Khasi-Jaintia Jaids(Surnames) and the Graphical law

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Abstract

We study the Khasi-Jaintia Jaids(Surnames). We draw the natural logarithm of the number of the Jaids of the Khasi-Jaintia tribes, normalised, starting with a letter vs the natural logarithm of the rank of the letter, normalised. We conclude that the Khasi-Jaintia Jaids(Surnames) can be characterised by the magnetisation curve, BW(c=0), of the Ising Model in the Bragg-Williams approximation in the absence of external magnetic field, H. $c = \frac{H}{\gamma\epsilon} = 0$.

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I. INTRODUCTION

The tribesmen and women in the Khasi and Jaintia Hills of Meghalaya of North-Eastern India, exibit huge diversity when it comes to their surnames, referred to as Jaids. In our previous paper, [1], we have collected a reasonable set of surnames of the Khasi-Jaintia people. Out of curiosity we ask to ourselves, is there a magnetic field pattern behind this set? The answer is in the affirmative. The rest of the paper goes to elaborate on the affirmation. 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 into, [3], 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,[4] and the basque language[5]. This was pursued by finding of the graphical law behind the Romanian language, [6], five more disciplines of knowledge, [7], Onsager core of Abor-Miri, Mising languages,[8], Onsager Core of Romanised Bengali language,[9], the graphical law behind the Little Oxford English Dictionary, [10], the Oxford Dictionary of Social Work and Social Care, [11], the Visayan-English Dictionary, [12], Garo to English School Dictionary, [13], Mursi-English-Amharic Dictionary, [14] and Names of Minor Planets, [15], A Dictionary of Tibetan and English, [16], Khasi English Dictionary, [17], Turkmen-English Dictionary, [18], Websters Universal Spanish-English Dictionary, [19], A Dictionary of Modern Italian, [20], Langenscheidt's German-English Dictionary, [21], Essential Dutch dictionary by G. Quist and D. Strik, [22], Swahili-English dictionary by C. W. Rechenbach, [23], Larousse Dictionnaire De Poche for the French, [24], the Onsager's solution behind the Arabic, [25], the graphical law behind Langenscheidt Taschenwörterbuch Deutsch-Englisch / Englisch-Deutsch, Völlige Neubearbeitung, [26], the graphical law behind the NTC's Hebrew and English Dictionary by Arie Comey and Naomi Tsur, [27], the graphical law behind the Oxford Dictionary Of Media and Communication, [28], the graphical law behind the Oxford Dictionary Of Mathematics, Penguin Dictionary Of Mathematics, [29], the Onsager's solution behind the Arabic Second part, [30], the graphical law behind the Penguin Dictionary Of Sociology, [31], behind the Concise Oxford Dictionary Of Politics, [32], a Dictionary Of Critical Theory by Ian Buchanan, [33], the Penguin Dictionary Of Economics, [34], the Concise Gojri-English Dictionary by Dr. Rafeeq Anjum, [35], A Dictionary of the Kachin Language by Rev.O.Hanson, [36], A Dictionary Of World History by Edmund Wright, [37], Ekagi-Dutch-English-Indonesian Dictionary by J. Steltenpool, [38], A Dictionary of Plant Sciences by Michael Allaby, [39], respectively. The graphical law was pursued more in Along the side of the Onsager's solution, the Ekagi language ,[40], Along the side of the Onsager's solution, the Ekagi language-Part Three, [41], Oxford Dictionary of Biology by Robert S. Hine and the Graphical law, [42], A Dictionary of the Mikir Language by G. D. Walker and the Graphical law, [43], A Dictionary of Zoology by Michael Allaby and the Graphical Law, [44], Dictionary of all Scriptures and Myths by G. A. Gaskell and the Graphical Law, [45], Dictionary of Culinary Terms by Philippe Pilibossian and the Graphical law, [46], A Greek and English Lexicon by H.G.Liddle et al simplified by Didier Fontaine and the Graphical law, [47], Learner's Mongol-English Dictionary and the Graphical law, [48], Complete Bulgarian-English Dictionary and the Graphical law, [49], A Dictionary of Sindhi Literature by Dr. Motilal Jotwani and the Graphical Law, [50], Penguin Dictionary of Physics, the Fourth Edition, by John Cullerne, and the Graphical law, [51], Oxford Dictionary of Chemistry, the seventh edition and the Graphical Law, [52], A Burmese-English Dictionary, Part I-Part V, by J. A. Stewart and C. W. Dunn et al, head entries and the Graphical Law, [53], The Graphical Law behind the head words of Dictionary Kannada and English written by W. Reeve, revised, corrected and enlarged by Daniel Sanderson, [54], Sanchayita and the Graphical Law, [55], Samsad Bangla Abhidan and The Graphical Law, [56], Bangiya Sabdakosh and The Graphical Law, [57], Samsad Bengali-English Dictionary and The Graphical Law, [58], Rudyard Kipling's Verse and the Graphical Law, [59], W. B. Yeats, The Poems and the Graphical Law, [60], The Penguin Encyclopedia of Places by W. G. Moore and the Graphical law, [61], The Poems of Tennyson and the Graphical Law, [62], respectively.

The planning of the paper is as follows. We give an introduction to the standard curves of magnetisation of Ising model in the section II. In the section III, we describe the graphical law analysis of the Jaids of the Khasi-Jaintia People, [1]. Sections IV, V are Acknowledgement and Bibliography respectively.

II. 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 paramagnet, 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, $\mu N L$, $M_{max} = \mu N$. $\frac{M}{M_{max}} = L$. $\frac{M}{M_{max}}$ is referred to as reduced magnetisation. Moreover, the Ising Hamiltonian,[64], 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, [65], $2\epsilon\gamma\bar{\sigma} + 2H$, where γ is the number of nearest neighbours of a spin. According to Boltzmann principle, $\frac{N_-}{N_+}$ equals $exp(-\frac{\triangle E}{k_B T})$, [66]. In the Bragg-Williams approximation,[67], $\bar{\sigma} = L$, considered in the thermal average sense. Consequently,

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

where, $c = \frac{H}{\gamma\epsilon}$, $T_c = \gamma\epsilon/k_B$, [68]. $\frac{T}{T_c}$ 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 [65]. W. L. Bragg was a professor of Hans Bethe. Rudlof Peierls was a friend of Hans Bethe. At the suggestion of W. L. Bragg, Rudlof 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, [64],[65],[66],[67],[68], due to Bethe-Peierls, [69], reduced magnetisation varies with reduced temperature, for γ neighbours, in absence of external magnetic field, as

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

$ln\frac{\gamma}{\gamma-2}$ 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 I. Reduced magnetisation vs reduced temperature datas 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 .

datas generated from the equation(1) and the equation(2) in the table, I, and curves of magnetisation plotted on the basis of those datas. 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, I, mean corresponding point pairs were not used for plotting a line.

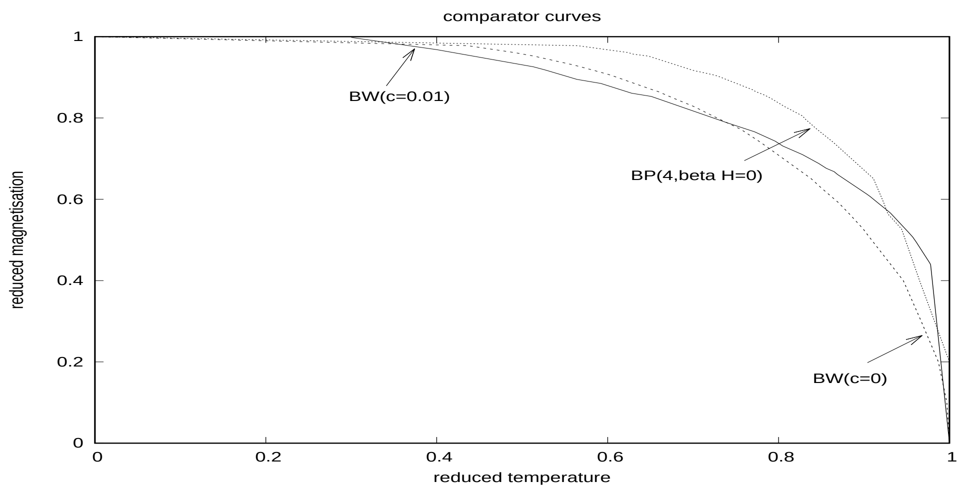

FIG. 1. Reduced magnetisation vs reduced temperature curves for the Bragg-Williams approximation, in the absence(broken line) of, BW(c=0) and the presence(inner in the top) of, BW(c=0.01), the external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$, and the Bethe-Peierls approximation in the absence of external magnetic field, for four nearest neighbours (outer in the top).

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	22	11	30	0	0	15	22	15	17	290	125	136	113	0	189	0	60	155	59	10	0	51	0	6	0

TABLE II. Khasi-Jaintia Jaids: the first row represents letters of the English alphabet in the serial order, the second row is the respective number of Jaids.

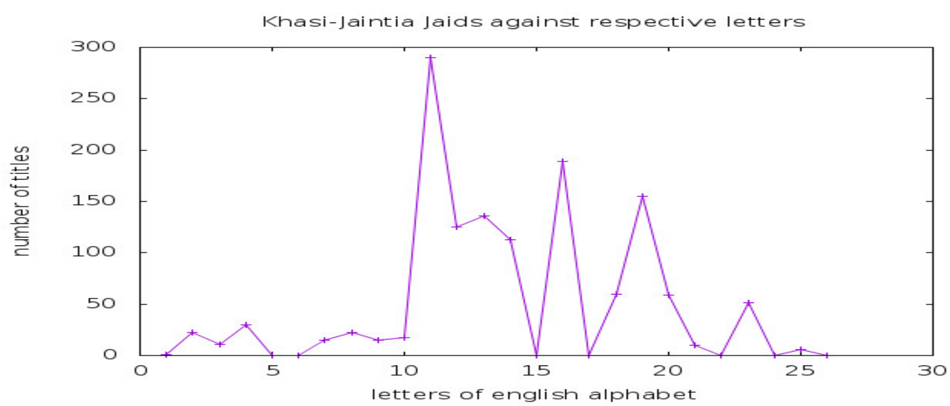

FIG. 2. The vertical axis is the number of the titles of Khasi-Jaintia People, [1]. The horizontal axis is the letters of the English alphabet. Letters are represented by the sequence number in the alphabet.

We count all the entries in the paper, [1], one by one from the beginning to the end, starting with different letters. The result is the table, II. To visualise we plot the number of surnames against the letters of the English alphabet, in the adjoining figure, fig.2.

III. THE GRAPHICAL LAW ANALYSIS

For the purpose of exploring graphical law, we assort the letters according to the number of Jaids, in the descending order, denoted by f and the respective rank, [63], denoted by k. k is a positive integer starting from one. Minimum number of surnames is one. The limiting rank, k_{lim}, is maximum rank, here it is seventeen and the limiting number of Jaids, is one. 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.3. We then ignore the letter with which the highest number of titles start, tabulate in the adjoining table, III, and redo the plot, normalising the lnfs with next-to-maximum lnf_{nmax}, and starting from $k = 2$ in the figure fig.4. This programme we follow getting figures up to the figure fig.7.

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}
1	0	0	290	5.670	1	Blank	Blank	Blank	Blank
2	0.69	0.244	189	5.242	0.925	1	Blank	Blank	Blank
3	1.10	0.389	155	5.043	0.889	0.962	1	Blank	Blank
4	1.39	0.491	136	4.913	0.866	0.937	0.974	1	Blank
5	1.61	0.569	125	4.828	0.851	0.921	0.957	0.983	1
6	1.79	0.633	113	4.727	0.834	0.902	0.937	0.962	0.979
7	1.95	0.689	60	4.094	0.722	0.781	0.812	0.833	0.848
8	2.08	0.735	59	4.078	0.719	0.778	0.809	0.830	0.845
9	2.20	0.777	51	3.932	0.693	0.750	0.780	0.800	0.814
10	2.30	0.813	30	3.401	0.600	0.649	0.674	0.692	0.704
11	2.40	0.848	22	3.091	0.545	0.590	0.613	0.629	0.640
12	2.48	0.876	17	2.833	0.500	0.540	0.562	0.577	0.587
13	2.56	0.905	15	2.708	0.478	0.517	0.537	0.551	0.561
14	2.64	0.933	11	2.398	0.423	0.457	0.476	0.488	0.497
15	2.71	0.958	10	2.303	0.406	0.439	0.457	0.469	0.477
16	2.77	0.979	6	1.792	0.316	0.342	0.355	0.365	0.371
17	2.83	1	1	0	0	0	0	0	0

TABLE III. Khasi-Jaintia Jaids: ranking, natural logarithm, normalisations

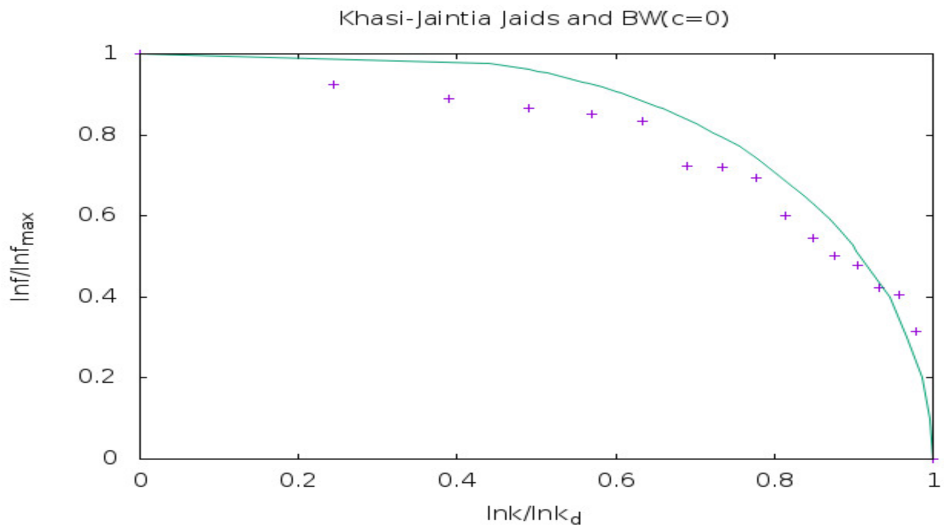

FIG. 3. The vertical axis is $\frac{lnf}{lnf_{max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the Khasi-Jaintia Jaids, with the fit curve being the Bragg-Williams curve in the absence of external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0$.

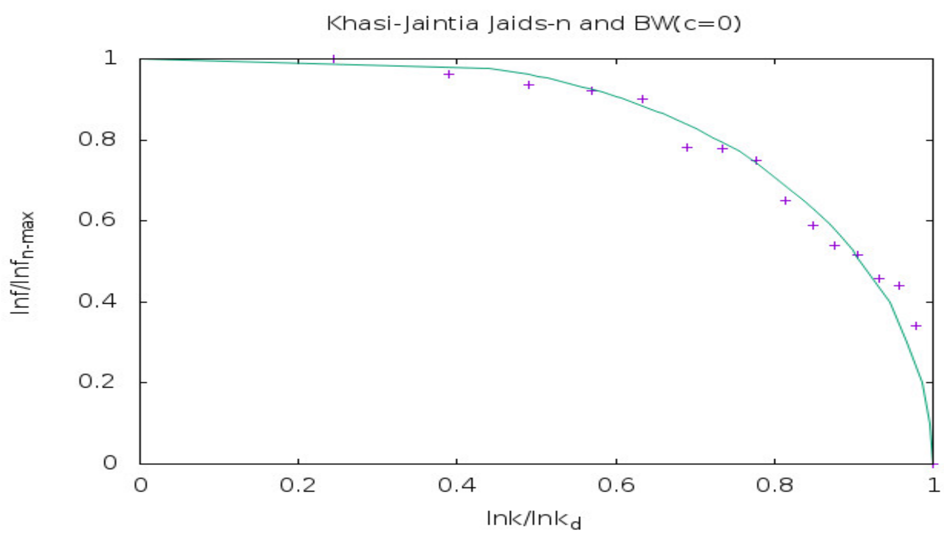

FIG. 4. The vertical axis is $\frac{lnf}{lnf_{n-max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the Khasi-Jaintia Jaids, with the fit curve being the Bragg-Williams curve in the absence of external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0$.

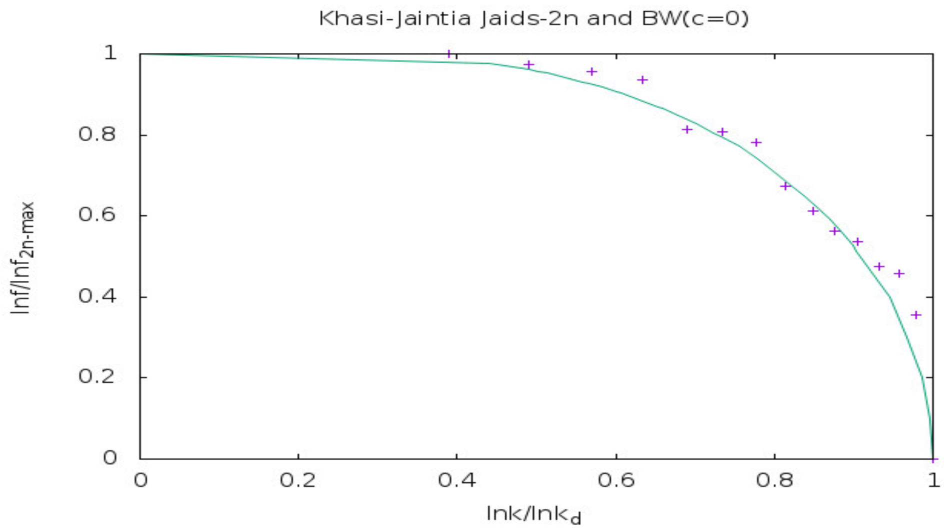

FIG. 5. The vertical axis is $\frac{lnf}{lnf_{2n-max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the Khasi-Jaintia Jaids, with the fit curve being the Bragg-Williams curve in the absence of external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0$.

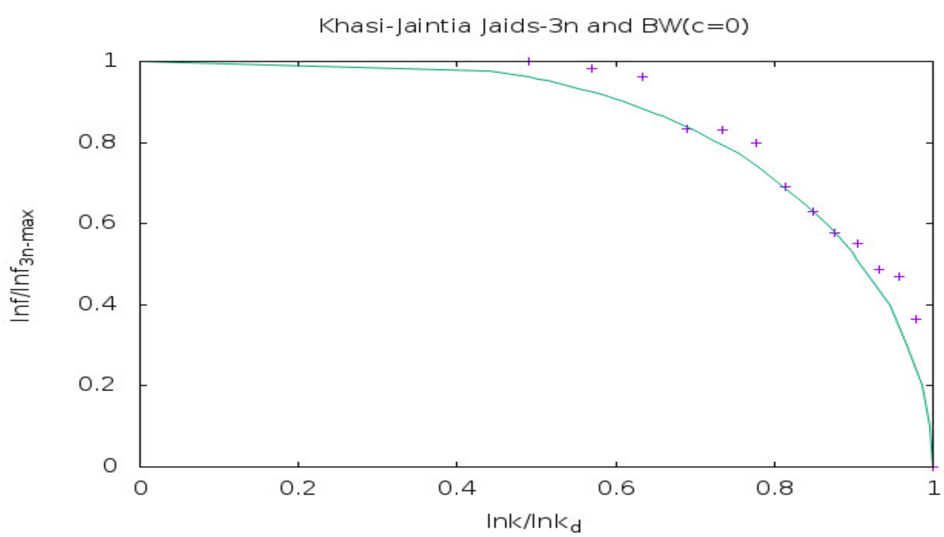

FIG. 6. The vertical axis is $\frac{lnf}{lnf_{3n-max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the Khasi-Jaintia Jaids, with the fit curve being the Bragg-Williams curve in the absence of external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0$.

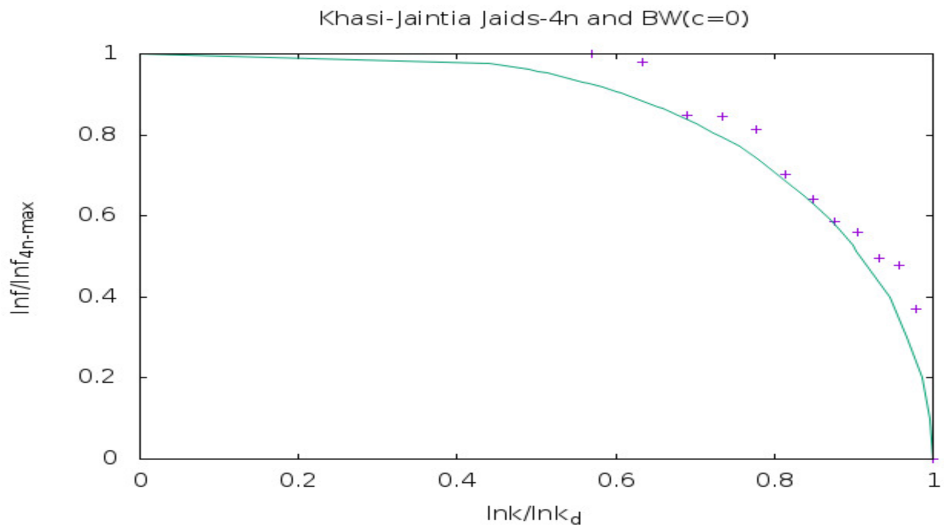

FIG. 7. The vertical axis is $\frac{lnf}{lnf_{4n-max}}$ and the horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the Khasi-Jaintia Jaids, with the fit curve being the Bragg-Williams curve in the absence of external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0$.

A. conclusion

From the figures (fig.3-fig.7), we observe that there is a curve of magnetisation, behind the Khasi-Jaintia Jaids, [1]. This is the magnetisation curve in the Bragg-Williams approximation of the Ising model, BW(c=0), in the absence of external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0$. Moreover, the associated correspondence is,

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

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [70]. As temperature decreases, i.e. lnk decreases, f increases. The letters which are recording higher entries compared to those which have lesser entries are at lower temperature.

IV. ACKNOWLEDGEMENT

We have used gnuplot for drawing the figures.

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