Huygens Institute - Royal Netherlands Academy of Arts and Sciences (KNAW)
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F.A.H. Schreinemakers & W.C. de Baat, On the quaternary system: <i>KCICuCl₂</i> + <i>H₂O</i> , in: KNAW, Proceedings, 17 II, 1914, pp. 781-783
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then ΔV is negative between this point H and the terminating point of the curve on side BC. It is apparent from the position of the curves sc and sa (fig. 6) that point s is chosen on that part of the quadruplecurve, where ΔV is positive. We distinguish now again the same three cases as above.

1st. The vapour is represented by s_1 .

It is apparent from the position of the points F, B, s and s_1 with respect to one another that the fourphase-reaction:

$$F + L_s \gtrsim B + G_{s_1} (\triangle V > 0)$$

 $F + L + G \text{ (Curve } sc)$ $B + L + G \text{ (Curve } sa)$
 $F + B + L$ $F + B + G$

takes place; it proceeds from left to right with increase of volume Hence it follows that the equilibria written at the right of the vertical line occur under lower pressures, the equilibria at the left occur under higher pressures. In accordance with the above we find, therefore, that starting from s (fig. 6) the pressure increases along sc (equilibrium F+L+G) and decreases along sa (equilibrium B+L+G).

2nd and 3rd. Also in these cases we find agreement with the previous considerations.

When a point of maximum temperature H occurs on the quadruple-curve B+F+L+G, then two points of intersection s occur at temperatures a little below T_H . When we consider now a point of intersection s between H and the terminating point of the quadruple-curve on side BC, then ΔV is negative. This involves that above in $1^{\rm st}-3^{\rm rd}$ increase of P is replaced by decrease of P and reversally. We find also the same when we consider the three phase-triangles solid-liquid-vapour.

To be continued.)

Chemistry. — "On the quaternary system: KCl— $CuCl_2$ — $BaCl_2$ — H_2O ."

By Prof. Schreinemakers and Miss W. C. de Baat.

(Communicated in the meeting of October 31, 1914).

In a previous communication 1) we have already discussed the equilibria occurring in this system at 40° and at 60°; the results of the analysis on which these considerations are based, we have hitherto not yet communicated. Now we will communicate the results of the analysis; all the points, curves etc. quoted in this communication apply to the two figures of the previous communication (l. c.). We want to draw the attention to the fact that fig. 1 represents the equilibria at 40° and fig. 2 the equilibria at 60°.

¹⁾ These Communications (1912) 326.

 $$\tilde{7}8\dot{2}$$ TABLE I. Composition of the solutions in percentages by weight at 40° (fig. 1. l.c.).

Point	KCI	Ba Cl ₂	Cu Cl ₂	H ₂ O	Solid phases
а	0	0	44.67	55.33	Cu Cl ₂ . 2 H ₂ O
b	0	3.72	4 2. 7 2	53.56	Ba Cl_2 . $\operatorname{2H}_2\operatorname{O}+\operatorname{CuCl}_2$. $\operatorname{2H}_2\operatorname{O}$
с	0	28.98	0	71.02	Ba Cl ₂ . H ₂ O
d	23.98	9.15	0	66.87	Ba Cl $_2$. 2 H $_2$ O $+$ K Cl
e	28.63	0	0	71.36	KCI
f	21.53	0	22.85	55.62	$KCl + D_{l-2-2}$
g	9.79	0	43.83	46.38	Cu Cl ₂ . 2 H ₂ O + D _{1·2·2}
b	0	3.72	42.72	53.56	Ba Cl ₂ . 2 H ₂ O + Cu Cl ₂ . 2 H ₂ O
Curve q	5.52	3.39	42.35	48.74	,,
h	9.88	2.99	42.07	45.06	BaCl ₂ . 2 H ₂ O + CuCl ₂ . 2H ₂ O + D ₁₋₂₋₂
d	23.98	9.15	0	66.87	Ba Cl ₂ . 2 H ₂ O + KCl
urve di	21.46	8.90	8.44	61.20	"
CE	20.61	7.63	14.31	57.45	n
i	20.61	5.40	20.47	53.52	Ba Cl_2 . 2 H_2 O + KCl + $D_{1\cdot 2\cdot 2}$.
f	21.53	0	22.85	55.62	KCl + D _{1·2·2} .
Curve fi	21.31	2.59	22.06	54.04	"
i	20.61	5.40	20.47	53.52	$BaCl_2$. $2H_2O + KCl + D_{1\cdot 2\cdot 2\cdot}$
g	9.79	0	43.83	46.38	CuCl ₂ . 2H ₂ O + D ₁ . _{2·2}
Curve _{og}	9.94	1.46	43.22	45.38	'n
h	9.88	2.99	42.07	45.06	$CuCl_2 \cdot 2H_2O + BaCl_2 \cdot 2H_2O + D_{1 \cdot 2 \cdot 2}$
i	20.61	5.40	20.47	53.52	$BaCl_2.2H_2O+KCl+D_{1\cdot 2\cdot 2\cdot}$
rve 1	16.44	4.72	27.22	51.62	$\operatorname{BaCl}_{2} \operatorname{2H}_{2} \operatorname{O} + \operatorname{D}_{1 \cdot 2 \cdot 2}.$
Curv ih	11.44	3.66	34.65	50.55	n
h	9.88	2.99	42.07	45.06	$CuCl_2$. $2H_2O + BaCl_2$. $2H_2O + D_{1\cdot 2\cdot 2}$
1	1				i

 $\label{eq:TABLE} \ddot{T}ABLE~I\dot{I}.$ Composition of the solutions in percentages by weight at 60° (fig. 2 l.c.).

a 0 0 47.42 52.58 CuCl₂.2H₂O CuCl₂.2H₂O + BaCl₂.2H₂O b 0 6.87 43.57 49.56 CuCl₂.2H₂O + BaCl₂.2H₂O c 0 31.7 0 68.3 BaCl₂.2H₂O + KCl d 23.09 14.83 0 62.08 BaCl₂.2H₂O + KCl e 31.2 0 0 68.8 KCl f 26.12 0 26.57 47.31 KCl + D₁-₂₂ g 17.13 0 43.45 39.42 D₁-₂₂ + D₁-₁ b 0 6.87 43.57 49.56 CuCl₂.2H₂O + BaCl₂.2H₂O + D₁-₁ b 0 6.87 43.68 44.01 " c 6.32 5.99 43.68 44.01 " d 12.45 4.93 44.09 38.53 CuCl₂.2H₂O + BaCl₂.2H₂O + KCl d 23.78 5.97 24.61 45.64 BaCl₂.2H₂O + KCl + D₁-₂₂₂ d 26.12 0 26.57 47.	Point	KC1	BaCl ₂	CuCl ₂	H_2O	Solid phases
c 0 31.7 0 68.3 BaCl ₂ 2H ₂ O HCI d 23.09 14.83 0 62.08 BaCl ₂ 2H ₂ O + KCI e 31.2 0 68.8 KCI f 26.12 0 26.57 47.31 KCI + D _{1·2·2} + D _{1·1} g 17.13 0 43.45 39.42 D _{1·2·2} + D _{1·1} k 13.67 0 46.40 39.93 CuCl ₂ 2H ₂ O + BaCl ₂ 2H ₂ O b 0 6.87 43.57 49.56 CuCl ₂ 2H ₂ O + BaCl ₂ 2H ₂ O + D _{1·1} d 0 6.87 43.68 44.01 " d 12.45 4.93 44.09 38.53 CuCl ₂ 2H ₂ O + BaCl ₂ 2H ₂ O + Cl d 23.15 10.01 12.01 54.83 BaCl ₂ 2H ₂ O + KCI + D _{1·2·2} f 26.12 0 26.57 47.31 KCI + D _{1·2·2} f 26.12 0 26.57 47.31 KCI + BaCl ₂ 2H ₂ O + D _{1·2·2} g 17.13 <	а	0	0	47.42	52.58	CuCl ₂ . 2H ₂ O
d 23.09 14.83 0 62.08 BaCl ₂ . 2H ₂ O + KCl e 31.2 0 0 68.8 KCl f 26.12 0 26.57 47.31 KCl + D _{1·2·2} + D _{1·1} g 17.13 0 43.45 39.42 D _{1·2·2} + D _{1·1} k 13.67 0 46.40 39.93 CuCl ₂ . 2H ₂ O + BaCl ₂ . 2H ₂ O b 0 6.87 43.57 49.56 CuCl ₂ . 2H ₂ O + BaCl ₂ . 2H ₂ O + D _{1·1} b 0 6.87 43.68 44.01 " d 6.32 5.99 43.68 44.01 " d 23.09 14.83 0 62.08 BaCl ₂ . 2H ₂ O + BaCl ₂ . 2H ₂ O + D _{1·1} d 23.15 10.01 12.01 54.83 " d 23.15 10.01 12.01 54.83 " d 26.12 0 26.57 47.31 KCl + D _{1·2·2} e 24.61 45.64 BaCl ₂ . 2H ₂ O + KCl + D _{1·2·2} g 17.13 0 43.45 39.42 <th< td=""><td>b</td><td>0</td><td>6.87</td><td>43.57</td><td>49.56</td><td>$CuCl_2$. $2H_2O + BaCl_2$. $2H_2O$</td></th<>	b	0	6.87	43.57	49.56	$CuCl_2$. $2H_2O + BaCl_2$. $2H_2O$
### 13.2 0 0 68.8 KCI	c	0	31.7	0	68.3	BaCl ₂ . 2H ₂ O
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	d	23.09	14.83	0	62.08	$BaCl_2 \cdot 2H_2O + KCl$
### 17.13	e	31.2	0	0	68.8	KCI
## 13.67 0 46.40 39.93 CuCl ₂ . 2H ₂ O + D ₁₋₁ ## 13.67 0 46.40 39.93 CuCl ₂ . 2H ₂ O + D ₁₋₁ ## 12.45 4.93 44.09 38.53 CuCl ₂ . 2H ₂ O + BaCl ₂ . 2H ₂ O + D ₁ ## 23.15 10.01 12.01 54.83 " ## 23.78 5.97 24.61 45.64 BaCl ₂ . 2H ₂ O + KCl + D ₁₋₂₋₂ ## 24.53 3.32 25.46 46.69 " ## 23.78 5.97 24.61 45.64 KCl + BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ ## 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ ## 13.04 2.52 45.24 39.20 " ## 13.04 2.52 45.24 39.20 " ## 13.04 2.52 45.24 39.20 " ## 13.04 2.52 45.24 39.20 " ## 13.05 5.97 24.61 45.64 KCl + BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ ## 13.04 2.52 45.24 39.20 " ## 13.05 5.97 24.61 45.64 KCl + BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ ## 13.06 CuCl ₂ . 2H ₂ O + D ₁₋₂₋₂ + D ₁₋₁ ## 13.07 0 46.40 39.93 CuCl ₂ . 2H ₂ O + D ₁₋₂₋₂ + D ₁₋₁ ## 13.08 5.97 24.61 45.64 KCl + BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ ## 13.09 38.53 CuCl ₂ . 2H ₂ O + BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ ## 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ ## 19.53 5.40 32.37 42.70 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ ## BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ ## 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ ## 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ ## 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ + D ₁₋₁ ## 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ + D ₁₋₁ ## 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ + D ₁₋₁ ## 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ + D ₁₋₁ ## 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ + D ₁₋₁ ## 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ + D ₁₋₁	f	26.12	0	26.57	47.31	$KC1 + D_{1\cdot 2\cdot 2}$
b 0 6.87 43.57 49.56 CuCl ₂ . 2H ₂ O + BaCl ₂ . 2H ₂ O 6.32 5.99 43.68 44.01 " 12.45 4.93 44.09 38.53 CuCl ₂ . 2H ₂ O + BaCl ₂ . 2H ₂ O + D ₁ d 23.09 14.83 0 62.08 BaCl ₂ . 2H ₂ O + KCl 23.15 10.01 12.01 54.83 " 23.78 5.97 24.61 45.64 BaCl ₂ . 2H ₂ O + KCl + D ₁₋₂₋₂ f 26.12 0 26.57 47.31 KCl + D ₁₋₂₋₂ 24.53 3.32 25.46 46.69 " 24.53 3.32 25.46 46.69 " 23.78 5.97 24.61 45.64 KCl + BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ g 17.13 0 43.45 39.42 D ₁₋₂₋₂ + D ₁₋₁ g 16.50 2.51 42.20 38.79 " h 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ + D ₁₋₁ k 13.04 2.52 45.24 39.20 " l 12.45 4.93 44.09 38.53 CuCl ₂ . 2H ₂ O + BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ h 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ h 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ h 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ h 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ h 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂ h 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D ₁₋₂₋₂	g	17.13	0	43.45	39.42	$\mathbf{D_{1\cdot 2\cdot 2}} + \mathbf{D_{1\cdot 1}}$
12.45	k	13.67	0	46.40	39.93	$CuCl_2 \cdot 2H_2O + D_{1\cdot 1}$
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	b	0	6.87	43.57	49.56	$CuCl_2$. $2H_2O + BaCl_2$. $2H_2O$
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	97 P	6.32	5.99	43.68	44.01	'n
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	l	12.45	4.93	44.09	38.53	$CuCl_2$. $2H_2O + BaCl_2$. $2H_2O + D_1$
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	d	23.09	14.83	0	62.08	BaCl ₂ .2H ₂ O + KCl
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	di	23.15	10.01	12.01	54.83	11
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	i	23.78	5.97	24.61	45.64	$BaCl_2 \cdot 2H_2O + KCl + D_{1\cdot 2\cdot 2}$
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	f	26.12	0	26.57	47.31	KCl + D ₁₋₂₋₂
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	f f	24.53	3.32	25.46	46.69	, , , , , , , , , , , , , , , , , , ,
k 13.67 0 46.40 39.93 CuCl ₂ · 2H ₂ O + D _{1·1} i 13.04 2.52 45.24 39.20 v i 12.45 4.93 44.69 38.53 CuCl ₂ · 2H ₂ O + BaCl ₂ · 2H ₂ O + D _{1·2·2} j 23.78 5.97 24.61 45.64 KCl + BaCl ₂ · 2H ₂ O + D _{1·2·2} j 19.53 5.40 32.37 42.70 BaCl ₂ · 2H ₂ O + D _{1·2·2} h 15.75 4.75 40.84 38.66 BaCl ₂ · 2H ₂ O + D _{1·2·2} + D _{1·1} h 15.75 4.75 40.84 38.66 BaCl ₂ · 2H ₂ O + D _{1·2·2} + D _{1·1} 14.78 4.83 42.13 38.26 BaCl ₂ · 2H ₂ O + D _{1·2·2} + D _{1·1}	i	23.78	5.97	24.61	45.64	$KCl + BaCl_2 \cdot 2H_2O + D_{1\cdot 2\cdot 2}$
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	g	17.13	0	43.45	39.42	$D_{1\cdot 2\cdot 2} + D_{1\cdot 1}$
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	nrve gh	16.50	2.51	42.20	38.79	'n
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	h	15.75	4.75	40.84	38.66	$BaCl_2 \cdot 2H_2O + D_{1\cdot 2\cdot 2} + D_{1\cdot 1}$
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	k	13.67	0	46.40	39.93	$CuCl_2$. $2H_2O + D_{1\cdot1}$
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	urve kl	13.04	2.52	45.24	39.20	v
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	ı	12.45	4.93	44.09	38.53	$CuCl_2 \cdot 2H_2O + BaCl_2 \cdot 2H_2O + D_1$
h 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D _{1 ·2·2} + D _{1·1} h 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D _{1·2·2} + D _{1·1} 14.78 4.83 42.13 38.26 BaCl ₂ . 2H ₂ O + D _{1·2·2}	<i>i</i> .	23.78	5.97	24.61	45.64	$KCl + BaCl_2 \cdot 2H_2O + D_{1 \cdot 2 \cdot 2}$
h 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D _{1 ·2·2} + D _{1·1} h 15.75 4.75 40.84 38.66 BaCl ₂ . 2H ₂ O + D _{1·2·2} + D _{1·1} 14.78 4.83 42.13 38.26 BaCl ₂ . 2H ₂ O + D _{1·1}	ih	19.53	5.40	32.37	42.70	$BaCl_2.2H_2O + D_{1\cdot 2\cdot 2}$
14.78 4.83 42.13 38.26 $BaCl_2 \cdot 2H_2O + D_{1.1}$	h	15.75	4.75	40.84	38.66	BaCl ₂ . $2H_2O + D_{12\cdot 2} + D_{1\cdot 1}$
	h	15.75	4.75	40.84	38.66	BaCl ₂ . $2H_2O + D_{1\cdot 2\cdot 2} + D_{1\cdot 1}$
l 12.45 4.93 44.09 38.53 $CuCl_2 \cdot 2H_2O + BaCl_2 \cdot 2H_2O + D_1$		14.78	4.83	42.13	38.26	$BaCl_2.2H_2O+D_{1.1}$
	ı	12.45	4.93	44.09	38.53	$CuCl_2 \cdot 2H_2O + BaCl_2 \cdot 2H_2O + D_1$

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