Samsad Bengali-English Dictionary and The Graphical Law

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Abstract

We study the entries of the dictionary, the Samsad Bengali-English Dictionary compiled by Sailendra Biswas, the first edition. We draw the natural logarithm of the number of entries, normalised, starting with a letter vs the natural logarithm of the rank of the letter, normalised. We conclude that the dictionary can be characterised by BW(c=0.01), the magnetisation curve of the Ising Model in the Bragg-Williams approximation in the presence of external magnetic field, H. $c = \frac{H}{\gamma\epsilon} = 0.01$ with ϵ being the strength of coupling between two neighbouring spins in the Ising Model, γ representing the number of nearest neighbours of a spin, which is very large.

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a	*á*	i	í	u	*ú*	ṛi	e	*é*	ei	o	*ó*	ou	ka	kha	ga	gha	gna	cha	chha	ja	jha	nya	ṭa
4547	2171	355	96	1440	114	85	460	0	59	163	0	40	4352	975	2013	564	0	1804	491	1462	354	0	376
ṭha	ḍa	ḍha	ṇa	ta	tha	da	dha	na	pa	pha	ba	bha	ma	ya	ra	la	va	sha	ṣha	sa	ha	ḷa	kṣha
193	295	166	7	1896	180	2525	964	2711	5485	667	4928	1388	3423	625	1442	783	0	1728	93	4708	1222	0	0

TABLE I. Samsad Bengali-English Dictionary entries: the odd rows represent letters of the Kannada alphabet,[2], in the serial order, omitting mostly non-zero entries, the even rows represent the number of entries of the Samsad Bengali-English Dictionary, [1].

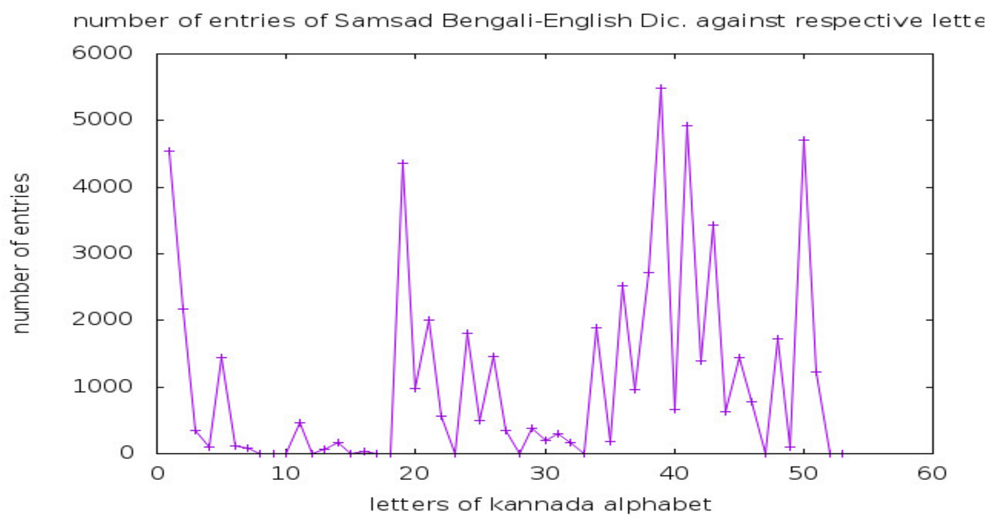

FIG. 1. The vertical axis is the number of entries of the Samsad Bengali-English Dictionary, [1]. The horizontal axis is the letters of the Kannada alphabet. Letters are represented by the sequence number in the alphabet as it appears in the dictionary, [2].

I. INTRODUCTION

"Biswas-ae milay bastu, torke bahudur."—-a bengali proverb.

The proverb implies to go as far as possible along the route of argument. So do we. We take another bengali dictionary, [1]. Here, it is a bengali-english dictionary. We have studied embedding the bengali letters in the Kannada alphabet ala, [2]. We do that in this paper also. We start counting the entries of the Samsad Bengali-English Dictionary compiled by Sailendra Biswas, the first edition, [1]. The result is the table, I. To visualise we plot the number of entries against the respective letters in the dictionary sequence,[1],[2], in the adjoining figure, fig.1.

a	*á*	i	í	u	*ú*	ṛi	e	*é*	ei	o	*ó*	ou	ka	kha	ga	gha	gna	cha	chha	ja	jha	nya	ṭa
4295	2029	271	59	1205	53	47	494	0	50	173	0	46	3864	835	1725	480	0	1531	495	1139	318	0	401
ṭha	ḍa	ḍha	ṇa	ta	tha	da	dha	na	pa	pha	ba	bha	ma	ya	ra	la	va	sha	ṣha	sa	ha	ḷa	kṣha
172	287	155	7	1653	153	2103	788	2263	4503	565	4745	1091	2902	577	1324	796	0	1586	88	4182	1119	0	0

TABLE II. Samsad Bangla Abhidan words: the odd rows represent letters of the Kannada alphabet,[2], in the serial order, omitting mostly non-zero entries, the even rows represent the number of entries of the Samsad Bangla Abhidan, [3].

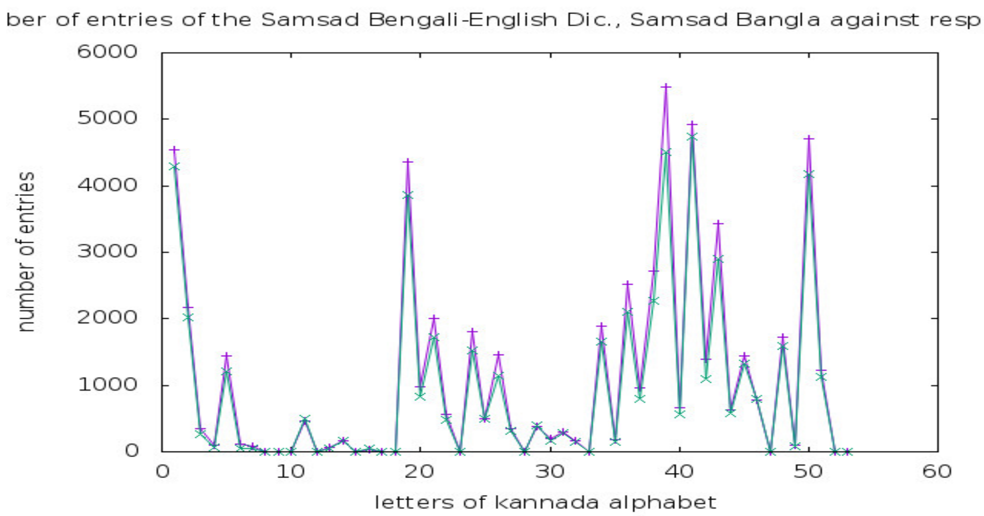

FIG. 2. The vertical axis is the number of entries, in red(green), of the Samsad Bengali-English Dictionary(Samsad Bangla Abhidan), [1]([3]). The horizontal axis is the letters of the Kannada alphabet. Letters are represented by the sequence number in the alphabet as it appears in the dictionary, [2].

We put the Samsda Bangla Abhidan, another bengali dictionary, [3], in the context in the following in the table, II and pictorially represent the number of entries against the respective letters in the dictionary sequence,[2], in the adjoining figure, fig.2.

Next on to the Graphical Law, we proceed in the rest of the paper. We have started considering magnetic field pattern in [4], in the languages we converse with. We have studied there, a set of natural languages, [4] 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 into, [5], dictionaries of five disciplines of knowledge and found existence of a curve magnetisation under each discipline. This was followed by finding of the graphical law behind the bengali language,[6] and the basque language[7]. This was pursued by finding of the graphical law behind the Romanian language, [8], five more disciplines of knowledge, [9], Onsager core of Abor-Miri, Mising languages,[10], Onsager Core of Romanised Bengali language,[11], the graphical law behind the Little Oxford English Dictionary, [12], the Oxford Dictionary of Social Work and Social Care, [13], the Visayan-English Dictionary, [14], Garo to English School Dictionary, [15], Mursi-English-Amharic Dictionary, [16] and Names of Minor Planets, [17], A Dictionary of Tibetan and English, [18], Khasi English Dictionary, [19], Turkmen-English Dictionary, [20], Websters Universal Spanish-English Dictionary, [21], A Dictionary of Modern Italian, [22], Langenscheidt's German-English Dictionary, [23], Essential Dutch dictionary by G. Quist and D. Strik, [24], Swahili-English dictionary by C. W. Rechenbach, [25], Larousse Dictionnaire De Poche for the French, [26], the Onsager's solution behind the Arabic, [27], the graphical law behind Langenscheidt Taschenwörterbuch Deutsch-Englisch / Englisch-Deutsch, Völlige Neubearbeitung, [28], the graphical law behind the NTC's Hebrew and English Dictionary by Arie Comey and Naomi Tsur, [29], the graphical law behind the Oxford Dictionary Of Media and Communication, [30], the graphical law behind the Oxford Dictionary Of Mathematics, Penguin Dictionary Of Mathematics, [31], the Onsager's solution behind the Arabic Second part, [32], the graphical law behind the Penguin Dictionary Of Sociology, [33], behind the Concise Oxford Dictionary Of Politics, [34], a Dictionary Of Critical Theory by Ian Buchanan, [35], the Penguin Dictionary Of Economics, [36], the Concise Gojri-English Dictionary by Dr. Rafeeq Anjum, [37], A Dictionary of the Kachin Language by Rev.O.Hanson, [38], A Dictionary Of World History by Edmund Wright, [39], Ekagi-Dutch-English-Indonesian Dictionary by J. Steltenpool, [40], A Dictionary of Plant Sciences by Michael Allaby, [41], respectively. The graphical law was pursued more in Along the side of the Onsager's solution, the Ekagi language ,[42], Along the side of the Onsager's solution, the Ekagi language-Part Three, [43], Oxford Dictionary of Biology by Robert S. Hine and the Graphical law, [44], A Dictionary of the Mikir Language by G. D. Walker and the Graphical law, [45], A Dictionary of Zoology by Michael Allaby and the Graphical Law, [46], Dictionary of all Scriptures and Myths by G. A. Gaskell and the Graphical Law, [47], Dictionary of Culinary Terms by Philippe Pilibossian and the Graphical law, [48], A Greek and English Lexicon by H.G.Liddle et al simplified by Didier Fontaine and the Graphical law, [49], Learner's Mongol-English Dictionary and the

Graphical law, [50], Complete Bulgarian-English Dictionary and the Graphical law, [51], A Dictionary of Sindhi Literature by Dr. Motilal Jotwani and the Graphical Law, [52], Penguin Dictionary of Physics, the Fourth Edition, by John Cullerne, and the Graphical law, [53], Oxford Dictionary of Chemistry, the seventh edition and the Graphical Law, [54], A Burmese-English Dictionary, Part I-Part V, by J. A. Stewart and C. W. Dunn et al, head entries and the Graphical Law, [55], The Graphical Law behind the head words of Dictionary Kannada and English written by W. Reeve, revised, corrected and enlarged by Daniel Sanderson, [56], Sanchayita and the Graphical Law, [57], Samsad Bangla Abhidan and The Graphical Law, [58], Bangiya Sabdakosh and The Graphical Law, [59], respectively.

In the previous papers, [6], [11], [58], [59], we have studied bengali-bengali dictionaries. On the otherhand, most of the languages we have studied, we took the dictionaries from that language to the English language. To complete the story, we took here a bengali to english dictionary. That too which was compiled by someone whose bengali to bengali dictionary we have already studied. We have found that the graphical law characterisation remain the same for his bengali-bengali and bengali-english dictionaries. This too coincides with the characterisation found from other bengali-bengali dictionaries allowing us to draw two conclusions. One particular conclusion is that we can safely say that the bengali language prevalent over the past hundred years is charcterised by BW(c=0.01), though it is evolving away from it. One general conclusion is that the graphical law characterisation of a language is probably independent of whether we are studying a dictionary from that language to english or, from that language to the same language.

The planning of the paper is as follows. In the next section, we describe the Graphical Law analysis of the entries of the Samsad Bengali-English Dictionary, [1]. The section III, we give an introduction to the standard curves of magnetisation of Ising model. The section IV is Acknowledgment. The last section is Bibliography.

II. THE GRAPHICAL LAW ANALYSIS

For the purpose of exploring graphical law, we assort the letters according to the number of entries, in the descending order, denoted by f and the respective rank, [60], denoted by k. k is a positive integer starting from one. Moreover, the minimum non-zero number of entries is seven. Hence, we attach a limiting entry number one. The limiting rank is maximum rank plus one, here it is forty two. 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.4. We then ignore the letter with the highest of entries, 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.5. 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.6. Normalising the lnfs with lnf_{3n-max} we record in the adjoining table,III, and plot starting from $k = 4$ in the figure fig.7. In this way we obtain up to the figure fig.8.

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	5485	8.610	1	Blank	Blank	Blank	Blank	Blank
2	0.69	0.184	4928	8.503	0.988	1	Blank	Blank	Blank	Blank
3	1.10	0.294	4708	8.457	0.982	0.995	1	Blank	Blank	Blank
4	1.39	0.372	4547	8.422	0.978	0.990	0.996	1	Blank	Blank
5	1.61	0.430	4352	8.378	0.973	0.985	0.991	0.995	1	Blank
6	1.79	0.479	3423	8.138	0.945	0.957	0.962	0.966	0.971	1
7	1.95	0.521	2711	7.905	0.918	0.930	0.935	0.939	0.944	0.971
8	2.08	0.556	2525	7.834	0.910	0.921	0.926	0.930	0.935	0.963
9	2.20	0.588	2171	7.683	0.892	0.904	0.908	0.912	0.917	0.944
10	2.30	0.615	2013	7.607	0.884	0.895	0.899	0.903	0.908	0.935
11	2.40	0.642	1896	7.548	0.877	0.888	0.893	0.896	0.901	0.928
12	2.48	0.663	1804	7.498	0.871	0.882	0.887	0.890	0.895	0.921
13	2.56	0.684	1728	7.455	0.866	0.877	0.882	0.885	0.890	0.916
14	2.64	0.706	1462	7.288	0.846	0.857	0.862	0.865	0.870	0.896
15	2.71	0.725	1442	7.274	0.845	0.855	0.860	0.864	0.868	0.894
16	2.77	0.741	1440	7.272	0.845	0.855	0.860	0.863	0.868	0.894
17	2.83	0.757	1388	7.236	0.840	0.851	0.856	0.859	0.864	0.889
18	2.89	0.773	1222	7.108	0.826	0.836	0.840	0.844	0.848	0.873
19	2.94	0.786	975	6.882	0.799	0.809	0.814	0.817	0.821	0.846
20	3.00	0.802	964	6.871	0.798	0.808	0.812	0.816	0.820	0.844
21	3.04	0.813	783	6.663	0.774	0.784	0.788	0.791	0.795	0.819
22	3.09	0.826	667	6.503	0.755	0.765	0.769	0.772	0.776	0.799
23	3.14	0.840	625	6.438	0.748	0.757	0.761	0.764	0.768	0.791
24	3.18	0.850	564	6.335	0.736	0.745	0.749	0.752	0.756	0.778
25	3.22	0.861	491	6.196	0.720	0.729	0.733	0.736	0.740	0.761
26	3.26	0.872	460	6.131	0.712	0.721	0.725	0.728	0.732	0.753
27	3.30	0.882	376	5.930	0.689	0.697	0.701	0.704	0.708	0.729
28	3.33	0.890	355	5.872	0.682	0.691	0.694	0.697	0.701	0.722
29	3.37	0.901	354	5.869	0.682	0.690	0.694	0.697	0.701	0.721
30	3.40	0.909	295	5.687	0.661	0.669	0.672	0.675	0.679	0.699
31	3.43	0.917	193	5.263	0.611	0.619	0.622	0.625	0.628	0.647
32	3.47	0.928	180	5.193	0.603	0.611	0.614	0.617	0.620	0.638
33	3.50	0.936	166	5.112	0.594	0.601	0.604	0.607	0.610	0.628
34	3.53	0.944	163	5.094	0.592	0.599	0.602	0.605	0.608	0.626
35	3.56	0.952	114	4.736	0.550	0.557	0.560	0.562	0.565	0.582
36	3.58	0.957	96	4.564	0.530	0.537	0.540	0.542	0.545	0.561
37	3.61	0.965	93	4.533	0.526	0.533	0.536	0.538	0.541	0.557
38	3.64	0.973	85	4.443	0.516	0.523	0.525	0.528	0.530	0.546
39	3.66	0.979	59	4.078	0.474	0.480	0.482	0.484	0.487	0.501
40	3.69	0.987	40	3.689	0.428	0.434	0.436	0.438	0.440	0.453
41	3.71	0.992	7	1.946	0.226	0.229	0.230	0.231	0.232	0.239
42	3.74	1	1	0	0	0	0	0	0	0

TABLE III. Samsad Bengali-English Dictionary entries: ranking,natural logarithm, normalisations

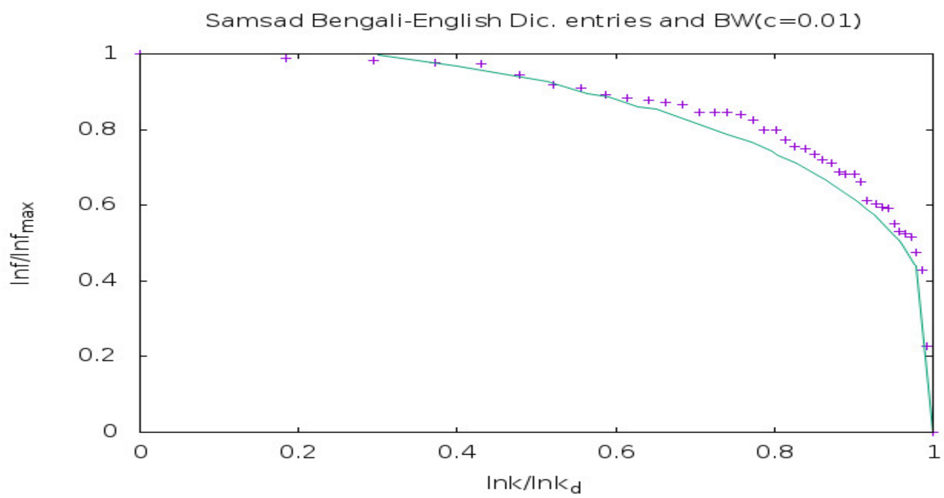

FIG. 3. The vertical axis is $\frac{lnf}{lnf_{max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the entries of the Samsad Bengali-English Dictionary, with the fit curve being the Bragg-Williams curve in the presence of external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$.

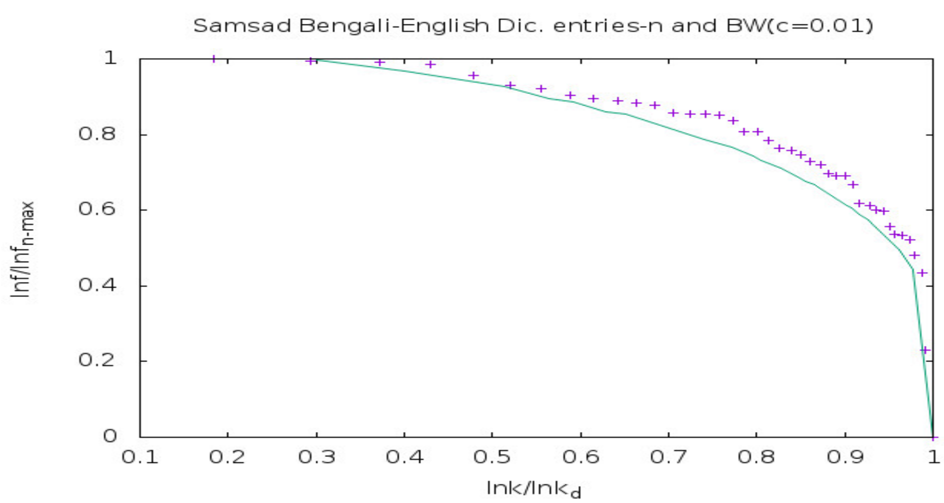

FIG. 4. The vertical axis is $\frac{lnf}{lnf_{n-max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the entries of the Samsad Bengali-English Dictionary, with the fit curve being the Bragg-Williams curve in the presence of external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$.

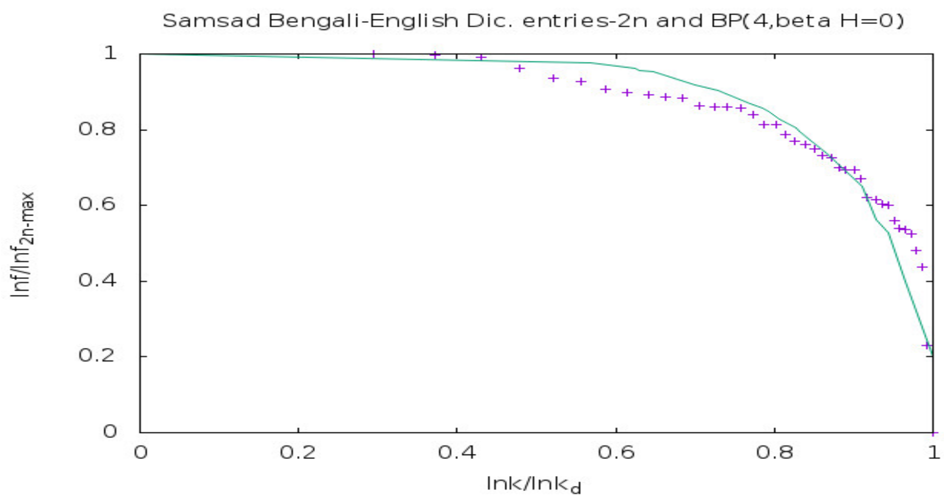

FIG. 5. The vertical axis is $\frac{lnf}{lnf_{2n-max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the entries of the Samsad Bengali-English Dictionary, with the fit curve, BP(4,$\beta H = 0$), being the Bethe-Peierls curve in the presence of four nearest neighbours and no external magnetic field, $m = 0$ or, $\beta H = 0$.

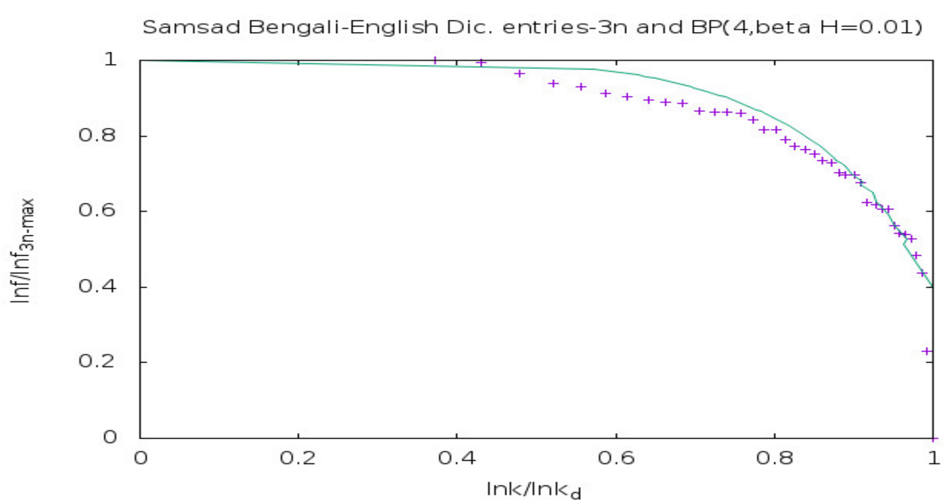

FIG. 6. The vertical axis is $\frac{lnf}{lnf_{3n-max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the entries of the Samsad Bengali-English Dictionary, with the fit curve, BP(4,$\beta H = 0.01$), being the Bethe-Peierls curve in the presence of four nearest neighbours and external magnetic field, $m = 0.005$ or, $\beta H = 0.01$.

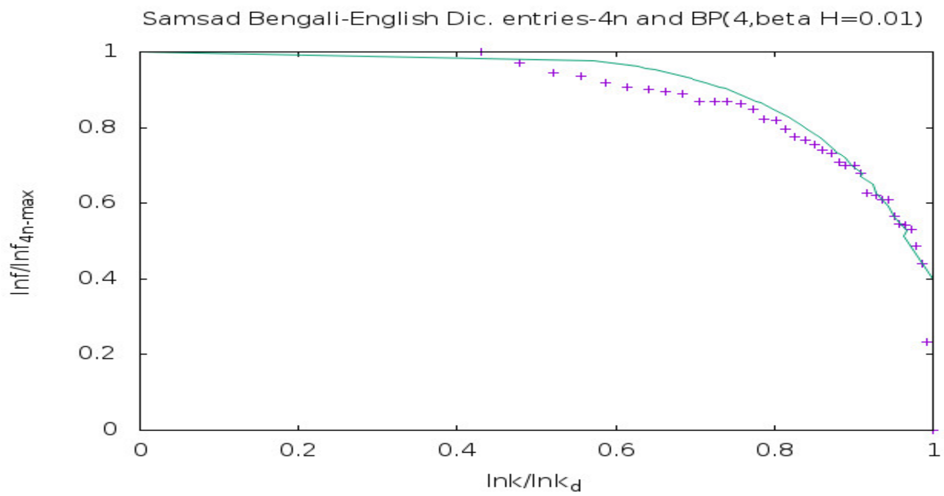

FIG. 7. The vertical axis is $\frac{lnf}{lnf_{4n-max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the entries of the Samsad Bengali-English Dictionary, with the fit curve, BP(4,$\beta H = 0.01$), being the Bethe-Peierls curve in the presence of four nearest neighbours and external magnetic field, $m = 0.005$ or, $\beta H = 0.01$.

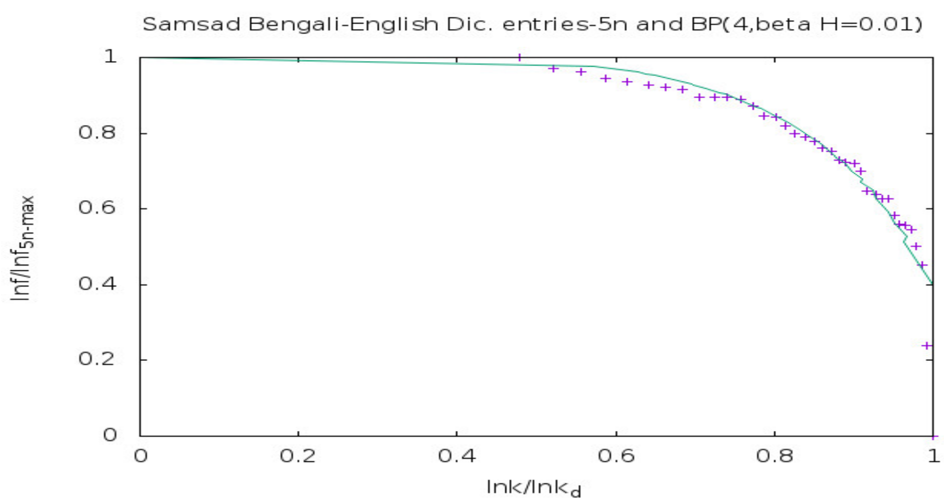

FIG. 8. The vertical axis is $\frac{lnf}{lnf_{5n-max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the entries of the Samsad Bengali-English Dictionary, with the fit curve, BP(4,$\beta H = 0.01$), being the Bethe-Peierls curve in the presence of four nearest neighbours and external magnetic field, $m = 0.005$ or, $\beta H = 0.01$.

A. conclusion

From the figures (fig.3-fig.8), we observe that there is a curve of magnetisation, behind the entries of the Samsad Bengali-English Dictionary,[1]. This is the magnetisation curve in the Bragg-Williams approximation of the Ising model, in the presence of external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$.

Moreover, the associated correspondence is,

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

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [67]. Nevertheless on successive normalisations, the entires of the Samsad Bengali-English Dictionary, go over to the magnetisation curve, BP(4,$\beta H = 0.01$). Hence, the the entires of the Samsad Bengali-English Dictionary, [1], has a Bethe-Peierls core(in the presence of four nearest neighbours and in the presence of external magnetic field).

III. 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,[61], 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, [62], $2\epsilon\gamma\bar{\sigma} + 2H$, where γ is the number of nearest neighbours of a spin. According to Boltzmann principle, $\frac{N_-}{N_+}$ equals $exp(-\frac{\triangle E}{k_B T})$, [63]. In the Bragg-Williams approximation,[64], $\bar{\sigma} = L$, considered in the thermal average sense. Consequently,

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

where, $c = \frac{H}{\gamma\epsilon}$, $T_c = \gamma\epsilon/k_B$, [65]. $\frac{T}{T_c}$ 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 [62]. 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 absence of external magnetic field

In the approximation scheme which is improvement over the Bragg-Williams, [61],[62],[63],[64],[65], due to Bethe-Peierls, [66], 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 search "reduced magnetisation vs reduced temperature curve". In the following, we describe

BW	BW(c=0.01)	BP(4,βH = 0)	reduced magnetisation
0	0	0	1
0.435	0.439	0.563	0.978
0.439	0.443	0.568	0.977
0.491	0.495	0.624	0.961
0.501	0.507	0.630	0.957
0.514	0.519	0.648	0.952
0.559	0.566	0.654	0.931
0.566	0.573	0.7	0.927
0.584	0.590	0.7	0.917
0.601	0.607	0.722	0.907
0.607	0.613	0.729	0.903
0.653	0.661	0.770	0.869
0.659	0.668	0.773	0.865
0.669	0.676	0.784	0.856
0.679	0.688	0.792	0.847
0.701	0.710	0.807	0.828
0.723	0.731	0.828	0.805
0.732	0.743	0.832	0.796
0.756	0.766	0.845	0.772
0.779	0.788	0.864	0.740
0.838	0.853	0.911	0.651
0.850	0.861	0.911	0.628
0.870	0.885	0.923	0.592
0.883	0.895	0.928	0.564
0.899	0.918		0.527
0.904	0.926	0.941	0.513
0.946	0.968	0.965	0.400
0.967	0.998	0.965	0.300
0.987		1	0.200
0.997		1	0.100
1	1	1	0

TABLE IV. Reduced magnetisation vs reduced temperature data s for Bragg-Williams approximation, in absence of and in presence of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$, and Bethe-Peierls approximation in absence of magnetic field, for four nearest neighbours.

data s generated from the equation(1) and the equation(2) in the table, IV, 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.1. Empty spaces in the table, IV, mean corresponding point pairs were not used for plotting a line.

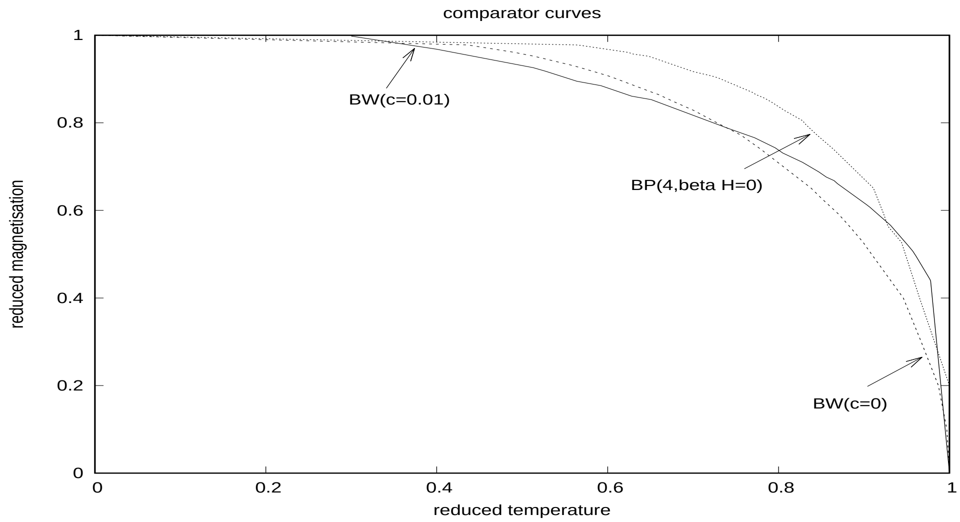

FIG. 9. Reduced magnetisation vs reduced temperature curves for Bragg-Williams approximation, in absence(dark) of and presence(inner in the top) of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$, and Bethe-Peierls approximation in absence of magnetic field, for four nearest neighbours (outer in the top).

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

In the Bethe-Peierls approximation scheme , [66], reduced magnetisation varies with reduced temperature, for γ neighbours, in presence of external magnetic field, as

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

Derivation of this formula ala [66] is given in the appendix of [9].

$ln\frac{\gamma}{\gamma-2}$ 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, V, 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.2. Empty spaces in the table, V, 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 V. Bethe-Peierls approx. in presence of little external magnetic fields

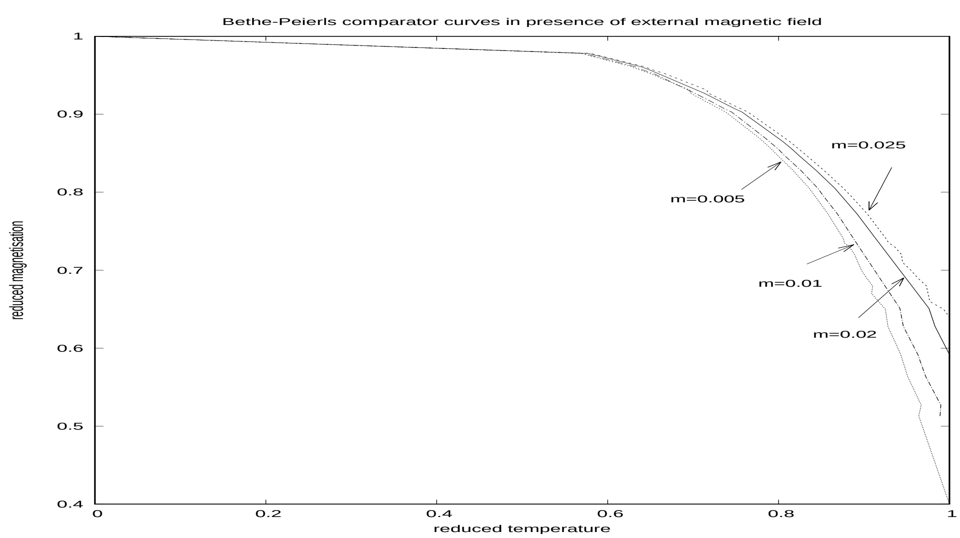

FIG. 10. Reduced magnetisation vs reduced temperature curves for Bethe-Peierls approximation in presence of little external magnetic fields, for four nearest neighbours, with $\beta H = 2m$.

IV. ACKNOWLEDGMENT

We have used gnuplot for plotting the figures in this paper.

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