TABLE XXI. Adiabatic and isothermal elastic constants (in units of 10^{11} dyn/cm^2) and the parameters Δ and λ of RbI as a function of pressure (in kilobars) at 220°K.

Pressure	C_{11}^S	C_{11}^T	C_{12}^S	C_{12}^T	C_{44}	B^S	B^T	Δ	λ
0.001	2.749	2.705	0.351	0.308	0.282	1.150	1.107	0.0395	1.00000
0.175	2.772	2.728	0.352	0.309	0.281	1.159	1.115	0.0390	1.00052
0.410	2.805	2.762	0.355	0.311	0.280	1.172	1.128	0.0384	1.00122
0.600	2.831	2.787	0.357	0.315	0.279	1.182	1.139	0.0378	1.00178
0.800	2.858	2.815	0.360	0.317	0.278	1.192	1.150	0.0373	1.00237
1.000	2.885	2.843	0.362	0.320	0.276	1.204	1.161	0.0367	1.00295
1.200	2.911	2.868	0.364	0.322	0.276	1.213	1.171	0.0362	1.00352
1.400	2.940	2.898	0.367	0.325	0.274	1.225	1.183	0.0356	1.00409
1.600	2.965	2.923	0.368	0.326	0.273	1.234	1.192	0.0351	1.00465
1.800	2.993	2.951	0.372	0.330	0.272	1.246	1.204	0.0345	1.00521
2.000	3.018	2.977	0.374	0.332	0.271	1.255	1.214	0.0340	1.00577
2.200	3.043	3.002	0.375	0.335	0.270	1.265	1.224	0.0334	1.00632
2.400	3.072	3.032	0.379	0.338	0.269	1.277	1.236	0.0329	1.00686
2.600	3.097	3.057	0.380	0.339	0.268	1.286	1.245	0.0323	1.00740
2.800	3.125	3.085	0.385	0.346	0.267	1.299	1.259	0.0318	1.00794
3.000	3.149	3.109	0.384	0.345	0.266	1.306	1.266	0.0312	1.00847

Cauchy Relation

In a cubic crystal when the forces between the ions are of central type and have a single-body character, the ions are centers of symmetry. At zero pressure the Cauchy relation[24] $C_{12}=C_{44}$, is approximately realized for the alkali halides. Love[24] has shown that under an external pressure P, Cauchy relation is given by $C_{44}(P)=C_{12}(P)-2P$. Here $C_{12}(P)$ and $C_{44}(P)$ are the effective elastic constants we measure at pressure P. The proof is simple and follows from Chung's work.[25]

$$C_{12}(P)=C_{12}+\eta(-C_{11}-C_{12}+2C_{112}+C_{123}), \quad (23)$$

$$C_{44}(P)=C_{44}+\eta(C_{11}+2C_{12}+C_{44}+C_{144}+2C_{166}), \quad (24)$$

where

$$\eta=-P/3B.$$

At room pressure we have the following Cauchy relation for second- and third-order elastic constants.

$$C_{12}=C_{44}, \qquad C_{123}=C_{456}=C_{144}, \qquad C_{122}=C_{166}, \quad (25)$$

TABLE XXII. Adiabatic and isothermal elastic constants (in units of 10^{11} dyn/cm^2) and the parameters Δ and λ of RbI as a function of pressure (in kilobars) at 178°K.

Pressure	C_{11}^S	C_{11}^T	C_{12}^S	C_{12}^T	C_{44}	B^S	B^T	Δ	λ
0.001	2.850	2.816	0.336	0.300	0.284	1.174	1.139	0.0306	1.00000
0.200	2.879	2.844	0.338	0.304	0.283	1.185	1.151	0.0302	1.00058
0.400	2.907	2.872	0.342	0.307	0.282	1.197	1.162	0.0298	1.00116
0.600	2.935	2.901	0.344	0.310	0.281	1.208	1.174	0.0294	1.00173
0.800	2.962	2.928	0.347	0.313	0.280	1.219	1.185	0.0290	1.00230
1.000	2.991	2.957	0.350	0.315	0.279	1.230	1.196	0.0285	1.00286
1.250	3.026	2.992	0.354	0.320	0.277	1.245	1.211	0.0280	1.00355
1.500	3.060	3.026	0.357	0.324	0.276	1.258	1.225	0.0275	1.00424
1.750	3.093	3.060	0.361	0.327	0.275	1.272	1.238	0.0270	1.00492
2.000	3.122	3.089	0.359	0.326	0.274	1.280	1.247	0.0264	1.00560
2.250	3.155	3.122	0.363	0.330	0.272	1.294	1.261	0.0259	1.00626
2.500	3.190	3.157	0.366	0.332	0.271	1.307	1.274	0.0254	1.00693
2.750	3.222	3.190	0.368	0.335	0.270	1.319	1.287	0.0249	1.00758
3.000	3.255	3.223	0.371	0.338	0.268	1.332	1.300	0.0244	1.00823

TABLE XXIII. Gruneisen γ_i for several modes of vibration in RbI at 300°K.

Direction of propagation		Longitudinal	Shear	
100	Present work	2.57	−1.15	−1.15
	Schuele and Smith	2.53	−1.06	−1.06
110	Present work	2.02	−1.15	+2.73
	Schuele and Smith	1.91	−1.06	+2.56
111	Present work	1.51	2.29	2.29
	Schuele and Smith	1.54	2.15	2.15

subtracting (24) from (23) and using (25) we get the Cauchy–Love relation

$$C_{44}(P)=C_{12}(P)-2P. \tag{26}$$

The ratio $P=0$

$$\delta=C_{12}/C_{44} \tag{27}$$

for RbCl, RbBr, and RbI is given in Table XXVII. For $P=0$, $\delta=1$ for a central-force crystal. The derivative of Eq. (26) gives

$$\tfrac{1}{2}[(dC_{12}/dP)-(dC_{44}/dP)]=1$$

for a central force crystal. The measured quantity

$$\tfrac{1}{2}[(dC_{12}/dP)-(dC_{44}/dP)]$$

for the three salts at different temperatures is given in Table XXVII.

First, we notice that δ does not assume a value of one for any of the halides within the range of variation in temperature as represented in Table XXVII. However, the values of δ tend towards one as the temperature decreases. The Cauchy–Love relation in the form of Eq. (28) is also approximately satisfied.

TABLE XXIV. Isothermal pressure derivatives of the adiabatic elastic constants of RbCl, RbBr, and RbI as a function of temperature (°K).

	Temperature (°K)	C_{11}	C_{12}	C_{44}	Bulk modulus
RbCl	304	13.74	1.342	−0.613	5.47
	260	13.51	1.395	−0.632	5.44
	222	13.66	1.310	−0.636	5.42
	180	13.90	1.313	−0.616	5.51
RbBr	300	13.62	1.460	−0.587	5.52
	260	13.46	1.577	−0.596	5.54
	220	13.69	1.172	−0.602	5.35
	180	13.02	0.938	−0.594	4.97
RbI	300	13.39	1.307	−0.522	5.33
	260	13.70	1.261	−0.529	5.32
	220	13.37	1.153	−0.535	5.22
	180	13.44	1.134	−0.527	5.23

TABLE XXV. Isothermal pressure derivatives of isothermal elastic constants of RbCl, RbBr, and RbI as a function of temperature (°K).

	Temperature (°K)	C_{11}	C_{12}	C_{44}	Bulk modulus
RbCl	304	13.91	1.517	−0.613	5.65
	260	13.65	1.532	−0.632	5.57
	222	13.76	1.414	−0.636	5.53
	180	13.96	1.378	−0.616	5.57
RbBr	300	13.81	1.643	−0.587	5.70
	260	13.61	1.722	−0.596	5.68
	220	13.83	1.308	−0.602	5.48
	180	13.14	1.053	−0.594	5.08
RbI	300	13.61	1.527	−0.522	5.55
	260	13.88	1.307	−0.529	5.50
	220	13.51	1.292	−0.535	5.36
	180	13.54	1.241	−0.527	5.34

We have not compared the values of δ as obtained by Dick[26] for two reasons: (1) his calculations refer to 4.2°K, and (2) according to him his calculations of δ are expected to be more reliable when the positive ion is small compared to the negative ion in the alkali halide crystals.

SUMMARY OF THE RESULTS

The main features of the results presented on RbCl, RbBr, and RbI are:

(i) The variation in the elastic constants of these halides with pressure and temperature is linear.

(ii) Whereas the values of C_{11} and C_{12} increase with

TABLE XXVI. Adiabatic pressure derivatives of adiabatic elastic constants of RbCl, RbBr, and RbI as a function of temperature (°K).

	Temperature (°K)	C_{11}	C_{12}	C_{44}	Bulk modulus
RbCl	304	12.84	1.441	−0.640	5.24
	260	12.74	1.480	−0.655	5.24
	222	13.00	1.383	−0.656	5.25
	180	13.36	1.372	−0.632	5.37
RbBr	300	12.72	1.573	−0.613	5.30
	260	12.70	1.672	−0.618	5.35
	220	13.07	1.250	−0.620	5.19
	180	12.52	1.000	−0.608	4.85
RbI	300	12.39	1.443	−0.545	5.09
	260	12.85	1.377	−0.548	5.11
	220	12.66	1.249	−0.551	5.05
	180	12.87	1.211	−0.540	5.09