The Oxford Dictionary of English Christian Names by E. G. Withycombe and the Graphical law

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Abstract

We study the Oxford Dictionary of English Christian Names by E. G. Withycombe, second edition. We draw the natural logarithm of the number of names, 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 BP(4,βH=0) i.e. a magnetisation curve in the Bethe-Peierls approximation of the Ising Model with four nearest neighbours with $\beta H = 0$ i.e. in the absence of external magnetic field, $H = 0$. β is $\frac{1}{k_B T}$ where, T is temperature, H is external magnetic field and k_B is the tiny Boltzmann constant.

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I. INTRODUCTION

To know whether the English Christian Names carry any imprint of magnetic field, we look forward to the Oxford Dictionary of English Christian Names by E. G. Withycombe, second edition, [1]. We count all the names one by one and probe for the magnetic field pattern. 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 the 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 references from [4] to [85].

We describe how the graphical law is hidden within the Oxford Dictionary of English Christian Names by E. G. Withycombe, second edition, [1], in this article. The planning of the paper is as follows. We give an introduction to the standard curves of magnetisation of the Ising Model in the section II. In the section III, we describe the graphical law analysis of the Oxford Dictionary of English Christian Names by E. G. Withycombe, second edition, [1]. The section IV is Acknowledgment. The last section is Bibliography.

II. MAGNETISATION

A. The 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, μNL, $M_{max} = \mu N$. $\frac{M}{M_{max}} = L$. $\frac{M}{M_{max}}$ is referred to as reduced magnetisation. Moreover, the Ising Hamiltonian,[86], 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, [87], $2\epsilon\gamma\bar{\sigma} + 2H$, where γ is the number of nearest neighbours of a spin. According to Boltzmann principle, $\frac{N_-}{N_+}$ equals $exp(-\frac{\triangle E}{k_B T})$, [88]. In the Bragg-Williams approximation,[89], $\bar{\sigma} = L$, 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, $c = \frac{H}{\gamma\epsilon}$, $T_c = \gamma\epsilon/k_B$, [90]. $\frac{T}{T_c}$ 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 [87]. 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. The Bethe-Peierls approximation in the presence of four nearest neighbours, in the absence of external magnetic field

In the approximation scheme which is improvement over the Bragg-Williams, [86],[87],[88],[89],[90], due to Bethe-Peierls, [91], 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 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.

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

In the Bethe-Peierls approximation scheme , [91], 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	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 the Bragg-Williams approximation, in absence of and in presence of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$, and the Bethe-Peierls approximation in absence of magnetic field, for four nearest neighbours, of the Ising Model.

Derivation of this formula ala [91] is given in the appendix.
$ln\frac{\gamma}{\gamma-2}$ 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, II, 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

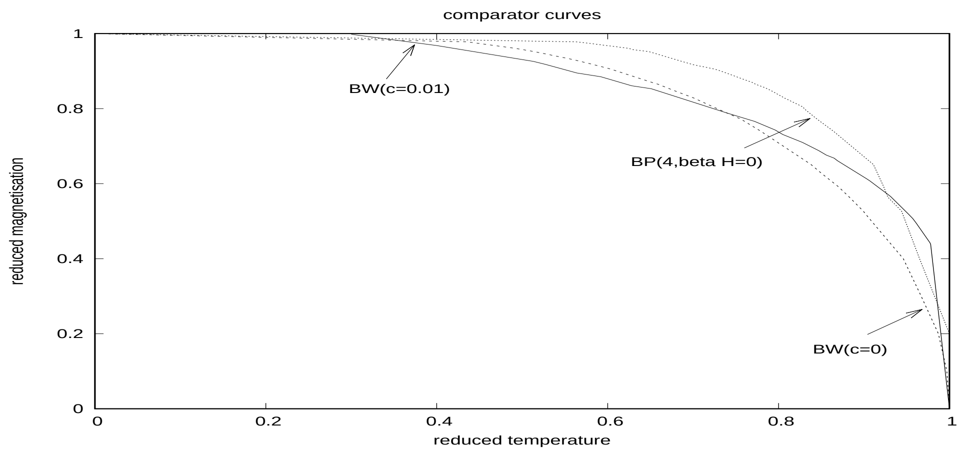

FIG. 1. Reduced magnetisation vs reduced temperature curves for the Bragg-Williams approximation, in the absence(dark) of and the presence(inner in the top) of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$, and the Bethe-Peierls approximation in absence of magnetic field, for four nearest neighbours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

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, II, 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 II. The Bethe-Peierls approx. in the presence of little external magnetic fields

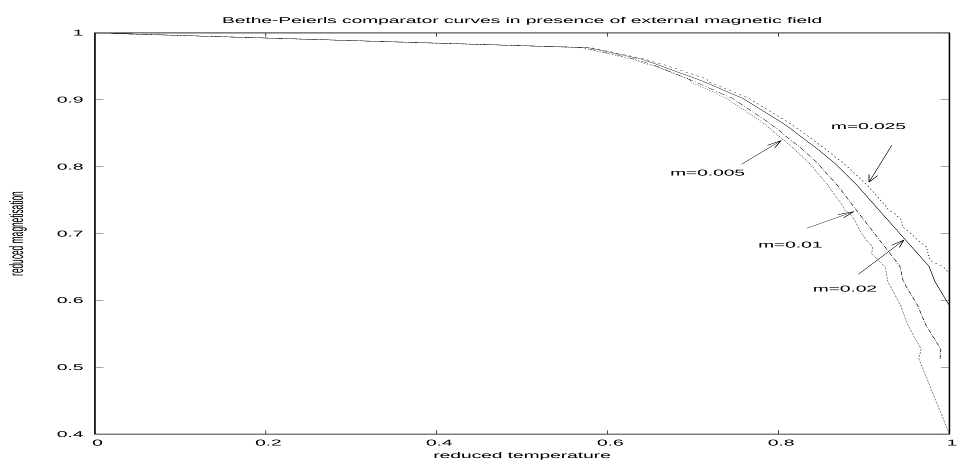

FIG. 2. Reduced magnetisation vs reduced temperature curves for the Bethe-Peierls approximation in the presence of little external magnetic fields, for four nearest neighbours, with $\beta H = 2m$, of the Ising Model.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	Y	Z
152	80	117	75	113	42	95	76	39	77	22	80	128	44	30	54	3	61	70	57	14	24	17	4	8

TABLE III. Number of the English Christian Names, [1]

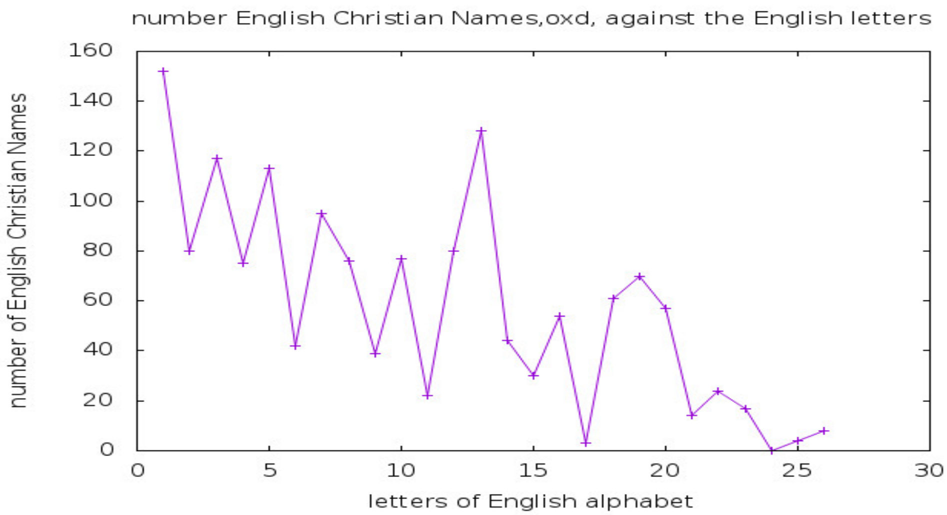

FIG. 3. The vertical axis is number of names in the Oxford Dictionary of English Christian Names by E. G. Withycombe, second edition, [1]. The horizontal axis is the letters of the English alphabet. Letters are represented by the sequence number in the alphabet.

III. ANALYSIS OF THE DICTIONARY OF ENGLISH CHRISTIAN NAMES BY E. G. WITHYCOMBE, SECOND EDITION

In the Oxford Dictionary of English Christian Names by E. G. Withycombe, second edition, [1], we have counted the names, one by one from the beginning to the end, starting with different letters. The result is the table, III. Highest number of names, one hundred fifty two, starts with the letter A followed by names numbering one hundred twenty eight beginning with the letter M, one hundred seventeen with the letter C. To visualise we plot the number of names against respective letters in the dictionary sequence,[1] in the figure fig.3.

For the purpose of exploring graphical law, we assort the letters according to the number of names, in the descending order, denoted by f and the respective rank, [92], denoted by k. k is a positive integer starting from one. Moreover, we attach a limiting rank, k_{lim}, or, k_d and a limiting number of names. The limiting rank is maximum rank plus one, here it is twenty five and the limiting number of names 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, IV, and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.4. We then ignore the letter with the highest number of names, tabulate in the adjoining table, IV, and redo the plot, normalising the lnfs with next-to-maximum lnf_{n-max}, and starting from $k = 2$ in the figure fig.5. This programme we repeat up to $k = 6$ getting figures up to the figure fig.9.

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	152	5.024	1	Blank	Blank	Blank	Blank	Blank
2	0.69	0.214	128	4.852	0.966	1	Blank	Blank	Blank	Blank
3	1.10	0.342	117	4.762	0.948	0.981	1	Blank	Blank	Blank
4	1.39	0.432	113	4.727	0.941	0.974	0.993	1	Blank	Blank
5	1.61	0.500	95	4.554	0.906	0.939	0.956	0.963	1	Blank
6	1.79	0.556	80	4.382	0.872	0.903	0.920	0.927	0.962	1
7	1.95	0.606	77	4.344	0.865	0.895	0.912	0.919	0.954	0.991
8	2.08	0.646	76	4.331	0.862	0.893	0.909	0.916	0.951	0.988
9	2.20	0.683	75	4.317	0.859	0.890	0.907	0.913	0.948	0.985
10	2.30	0.714	70	4.248	0.846	0.876	0.892	0.899	0.933	0.969
11	2.40	0.745	61	4.111	0.818	0.847	0.863	0.870	0.903	0.938
12	2.48	0.770	57	4.043	0.805	0.833	0.849	0.855	0.888	0.923
13	2.56	0.795	54	3.989	0.794	0.822	0.838	0.844	0.876	0.910
14	2.64	0.820	44	3.784	0.753	0.780	0.795	0.801	0.831	0.864
15	2.71	0.842	42	3.738	0.744	0.770	0.785	0.791	0.821	0.853
16	2.77	0.860	39	3.664	0.729	0.755	0.769	0.775	0.805	0.836
17	2.83	0.879	30	3.401	0.677	0.701	0.714	0.719	0.747	0.776
18	2.89	0.898	24	3.178	0.633	0.655	0.667	0.672	0.698	0.725
19	2.94	0.913	22	3.091	0.615	0.637	0.649	0.654	0.679	0.705
20	3.00	0.932	17	2.833	0.564	0.584	0.595	0.599	0.622	0.647
21	3.04	0.944	14	2.639	0.525	0.544	0.554	0.558	0.579	0.602
22	3.09	0.960	8	2.079	0.414	0.428	0.437	0.440	0.457	0.474
23	3.14	0.975	4	1.386	0.276	0.286	0.291	0.293	0.304	0.316
24	3.18	0.988	3	1.099	0.219	0.227	0.231	0.232	0.241	0.251
25	3.22	1	1	0	0	0	0	0	0	0

TABLE IV. Entries of the Oxford Dictionary of English Christian Names by E. G. Withycombe, second edition, [1]: ranking, natural logarithm, normalisations

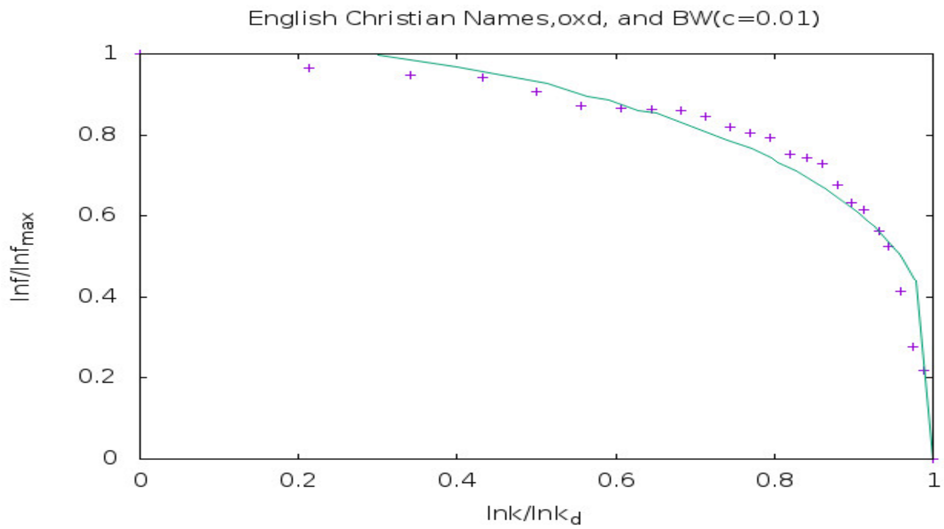

FIG. 4. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the English Christian Names with the fit curve being the Bragg-Williams approximation curve of the Ising Model, in the presence of external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$.

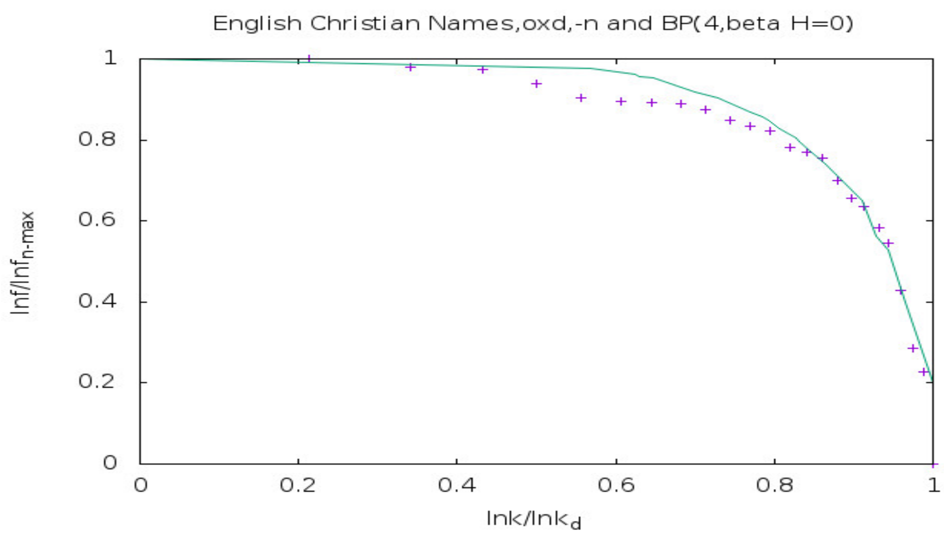

FIG. 5. Vertical axis is $\frac{lnf}{lnf_{n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the English Christian Names with the fit curve being the Bethe-Peierls curve of the Ising Model, in the presence of four nearest neighbours, in the absence of external magnetic field i.e.$H = 0$.

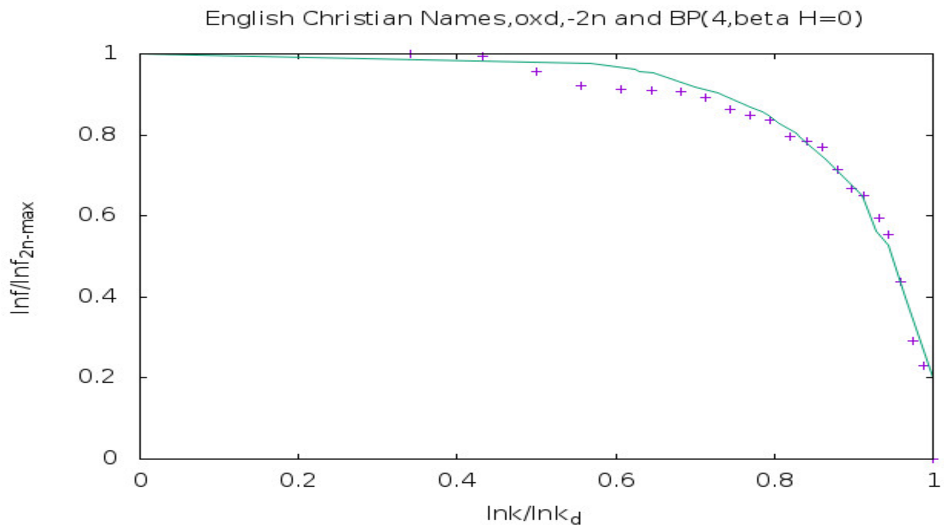

FIG. 6. Vertical axis is $\frac{lnf}{lnf_{2n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the English Christian Names with the fit curve being the Bethe-Peierls curve of the Ising Model, in the presence of four nearest neighbours, in the absence of external magnetic field i.e. $H = 0$.

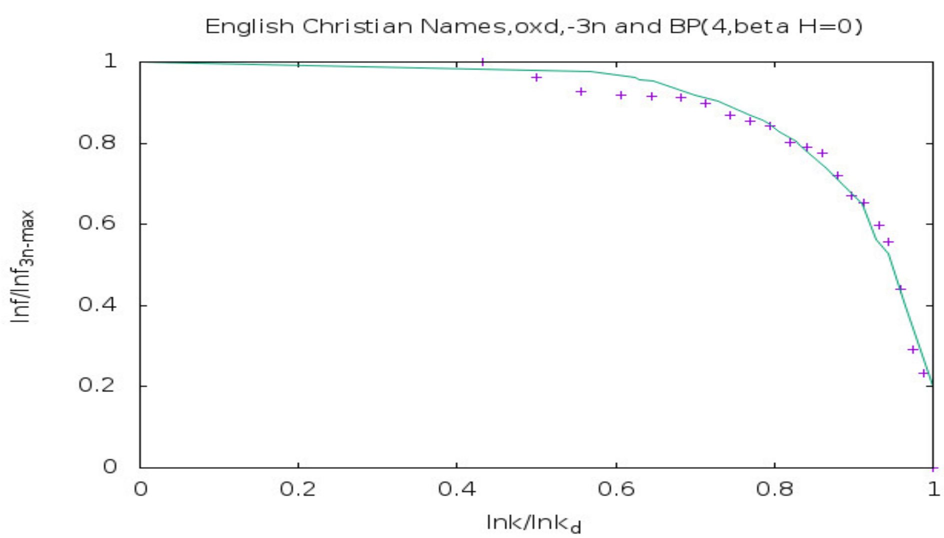

FIG. 7. Vertical axis is $\frac{lnf}{lnf_{3n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the English Christian Names with the fit curve being the Bethe-Peierls curve of the Ising Model, in the presence of four nearest neighbours, in the absence of external magnetic field i.e. $H = 0$.

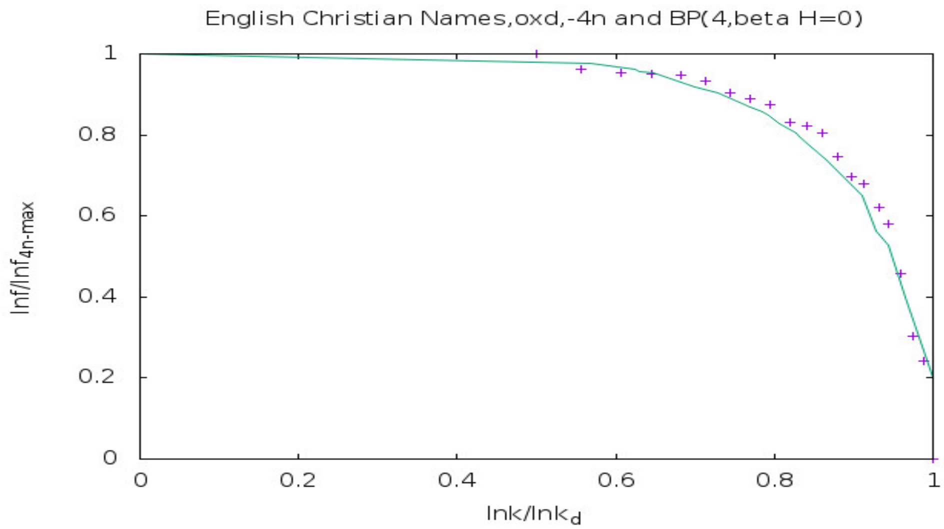

FIG. 8. Vertical axis is $\frac{lnf}{lnf_{4n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the English Christian Names with the fit curve being the Bethe-Peierls curve of the Ising Model, in the presence of four nearest neighbours, in the absence of external magnetic field i.e. $H = 0$.

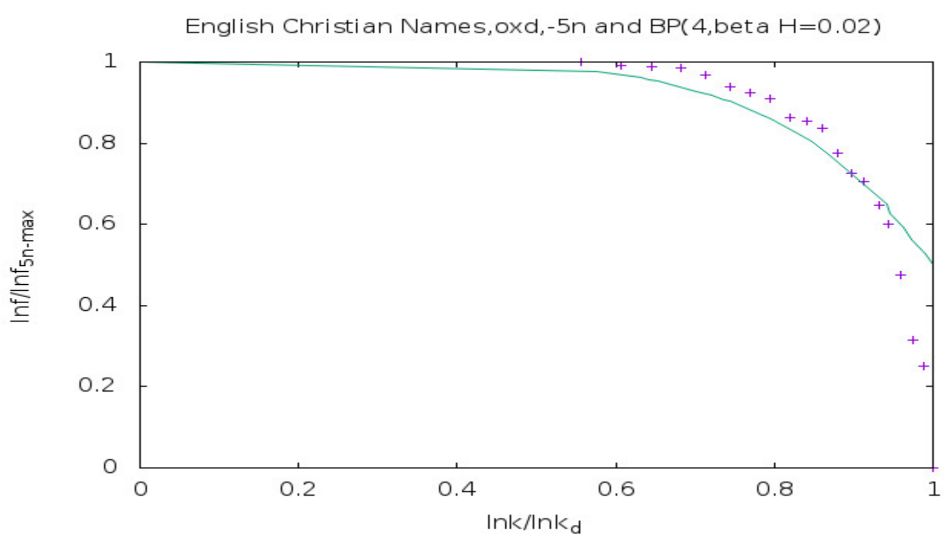

FIG. 9. Vertical axis is $\frac{lnf}{lnf_{5n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the English Christian Names with the fit curve being the Bethe-Peierls curve of the Ising Model, in the presence of four nearest neighbours and little external magnetic field, $m = 0.01$ or, $\beta H = 0.02$.

A. conclusion

From the figures (fig.4-fig.9), we observe that behind the Oxford Dictionary of English Christian Names by E. G. Withycombe, second edition, [1], there is a magnetisation curve, BP(4,βH=0), in the Bethe-Peierls approximation of the Ising Model, with four nearest neighbours, in the absence of external magnetic field i.e. H=0.
Moreover, the associated correspondance with the Ising model is,

$$\frac{lnf}{lnf_{3n-max}} \longleftrightarrow \frac{M}{M_{max}},$$

and

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [93].

IV. ACKNOWLEDGMENT

The author would like to thank the State Central Library, West Bengal, Calcutta, to allow us to use the Oxford Dictionary of English Christian Names by E. G. Withycombe, second edition, [1], in its premises. We have used gnuplot for plotting the figures in this paper.

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[1] The Oxford Dictionary of English Christian Names by E. G. Withycombe, the second edition, Oxford At the Clarendon Press, Reprinted with corrections, 1959; Printed in Great Britain at the University Press, Oxford, by Vivian Ridler, Printer to the University.

[2] Anindya Kumar Biswas, "Graphical Law beneath each written natural language", arXiv:1307.6235v3[physics.gen-ph]. A preliminary study of head entries of dictionaries of twenty six languages, more accurate study of head entries of dictionary of Chinese usage and all parts of speech of dictionary of Lakher(Mara) language and of verbs, adverbs and adjectives of dictionaries of six languages are included.

[3] Anindya Kumar Biswas, "A discipline of knowledge and the graphical law", IJARPS Volume 1(4), p 21, 2014; viXra: 1908:0090[Linguistics].

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