Å^{-3} and 0·6 e.Å^{-3}. Evidently, these effects are due to the use of inadequate spherical scattering factors.

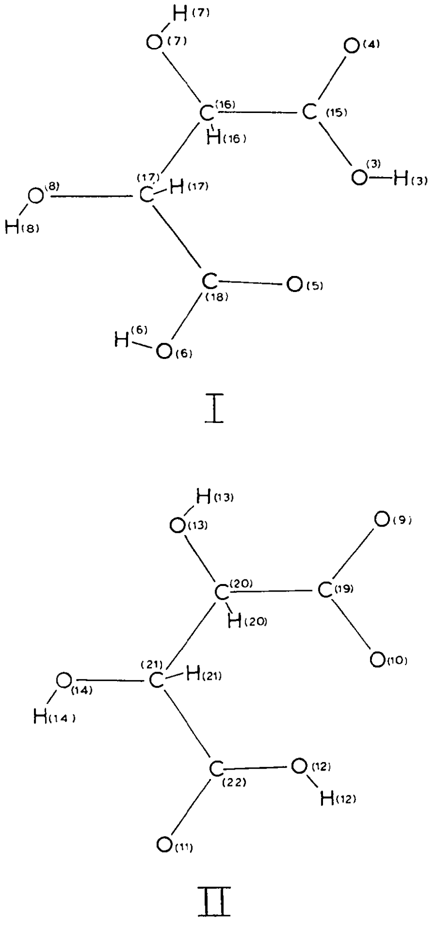

Fig. 1. Numbering scheme for the two independent *meso*-tartrate molecules.

Table 3. *Observed and calculated structure factors*

The reflexions suspected of extinction and omitted from the refinement are marked with an asterisk.

The colums of each group are *h,k,l*, $|10F_o|$, $10F_c$.

12	-9	4	119	-118
		5	38	-39
		6	23	-19
11	-8	5	171	-168
		6	14	-19
		7	129	124
12	-8	-13	48	-51
		-12	82	-80
		-11	120	-117
		4	122	-121
		5	94	94
		6	101	96
9	-7	6	123	127
		7	19	-19
		8	68	-65
		9	98	94
10	-7	-6	74	-77
		-5	138	-138
		-4	152	-149
		-3	15	-13
		-2	126	126
		-1	49	51
		0	98	101
		1	54	-60
		2	115	-118
		3	161	-160
		4	21	-18
		5	122	119
		6	66	-62
		7	25	29
		8	79	78
11	-7	-14	37	-30
		-13	27	27
		-12	62	59
		5	21	5
		6	41	-43
		7	7	-9
12	-7	-13	70	-68
		-12	114	118
		-11	39	36
		5	38	-33
8	-6	1	76	79
		2	134	-133
		3	125	-130
		4	149	154
		5	51	-46
		6	45	-51
		7	200	199
		8	42	-44
		9	158	-155
		10	43	-41
9	-6	-10	92	-96
		-9	50	44
		-8	193	-199
		-7	271	-275
		-6	81	-82
		-5	282	288
		-4	307	311
		-3	126	-130
		-2	58	57
		-1	97	95
		0	232	-239
		1	159	-156
		2	7	-8
		3	129	130
		4	33	37
		5	211	211
		6	70	73
		8	112	-112
		9	83	-82
10	-6	-14	46	-51
		-13	84	87
		-12	94	94
		-11	97	-95
		-10	2	-9
		-9	16	20
		-8	142	-141
		-7	169	-170
		-6	149	151
		-5	79	74
		-4	106	-109
		-3	11	-16
		-2	69	66
		-1	175	-181
		0	113	-116
		1	86	89
		2	124	127
		3	41	38
		4	28	-21
		6	70	-74
		8	8	-3
11	-6	-14	173	168
		-13	49	52
		-12	121	-121
		5	46	-49
		6	80	-81
		7	69	-63
12	-6	-13	46	-47
		-12	7	-12
		-11	33	35
		3	21	24
		5	121	-120
6	-5	9	50	47
		10	18	-15
		11	66	-59
7	-5	-3	29	-31
		-2	104	106
		-1	293	-294
		0	61	-61
		1	105	-109
		2	97	-88
		3	26	24
		4	111	-115
		5	202	206
		6	147	153
		7	106	-108
		8	111	-114
		9	27	-24
		10	95	-91
		11	60	-56
8	-5	-14	100	100
		-13	143	144
		-12	122	-122
		-11	147	146
		-10	126	127
		-9	257	-254
		-8	131	-129
		-7	86	94
		-6	25	24
		-5	180	181
		-4	485	487
		-3	114	105
		-2	461	-463
		-1	225	-223
		0	16	17
		1	91	96
		2	132	-135
		3	166	172
		4	90	98
		5	62	-72
		6	155	-155
		7	76	78
		8	67	-66
		9	52	-48
		10	16	16
9	-5	-15	73	78
		-14	51	56
		-13	36	41
		-12	66	68
		-11	83	-81
		-10	141	-145
		-9	80	-79
		-8	105	101
		-7	86	87
		-6	143	151
		-5	18	15
		-4	237	238
		-3	139	-138
		-2	157	-158
		-1	33	32
		0	70	71
		1	44	-44
		2	32	40
		3	296	304
		4	26	-30
		5	202	-206
		6	129	-129
		7	34	31
		8	68	62
		9	41	-37
10	-5	-14	46	-47
		-13	17	19
		-12	113	-108
		-11	180	-176
		-10	51	49
		-9	97	99
		-8	131	135
		-7	67	-70
		-6	11	-1
		-5	5	0
		-4	85	-89
		-3	87	-78
		-2	66	66
		-1	248	251
		0	21	13
		1	61	-61
		2	65	58
		3	73	-73
		4	85	-88
		5	45	48
		6	181	180
		8	44	-39
11	-5	-13	79	-75
		-12	68	-61
		5	177	174
		6	95	95
12	-5	-13	52	51
		-12	42	-32
		-11	127	125
		-10	112	110
		2	65	66
		3	52	51
		4	27	31
		5	16	-13
5	-4	5	245	250
		6	70	-76
		7	78	81
		8	11	7
		9	254	-251
		10	63	-66
		11	36	32
		12	27	32
6	-4	-7	194	-189
		-6	35	42
		-5	150	153
		-4	354	342
		-3	9	-9
		-2	349	-343
		-1	172	168
		1	144	-140
		2	126	120
		3	410	419
		4	22	20
		5	80	-85
		6	37	-36
		7	50	-50
		8	25	-21
		9	38	-34
		10	68	67
		11	119	117
7	-4	-15	41	43
		-14	64	64
		-13	130	124
		-12	18	-8
		-11	226	-229
		-10	196	-200
		-9	67	75
		-8	17	-13
		-7	312	-312
		-6	147	144
		-5	472	465
		-4	130	-121
		-3	232	-234
		-2	72	70
		-1	263	-262
		0	348	-344
		1	335	340
		2	79	76
		3	51	49
		4	69	-65
		5	136	144
		6	22	-27
		7	10	-13
		8	17	-16
		10	48	47
		11	19	-18
8	-4	-15	74	69
		-13	10	-11
		-12	99	-93
		-11	102	-104
		-10	185	186
		-9	20	27
		-8	121	126
		-7	91	-97
		-6	27	23
		-5	272	-271
		-4	243	-234
		-3	114	-113
		-2	177	172
		-1	323	327
		0	55	-65
		1	65	64
		2	78	-79
		3	343	-350
		4	87	-89
		5	71	70
		6	68	72
		7	22	-20
		8	271	266
		9	36	33
		10	138	-134
9	-4	-15	33	34
		-14	17	11
		-13	118	-112
		-12	99	95
		-11	79	73
		-10	7	-4
		-9	14	21
		-8	69	67
		-7	29	37
		-6	119	-117
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		-4	11	-11
		-3	59	69
		-2	69	-70
		-1	24	-25
		0	44	35
		1	67	-71
		2	132	-126
		3	23	-18
		4	64	63
		5	51	-52
		6	28	21
		7	82	82
		8	17	-10
10	-4	-14	54	-51
		-13	24	24
		-12	156	155
		-11	230	225
		-10	67	63
		-9	55	-55
		-8	186	-187
		-7	266	-269
		-6	43	-44
		-5	297	307
		-4	300	299
		-3	110	114
		-2	102	-97
		-1	73	70
		0	155	-164
		1	191	-196
		2	57	-55
		3	136	137
		4	26	29
		5	15	6
		6	90	88
		7	12	9
11	-4	-13	36	38
		-11	108	-108
		5	125	-120
		6	44	-50
12	-4	-12	157	-156
		-11	166	-165
		-10	7	2
		1	141	138
		2	40	33
		3	104	-100
		4	21	20
3	-3	13	179	171
4	-3	1	22	-31
4	-3	2	27	-28
		3	135	-122
		4	136	129
		5	88	86
		6	91	90
		7	211	-219
		8	26	-25
		9	39	39
		10	58	61
		11	51	-57
		12	43	39
		13	80	80
5	-3	-11	54	-58
		-10	7	14
		-9	51	-58
		-8	128	-129
		-7	307	300
		-6	209	261
		-5	19	-22
		-4	262	-263
		-3	81	81
		-2	282	-288
		-1	48	36
		0	156	159
		1	116	121
		2	195	-189
		3	64	-61
		4	50	47
		5	17	6
		6	302	-308
		7	59	-61
		8	140	148
		9	52	52
		10	24	11
		11	7	9
6	-3	-15	104	105
		-14	36	35
		-13	140	-141
		-12	32	-35
		-11	64	62
		-10	108	-111
		-8	361	367
		-7	57	59
		-5	87	-87
		-4	63	63
		-3	4	6
		-2	307	-296
		-1	316	318
		0	403	390
		1	155	147
		2	396	-392
		3	41	41
		4	131	-130
		5	238	-241
		6	183	193
		7	187	189
		3	30	29
		9	138	-141
		10	56	-54
7	-3	-15	120	-119
		-14	94	-92
		-13	32	-29
		-11	29	-28
		-10	306	309
		-9	27	-39
		-8	81	-85
		-7	211	-209
		-6	233	-232
		-5	173	173
		-4	232	243
		-3	71	72
		-2	18	14
		-1	328	326
		0	130	123
		1	302	-299
		2	40	-47
		3	24	-14
		4	78	75
		5	123	-131
		6	249	253
		7	169	167
		8	103	-101
		9	138	-137
		10	56	50
8	-3	-15	177	-179
		-14	105	-106
		-13	54	56
		-12	50	53
		-10	133	130
		-9	144	149
		-8	394	-390
		-7	229	-234
		-5	23	12
		-4	55	-57
		-3	338	347
		-2	168	162
		-1	72	-78
		0	264	-266
		1	98	-57
		2	82	84
		3	78	73
		4	79	83
		5	59	53
		6	75	74
		7	47	-50
		8	7	-6
		9	30	-23
9	-3	-14	173	176
		-13	82	81
		-12	74	-72
		-11	92	-96
		-10	58	49
		-8	220	-220
		-7	74	76
		-6	86	82
		-5	78	86
		-4	43	-46
		-3	75	76
		-2	171	-172
		-1	203	-209
		0	18	17
		1	72	71
		2	74	74
		3	24	-30
		4	52	50
		5	40	40
		6	89	-88
		7	23	-24
		8	28	26
10	-3	-14	65	69
		-13	61	-62
		-11	51	48
		-10	87	-86
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		13	90	93
-8	12	-7	131	-130
		-6	12	-10
		-5	6	-10
		-4	94	98
		-3	180	168
		-2	136	-140
		-1	159	-164
		0	31	31
		1	35	-36
		2	194	-193
		3	86	86
		4	141	141
		5	59	60
		6	16	-16
		7	55	51
		8	96	-95
		9	127	-122
		10	43	39
		12	67	64
-7	12	-9	76	-72
		-8	28	27
		-7	28	-28
		-6	17	-14
		-5	64	64
		-4	168	173
		-3	44	-47
		-2	169	-173
		-1	40	-44
		0	118	-124
		1	55	-59
		2	108	114
		3	251	259
		4	38	-41
		5	148	-152
		6	40	-51
		7	55	-57
		8	74	-70
		9	6	-5
		10	20	30
		11	116	114
		12	9	4
-6	12	-9	26	33
-6	12	-8	67	67
		-5	57	60
		-4	71	71
		-3	73	-69
		-2	81	82
		-1	119	-120
		0	120	-116
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		2	216	220
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		4	131	-132
		5	46	-45
		6	35	33
		7	26	-21
		8	116	-119
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		10	91	88
		11	109	-108
		12	32	-29
-5	12	-9	64	59
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		-7	92	93
		-6	74	75
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		-4	121	-122
		-3	60	63
		-2	139	145
		-1	155	163
		0	48	-48
		1	121	122
		2	79	-79
		3	141	-145
		4	103	-102
		5	164	168
		6	28	-29
		7	109	-110
		8	205	200
		9	72	66
		10	101	-105
		11	135	-129
-4	12	-9	130	-134
		-8	41	38
		-7	60	57
		-6	16	8
		-5	57	-58
		-4	24	18
		-3	176	159
		-2	82	-82
		-1	85	-90
		0	33	26
		1	47	50
		2	147	-147
		3	72	75
		4	102	106
		5	101	102
		6	22	-9
		7	27	-24
		8	27	-27
		9	72	-72
		10	62	-62
-3	12	-9	68	-65
		-8	13	9
		-7	210	-206
		-6	87	-86
		-5	133	135
		-4	227	230
		-3	21	-33
		-2	37	-38
		-1	13	6
		0	151	-156
		1	95	-91
		2	19	1
		3	41	45
		4	141	140
		5	57	51
		6	77	76
		7	66	-69
		8	21	8
		9	83	-78
-2	12	-9	29	26
		-8	82	85
		-7	29	27
		-6	76	-71
		-5	124	123
		-4	61	-67
		-3	87	-89
		-2	36	-36
		-1	21	29
		0	145	-146
		1	37	-41
		2	244	243
		3	66	68
		4	61	-77
		5	61	-65
		6	44	-42
		7	87	-84
-1	12	-8	23	19
		-7	104	96
		-6	57	55
		-5	89	-89
		-4	41	-45
		-3	29	24
		0	18	-19
		1	22	27
		2	100	-98
		3	63	-60
		5	97	96
		6	52	-53
		7	49	-41
0	12	-7	26	28
		-5	89	-88
		-4	48	-48
		-3	37	32
		-2	28	24
		-1	79	71
		0	182	178
		1	48	-46
		2	211	-208
		3	98	-59
		4	103	100
		5	46	-45
1	12	-6	22	-18
		-5	132	130
		-4	110	109
		-3	29	25
		-2	35	-31
		-1	11	-12
		0	103	-106
		1	20	-18
		2	27	-27
		3	59	61
-12	13	-5	50	-52
		-4	38	-40
		-3	10	10
		-2	35	-29
		9	29	31
		10	93	-87
		11	36	-35
		12	25	24
-11	13	-5	69	-67
		-4	74	75
		10	32	-32
		11	35	33
		12	31	28
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		-5	74	80
		10	34	-38
		11	32	23
		12	51	58
-9	13	-7	157	-154
		-6	54	50
		-5	131	129
-9	13	10	8	-5
		11	30	-33
		12	46	-47
-8	13	-8	5	11
		-7	74	74
		-6	88	89
		10	29	-24
		11	17	-17
		12	25	18
		-8	71	76
		-7	32	32
		-6	50	-52
		9	122	-121
		10	7	-2
		11	39	-39
-6	13	-8	41	39
		-7	73	-74
		-6	154	-152
		9	77	-74
		10	50	52
		11	16	8
-5	13	-8	54	-52
		-7	110	-104
		-6	102	103
		8	46	-50
		9	26	-27
		10	22	-21
-4	13	-8	13	7
		-7	50	53
		-6	26	29
		7	92	-89
		8	74	77
		9	83	81
-3	13	-8	16	-17
		-7	174	173
		-6	45	-47
		-5	85	-89
		5	105	-106
		6	115	-117
		7	101	102
		8	46	41
-2	13	-7	57	-56
		-6	79	-80
		-5	16	-9
		-4	11	-7
		-3	9	4
		3	24	-28
		4	36	37
		5	67	66
		6	73	76
		7	86	85
-1	13	-6	63	59
		-5	29	27
		-4	28	-26
		-3	6	-1
		-2	114	110
		-1	22	13
		0	20	-24
		1	125	-122
		2	57	-53
		3	7	2
		4	16	18
		5	107	103
0	13	-4	15	-16
		-3	6	12
		-2	70	-72
		-1	34	-39
		0	70	-68
		1	49	48
		2	31	28
-12	14	-3	66	66
		-2	83	83
		-1	16	-20
		8	46	-51
		9	21	-19
		10	99	-91
		11	61	-56
-11	14	-5	19	14
		-4	16	15
		-3	61	56
		10	73	77
		11	46	-41
-10	14	-6	78	-71
		-5	35	-38
		-4	78	78
		9	27	26
		10	38	39
		11	74	73
-9	14	-6	13	-10
		-5	29	-35
		-4	77	-72
		9	34	-31
		10	93	90
		11	70	-74
-8	14	-7	51	-52
		-6	47	44
		-5	17	-5
		8	7	-17
		9	40	-40
		10	171	-169
		11	86	-83
-7	14	-6	91	-98
		-5	41	-34
		8	80	75
		9	33	28
		10	41	-42
-6	14	-7	68	68
		-6	7	-15
		-5	37	-37
		7	127	-121
		8	79	79
		9	106	101
-5	14	-7	8	10
		-6	100	-102
		-5	57	53
		-4	31	-31
		6	170	170
		7	34	34
		8	100	-94
		9	63	59
-4	14	-7	16	2
		-6	44	-43
		-5	22	-29
		-4	130	-131
		-3	40	-38
		4	76	-74
		5	100	97
		6	24	21
		7	13	14
-3	14	-6	57	-54
		-5	41	-40
		-4	136	134
		-3	67	69
		-2	15	21
		-1	90	-95
		0	15	-13
		1	92	-91
		2	35	-32
		3	15	21
		4	60	61
		5	78	71
		6	63	-62
-2	14	-5	4	0
		-4	129	120
		-2	66	-68
		-1	55	55
		0	55	55
		1	67	-68
		2	54	-46
		3	87	84
		4	66	66
-1	14	-2	16	12
		-1	57	55

Discussion of the structure

Intramolecular bond lengths and angles are given in Table 4 (for the numbering of the atoms in the two independent molecules see Fig. 1). Table 5 is concerned with the conformations around the carbon–carbon bonds of the molecules. The molecules occur as enantiomorphic pairs. The carboxyl group C(18)O(5)O(6)-H(6) has a conformation which to our knowledge has never been seen before in crystals. The O–H bond is in an *anti* direction with respect to the C=O bond. The same carboxyl group also deviates from the general findings that the α-hydroxyl group is in a *syn* position

Table 4. *Bond lengths* (Å) *and angles* (°) *in the meso-tartaric acid molecules and their estimated standard deviations in parentheses*

The hydrogen atoms H(6) and H(12) are supposed to be located at special positions.

C(15)–O(3)	1·324 (1)	C(19–O(10)	1·255 (1)
C(15)–O(4)	1·219 (2)	C(19)–O(9)	1·271 (1)
C(18)–O(5)	1·231 (2)	C(22)–O(12)	1·297 (1)
C(18)–O(6)	1·297 (1)	C(22)–O(11)	1·229 (1)
C(16)–O(7)	1·419 (1)	C(20)–O(13)	1·413 (1)
C(17)–O(8)	1·414 (2)	C(21)–O(14)	1·423 (2)
C(15)–C(16)	1·526 (2)	C(19)–C(20)	1·530 (2)
C(16)–C(17)	1·534 (2)	C(20)–C(21)	1·522 (2)
C(17)–C(18)	1·535 (2)	C(21)–C(22)	1·529 (2)
O(3)—H(3)	0·90 (4)		
O(6)—H(6)	1·241 (1)	O(12)–H(12)	1·226 (1)
O(7)—H(7)	0·76 (3)	O(13)–H(13)	0·82 (3)
O(8)—H(8)	0·80 (3)	O(14)–H(14)	0·79 (3)
C(16)–H(16)	0·95 (3)	C(20)–H(20)	0·94 (3)
C(17)–H(17)	0·93 (3)	C(21)–H(21)	0·92 (3)

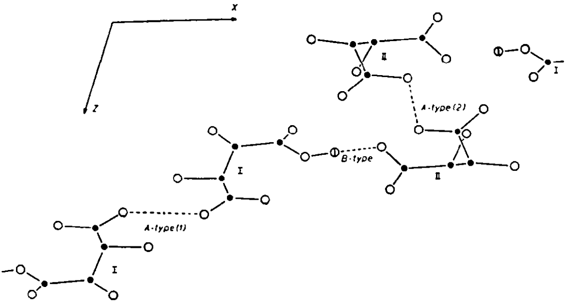

Fig. 2. Projection of part of the structure of potassium hydrogen *meso*-tartrate along the *b* axis. Hydrogen bonds are indicated by broken lines. I and II denote the independent mesotartrate molecules in the unit cell.

Table 4 (*cont.*)

O(3)—C(15)–O(4)	124·8 (1)°	O(10)–C(19)–O(9)	125·1 (1)°
O(5)—C(18)–O(6)	121·5 (1)	O(12)–C(22)–O(11)	124·6 (1)
O(3)—C(15)–C(16)	112·8 (1)	O(10)–C(19)–C(20)	117·4 (1)
O(4)—C(15)–C(16)	122·3 (1)	O(9)—C(19)–C(20)	117·5 (1)
O(5)—C(18)–C(17)	117·3 (1)	O(12)–C(22)–C(21)	113·0 (1)
O(6)—C(18)–C(17)	121·2 (1)	O(11)–C(22)–C(21)	122·4 (1)
C(15)–C(16)–O(7)	110·3 (1)	C(19)–C(20)–O(13)	113·7 (1)
O(7)—C(16)–C(17)	108·0 (1)	O(13)–C(20)–C(21)	107·1 (1)
C(18)–C(17)–O(8)	113·7 (1)	C(22)–C(21)–O(14)	111·5 (1)
O(8)—C(17)–C(16)	107·9 (1)	O(14)–C(21)–C(20)	108·1 (1)
C(15)–C(16)–C(17)	112·6 (1)	C(19)–C(20)–C(21)	113·4 (1)
C(16)–C(17)–C(18)	109·6 (1)	C(20)–C(21)–C(22)	110·3 (1)
C(15)–O(3)—H(3)	109 (2)	C(22)–O(12)—H(12)	109·4 (1)
C(18)–O(6)—H(6)	129·6 (1)	C(20)–O(13)–H(13)	108 (1)
C(16)–O(7)—H(7)	109 (2)	C(21)–O(14)–H(14)	109 (2)
C(17)–O(8)—H(8)	106 (2)	H(20)–C(20)–O(13)	111 (1)
H(16)–C(16)–O(7)	112 (2)	H(20)–C(20)–C(19)	106 (2)
H(16)–C(16)–C(15)	107 (2)	H(20)–C(20)–C(21)	106 (2)
H(16)–C(16)–C(17)	107 (2)	H(21)–C(21)–O(14)	109 (2)
H(17)–C(17)–O(8)	111 (2)	H(21)–C(21)–C(20)	109 (2)
H(17)–C(17)–C(16)	107 (1)	H(21)–C(21)–C(22)	108 (1)
H(17)–C(17)–C(18)	108 (2)		

Table 5. *Geometry of the meso-tartaric acid molecules*

Its distance from the mean plane is given below each atom in Å.

Plane through:				Plane through:			Dihedral angle	Conformation about:	
O(3)	O(4)	C(15)	C(16)	O(7)	C(15)	C(16)	1°	C(15)–C(16)	sp^2–sp^3
0·004 (1)	0·015 (1)	0·013 (2)	0·004 (2)						
O(5)	O(6)	C(17)	C(18)	O(8)	C(17)	C(18)	6	C(17)–C(18)	sp^2–sp^3
0·002 (1)	0·002 (1)	0·001 (2)	0·005 (2)						
O(9)	O(10)	C(19)	C(20)	O(13)	C(19)	C(20)	1	C(19)–C(20)	sp^2–sp^3
0·006 (1)	0·006 (1)	0·016 (2)	0·004 (2)						
O(11)	O(12)	C(21)	C(22)	O(14)	C(21)	C(22)	8	C(21)–C(22)	sp^2–sp^3
0·001 (1)	0·001 (1)	0·000 (2)	0·002 (2)						
C(15)	C(16)	C(17)		O(8)	C(16)	C(17)	4	C(16)–C(17)	sp^3–sp^3
C(19)	C(20)	C(21)		O(14)	C(20)	C(21)	11	C(20)–C(21)	sp^3–sp^3

Table 6. *Hydrogen bonds in the structure of K–H-meso-tartrate*

Estimated standard deviations are in parentheses.

Donor group (d)	Acceptor (a)				Distance $d\ldots a$	Distance $H\cdots a$	Angle d–$H\cdots a$
O(3)—H(3)	O(9)	$(\ -x$	$-y$	$1-z)$	2·543 (1) Å	1·65 (4) Å	171 (4)°
O(6)—H(6)	O(6)	$(1-x$	$1-y$	$1-z)$	2·483 (2)	A-type bonds	
O(12)-H(12)	O(12)	$(1-x$	$-y$	$-z)$	2·452 (2)		
O(7)—H(7)	O(9)	$(\ x$	y	$1+z)$	2·768 (1)	2·02 (3)	170 (3)
O(8)—H(8)	O(10)	$(\ x$	y	$z)$	2·720 (1)	1·94 (3)	164 (3)
O(13)-H(13)	O(7)	$(1-x$	$1-y$	$1-z)$	2·877 (1)	2·10 (3)	159 (2)
O(14)-H(14)	O(6)	$(1+x$	y	$z)$	2·838 (2)	2·07 (3)	167 (2)

with respect to the C=O bond (Kanters, Kroon, Peerdeman & Schoone, 1967).

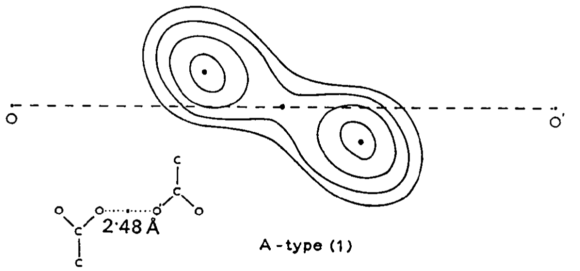

Fig. 3. Electron density in the section through donor, acceptor and H atoms in the A-type $O(6)\cdots O(6)$ hydrogen bond. Contours are in steps of 0·05 e.Å^{-3}, starting at 0·20 e.Å^{-3}.

Table 7. *Potassium–oxygen distances shorter than* 3·25 Å *and their estimated standard deviations in parentheses*

$K(1)\cdots O(3)$	$(\ -x$	$-y$	$1-z)$	2·957 (1) Å
$K(1)\ldots O(4)$	$(\ x$	y	$-1+z)$	3·161 (1)
$K(1)\cdots O(6)$	$(\ x$	y	$z)$	3·127 (1)
$K(1)\cdots O(7)$	$(\ 1-x$	$1-y$	$1-z)$	2·763 (1)
$K(1)\cdots O(8)$	$(\ 1-x$	$1-y$	$1-z)$	2·860 (1)
$K(1)\cdots O(9)$	$(\ x$	y	$z)$	3·029 (1)
$K(1)\cdots O(11)$	$(-1+x$	y	$z)$	2·695 (1)
$K(1)\cdots O(13)$	$(\ 1-x$	$1-y$	$-z)$	2·643 (1)
$K(1)\cdots O(14)$	$(-1+x$	y	$z)$	2·766 (1)
$K(2)\cdots O(4)$	$(\ -x$	$1-y$	$1-z)$	2·733 (1) Å
$K(2)\cdots O(8)$	$(\ 1-x$	$1-y$	$1-z)$	3·053 (1)
$K(2)\cdots O(10)$	$(\ x$	$1+y$	$z)$	2·949 (1)
$K(2)\cdots O(10)$	$(\ 1-x$	$1-y$	$1-z)$	2·948 (1)
$K(2)\cdots O(11)$	$(\ 1-x$	$1-y$	$-z)$	2·775 (1)
$K(2)\cdots O(12)$	$(\ x$	$1+y$	$z)$	2·950 (1)
$K(2)\cdots O(14)$	$(-1+x$	y	$z)$	2·900 (1)

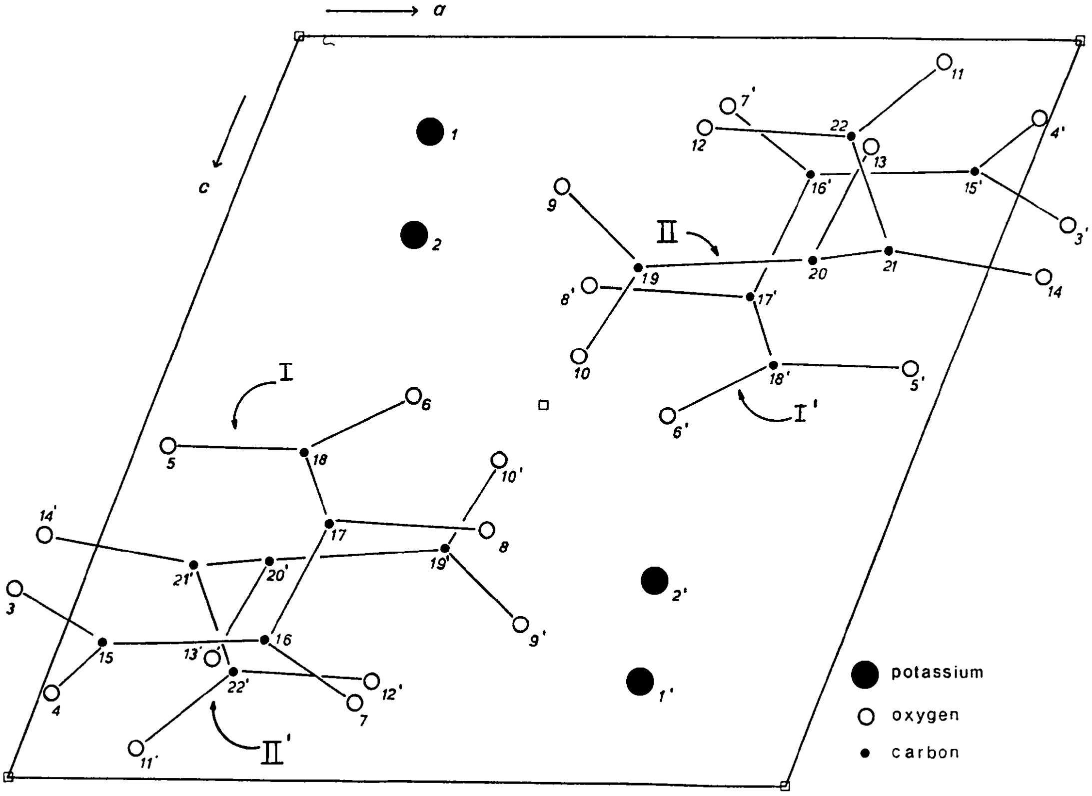

Fig. 4. Projection of the cell-contents in the structure of potassium hydrogen *meso*-tartrate along the b axis. I and I′ as well as II and II′ denote the centrosymmetrically related pairs of the independent molecules. (For clarity, hydrogen atoms are omitted.)

All hydrogen bonds are intermolecular (see Table 6). The hydrogen bond scheme, as far as carboxyl coupling is concerned, is shown in Fig. 2. This acid salt belongs to an *A*-type as well as to a *B*-type (Shrivastava & Speakman, 1961). When comparing corresponding antipodes it appears that apart from the hydrogen atoms and neglecting minor deviations in molecular geometry, the carboxyl group C(15)O(3)O(4) coincides with C(19)O(9)O(10) and the group C(18)O(5)O(6) with C(22)O(11)O(12) on superimposing. It is then noteworthy that the first two groups are involved in a *B*-type hydrogen bond, whereas the second two groups are involved in two *A*-type hydrogen bonds. A closer inspection of the electron density in the *A*-type hydrogen bonds revealed that the maximum in at least one of these bonds lies at a significant distance from the centre of the bond (Fig. 3). The implication of this observation is discussed in more detail elsewhere (Currie & Speakman, 1970; Kroon, Kanters & Peerdeman, 1971; Kroon, Kanters, Peerdeman & Vos, 1971). The environment of the potassium ions is given in Table 7; other intermolecular contacts are of no particular interest. The projection of the cell contents along the *b* axis can be seen in Fig. 4.

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References

BOOTSMA, G. A. & SCHOONE, J. C. (1967). *Acta Cryst.* **22**, 522.

CURRIE, M. & SPEAKMAN, J. C. (1970). *J. Chem. Soc.* (*A*), p. 1923.

KANTERS, J. A. & KROON, J. (1972). To be published.

KANTERS, J. A., KROON, J., PEERDEMAN, A. F. & SCHOONE, J. C. (1967). *Tetrahedron*, **23**, 4027.

KROON, J., KANTERS, J. A. & PEERDEMAN, A. F. (1971). *Nature, Lond.* **229**, 121.

KROON, J., KANTERS, J. A., PEERDEMAN, A. F. & VOS, A. (1971). *Nature, Lond.* **232**, 107.

KROON, J., PEERDEMAN, A. F. & BIJVOET, J. M. (1965). *Acta Cryst.* **19**, 293.

MOORE, F. H. (1963). *Acta Cryst.* **16**, 1169.

SHRIVASTAVA, H. N. & SPEAKMAN, J. C. (1961). *J. Chem. Soc.* (*A*), p. 1151.

Acta Cryst. (1972). B**28**, 722

Mise en Évidence d'un Nouveau Type de Surstructure NaCl; Structure des Composés $TNaO_2$ (T=Dy, Ho, Y, Er)

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A new superstructure has been found in the compounds of NaCl-type $TNaO_2$ (T=Dy, Ho, Y, Er). The structure, determined by X-ray powder diffraction, is monoclinic (space group $C2/c$). The structure is intermediate between the $FeLiO_2$ Q_I type structure and the α-$NaFeO_2$ type structure.

Introduction

Les composés $TNaO_2$, du lanthane au lutétium, ont fait l'objet de plusieurs publications. Suivant le rayon ionique de la terre rare, quatre formes cristallines ont été observées. Les trois formes connues dérivent de la structure NaCl; références et types de structures sont résumés dans le Tableau 1.

Tableau 1. *Références et type de structure pour les composés* $TNaO_2$

T	La···Gd	Tb···Ho	Y		Er			Tm···Lu
Référence	(1)	(1)	(2)	(1)	(1)	(3)	(4)	(1)
Structure type	*Q*	*	*R*	*	*	*C*	*R*	*R*

(1) Blasse (1966)
(2) Hoppe (1965)
(3) Hestermann & Hoppe (1968)
(4) Murav'eva, Kovba & Spitsyn (1967)

Q: Quadratique, type $FeLiO_2Q_I$, Barblan, Branderberger & Niggli (1944)
C: Cubique, type $FeLiO_2$ désordonné, Posnjak & Barth (1931)
R: Rhomboédrique, type α-$NaFeO_2$, Goldsztaub (1935)
*: Inconnue.