An Icelandic-English Dictionary and The Graphical Law - PartII

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Abstract

We continue to study An Icelandic-English Dictionary, the Second Edition, brought out by the Oxford University Press, way back in the year 1957. We draw the natural logarithm of the number of words(in bold) without and with supplementary words, normalised, starting with a letter vs the natural logarithm of the rank of the letter, normalised. We find that the words(in bold) underlie a magnetisation curve. This is the magnetisation curve in the Bethe-Peierls approximation of the Ising model, BP(4,$\beta H = 0.06$), in the presence of four nearest neighbours and little external magnetic field, $\beta H = 0.06$. Unlike the head words, all words(in bold) being in use for a few hundred years do not go over, under successive normalisations, fully to the exact Onsager solution of the two dimensional Ising model in the absence of external magnetic field, reflecting going over of the Icelandic language to its offsprings. Moreover, drawing the natural logarithm of the number of words(in bold) with supplementary words, normalised, starting with a letter in the expanded alphabet scheme (i.e. like considering A and $A^{'}$ separate) as it is laid out in the Icelandic dictionary, vs the natural logarithm of the rank of the letter, normalised, we find that the underlying magnetisation curve is BP(4,$\beta H = 0.04$).

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letter	A(A+A')	B	C	D	E	F	G	H	I(I+I'+J)	K	L	M	N	O(O+O')
number	2048+707	2238	3	978	1194	3541	2466	6577	254+281+807	2549	2306	2322	928	527+188
addenda	85	102	0	41	28	77	38	73	5+0+8	49	34	35	17	18
subtotal	2840	2340	3	1019	1222	3618	2504	6650	1355	2598	2340	2357	945	733
supplement	313+142	370	0	176	189	541	243	593	32+24+62	244	217	259	46	83+129
total	3295	2710	3	1195	1411	4159	2747	7243	1473	2842	2557	2616	991	945
letter	P	Q	R	S	T	U(U+U')	V	X	Y(Y+Y')	Z	p	Æ	$\ddot{O}$	
number	544	1	1557	6849	1533	559+1750	2690	1	203+53	1	1447	227	433	
addenda	6	0	26	90	12	11	12	0	1	0	10	0	0	
subtotal	550	1	1583	6939	1545	2320	2702	1	257	1	1457	227	433	
supplement	78	0	160	685	220	112+62	290	0	41	0	138	22	41	
total	628	1	1743	7624	1765	2494	2992	1	298	1	1595	249	474	

TABLE I. Icelandic words: the first(the seventh) row represents letters of the Icelandic alphabet,[1], in the serial order. The second(the eighth row) represents number of words, appearing in bold in the main part of the dictionary.

I. INTRODUCTION

In this paper, we come back to An Icelandic-English Dictionary, [1]. We go through the all the words, written in bold. We count all the words, written in bold, of the dictionary,[1], one by one from the beginning to the end. We count the words appearing in the addenda. We count the words in the supplement. The result is the table, tableIV. To visualise we plot the number of words against the respective letters in the Icelandic alphabet, [1] , in the adjoining figure, fig.1.

Next we look for the graphical law. We have started considering magnetic field pattern in [2], in the languages we converse with. We have studied there, a set of natural languages, [2], and have found existence of a magnetisation curve under each language. We have termed this phenomenon as the Graphical Law. Then, we moved on to investigate, [3], into dictionaries of five disciplines of knowledge and found the existence of a curve of magnetisation under each discipline. This was followed by finding of the graphical law in the references from [4] to [107].

The planning of the paper is as follows. In the next section, we describe the Graphical Law analysis of the words, in bold, without supplement, of An Icelandic-English Dictionary, [1]. In the section III, we describe the Graphical Law analysis of the words, in bold, with supplement, of An Icelandic-English Dictionary, [1]. In the section IV, we describe the

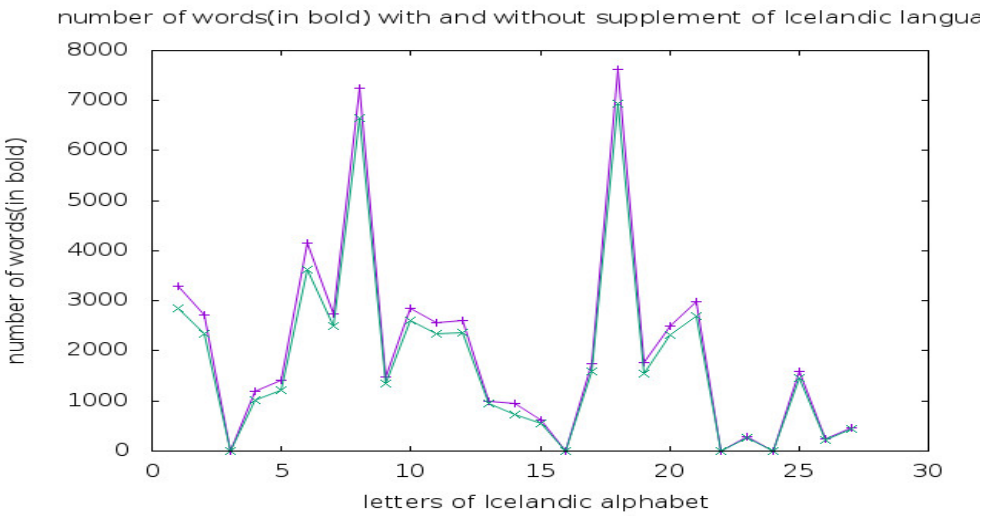

FIG. 1. The vertical axis is the number of the words with and without supplement, of An Icelandic-English Dictionary, [1]. The horizontal axis is the letters of the Icelandic alphabet. Letters are represented by the sequence number in the alphabet as it appears in the dictionary, [1].

Graphical Law analysis of the words, in bold, with supplement, of An Icelandic-English Dictionary, [1], in the expanded alphabet scheme. In the section V, we give an introduction to the standard curves of magnetisation of Ising model. The section VI is Acknowledgment. The last section is Bibliography.

II. THE GRAPHICAL LAW ANALYSIS: WITHOUT WORDS IN THE SUPPLEMENT

For the purpose of exploring graphical law, we assort the letters according to the number of words, in the descending order, denoted by f and the respective rank, [118], denoted by k. k is a positive integer starting from one. Moreover, the minimum non-zero number of words is one. The limiting rank is maximum rank, here it is twenty four. As a result both $\frac{lnf}{lnf_{max}}$ and $\frac{lnk}{lnk_{lim}}$ varies from zero to one. Then we tabulate in the adjoining table,II, and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.2. We then ignore the letter with the highest number of words, tabulate in the adjoining table,II,and redo the plot, normalising the lnfs with lnf_{n-max}, and starting from $k = 2$ in the figure fig.II. Normalising the lnfs with lnf_{2n-max}, we tabulate in the adjoining table,II, and starting from $k = 3$ we draw in the figure fig.4. Normalising the lnfs with lnf_{3n-max} we record in the adjoining table,II, and plot starting from $k = 4$ in the figure fig.5. In this way we obtain figures up to the figure fig.12.

k	lnk	lnk/lnk_{lim}	f	lnf	lnf/lnf_{max}	lnf/lnf_{n-max}	lnf/lnf_{2n-max}	lnf/lnf_{3n-max}	lnf/lnf_{4n-max}	lnf/lnf_{5n-max}	lnf/lnf_{6n-max}	lnf/lnf_{7n-max}	lnf/lnf_{8n-max}	lnf/lnf_{9n-max}	lnf/$lnf_{10n-max}$
1	0	0	6939	8.845	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank
2	0.69	0.217	6650	8.802	0.995	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank
3	1.10	0.346	3618	8.194	0.926	0.931	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank
4	1.39	0.437	2840	7.952	0.899	0.903	0.970	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank
5	1.61	0.506	2702	7.902	0.893	0.898	0.964	0.994	1	Blank	Blank	Blank	Blank	Blank	Blank
6	1.79	0.563	2598	7.862	0.889	0.893	0.959	0.989	0.995	1	Blank	Blank	Blank	Blank	Blank
7	1.95	0.613	2504	7.826	0.885	0.889	0.955	0.984	0.990	0.995	1	Blank	Blank	Blank	Blank
8	2.08	0.654	2357	7.765	0.878	0.882	0.948	0.976	0.983	0.988	0.992	1	Blank	Blank	Blank
9	2.20	0.692	2340	7.758	0.877	0.881	0.947	0.976	0.982	0.987	0.991	0.999	1	Blank	Blank
10	2.30	0.723	2320	7.749	0.876	0.880	0.946	0.974	0.981	0.986	0.990	0.998	0.999	1	Blank
11	2.40	0.755	1583	7.367	0.833	0.837	0.899	0.926	0.932	0.937	0.941	0.949	0.950	0.951	1
12	2.48	0.780	1545	7.343	0.830	0.834	0.896	0.923	0.929	0.934	0.938	0.946	0.947	0.948	0.997
13	2.56	0.805	1457	7.284	0.824	0.828	0.889	0.916	0.922	0.926	0.931	0.938	0.939	0.940	0.989
14	2.64	0.830	1355	7.212	0.815	0.819	0.880	0.907	0.913	0.917	0.922	0.929	0.930	0.931	0.979
15	2.71	0.852	1222	7.108	0.804	0.808	0.867	0.894	0.900	0.904	0.908	0.915	0.916	0.917	0.965
16	2.77	0.871	1019	6.927	0.783	0.787	0.845	0.871	0.877	0.881	0.885	0.892	0.893	0.894	0.940
17	2.83	0.890	945	6.851	0.775	0.778	0.836	0.862	0.867	0.871	0.875	0.882	0.883	0.884	0.930
18	2.89	0.909	733	6.597	0.746	0.749	0.805	0.830	0.835	0.839	0.843	0.850	0.850	0.851	0.895
19	2.94	0.925	550	6.310	0.713	0.717	0.770	0.794	0.799	0.803	0.806	0.813	0.813	0.814	0.857
20	3.00	0.943	433	6.071	0.686	0.690	0.741	0.763	0.768	0.772	0.776	0.782	0.783	0.783	0.824
21	3.04	0.956	257	5.549	0.627	0.630	0.677	0.698	0.702	0.706	0.709	0.715	0.715	0.716	0.753
22	3.09	0.972	227	5.425	0.613	0.616	0.662	0.682	0.687	0.690	0.693	0.699	0.699	0.700	0.736
23	3.14	0.987	3	1.099	0.124	0.125	0.134	0.138	0.139	0.140	0.140	0.142	0.142	0.142	0.149
24	3.18	1	1	0	0	0	0	0	0	0	0	0	0	0	0

TABLE II. Icelandic words, in bold(without words of the supplement): ranking, natural logarithm, normalisations

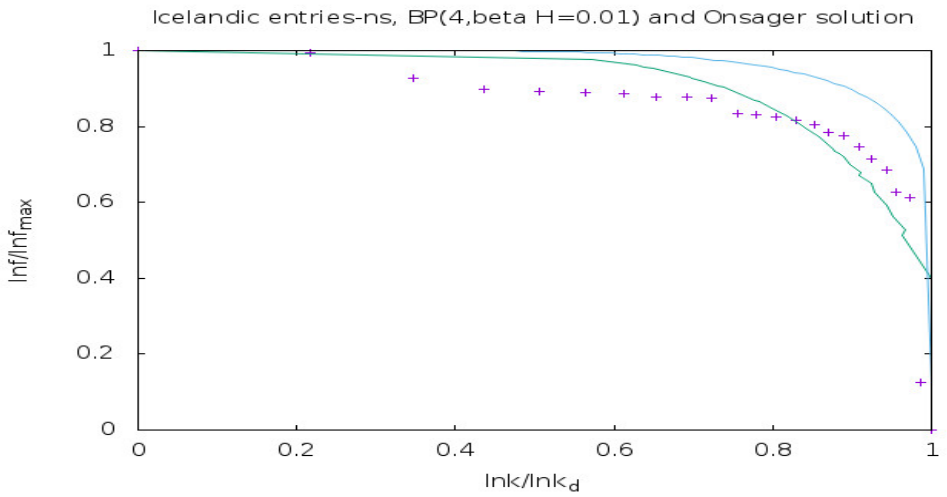

FIG. 2. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold(no supplement), with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.005 or, $\beta H = 0.01$. The uppermost curve is the Onsager solution.

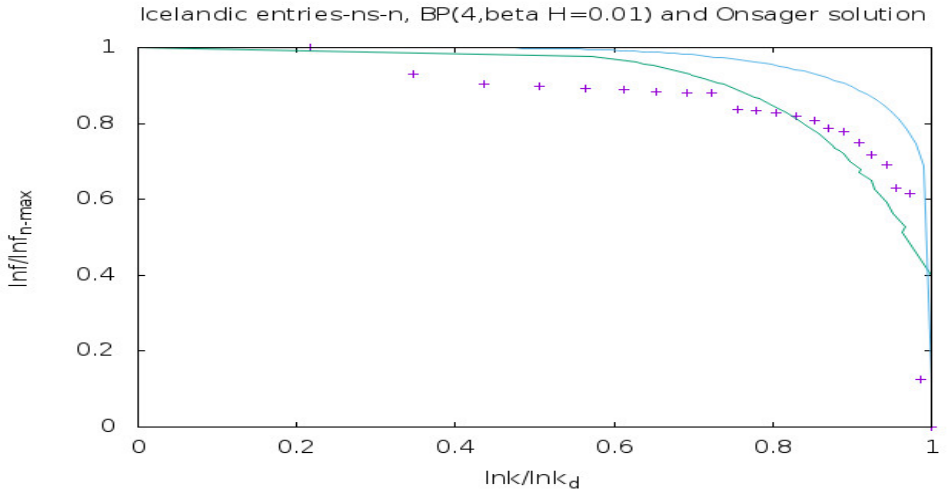

FIG. 3. Vertical axis is $\frac{lnf}{lnf_{n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold(no supplement), with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.005 or, $\beta H = 0.01$. The uppermost curve is the Onsager solution.

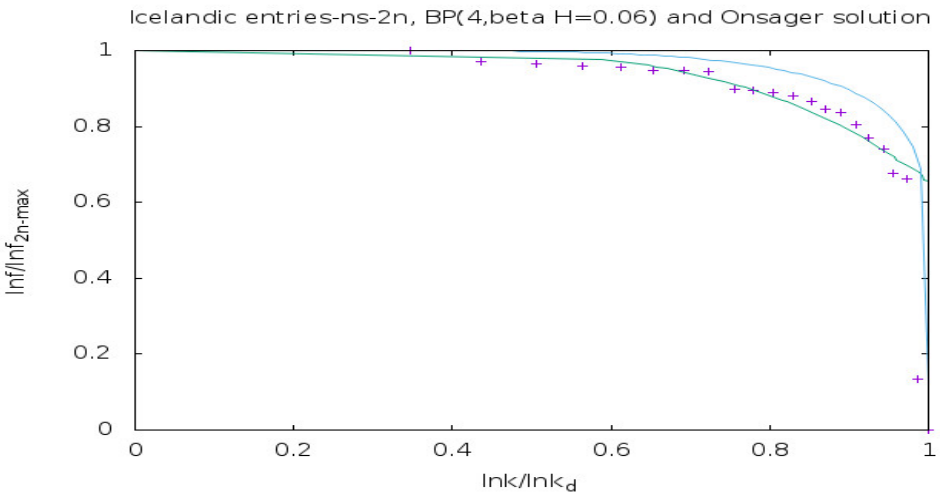

FIG. 4. Vertical axis is $\frac{lnf}{lnf_{2n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold(no supplement), with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.03 or, $\beta H = 0.06$. The uppermost curve is the Onsager solution.

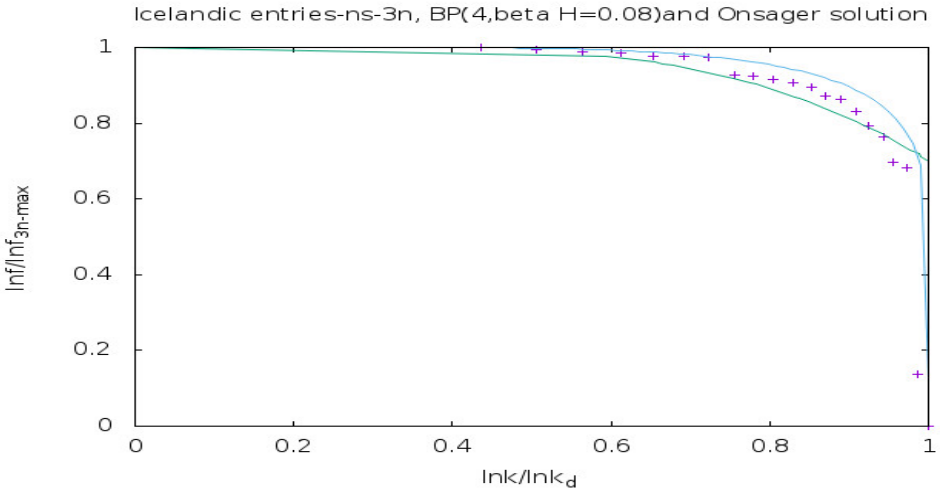

FIG. 5. Vertical axis is $\frac{lnf}{lnf_{3n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold(no supplement), with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.04 or, $\beta H = 0.08$. The uppermost curve is the Onsager solution.

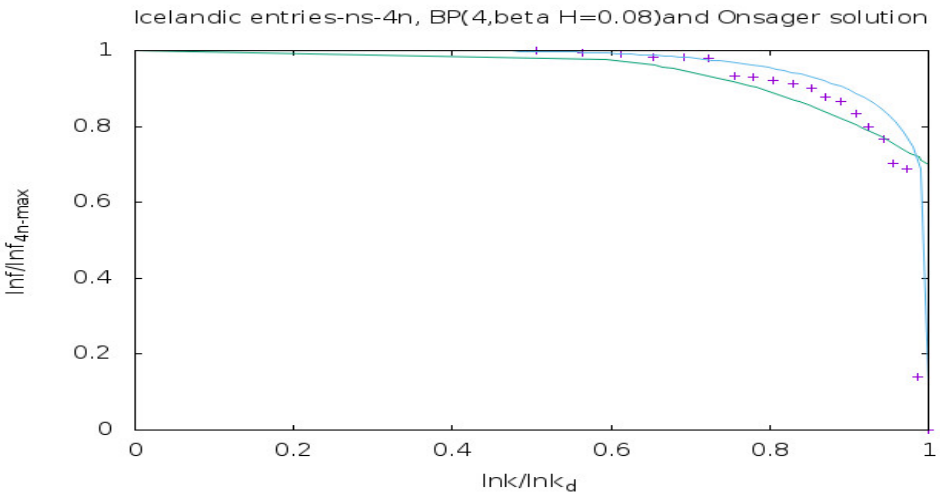

FIG. 6. Vertical axis is $\frac{lnf}{lnf_{4n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold(no supplement), with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.04 or, $\beta H = 0.08$. The uppermost curve is the Onsager solution.

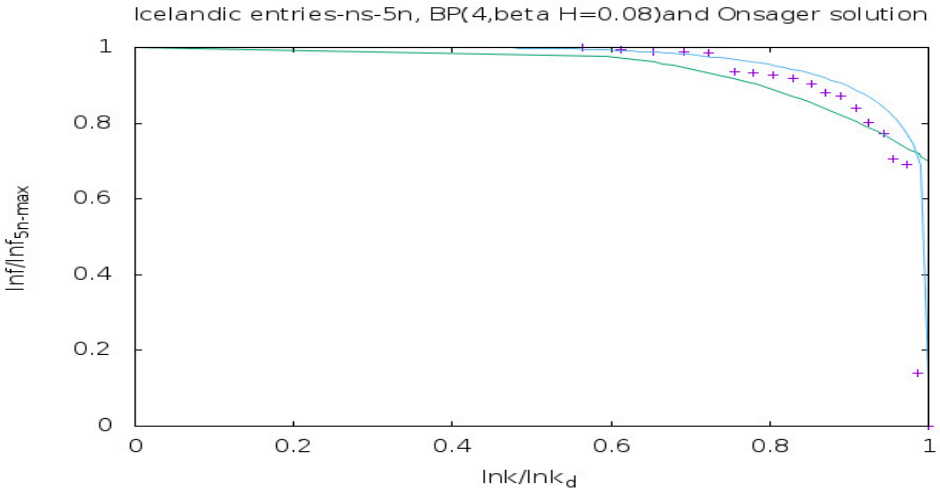

FIG. 7. Vertical axis is $\frac{lnf}{lnf_{5n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold(no supplement), with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.04 or, $\beta H = 0.08$. The uppermost curve is the Onsager solution.

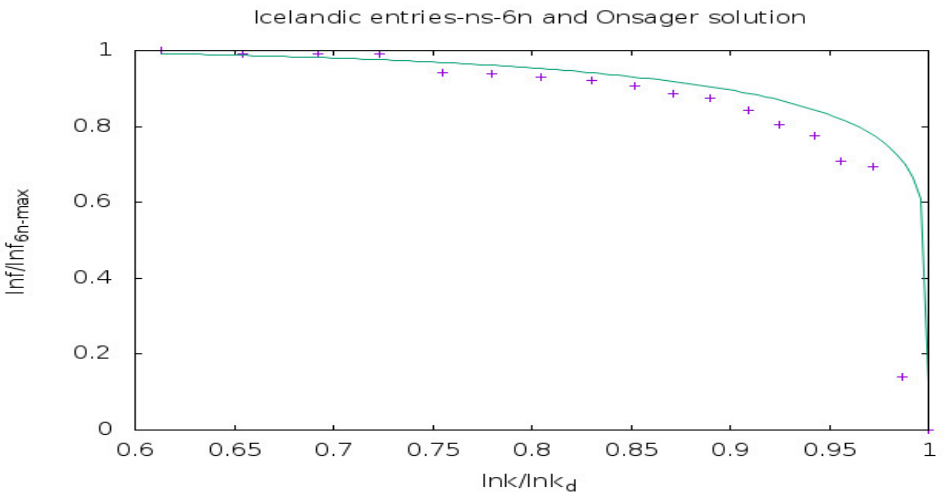

FIG. 8. Vertical axis is $\frac{lnf}{lnf_{6n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold(no supplement), with the fit curve the Onsager solution.

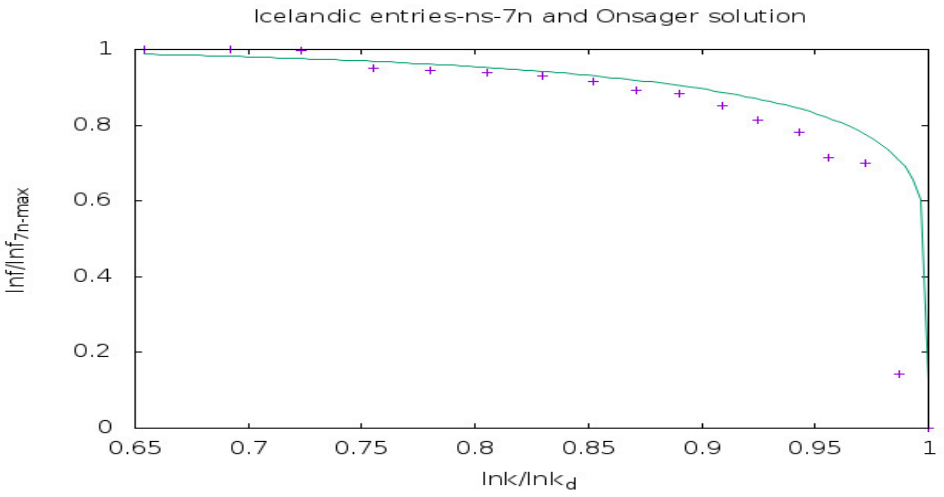

FIG. 9. Vertical axis is $\frac{lnf}{lnf_{7n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold(no supplement), with the fit curve being the Onsager solution.

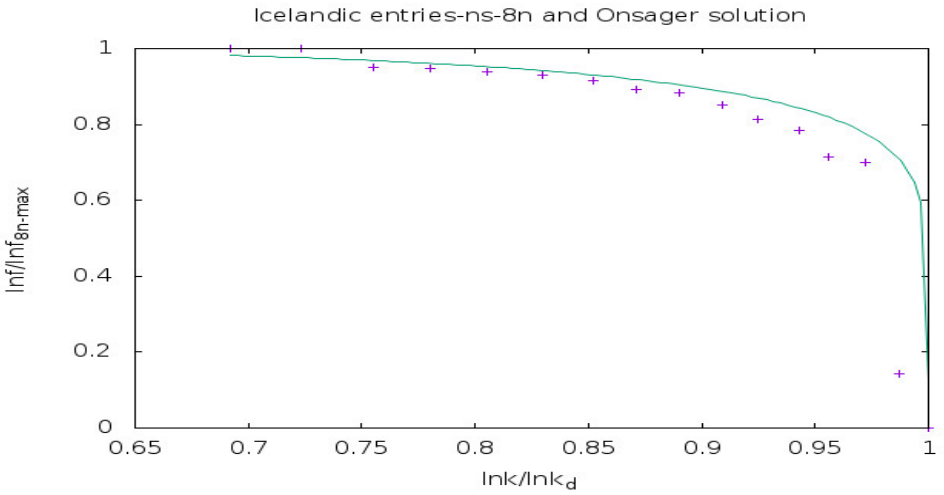

FIG. 10. Vertical axis is $\frac{lnf}{lnf_{8n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold(no supplement), with the fit curve being the Onsager solution.

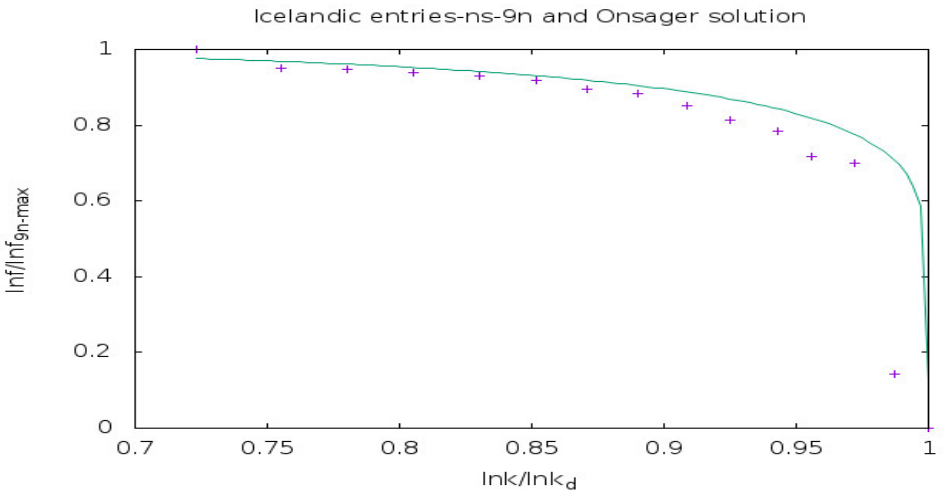

FIG. 11. Vertical axis is $\frac{lnf}{lnf_{9n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold(no supplement), with the fit curve being the Onsager solution.

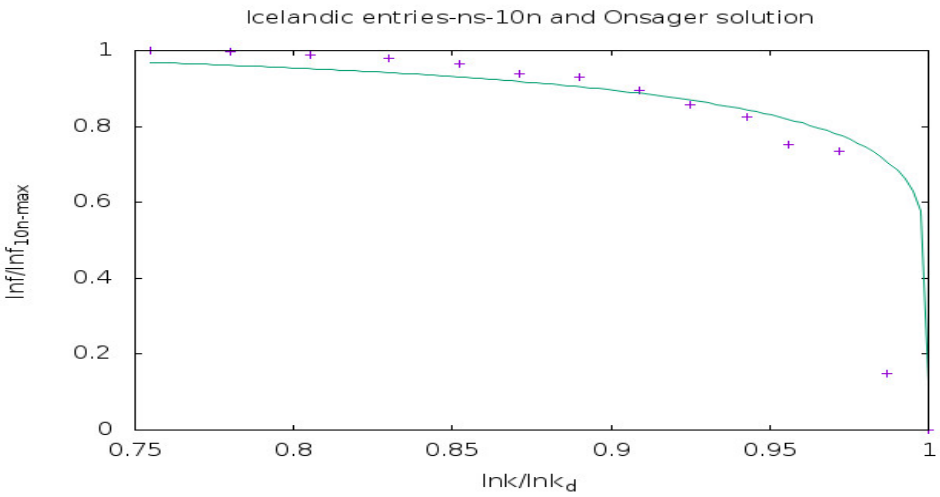

FIG. 12. Vertical axis is $\frac{lnf}{lnf_{10n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold(no supplement), with the fit curve being the Onsager solution of the Ising Model.

A. conclusion

From the figures (fig.2-fig.12), we observe that there is a curve of magnetisation, behind the words of the Icelandic language, in bold(no supplement),[1]. This is the magnetisation curve in the Bethe-Peierls approximation of the Ising model, BP(4,$\beta H = 0.06$), in the presence of four nearest neighbours and little external magnetic field, $m = 0.03$ or, $\beta H = 0.06$
Moreover, the associated correspondence is,

$$\frac{lnf}{lnf_{2n-max}} \longleftrightarrow \frac{M}{M_{max}},$$

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [119].

On the top of it, on successive normalisations, the words of the Icelandic language, in bold(no supplement),[1], do not go over fully to the exact Onsager solution of the two dimensional Ising model in the absence of external magnetic field. This is in difference to the head words of the Icelandic language, [1], which underlie fully the exact Onsager solution of the two dimensional Ising model in the absence of external magnetic field, [107]. This reflects the fact that the words, in bold, in use for a few hundred years represent the going over of the Icelandic language to its offsprings. It is interesting to look at the figures(fig.2-fig.12), in parallel with the corresponding figures in the reference, [25].

III. THE GRAPHICAL LAW ANALYSIS: WITH WORDS IN THE SUPPLEMENT

For the purpose of exploring graphical law, we assort the letters according to the number of words, in the descending order, denoted by f and the respective rank, [118], denoted by k. k is a positive integer starting from one. Moreover, the minimum non-zero number of words is one. The limiting rank is maximum rank, here it is twenty five. As a result both $\frac{lnf}{lnf_{max}}$ and $\frac{lnk}{lnk_{lim}}$ varies from zero to one. Then we tabulate in the adjoining table,III, and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.13. We then ignore the letter with the highest number of words, tabulate in the adjoining table,III,and redo the plot, normalising the lnfs with lnf_{n-max}, and starting from $k = 2$ in the figure fig.14. Normalising the lnfs with lnf_{2n-max}, we tabulate in the adjoining table,III, and starting from $k = 3$ we draw in the figure fig.15. Normalising the lnfs with lnf_{3n-max} we record in the adjoining table,III, and plot starting from $k = 4$ in the figure fig.16. In this way we obtain figures up to the figure fig.20.

k	lnk	lnk/lnk_{lim}	f	lnf	lnf/lnf_{max}	lnf/lnf_{n-max}	lnf/lnf_{2nmax}	lnf/lnf_{3nmax}	lnf/lnf_{4nmax}	lnf/lnf_{5nmax}	lnf/lnf_{9nmax}	lnf/lnf_{10nmax}
1	0	0	7624	8.939	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank
2	0.69	0.214	7243	8.888	0.994	1	Blank	Blank	Blank	Blank	Blank	Blank
3	1.10	0.342	4159	8.333	0.932	0.938	1	Blank	Blank	Blank	Blank	Blank
4	1.39	0.432	3295	8.100	0.906	0.911	0.972	1	Blank	Blank	Blank	Blank
5	1.61	0.500	2992	8.004	0.895	0.901	0.961	0.988	1	Blank	Blank	Blank
6	1.79	0.556	2842	7.952	0.890	0.895	0.954	0.982	0.994	1	Blank	Blank
7	1.95	0.606	2747	7.918	0.886	0.891	0.950	0.978	0.989	0.996	Blank	Blank
8	2.08	0.646	2710	7.905	0.884	0.889	0.949	0.976	0.988	0.994	Blank	Blank
9	2.20	0.683	2616	7.869	0.880	0.885	0.944	0.971	0.983	0.990	Blank	Blank
10	2.30	0.714	2557	7.847	0.878	0.883	0.942	0.969	0.980	0.987	1	Blank
11	2.40	0.745	2494	7.822	0.875	0.880	0.939	0.966	0.977	0.984	0.997	1
12	2.48	0.770	1765	7.476	0.836	0.841	0.897	0.923	0.934	0.940	0.953	0.956
13	2.56	0.795	1743	7.463	0.835	0.840	0.896	0.921	0.932	0.939	0.951	0.954
14	2.64	0.820	1595	7.375	0.825	0.830	0.885	0.910	0.921	0.927	0.940	0.943
15	2.71	0.842	1473	7.295	0.816	0.821	0.875	0.901	0.911	0.917	0.930	0.933
16	2.77	0.860	1411	7.252	0.811	0.816	0.870	0.895	0.906	0.912	0.924	0.927
17	2.83	0.879	1195	7.086	0.793	0.797	0.850	0.875	0.885	0.891	0.903	0.906
18	2.89	0.898	991	6.899	0.772	0.776	0.828	0.852	0.862	0.868	0.879	0.882
19	2.94	0.913	945	6.851	0.766	0.771	0.822	0.846	0.856	0.862	0.873	0.876
20	3.00	0.932	628	6.443	0.721	0.725	0.773	0.795	0.805	0.810	0.821	0.824
21	3.04	0.944	474	6.161	0.689	0.693	0.739	0.761	0.770	0.775	0.785	0.788
22	3.09	0.960	298	5.697	0.637	0.641	0.684	0.703	0.712	0.716	0.726	0.728
23	3.14	0.975	249	5.517	0.617	0.621	0.662	0.681	0.689	0.694	0.703	0.705
24	3.18	0.988	3	1.099	0.123	0.124	0.132	0.136	0.137	0.138	0.140	0.141
25	3.22	1	1	0	0	0	0	0	0	0	0	0

TABLE III. Icelandic words, in bold: ranking, natural logarithm, normalisations

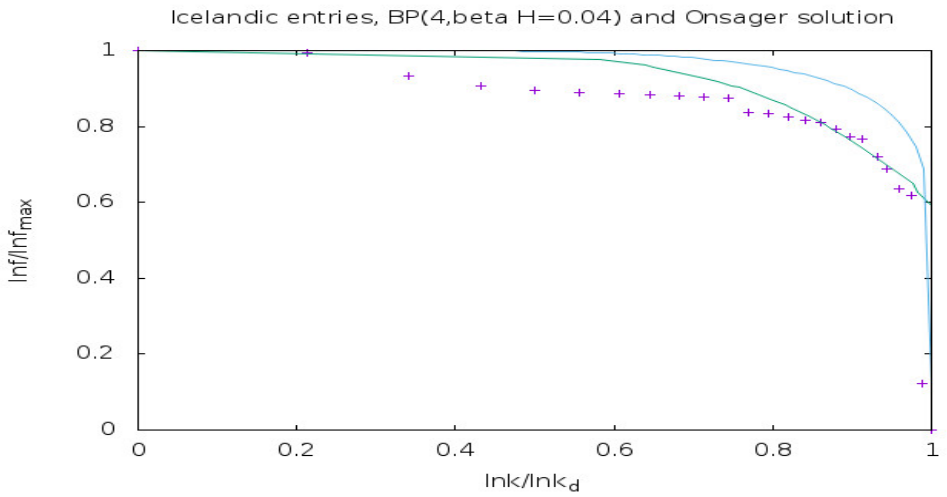

FIG. 13. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold, with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little external magnetic field, m=0.02 or, $\beta H = 0.04$. The uppermost curve is the Onsager solution.

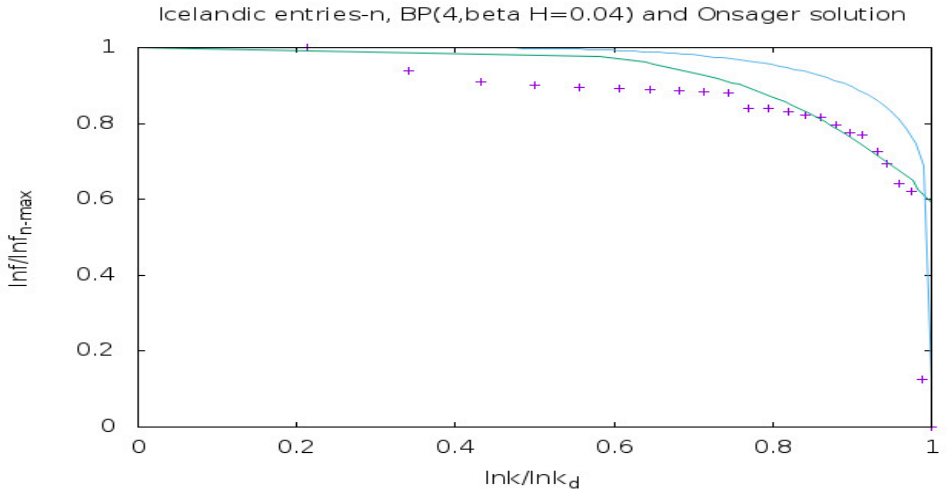

FIG. 14. Vertical axis is $\frac{lnf}{lnf_{n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold, with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little external magnetic field, m=0.02 or, $\beta H = 0.04$. The uppermost curve is the Onsager solution.

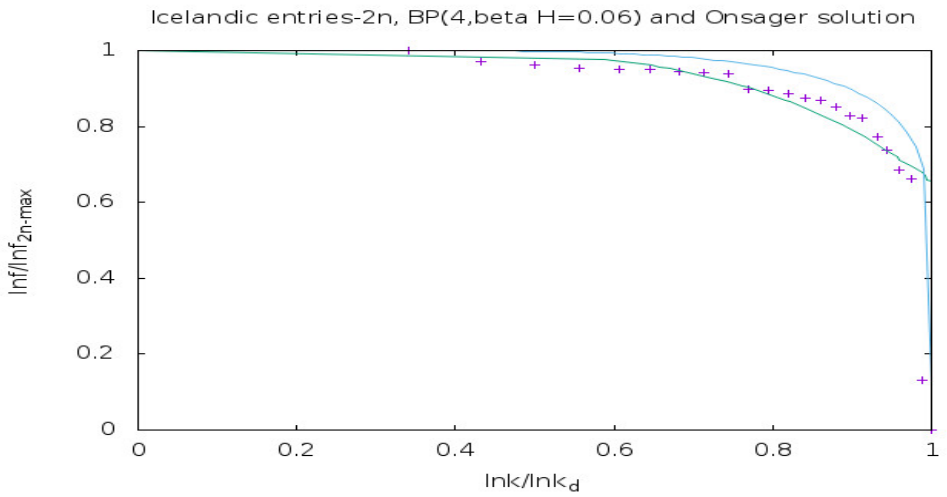

FIG. 15. Vertical axis is $\frac{lnf}{lnf_{2n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold, with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little external magnetic field, m=0.03 or, $\beta H = 0.06$. The uppermost curve is the Onsager solution.

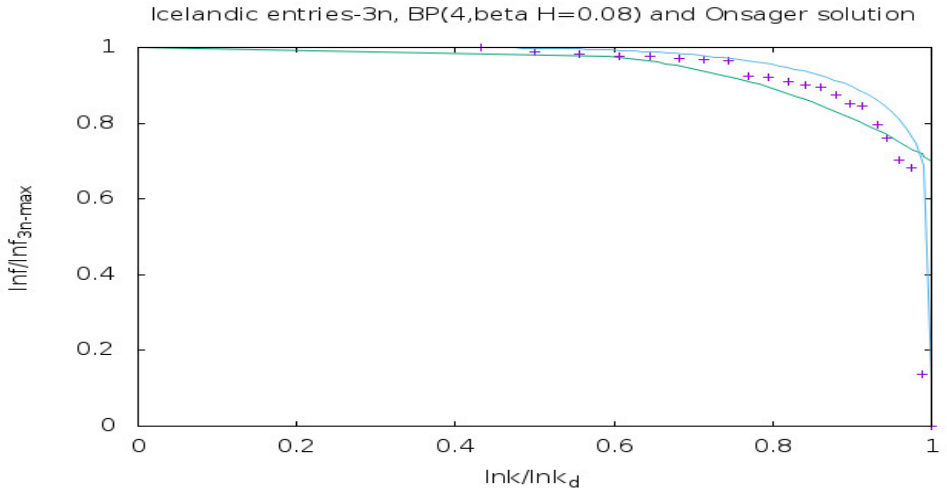

FIG. 16. Vertical axis is $\frac{lnf}{lnf_{3n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold, with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little external magnetic field, m=0.05 or, $\beta H = 0.1$. The uppermost curve is the Onsager solution.

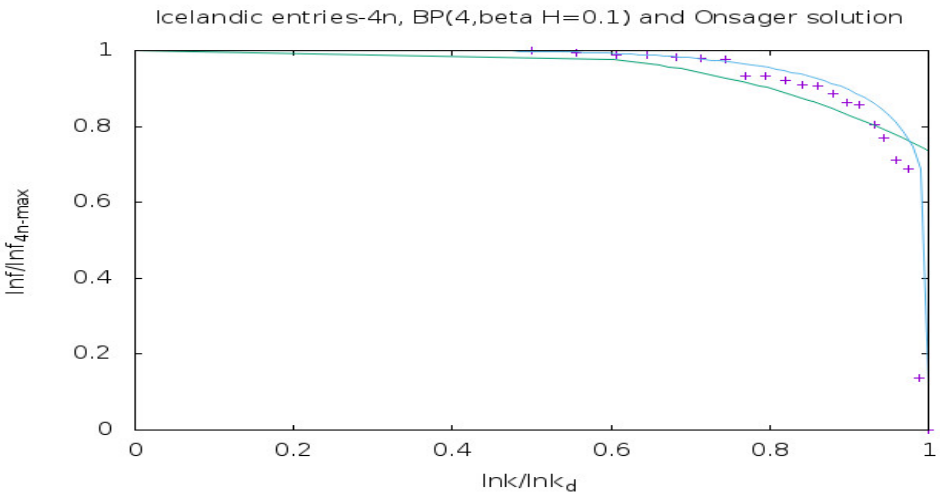

FIG. 17. Vertical axis is $\frac{lnf}{lnf_{4n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold, with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little external magnetic field, m=0.05 or, $\beta H = 0.1$. The uppermost curve is the Onsager solution.

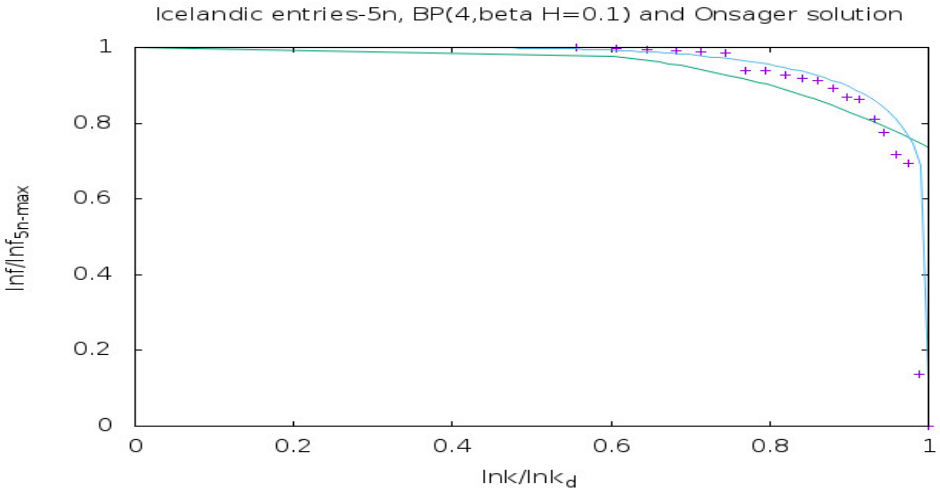

FIG. 18. Vertical axis is $\frac{lnf}{lnf_{5n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold, with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little external magnetic field, m=0.05 or, $\beta H = 0.1$. The uppermost curve is the Onsager solution.

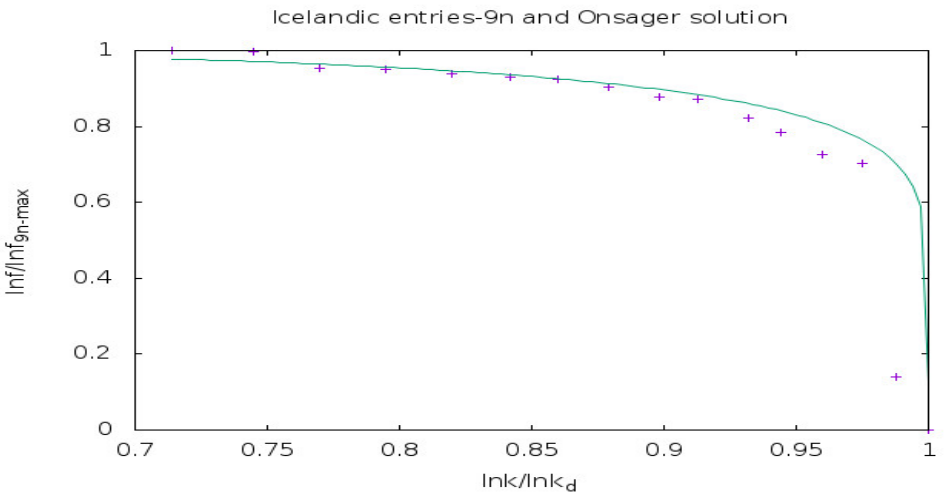

FIG. 19. Vertical axis is $\frac{lnf}{lnf_{9n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold, with the fit curve being the Onsager solution.

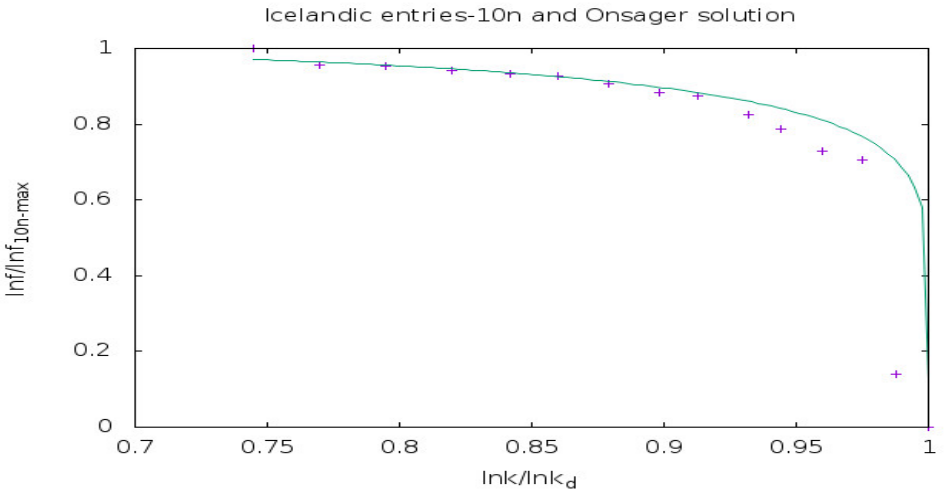

FIG. 20. Vertical axis is $\frac{lnf}{lnf_{10n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold, with the fit curve being the Onsager solution of the Ising Model.

A. conclusion

From the figures (fig.13-fig.20), we observe that there is a curve of magnetisation, behind the words of the Icelandic language, in bold,[1]. This is the magnetisation curve in the Bethe-Peierls approximation of the Ising model, BP(4,$\beta H = 0.06$), in the presence of four nearest neighbours and little external magnetic field, $m = 0.03$ or, $\beta H = 0.06$
Moreover, the associated correspondence is,

$$\frac{lnf}{lnf_{2n-max}} \longleftrightarrow \frac{M}{M_{max}},$$

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [119].

On the top of it, on successive normalisations, the words of the Icelandic language,[1], do not go over fully to the exact Onsager solution of the two dimensional Ising model in the absence of external magnetic field. This is in difference to the head words of the Icelandic language, [1], which underlie fully the exact Onsager solution of the two dimensional Ising model in the absence of external magnetic field, [107]. This reflects the fact that the words, in bold, in use for a few hundred years represent the going over of the Icelandic language to its offsprings. It is interesting to see the figures(fig.13-fig.20), in parallel with the corresponding figures in the reference, [25].

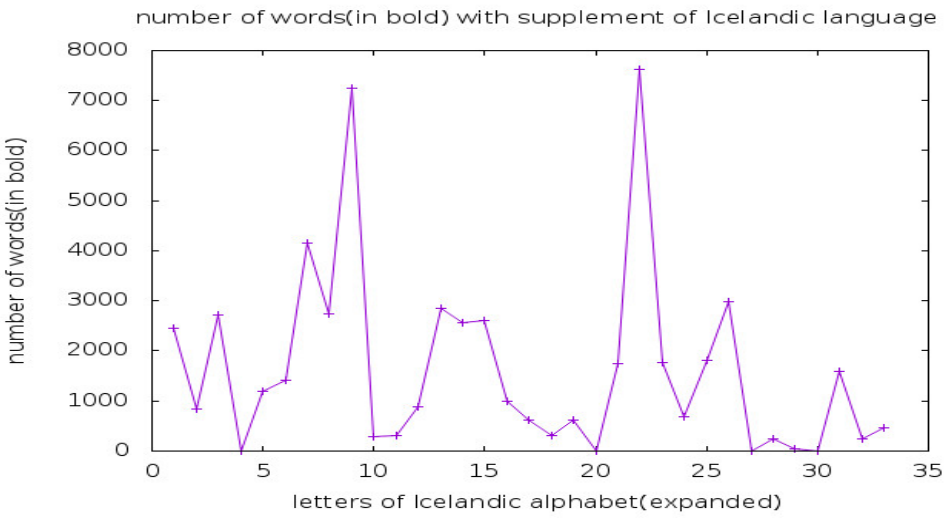

FIG. 21. The vertical axis is the number of the words, in bold, of An Icelandic-English Dictionary, [1]. The horizontal axis is the letters of the Icelandic alphabet expanded. Letters are represented by the sequence number in the expanded alphabet as it is laid out in the dictionary, [1]. The lower line represents the number of words, in bold, without supplement.

IV. ICELANDIC WORDS EXPANDED

In this section, we consider the Icelandic words, in bold, as appear serially along the letters with diacritical marks, in the dictionary, [1]. The result is the table, IV and the figure, 21.

For the purpose of exploring graphical law, we assort the letters according to the number of words, in the descending order, denoted by f and the respective rank, [118], denoted by k. k is a positive integer starting from one. Moreover, the minimum non-zero number of words is one. The limiting rank is maximum rank, here it is thirty. As a result both $\frac{lnf}{lnf_{max}}$ and $\frac{lnk}{lnk_{lim}}$ varies from zero to one. Then we tabulate in the adjoining table,V, and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.22. We then ignore the letter with the highest number of words, tabulate in the adjoining table,V,and redo the plot, normalising the lnfs with lnf_{n-max}, and starting from $k = 2$ in the figure fig.23. Normalising the lnfs with lnf_{2n-max}, we tabulate in the adjoining table,V, and starting from $k = 3$ we draw in the figure fig.24. Normalising the lnfs with lnf_{3n-max} we record in the adjoining table,V, and plot starting from $k = 4$ in the figure fig.25. In this way we obtain figures up to the figure fig.27.

letter	A	A'	B	C	D	E	F	G	H	I	I'	J	K	L	M	N	
number	2048	707	2238	3	978	1194	3541	2466	6577	254	281	807	2549	2306	2322	928	
addenda	85	0	102	0	41	28	77	38	73	5	0	8	49	34	35	17	
supplement	313	142	370	0	176	189	541	243	593	32	24	62	244	217	259	46	
total	2446	849	2710	3	1195	1411	4159	2747	7243	291	305	877	2842	2557	2616	991	
letter	O	O'	P	Q	R	S	T	U	U'	V	X	Y	Y'	Z	p	Æ	$\ddot{O}$
number	527	188	544	1	1557	6849	1533	559	1750	2690	1	203	53	1	1447	227	433
addenda	18	0	6	0	26	90	12	11	0	12	0	0	1	0	10	0	0
supplement	83	129	78	0	160	685	220	112	62	290	0	40	1	0	138	22	41
total	628	317	628	1	1743	7624	1765	682	1812	2992	1	243	55	1	1595	249	474

TABLE IV. Icelandic words(in bold): the first(sixth) row represents letters of the Icelandic alphabet,[1], expanded in the serial order. The fifth(the tenth) row represents total number words(in bold plus addenda plus supplement) of the Icelandic language.

k	lnk	lnk/lnk_{lim}	f	lnf	lnf/lnf_{max}	lnf/lnf_{n-max}	lnf/lnf_{2n-max}	lnf/lnf_{3n-max}	lnf/lnf_{4n-max}	lnf/lnf_{5n-max}
1	0	0	7624	8.939	1	Blank	Blank	Blank	Blank	Blank
2	0.69	0.203	7243	8.888	0.994	1	Blank	Blank	Blank	Blank
3	1.10	0.324	4159	8.333	0.932	0.938	1	Blank	Blank	Blank
4	1.39	0.409	2992	8.004	0.895	0.901	0.961	1	Blank	Blank
5	1.61	0.474	2842	7.952	0.890	0.895	0.954	0.994	1	Blank
6	1.79	0.526	2747	7.918	0.886	0.891	0.950	0.989	0.996	1
7	1.95	0.574	2710	7.905	0.884	0.889	0.949	0.988	0.994	0.998
8	2.08	0.612	2616	7.869	0.880	0.885	0.944	0.983	0.990	0.994
9	2.20	0.647	2557	7.847	0.878	0.883	0.942	0.980	0.987	0.991
10	2.30	0.676	2446	7.802	0.873	0.878	0.936	0.975	0.981	0.985
11	2.40	0.706	1812	7.502	0.839	0.844	0.900	0.937	0.943	0.947
12	2.48	0.729	1765	7.476	0.836	0.841	0.897	0.934	0.940	0.944
13	2.56	0.753	1743	7.463	0.835	0.840	0.896	0.932	0.939	0.943
14	2.64	0.776	1595	7.375	0.825	0.830	0.885	0.921	0.927	0.931
15	2.71	0.797	1411	7.252	0.811	0.816	0.870	0.906	0.912	0.916
16	2.77	0.815	1195	7.086	0.793	0.797	0.850	0.885	0.891	0.895
17	2.83	0.832	991	6.899	0.772	0.776	0.828	0.862	0.868	0.871
18	2.89	0.850	877	6.777	0.758	0.762	0.813	0.847	0.852	0.856
19	2.94	0.865	849	6.744	0.754	0.759	0.809	0.843	0.848	0.852
20	3.00	0.882	682	6.525	0.730	0.734	0.783	0.815	0.821	0.824
21	3.04	0.894	628	6.443	0.721	0.725	0.773	0.805	0.810	0.814
22	3.09	0.909	474	6.161	0.689	0.693	0.739	0.770	0.775	0.778
23	3.14	0.924	317	5.759	0.644	0.648	0.691	0.720	0.724	0.727
24	3.18	0.935	305	5.720	0.640	0.644	0.686	0.715	0.719	0.722
25	3.22	0.947	291	5.673	0.635	0.638	0.681	0.709	0.713	0.716
26	3.26	0.959	249	5.517	0.617	0.621	0.662	0.689	0.694	0.697
27	3.30	0.971	243	5.493	0.614	0.618	0.659	0.686	0.691	0.694
28	3.33	0.979	55	4.007	0.448	0.451	0.481	0.501	0.504	0.506
29	3.37	0.991	3	1.009	0.123	0.124	0.132	0.137	0.138	0.139
30	3.40	1	1	0	0	0	0	0	0	0

TABLE V. Words(in bold) of An Icelandic-English Dictionary, [1] in expanded Icelandic alphabet: ranking, natural logarithm, normalisations

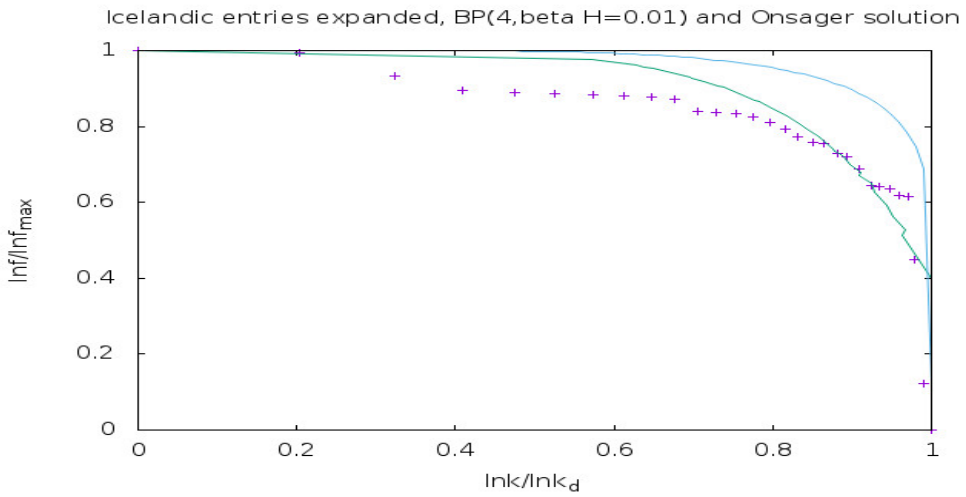

FIG. 22. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold, in expanded Icelandic alphabet, with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little external magnetic field, m=0.005 or, $\beta H = 0.01$. The uppermost curve is the Onsager solution.

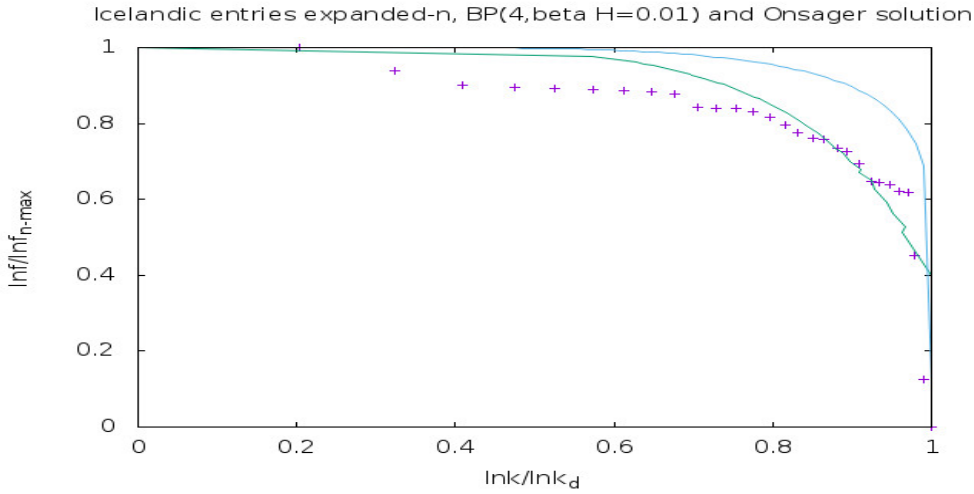

FIG. 23. Vertical axis is $\frac{lnf}{lnf_{n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold, in expanded Icelandic alphabet, with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little external magnetic field, m=0.005 or, $\beta H = 0.01$. The uppermost curve is the Onsager solution.

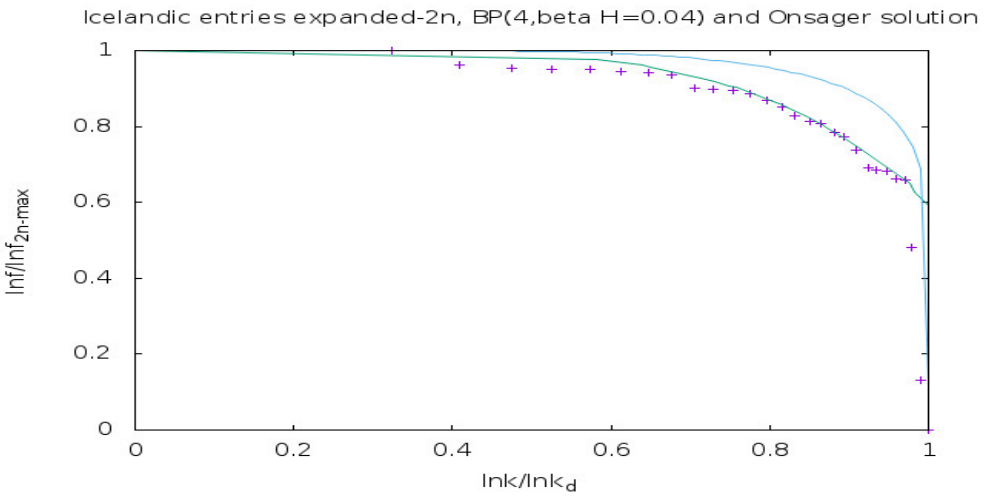

FIG. 24. Vertical axis is $\frac{lnf}{lnf_{2n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold, in expanded Icelandic alphabet, with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little external magnetic field, m=0.02 or, $\beta H = 0.04$. The uppermost curve is the Onsager solution.

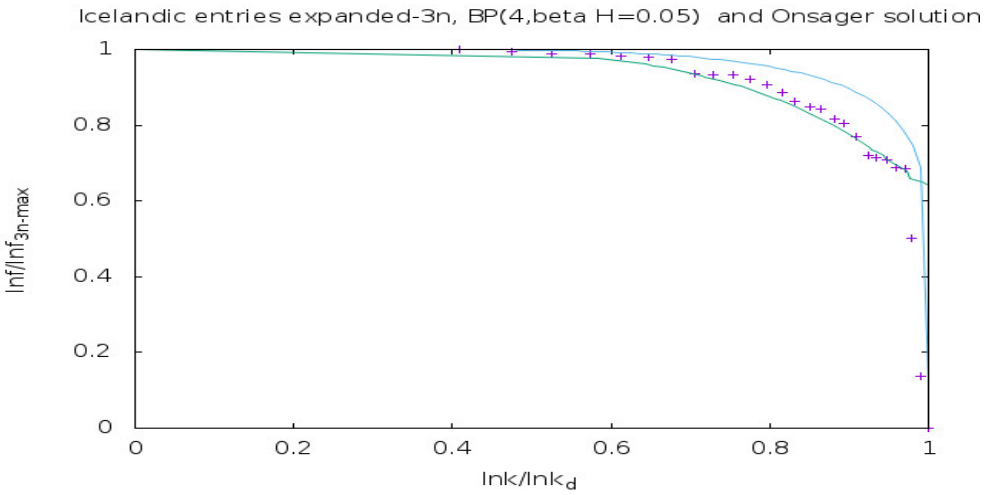

FIG. 25. Vertical axis is $\frac{lnf}{lnf_{3n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold, in expanded Icelandic alphabet, with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little external magnetic field, m=0.025 or, $\beta H = 0.05$. The uppermost curve is the Onsager solution.

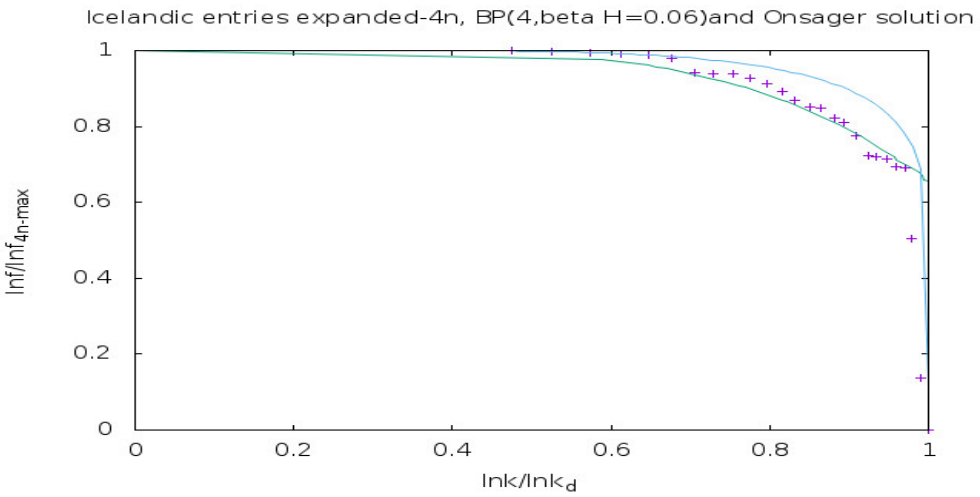

FIG. 26. Vertical axis is $\frac{lnf}{lnf_{4n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold, in expanded Icelandic alphabet, with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little external magnetic field, m=0.03 or, $\beta H = 0.06$. The uppermost curve is the Onsager solution.

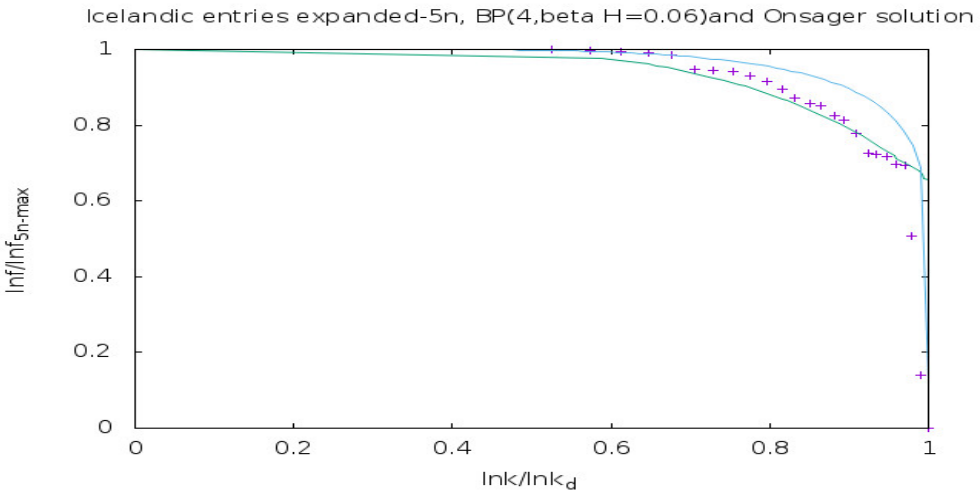

FIG. 27. Vertical axis is $\frac{lnf}{lnf_{5n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Icelandic language, in bold, in expanded Icelandic alphabet, with the fit curve being the Bethe-Peierls curve with four nearest neighbours, in presence of little external magnetic field, m=0.03 or, $\beta H = 0.06$. The uppermost curve is the Onsager solution.

A. conclusion

From the figures (fig.22-fig.27), we observe that there is a curve of magnetisation, behind the words of the Icelandic language, in bold, in expanded Icelandic alphabet,[1]. This is the magnetisation curve in the Bethe-Peierls approximation of the Ising model, BP(4,$\beta H = 0.04$), in the presence of four nearest neighbours and little external magnetic field, $m = 0.02$ or, $\beta H = 0.04$

Moreover, the associated correspondence is,

$$\frac{lnf}{lnf_{2n-max}} \longleftrightarrow \frac{M}{M_{max}},$$

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [119].

On the top of it, on successive normalisations, the words, in bold, of the Icelandic language,[1], in the expanded alphabet scheme, do not go over to the exact Onsager solution of the two dimensional Ising model in the absence of external magnetic field.

V. APENDIX: MAGNETISATION

A. Bragg-Williams approximation

Let us consider a coin. Let us toss it many times. Probability of getting head or, tale is half i.e. we will get head and tale equal number of times. If we attach value one to head, minus one to tale, the average value we obtain, after many tossing is zero. Instead let us consider a one-sided loaded coin, say on the head side. The probability of getting head is more than one half, getting tale is less than one-half. Average value, in this case, after many tossing we obtain is non-zero, the precise number depends on the loading. The loaded coin is like ferromagnet, the unloaded coin is like para magnet, at zero external magnetic field. Average value we obtain is like magnetisation, loading is like coupling among the spins of the ferromagnetic units. Outcome of single coin toss is random, but average value we get after long sequence of tossing is fixed. This is long-range order. But if we take a small sequence of tossing, say, three consecutive tossing, the average value we obtain is not fixed, can be anything. There is no short-range order.

Let us consider a row of spins, one can imagine them as spears which can be vertically up or, down. Assume there is a long-range order with probability to get a spin up is two third. That would mean when we consider a long sequence of spins, two third of those are with spin up. Moreover, assign with each up spin a value one and a down spin a value minus one. Then total spin we obtain is one third. This value is referred to as the value of long-range order parameter. Now consider a short-range order existing which is identical with the long-range order. That would mean if we pick up any three consecutive spins, two will be up, one down. Bragg-Williams approximation means short-range order is identical with long-range order, applied to a lattice of spins, in general. Row of spins is a lattice of one dimension.

Now let us imagine an arbitrary lattice, with each up spin assigned a value one and a down spin a value minus one, with an unspecified long-range order parameter defined as above by $L = \frac{1}{N}\Sigma_i\sigma_i$, where σ_i is i-th spin, N being total number of spins. L can vary from minus one to one. $N = N_+ + N_-$, where N_+ is the number of up spins, N_- is the number of down spins. $L = \frac{1}{N}(N_+ - N_-)$. As a result, $N_+ = \frac{N}{2}(1 + L)$ and $N_- = \frac{N}{2}(1 - L)$. Magnetisation or, net magnetic moment , M is $\mu\Sigma_i\sigma_i$ or, $\mu(N_+ - N_-)$ or, μNL, $M_{max} = \mu N$. $\frac{M}{M_{max}} = L$.

$\frac{M}{M_{max}}$ is referred to as reduced magnetisation. Moreover, the Ising Hamiltonian,[108], for the lattice of spins, setting μ to one, is $-\epsilon\Sigma_{n.n}\sigma_i\sigma_j - H\Sigma_i\sigma_i$, where n.n refers to nearest neighbour pairs.

The difference $\triangle E$ of energy if we flip an up spin to down spin is, [109], $2\epsilon\gamma\bar{\sigma} + 2H$, where γ is the number of nearest neighbours of a spin. According to Boltzmann principle, $\frac{N_-}{N_+}$ equals $exp(-\frac{\triangle E}{k_BT})$, [110]. In the Bragg-Williams approximation,[111], $\bar{\sigma} = L$, considered in the thermal average sense. Consequently,

$$ln\frac{1+L}{1-L} = 2\frac{\gamma\epsilon L + H}{k_BT} = 2\frac{L + \frac{H}{\gamma\epsilon}}{\frac{T}{\gamma\epsilon/k_B}} = 2\frac{L+c}{\frac{T}{T_c}} \tag{1}$$

where, $c = \frac{H}{\gamma\epsilon}$, $T_c = \gamma\epsilon/k_B$, [112]. $\frac{T}{T_c}$ is referred to as reduced temperature.

Plot of L vs $\frac{T}{T_c}$ or, reduced magentisation vs. reduced temperature is used as reference curve. In the presence of magnetic field, $c \neq 0$, the curve bulges outward. Bragg-Williams is a Mean Field approximation. This approximation holds when number of neighbours interacting with a site is very large, reducing the importance of local fluctuation or, local order, making the long-range order or, average degree of freedom as the only degree of freedom of the lattice. To have a feeling how this approximation leads to matching between experimental and Ising model prediction one can refer to FIG.12.12 of [109]. W. L. Bragg was a professor of Hans Bethe. Rudolf Peierls was a friend of Hans Bethe. At the suggestion of W. L. Bragg, Rudolf Peierls following Hans Bethe improved the approximation scheme, applying quasi-chemical method.

B. Bethe-peierls approximation in presence of four nearest neighbours, in the absence of external magnetic field

In the approximation scheme which is improvement over the Bragg-Williams, [108],[109],[110],[111],[112], due to Bethe-Peierls, [113], reduced magnetisation varies with reduced temperature, for γ neighbours, in absence of external magnetic field, as

$$\frac{ln\frac{\gamma}{\gamma-2}}{ln\frac{factor-1}{factor^{\frac{\gamma-1}{\gamma}} - factor^{\frac{1}{\gamma}}}} = \frac{T}{T_c}; factor = \frac{\frac{M}{M_{max}} + 1}{1 - \frac{M}{M_{max}}}. \tag{2}$$

$ln\frac{\gamma}{\gamma-2}$ for four nearest neighbours i.e. for $\gamma = 4$ is 0.693. For a snapshot of different kind of magnetisation curves for magnetic materials the reader is urged to give a google

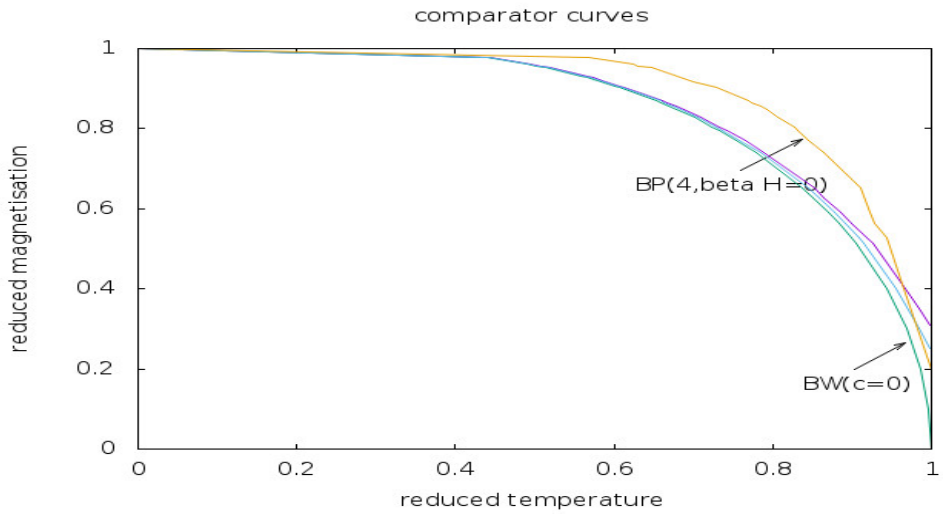

FIG. 28. Reduced magnetisation vs reduced temperature curves, for the Bragg-Williams approximation, in the absence (BW(c=0)) and in the presence (BW(c=0.005), BW(c=0.01)) of magnetic field, $c = 0$, $c = \frac{H}{\gamma\epsilon} = 0.005$, $c = \frac{H}{\gamma\epsilon} = 0.01$, outwards; and in the Bethe-Peierls approximation, BP(4,βH=0), in the absence of magnetic field, for four nearest neighbours (outer in the top).

search "reduced magnetisation vs reduced temperature curve". In the following, we describe data s generated from the equation(1) and the equation(2) in the table, VI, and curves of magnetisation plotted on the basis of those data s. BW stands for reduced temperature in Bragg-Williams approximation, calculated from the equation(1). BP(4) represents reduced temperature in the Bethe-Peierls approximation, for four nearest neighbours, computed from the equation(2). The data set is used to plot fig.28. Empty spaces in the table, VI, mean corresponding point pairs were not used for plotting a line.

C. Bethe-peierls approximation in presence of four nearest neighbours, in the presence of external magnetic field

In the Bethe-Peierls approximation scheme , [113], reduced magnetisation varies with reduced temperature, for γ neighbours, in presence of external magnetic field, as

$$\frac{ln\frac{\gamma}{\gamma-2}}{ln\frac{factor-1}{e^{\frac{2\beta H}{\gamma}}factor^{\frac{\gamma-1}{\gamma}}-e^{-\frac{2\beta H}{\gamma}}factor^{\frac{1}{\gamma}}}} = \frac{T}{T_c}; factor = \frac{\frac{M}{M_{max}}+1}{1-\frac{M}{M_{max}}}. \tag{3}$$

BW(c=0)	BW(c=0.005)	BW(c=0.01)	BP(4,$\beta H = 0$)	reduced magnetisation
0	0	0	0	1
0.435	0.437	0.439	0.563	0.978
0.439	0.441	0.443	0.568	0.977
0.491	0.493	0.495	0.624	0.961
0.501	0.504	0.507	0.630	0.957
0.514	0.517	0.519	0.648	0.952
0.559	0.562	0.565	0.654	0.931
0.566	0.569	0.573	0.7	0.927
0.584	0.587	0.590	0.7	0.917
0.601	0.604	0.607	0.722	0.907
0.607	0.610	0.613	0.729	0.903
0.653	0.658	0.661	0.770	0.869
0.659	0.663	0.666	0.773	0.865
0.669	0.674	0.678	0.784	0.856
0.679	0.684	0.688	0.792	0.847
0.701	0.705	0.709	0.807	0.828
0.723	0.728	0.732	0.828	0.805
0.732	0.736	0.743	0.832	0.796
0.753	0.758	0.766	0.845	0.772
0.779	0.784	0.788	0.864	0.740
0.838	0.844	0.853	0.911	0.651
0.850	0.858	0.864	0.911	0.628
0.870	0.877	0.885	0.923	0.592
0.883	0.891	0.899	0.928	0.564
0.899	0.908	0.918		0.527
0.905	0.914	0.926	0.941	0.513
0.944	0.956	0.968	0.965	0.400
		0.985		0.350
		0.998		0.310
0.969	0.985		0.965	0.300
	0.998			0.250
0.987			1	0.200
0.997			1	0.100
1			1	0

TABLE VI. Datas for Reduced temperature[for the Bragg-Williams approximation, in the absence (BW(c=0)) and in the presence (BW(c=0.005), BW(c=0.01)) of magnetic field, $c = 0$, $c = \frac{H}{\gamma\epsilon} = 0.005$, $c = \frac{H}{\gamma\epsilon} = 0.01$ respectively and in the Bethe-Peierls approximation, BP(4,βH=0), in the absence of magnetic field, for four nearest neighbours] vs reduced magnetisation. Reduced temperature is drawn along the x-axis and Reduced magnetisation is drawn along the y-axis. In gnuplot the command is plot ".dat" using 1:2 with line; 1 standing for x-axis and 2 standing for y-axis datas.

Derivation of this formula ala [113] is given in the appendix of [7].
$ln\frac{\gamma}{\gamma-2}$ for four nearest neighbours i.e. for $\gamma = 4$ is 0.693. For four neighbours,

$$\frac{0.693}{ln\frac{factor-1}{e^{\frac{2\beta H}{\gamma}}factor^{\frac{\gamma-1}{\gamma}}-e^{-\frac{2\beta H}{\gamma}}factor^{\frac{1}{\gamma}}}} = \frac{T}{T_c}; factor = \frac{\frac{M}{M_{max}}+1}{1-\frac{M}{M_{max}}}. \tag{4}$$

In the following, we describe datas in the table, VII, generated from the equation(4) and curves of magnetisation plotted on the basis of those datas. BP(m=0.03) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that $\beta H = 0.06$. calculated from the equation(4). BP(m=0.025) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that $\beta H = 0.05$. calculated from the equation(4). BP(m=0.02) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that $\beta H = 0.04$. calculated from the equation(4). BP(m=0.01) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that $\beta H = 0.02$. calculated from the equation(4). BP(m=0.005) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that $\beta H = 0.01$. calculated from the equation(4). The data set is used to plot fig.29. Empty spaces in the table, VII, mean corresponding point pairs were not used for plotting a line.

BP(m=0.03)	BP(m=0.025)	BP(m=0.02)	BP(m=0.01)	BP(m=0.005)	reduced magnetisation
0	0	0	0	0	1
0.583	0.580	0.577	0.572	0.569	0.978
0.587	0.584	0.581	0.575	0.572	0.977
0.647	0.643	0.639	0.632	0.628	0.961
0.657	0.653	0.649	0.641	0.637	0.957
0.671	0.667		0.654	0.650	0.952
	0.716			0.696	0.931
0.723	0.718	0.713	0.702	0.697	0.927
0.743	0.737	0.731	0.720	0.714	0.917
0.762	0.756	0.749	0.737	0.731	0.907
0.770	0.764	0.757	0.745	0.738	0.903
0.816	0.808	0.800	0.785	0.778	0.869
0.821	0.813	0.805	0.789	0.782	0.865
0.832	0.823	0.815	0.799	0.791	0.856
0.841	0.833	0.824	0.807	0.799	0.847
0.863	0.853	0.844	0.826	0.817	0.828
0.887	0.876	0.866	0.846	0.836	0.805
0.895	0.884	0.873	0.852	0.842	0.796
0.916	0.904	0.892	0.869	0.858	0.772
0.940	0.926	0.914	0.888	0.876	0.740
	0.929			0.877	0.735
	0.936			0.883	0.730
	0.944			0.889	0.720
	0.945				0.710
	0.955			0.897	0.700
	0.963			0.903	0.690
	0.973			0.910	0.680
				0.909	0.670
	0.993			0.925	0.650
		0.976	0.942		0.651
	1.00				0.640
		0.983	0.946	0.928	0.628
		1.00	0.963	0.943	0.592
			0.972	0.951	0.564
			0.990	0.967	0.527
				0.964	0.513
			1.00		0.500
				1.00	0.400
					0.300
					0.200
					0.100
					0

TABLE VII. Bethe-Peierls approx. in presence of little external magnetic fields

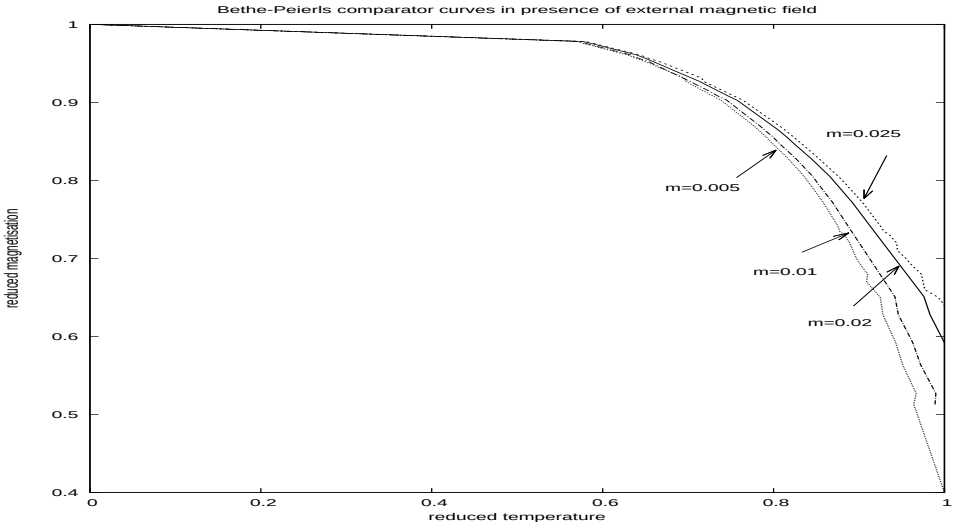

FIG. 29. Reduced magnetisation vs reduced temperature curves for Bethe-Peierls approximation in presence of little external magnetic fields, for four nearest neighbours, with $\beta H = 2m$.

D. Onsager solution

The two dimensional Ising model, [108], in the absence of external magnetic field is prototype of an Ising model. In case of square lattice of planar spins, one spin interacts with four other nearest neighbour spins i.e. on an average to another one spin. Below a certain ambient temperature, denoted as T_c, the two dimensional array of spins reduces to a planar magnet with magnetic moment per site varying as a function of $\frac{T}{T_c}$. This function was inferred, [114], by Lars Onsager way back in 1948 and thoroughly deduced thereafter by C.N.Yang, [117]. This function we are referring to as Onsager solution. Moreover, systems, [115], showing behaviour like Onsager solution is rare to come across. Graphically, the Onsager solution appears as in fig.30.

To have a comprehension, let us imagine an arbitrary lattice, with each up spin assigned a

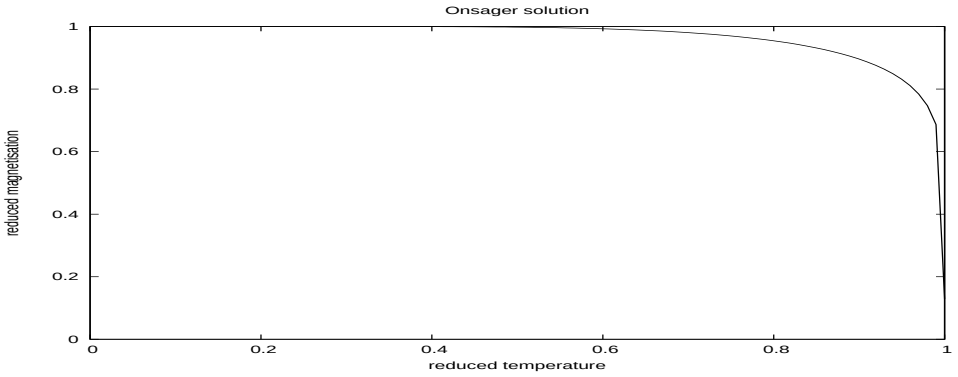

FIG. 30. Reduced magnetisation vs reduced temperature curves for exact solution of two dimensional Ising model, due to Onsager, in the the absence of external magnetic field

value one and a down spin a value minus one, with an unspecified long-range order parameter defined as above by $L = \frac{1}{N}\Sigma_i\sigma_i$, where σ_i is i-th spin, N being total number of spins. L can vary from minus one to one. $N = N_+ + N_-$, where N_+ is the number of up spins, N_- is the number of down spins. $L = \frac{1}{N}(N_+ - N_-)$. As a result, $N_+ = \frac{N}{2}(1 + L)$ and $N_- = \frac{N}{2}(1 - L)$. Magnetisation or, net magnetic moment , M is $\mu\Sigma_i\sigma_i$ or, $\mu(N_+ - N_-)$ or, μNL, $M_{max} = \mu N$. $\frac{M}{M_{max}} = L$. $\frac{M}{M_{max}}$ is referred to as reduced magnetisation. Moreover, the Ising Hamiltonian,[108], for the lattice of spins, setting μ to one, is $-\epsilon\Sigma_{n.n}\sigma_i\sigma_j - H\Sigma_i\sigma_i$, where n.n refers to nearest neighbour pairs.

At a temperature T, below a certain temperature called phase transition temperature, T_c,

for the two dimensional Ising model in the absence of external magnetic field i.e. for H equal to zero, the exact, unapproximated, Onsager solution gives reduced magnetisation as a function of reduced temperature as, [114], [116], [117], [113],

$$\frac{M}{M_{max}} = [1 - (sinh\frac{0.8813736}{\frac{T}{T_c}})^{-4}]^{1/8}.$$

and appears as in fig.30.

VI. ACKNOWLEDGMENT

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