Webster's Universal Spanish-English Dictionary, the Graphical law and A Dictionary of Geography of Oxford University Press

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Abstract

We study the Webster's Universal Spanish-English Dictionary by Geddes and Grosset. 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 BP(4,βH=0) i.e. a magnetisation curve for the Bethe-Peierls approximation of the Ising model with four nearest neighbours in absence of external magnetic field. H is external magnetic field, β is $\frac{1}{k_B T}$ where, T is temperature and k_B is the Boltzmann constant. Moreover, We compare the Spanish language with two other Romance languages, the Basque and the Romanian languages respectively. On the top of it, we compare the Spanish-English Dictionary with A Dictionary of Geography of Oxford University Press by Susan Mayhew and find a tantalizing similarity between the Spanish and the jargon of Geography.

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I. INTRODUCTION

Spain is a country in the south of Europe. The Spaniards are the people. The Spanish is the language. It is the world's second-most spoken native language. To study the language we consult a dictionary of the Spanish. This is Spanish-English dictionary, [1]. Here, we introduce the Spanish by reproducing few entries from the dictionary,[1], in the following. *ã*nil in the Spanish means indigo plant, azul means blue, batir means to beat, diana means bull's-eye, gana means desire, haba means broad bean, hilar means to spin, honda means catapult, jorabar means to annoy, joya means jewel, jugar means to play or, to gamble, mani means peanut, manta means blanket, mar means sea, mote means nickname, ni*ñ*a means little girl, paja means straw, podar means to prune, pompa means bubble, rana means frog, raya means line, rayado means ruled, resma means ream(of paper), sesgo means slope, sierra means saw or, range of mountains, sisa means petty theft, sol means sun, subida means climb, subir means to raise, sudar means to sweat, suma means total, sumar means to add, sumir means to sink, sumo means great, sur means south, surcar means to cut, tabla means slab, tala means felling of trees, topo means mole or, stumbler, torpe means dull, tu means your, tú means you, vara means pole, zahori means clairvoyant and so on.

In this article, we study magnetic field pattern behind this dictionary of the Spanish,[1]. 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 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] 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 analysis of the entries of the Spanish language, [1]. The section IV is comparisons with other Romance languages. In the section V, we bring forth the similarity of the Spanish and the jargon of geography. Sections VI and VII are Acknowledgment 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 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, $\mu N L$, $M_{max} = \mu N$. $\frac{M}{M_{max}} = L$. $\frac{M}{M_{max}}$ is referred to as reduced magnetisation. Moreover, the Ising Hamiltonian,[19], 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, [20], $2\epsilon\gamma\bar{\sigma} + 2H$, where γ is the number of nearest neighbours of a spin. According to Boltzmann principle, $\frac{N_-}{N_+}$ equals $exp(-\frac{\triangle E}{k_B T})$, [21]. In the Bragg-Williams approximation,[22], $\bar{\sigma} = L$, 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, $c = \frac{H}{\gamma\epsilon}$, $T_c = \gamma\epsilon/k_B$, [23]. $\frac{T}{T_c}$ 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 [20]. 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, [19],[20],[21],[22],[23], due to Bethe-Peierls, [24], reduced magnetisation varies with reduced temperature, for γ

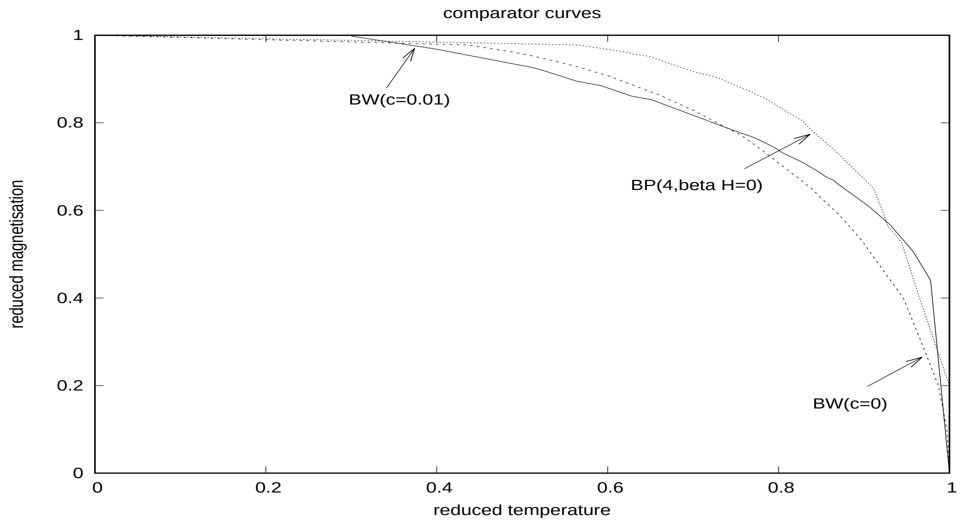

FIG. 1. Reduced magnetisation vs reduced temperature curves for Bragg-Williams approximation, in absence(dark) of and presence(inner in the top) of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$, and Bethe-Peierls approximation in absence of magnetic field, for four nearest neighbours (outer in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

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.

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 .

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

In the Bethe-Peierls approximation scheme , [24], reduced magnetisation varies with reduced temperature, for γ neighbours, in presence of external magnetic field, as

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

Derivation of this formula ala [24] 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,

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

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 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. Similarly, we plot fig.3. 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. Bethe-Peierls approx. in presence of little external magnetic fields

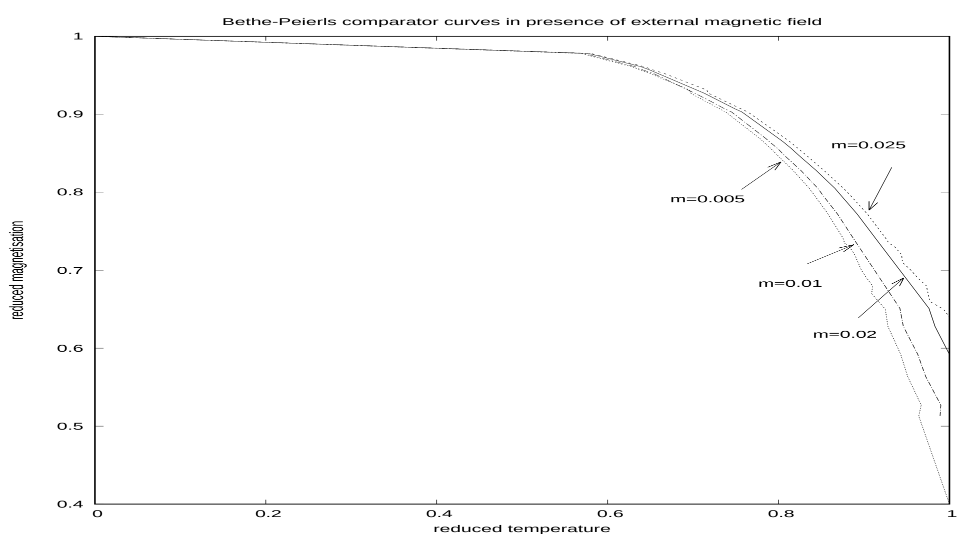

FIG. 2. Reduced magnetisation vs reduced temperature curves for Bethe-Peierls approximation in presence of little external magnetic fields, for four nearest neighbours, with $\beta H = 2m$.

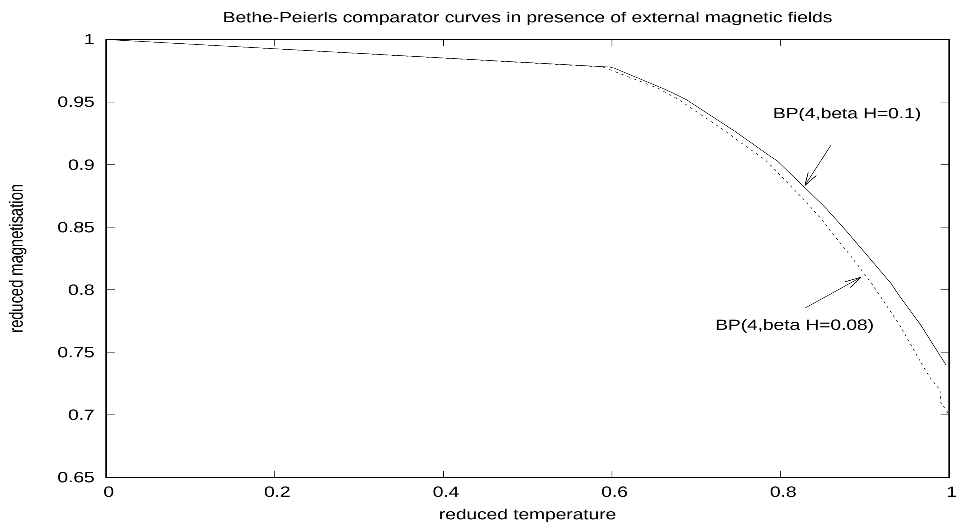

FIG. 3. Reduced magnetisation vs reduced temperature curves for Bethe-Peierls approximation in presence of little external magnetic fields, for four nearest neighbours, with $\beta H = 2m$.

D. Onsager solution

At a temperature T, below a certain temperature called phase transition temperature, T_c, for the two dimensional Ising model in 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, [25], [26], [27], [24],

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

Graphically, the Onsager solution appears as in fig.4.

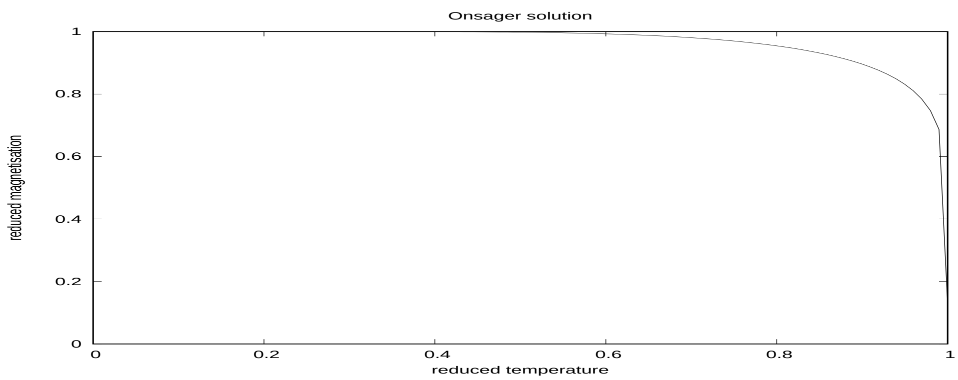

FIG. 4. Reduced magnetisation vs reduced temperature curves for exact solution of two dimensional Ising model, due to Onsager, in absence of external magnetic field

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
2605	775	2688	1531	1815	633	495	433	917	159	7	556	1072	295	373	1885	102	1195	1074	978	103	565	4	3	33	102

TABLE III. Spanish words

FIG. 5. Vertical axis is number of words of the Spanish, [1], and horizontal axis is respective letters. Letters are represented by the sequence number in the alphabet or, dictionary sequence,[1].

III. ANALYSIS OF WORDS OF THE SPANISH-ENGLISH DICTIONARY

The Spanish language alphabet is composed of twenty six letters like English. We take a Spanish-English dictionary,[1]. Then we count all the entries, [1], one by one from the beginning to the end, starting with different letters. The result is the table, III.

Highest number of entries, two thousand six hundred eighty eight, starts with the letter C followed by entries numbering two thousand six hundred five beginning with A, one thousand eight hundred eighty five with the letter P etc. To visualise we plot the number of words against respective letters in the dictionary sequence, [1], in the figure fig.5.

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, denoted by k. k is a positive integer starting from one. Moreover, we attach a limiting rank, k_{lim}, and a limiting number of words. The limiting rank is maximum rank plus one, here it is twenty six and the limiting number of words 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

k	lnk	lnk/lnk_{lim}	f	lnf	lnf/lnf_{max}	lnf/lnf_{nmax}	lnf/lnf_{2nmax}	lnf/lnf_{3nmax}	lnf/lnf_{4nmax}	lnf/lnf_{5nmax}	lnf/lnf_{10nmax}
1	0	0	2688	7.897	1	Blank	Blank	Blank	Blank	Blank	Blank
2	0.69	0.212	2605	7.865	0.996	1	Blank	Blank	Blank	Blank	Blank
3	1.10	0.337	1885	7.542	0.955	0.959	1	Blank	Blank	Blank	Blank
4	1.39	0.426	1815	7.504	0.950	0.954	0.995	1	Blank	Blank	Blank
5	1.61	0.494	1531	7.334	0.929	0.932	0.972	0.977	1	Blank	Blank
6	1.79	0.549	1195	7.086	0.897	0.901	0.940	0.944	0.966	1	Blank
7	1.95	0.598	1074	6.979	0.884	0.887	0.925	0.930	0.952	0.985	Blank
8	2.08	0.638	1072	6.977	0.884	0.887	0.925	0.930	0.951	0.985	Blank
9	2.20	0.675	978	6.886	0.872	0.876	0.913	0.918	0.939	0.972	Blank
10	2.30	0.706	917	6.821	0.864	0.867	0.904	0.909	0.930	0.963	Blank
11	2.40	0.736	775	6.653	0.842	0.846	0.882	0.887	0.907	0.939	1
12	2.48	0.761	633	6.450	0.817	0.820	0.855	0.860	0.879	0.910	0.969
13	2.56	0.785	565	6.337	0.802	0.806	0.840	0.844	0.864	0.894	0.953
14	2.64	0.810	556	6.321	0.800	0.804	0.838	0.842	0.862	0.892	0.950
15	2.71	0.831	495	6.205	0.786	0.789	0.823	0.827	0.846	0.876	0.933
16	2.77	0.850	433	6.071	0.769	0.772	0.805	0.809	0.828	0.857	0.913
17	2.83	0.868	373	5.922	0.750	0.753	0.785	0.789	0.807	0.836	0.890
18	2.89	0.887	295	5.687	0.720	0.723	0.754	0.758	0.775	0.803	0.855
19	2.94	0.902	159	5.069	0.642	0.645	0.672	0.676	0.691	0.715	0.762
20	3.00	0.920	103	4.635	0.587	0.589	0.615	0.618	0.632	0.654	0.697
21	3.04	0.933	102	4.625	0.586	0.588	0.613	0.616	0.631	0.653	0.695
22	3.09	0.948	33	3.497	0.443	0.445	0.464	0.466	0.477	0.494	0.526
23	3.14	0.963	7	1.946	0.246	0.247	0.258	0.259	0.265	0.275	0.292
24	3.18	0.975	4	1.386	0.176	0.176	0.184	0.185	0.189	0.196	0.208
25	3.22	0.988	3	1.099	0.139	0.140	0.146	0.146	0.150	0.155	0.165
26	3.26	1	1	0	0	0	0	0	0	0	0

TABLE IV. Spanish words:ranking,natural logarithm,normalisations

fig.6.

We then ignore the letter with the highest of words, tabulate in the adjoining table, IV and redo the plot, normalising the lnfs with next-to-maximum $lnf_{nextmax}$, and starting from $k = 2$ in the figure fig.7. Normalising the lnfs with next-to-next-to-maximum $lnf_{nextnextmax}$, we tabulate in the adjoining table, IV, and starting from $k = 3$ we draw in the figure fig.8. Normalising the lnfs with next-to-next-to-next-to-maximum $lnf_{nextnextnextmax}$ we record in the adjoining table, IV, and plot starting from $k = 4$ in the figure fig.9. Normalising the lnfs with next-to-next-to-next-to-next-to-maximum $lnf_{nnnnmax}$ we record in the adjoining table, IV, and plot starting from $k = 5$ in the figure fig.10. Normalising the lnfs with nextnextnextnextnext-maximum $lnf_{nnnnnmax}$ we record in the adjoining table, IV, and plot starting from $k = 6$ in the figure fig.11. We continue upto normalising the lnfs with 10n-maximum lnf_{10nmax} we record in the adjoining table, IV, and plot starting from $k = 11$ in the figure fig.12.

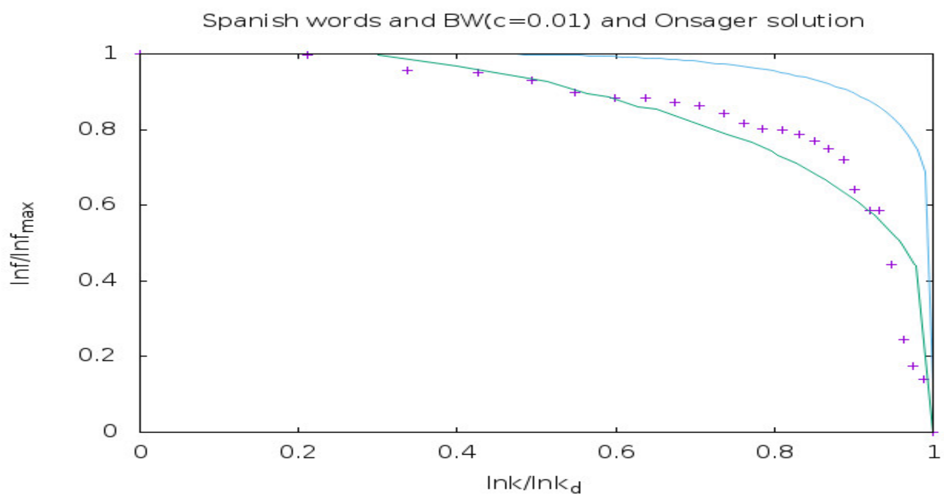

FIG. 6. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Spanish with the fit curve being Bragg-Williams approximation curve in the presence of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$. The uppermost curve is the Onsager solution.

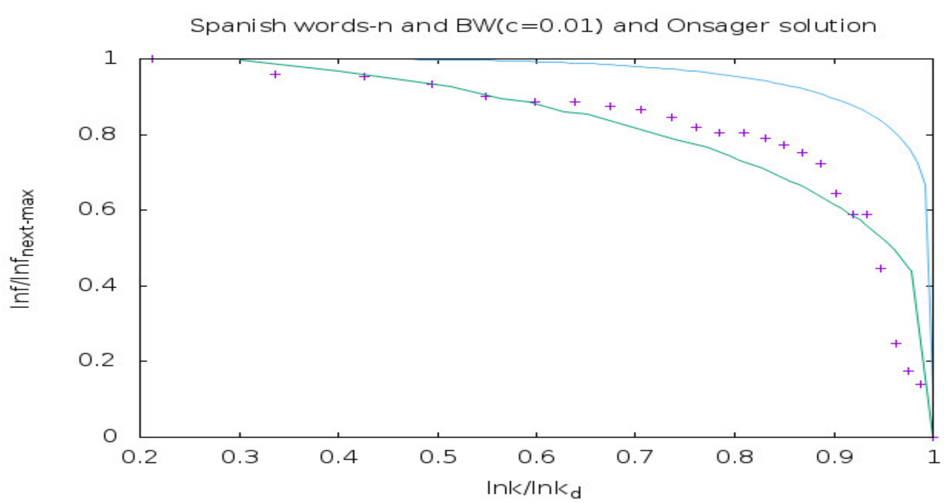

FIG. 7. Vertical axis is $\frac{lnf}{lnf_{next-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Spanish with the fit curve being Bragg-Williams approximation curve in the presence of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$. The uppermost curve is the Onsager solution.

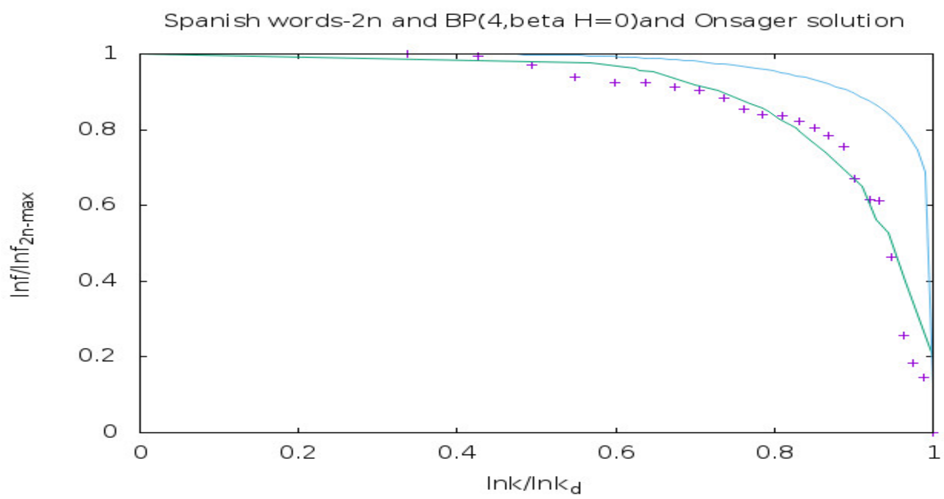

FIG. 8. Vertical axis is $\frac{lnf}{lnf_{nextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Spanish with fit curve being Bethe-Peierls curve with four nearest neighbours, in absence of magnetic field. The uppermost curve is the Onsager solution.

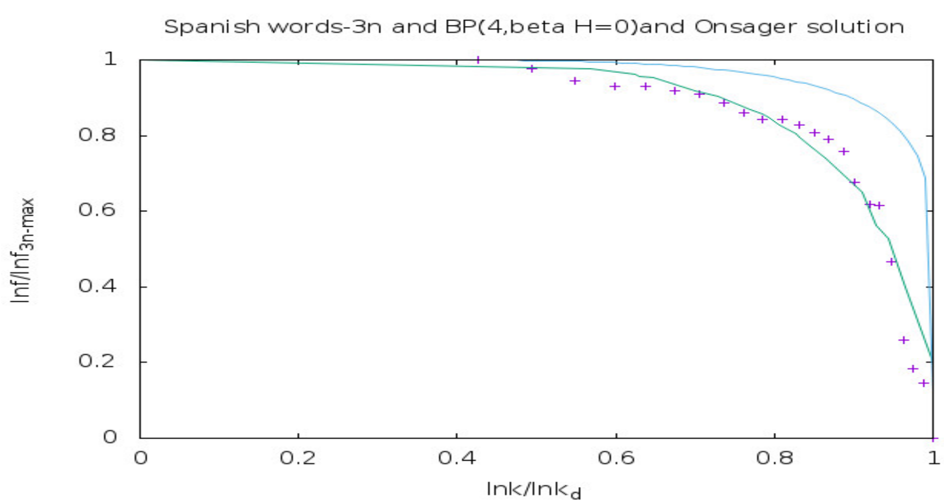

FIG. 9. Vertical axis is $\frac{lnf}{lnf_{nextnextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Spanish with fit curve being Bethe-Peierls curve with four nearest neighbours, in absence of magnetic field. The uppermost curve is the Onsager solution.

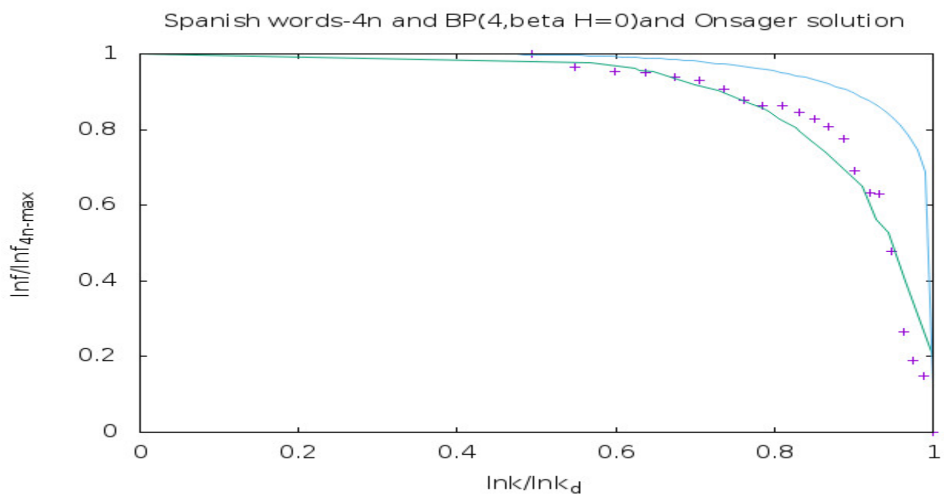

FIG. 10. Vertical axis is $\frac{lnf}{lnf_{nextnextnextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Spanish with fit curve being Bethe-Peierls curve with four nearest neighbours, in absence of magnetic field. The uppermost curve is the Onsager solution.

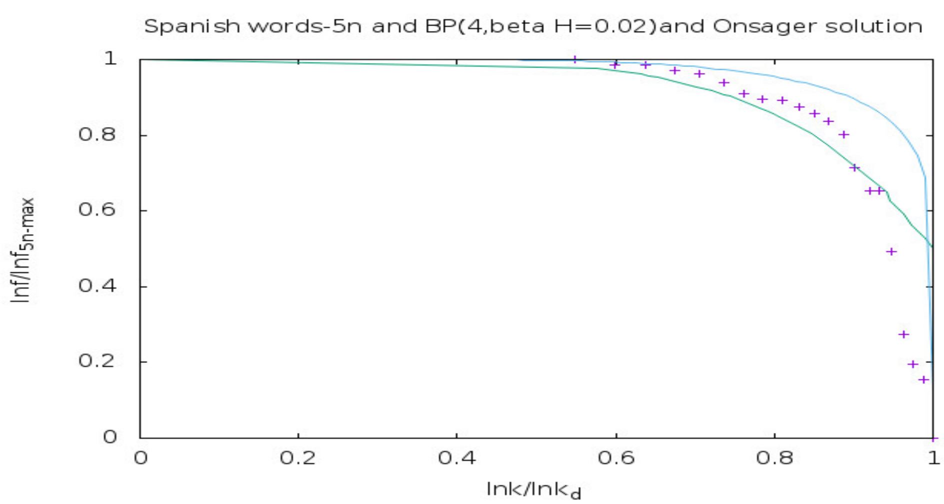

FIG. 11. Vertical axis is $\frac{lnf}{lnf_{nnnnn-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Spanish with fit curve being Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.01 or, $\beta H = 0.02$. The uppermost curve is the Onsager solution.

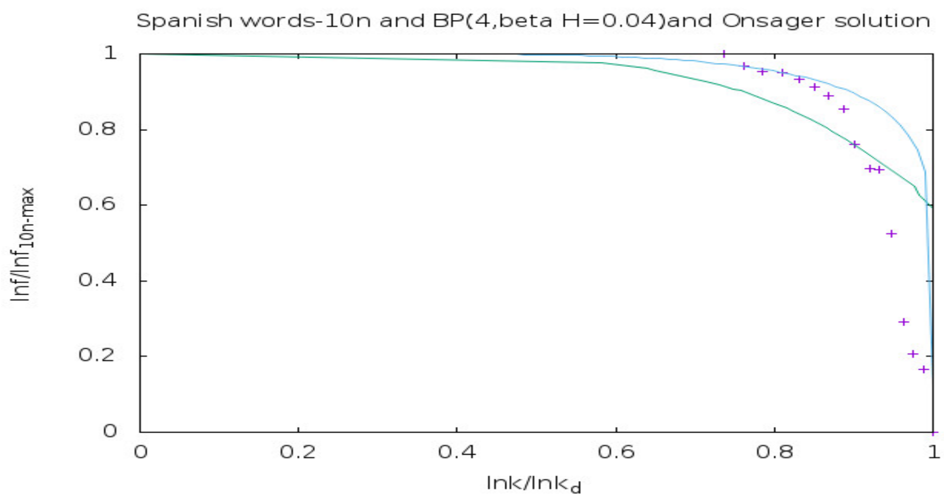

FIG. 12. Vertical axis is $\frac{lnf}{lnf_{10n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Spanish with fit curve being Bethe-Peierls curve with four nearest neighbours, in presence of little magnetic field, m=0.02 or, $\beta H = 0.04$. The uppermost curve is the Onsager solution.

A. conclusion

From the figures (fig.6-fig.12), we observe that there is a curve of magnetisation, behind the entries of Spanish language,[1]. This is magnetisation curve, BP(4,βH=0), in the Bethe-Peierls approximation in absence of external magnetic field.
Moreover, the associated correspondence is,

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

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [29].
On the top of it, on successive higher normalisations, entries of the Spanish,[1], do not go over to Onsager solution in the normalised lnf vs $\frac{lnk}{lnk_{lim}}$ graphs.
Interestingly, $\frac{lnf}{lnf_{max}}$ vs $\frac{lnk}{lnk_{lim}}$ is matched by BW(c=0.01) as in the Tibetan, Basque, Romanian, Turkmen, Khasi languages respectively.
As matching of the plots in the figures fig.(6-12), with comparator curves i.e. the magnetisation curves of Bethe-Peierls approximations, is with dispersion and dispersion does not reduce to zero over higher orders of normalisations, to explore for possible existence of spin-glass transition, in presence of little external magnetic field, $\frac{lnf}{lnf_{max}}$, $\frac{lnf}{lnf_{next-max}}$ and $\frac{lnf}{lnf_{nn-max}}$ are drawn against lnk in the figures fig.13-fig.15.

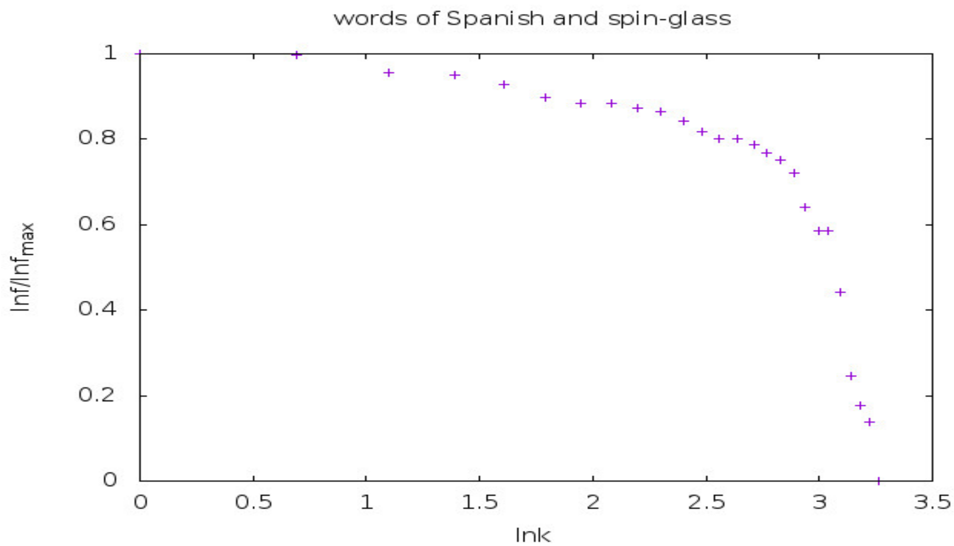

FIG. 13. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is lnk. The + points represent the entries of the Spanish language.

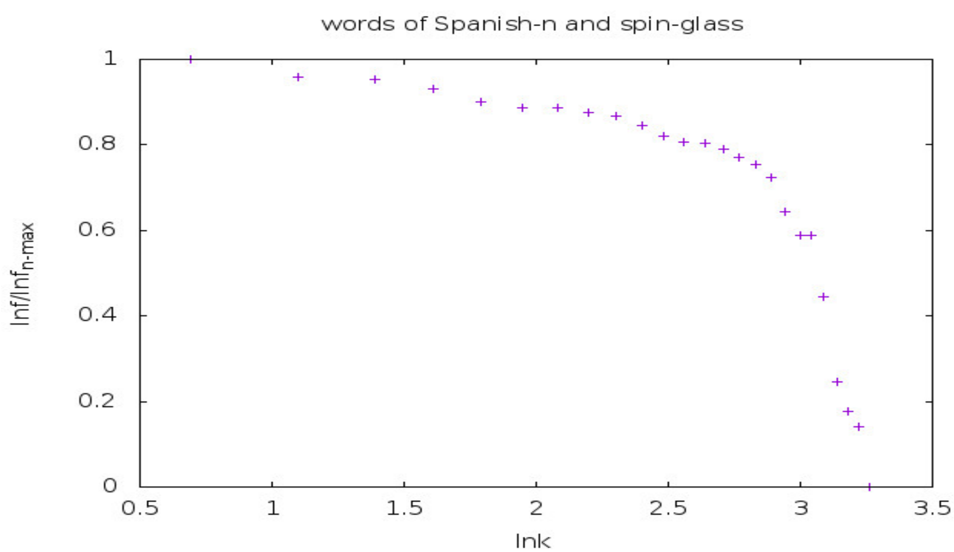

FIG. 14. Vertical axis is $\frac{lnf}{lnf_{next-max}}$ and horizontal axis is lnk. The + points represent the entries of the Spanish language.

In the figures Fig.15-Fig.17, the points has a smoothed transition, rather than a clear-cut transition. Above the transition point(s), the lines are with slopes rather than horizontal and below the transition point(s), points-line rises like the branch of a rectangular hyperbola. Hence, the words of the Spanish, [1], has resemblance of a Spin-Glass magnetisation curve,

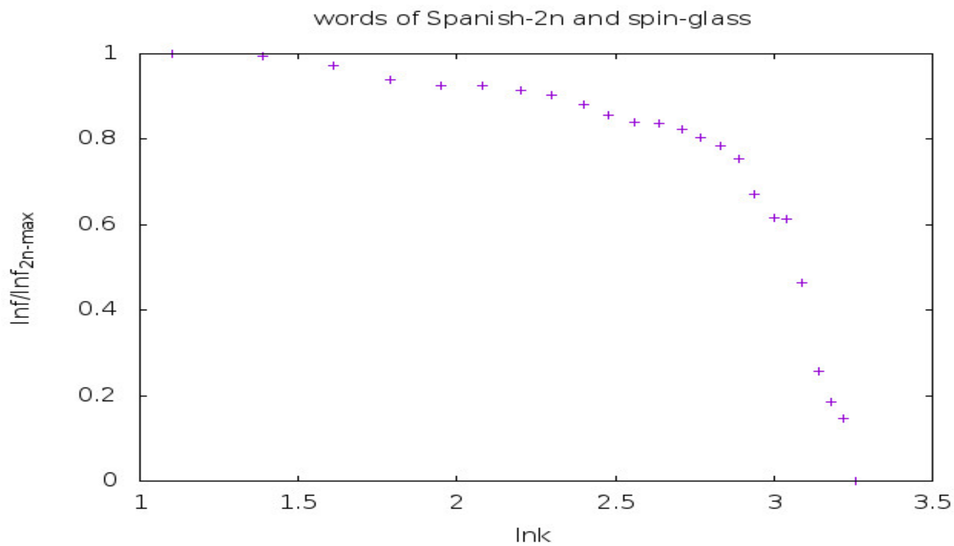

FIG. 15. Vertical axis is $\frac{lnf}{lnf_{nn-max}}$ and horizontal axis is lnk. The + points represent the entries of the Spanish language.

[30], in the presence of little magnetic field to some extent.

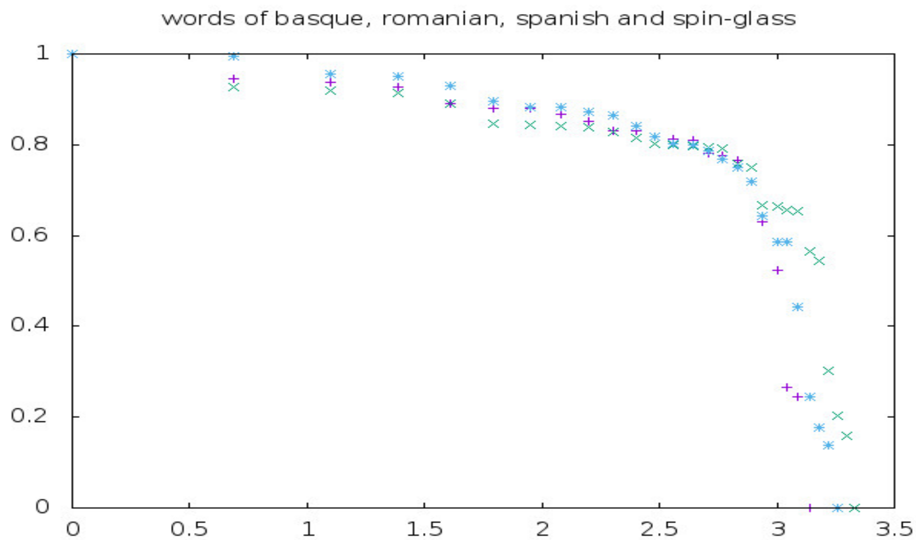

FIG. 16. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is lnk. The + points represent the entries of the Basque language, [5]. The $*$ points represent the entries of the Spanish language, [1]. The $\times$ points represent the entries of the Romanian language, [6].

IV. SPANISH AND ROMANCE LANGUAGES

Spain is a country in the Iberian peninsula flanking Portugal, Basque region in coastal Atlantic to the west, neighbouring France to the North, Italy, Romania to the east crossing Mediterranean. Latin was the language of the region. It broke into spoken form, called vulgar Latin or, Romance languages. The Spanish is one of the earliest Romance languages. We have studied two Romance languages Romanian, [6] and Basque, [5], in detail before. Those were better fit by spin-glass magnetisation curves in presence of little external magnetic field. We compare the spin-glass magnetisation curve nature of the Romanian and the Basque languages with the Spanish in the figures 16 to 18. We conclude from the figures 16 to 18, that the Romanian language comes closest to the spin-glass behaviour, whereas the Basque language comes closer and the Spanish is farther away. Being one of the earliest Romance languages, the Spanish has veered away far with its speakers circumnavigating the globe.

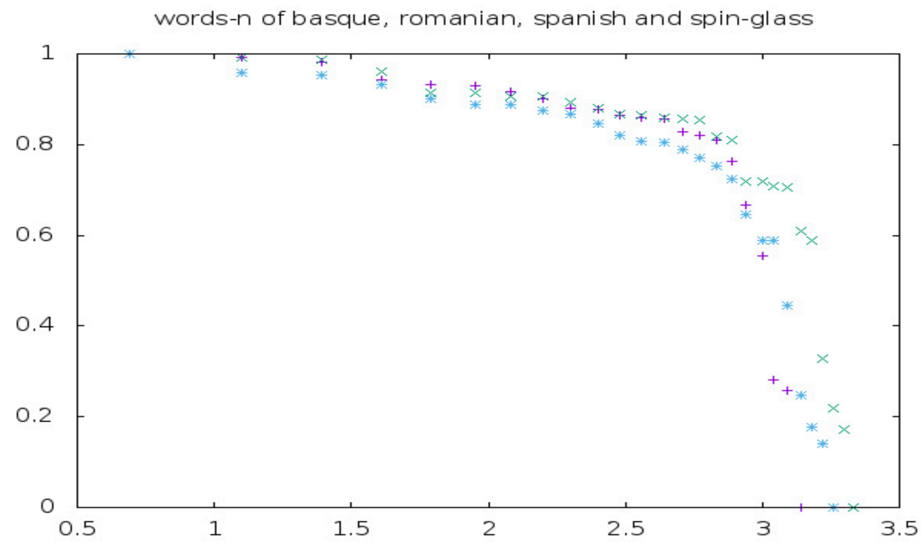

FIG. 17. Vertical axis is $\frac{lnf}{lnf_{next-max}}$ and horizontal axis is lnk. The $+$ points represent the entries of the Basque language, [5]. The $*$ points represent the entries of the Spanish language, [1]. The $\times$ points represent the entries of the Romanian language, [6].

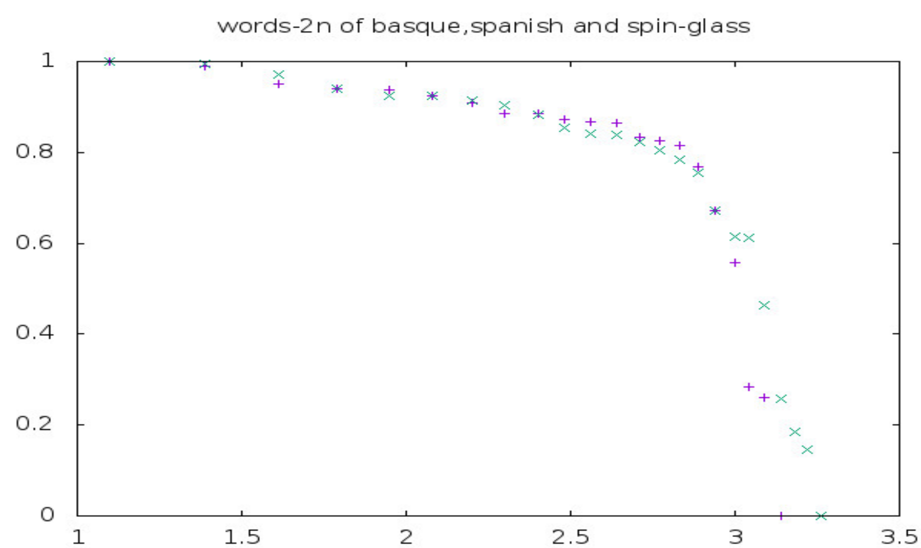

FIG. 18. Vertical axis is $\frac{lnf}{lnf_{nn-max}}$ and horizontal axis is lnk. The $+$ points represent the entries of the Basque language, [5]. The $\times$ points represent the entries of the Spanish language, [1].

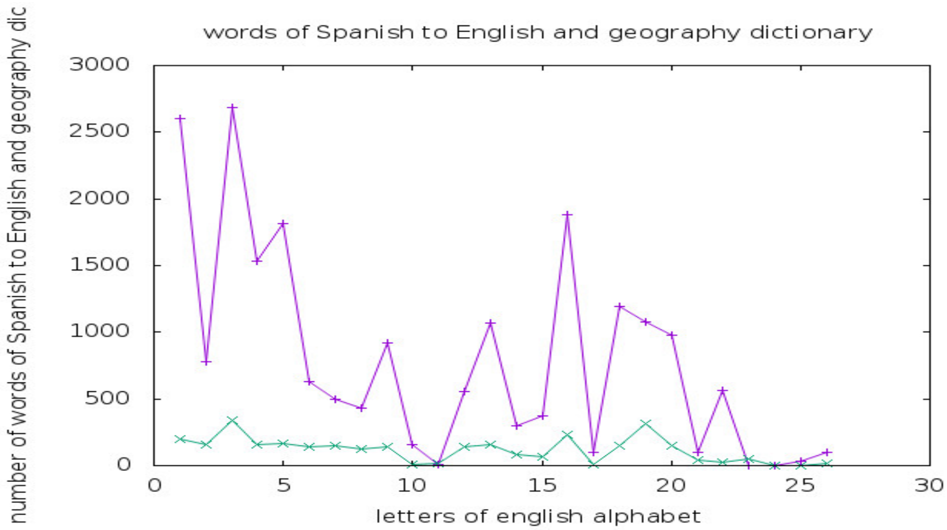

FIG. 19. Vertical axis is number of entries and horizontal axis is respective letters. Letters are represented by the number in the alphabet or, dictionary sequence,[1]. The + points represent the Spanish words. The × points represent the entries of geography dictionary, [31].

V. SPANISH AND GEOGRAPHY

Spreading from a table land of 700 meter altitude, in the center, outwards, Spain was at its pinnacle of its glory and power around sixteenth century. It was then the world power. Christopher Columbus was from that country. That has been a country of navigators and explorers. Naturally the subject of geography should be ingrained in the culture, embedded in the language. Here in this section, we take a curious dip into this aspect by comparing a dictionary of geography, [31], we have studied before, [7], with this dictionary of the Spanish, [1].

we have observed that there is a curve of magnetisation, behind the entries of Spanish language,[1]. This is magnetisation curve, BP(4,βH=0), in the Bethe-Peierls approximation in absence of external magnetic field. This is the case with the dictionary of geography. To bring the parallel in the forefront, we compare the the patterns of variations of number of entries along the English alphabet for both the dictionaries in the figure, 19. To make the rise and fall clearer we multiply all the frequencies corresponding to letters of the geography dictionary by five and redo the plot in the figure, 20. We conclude that the words of the Spanish, [1], and the entries of geography, [31], are rising and falling in unison along the letters of the English alphabet in most of the places.

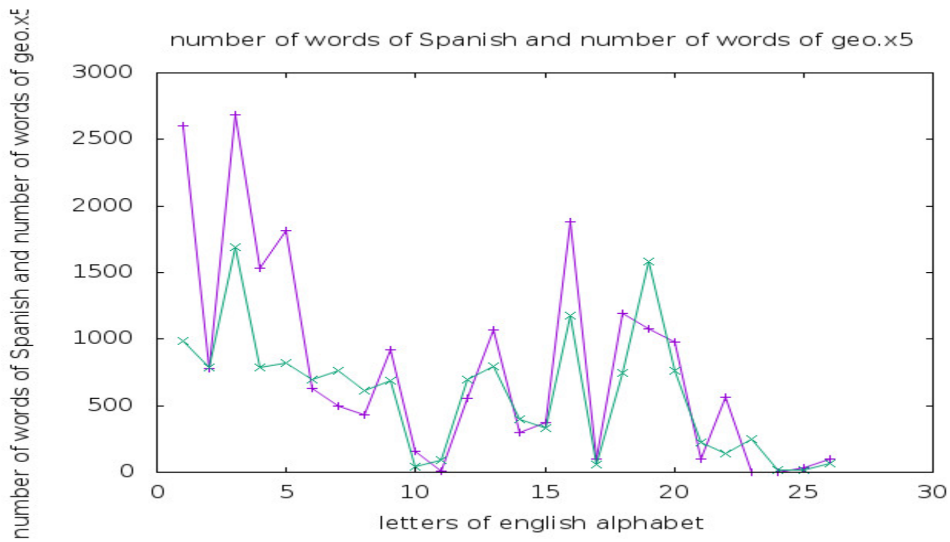

FIG. 20. Vertical axis is number of entries and horizontal axis is respective letters. Letters are represented by the number in the alphabet or, dictionary sequence,[1]. The + points represent the Spanish words. The $\times$ points represent the entries of geography dictionary, [31].

VI. ACKNOWLEDGMENT

We have used gnuplot for plotting the figures in this paper. We have benefited from reading related web pages of wiki travel and Wikipedia.

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