Romanian language, the graphical law and more

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Abstract

We study a Romanian to English dictionary. We draw in the natural logarithm scale, number of words, normalised, starting with a letter vs natural logarithm of the rank of the letter. We find that the words underlie a magnetisation curve of a Spin-Glass in presence of an external magnetic field. Then we draw in the natural logarithm scale, number of nouns, adjectives, verbs, adverbs respectively, starting with a letter vs rank of the letter, both normalised. We find that the graphs are closer to the curves of reduced magnetisation vs reduced temperature for various approximations of Ising model with non-random coupling.

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I. INTRODUCTION

”mor gayero shimane,

paharer opare,

....

protiddhoni shuni ami.”

———Bhupen Hazarika.

In the backdrop of the Carpethian mountain, extends a marvellous country, with diversities permeating into space and time, in its vastness stretching from the central Europe in the west to the Black Sea in the East. The name of the country is Romania. The name of the river is Danube. The language of the majority is Romanian. Football is the main sport, followed by lawn tennis and handball and gymnastics. Here from comes Halep, here from came Nadia Comăneci.

Far away in the foothills of the Himalaya, in the state of Assam, of India, on the banks of mighty river Brahmaputra, starting from the place of Sadiya, inhabits the tribe Abor-Miri alias Mishing, in short miri. ”kape dun, i dun” is the commonest way of conversation. Abor-Miri is the language of this creative tribe. They are the largest plane tribe of the state of Assam.

As we contemplate staring at the majestic Himalaya, arrives floating to our mind in ”um thum thum” way, from faraway magnanimous Carpethian, would someone making houses with wetty sands in a bank of the Brahmaputra, one day emaluate Nadia Comăneci, recreate those mesmirising feats.

One way to answer may be the following. The culture which has supported the emergence of Nadia, if it has similarity with that of the Abor-Miris, probably the expectation is correct. Moreover, the culture is coded in the lexicon. Dictionaries of the Romanian to English[1] and Abor-Miri to English[2] are, plausibly, the places to find similarity in.

Both the languages do not have the letter Q originally. The number of letters of Romanian is thirty one (with the three letters Q, W, Y introduced in 1982, used for foreign words only, $\hat{A}$ is almost obsolete, K is rarely used), whereas that of Abor-Miri is eighteen. Number of words for letters B, E, O and P are almost the same in both the languages. If we draw the number of words vs letters, fig.1, than we notice that the letters missing in the Abor-Miri

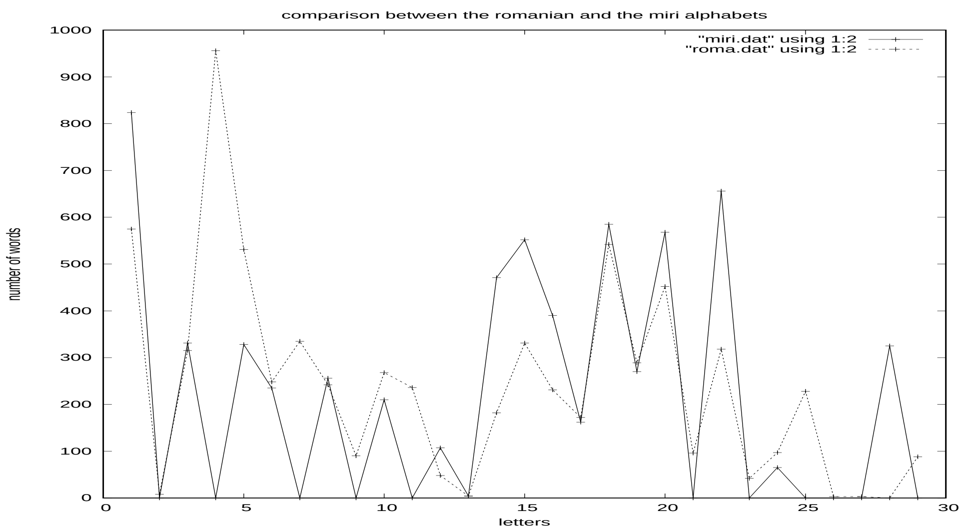

FIG. 1. Vertical axis is number of words and horizontal axis is respective letters. Letters are represented by the number in the alphabet or, dictionary sequence,[1].

are falling on some of the maxima or, minima of the Romanian. Romanian is an offshoot of Latin, original name being Dracia.

	A	Ă	B	C	D	E	F	G	H	I	Î	J	K	L	M	N	O	P	R	S	Ş	T	Ţ	U	V	W	X	Y	Z
romanian	574	8	315	956	531	248	335	242	90	268	236	48	4	182	331	231	172	542	289	452	96	318	42	97	228	3	3		88
miri	824		331		328	235	256			210		107	650	471	552	390	162	585	270	568		656		65				325	

In recent works, [3], the present author studied natural languages and have found existence of a curve magnetisation under each language. We termed this phenomenon as graphical law. Then we looked into, [4], dictionaries of five discipline of knowledge and found existence of a curve magnetisation under each discipline. This was followed by finding of graphical law behind bengali, [5] and Basque languages,[6].

We have found, [3], three type of languages. For the first kind, the points associated with a language fall on one curve of magnetisation, of Ising model with non-random coupling. For the second kind, the points associated with a language fall on one curve of magnetisation, once we remove the letter with maximum number of words or, letters with maximum and next-maximum number of words or, letters with maximum, next-maximum and nextnext-maximum number of words, from consideration. There are third kind of languages, for which the points associated with a language fall on one curve of magnetisation with fitting not that well or, with high dispersion. Those third kind of languages seem to underlie magnetisation curves for a Spin-Glass in presence of an external magnetic field.

We describe how a graphical law is hidden within in the Romanian language, in this article. 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. This section is semi-technical. If a reader is not interested to know the relevance of the comarator curves in the subject of magnetisation, she or, he can start from the section III. In the section III, we describe analysis of Romanian words. In the sections IV to VII, we analyse different parts of speech viz. nouns, adjectives, verbs, adverbs in the light of the graphical law. Section VIII is discussion. We end up through acknowledgement section IX and bibliography.

II. MAGNETISATION

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,[7], the lattice of spins is $-J\Sigma_{n.n}\sigma_i\sigma_j - \mu B\Sigma_i\sigma_i$, where n.n refers to nearest neighbour pairs.

The difference $\triangle\epsilon$ of energy if we flip an up spin to down spin is, [8], $2J\gamma\bar{\sigma} + 2\mu B$, where γ is the number of nearest neighbours of a spin. According to Boltzmann principle, $\frac{N_-}{N_+}$ equals $exp(-\frac{\triangle\epsilon}{k_BT})$, [9]. In the Bragg-Williams approximation,[10], $\bar{\sigma} = L$, considered in the thermal average sense. Consequently,

$$ln\frac{1+L}{1-L} = 2\frac{\gamma JL + \mu B}{k_BT} = 2\frac{L + \frac{\mu B}{\gamma J}}{\frac{T}{\gamma J/k_B}} = 2\frac{L+c}{\frac{T}{T_c}} \qquad (1)$$

where, $c = \frac{\mu B}{\gamma J}$, $T_c = \gamma J/k_B$, [11]. $\frac{T}{T_c}$ 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 [8]. 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.
In the approximation scheme which is improvement over the Bragg-Williams, due to Bethe-Peierls, [12], 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 datas generated from the equation(1) and the equation(2) and curves of magnetisation plotted on the basis of those datas.

A. Reduced magnetisation vs reduced temperature datas

BW stands for reduced temperature in Bragg-Williams approximation, calculated from the equation(1). Bethe(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.2. Empty spaces in the table mean corresponding point pairs were not used for plotting a line.

BW	BW(c=0.01)	Bethe(4)	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

In the case coupling between the spins in the Ising model is random, we get Spin-Glass,[13]. To understand, let us consider a row of coins, unloaded and coupled randomly(alternately a row of spins). Probability to get two heads for the same coin differs from one fourth, however apart in time the coin is ”tossed”, due to random coupling. At a particular time, net value of of head(alternately net value of spin or, net magnetic moment or, average magnetic moment over the row or, magnetisation) is zero due to random coupling. Long-range order in space is zero. But net value, dispersion, of two heads for a particular coin over long time is non-zero, due to random coupling. This is long-range order in time. Crudely speaking, existence of this long-range order in time, [14], is referred to as Spin-Glass phase. Going from a row of fixedly coupled unloaded coins(alternately spins) to a row of randomly coupled unloaded coins(alternately spins) is like going over to Spin-Glass phase or, is like

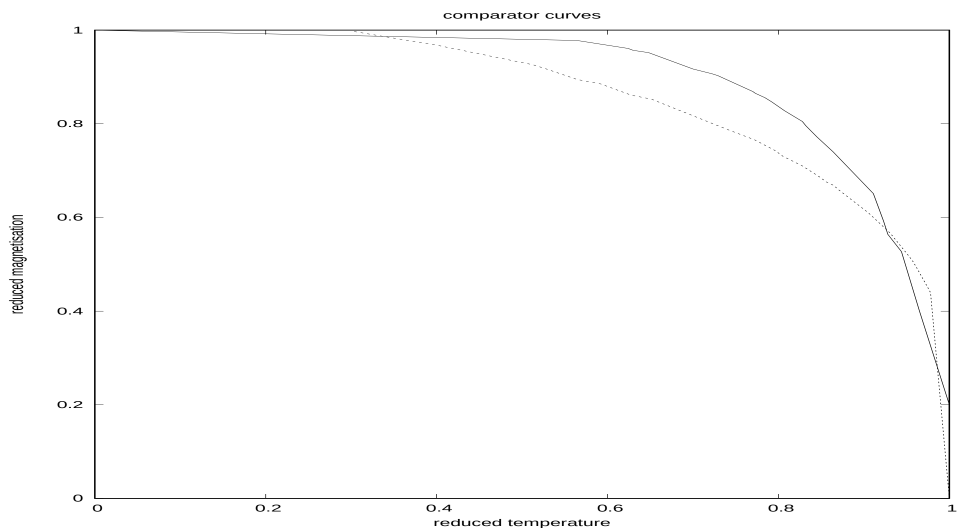

FIG. 2. Reduced magnetisation vs reduced reduced temperature curves for Bragg-Williams approximation, in presence of little magnetic field and Bethe-Peierls approximation in absence of magnetic field, for four nearest neighbours (outer one).

occurance of a Spin-Glass phase transition.

When a lattice of spins randomly coupled and in an external magnetic field, goes over to the Spin-Glass phase, magnetisation increases steeply like $\frac{1}{T-T_c}$ upto the the phase transition temperature, followed by very little increase,[13], in magnetisation, as the ambient temperature continues to drop.

III. ANALYSIS OF WORDS

We take the Romanian-English dictionary,[1]. Then we count the words, one by one from the beginning to the end, starting with different letters. The result is the following table.

A	Ă	B	C	D	E	F	G	H	I	Î	J	K	L	M	N	O	P	R	S	Ș	T	Ŧ	U	V	W	X	Z
575	8	315	956	531	248	335	242	90	268	236	48	4	182	331	231	172	542	289	452	96	318	42	97	228	3	3	88

Highest number of words, nine hundred fifty six, start with the letter C followed by words numbering five hundred seventyfive beginning with A, five hundred forty two with the letter P. To visualise we plot the number of words again 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 words, in the descending order, denoted by f and the respective rank, denoted by k. k

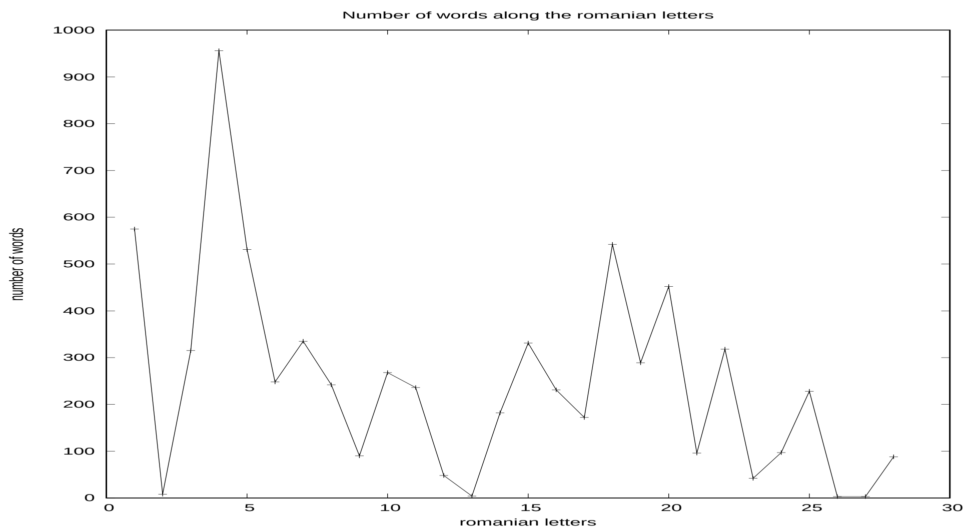

FIG. 3. Vertical axis is number of words and horizontal axis is respective letters. Letters are represented by the number in the alphabet or, dictionary sequence,[1].

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 eight 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 below and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.4.

We then ignore the letters with the highest and then next highest number of words, tabulate in the adjoining table below and redo the plot, normalising the lnfs with next-to-maximum $lnf_{nextmax}$, and starting from $k = 2$ in the figure fig.5. Normalising the lnfs with next-to-next-to-maximum $lnf_{nextnextmax}$, we tabulate in the adjoining table below and starting from $k = 3$ we draw in the figure fig.6. Normalising the lnfs with next-to-next-to-next-to-maximum $lnf_{nextnextnextmax}$ we record in the adjoining table below and plot starting from $k = 4$ in the figure fig.7.

k	lnk	lnk/lnk_{lim}	f	lnf	lnf/lnf_{max}	lnf/$lnf_{nextmax}$	lnf/lnf_{nnmax}	lnf/lnf_{nnnmax}
1	0	0	956	6.86	1	Blank	Blank	Blank
2	0.69	0.207	575	6.35	0.926	1	Blank	Blank
3	1.10	0.330	542	6.30	0.918	0.992	1	Blank
4	1.39	0.417	531	6.27	0.914	0.987	0.995	1
5	1.61	0.483	452	6.11	0.891	0.962	0.970	0.974
6	1.79	0.538	335	5.81	0.847	0.915	0.922	0.927
7	1.95	0.586	331	5.80	0.845	0.913	0.921	0.925
8	2.08	0.625	318	5.76	0.840	0.907	0.914	0.919
9	2.20	0.661	315	5.75	0.838	0.906	0.913	0.917
10	2.30	0.691	289	5.67	0.827	0.893	0.900	0.904
11	2.40	0.721	268	5.59	0.815	0.880	0.887	0.892
12	2.48	0.745	248	5.51	0.803	0.868	0.875	0.879
13	2.56	0.769	242	5.49	0.800	0.865	0.871	0.876
14	2.64	0.793	236	5.46	0.796	0.860	0.867	0.871
15	2.71	0.814	231	5.44	0.793	0.857	0.863	0.868
16	2.77	0.832	228	5.43	0.792	0.855	0.862	0.866
17	2.83	0.850	182	5.20	0.758	0.819	0.825	0.829
18	2.89	0.868	172	5.15	0.751	0.811	0.817	0.821
19	2.94	0.883	97	4.57	0.666	0.720	0.725	0.729
20	3.00	0.901	96	4.56	0.665	0.718	0.724	0.727
21	3.04	0.913	90	4.50	0.656	0.709	0.714	0.718
22	3.09	0.928	88	4.48	0.653	0.706	0.711	0.715
23	3.14	0.943	48	3.87	0.564	0.609	0.614	0.617
24	3.18	0.955	42	3.74	0.545	0.589	0.594	0.596
25	3.22	0.967	8	2.08	0.303	0.328	0.330	0.332
26	3.26	0.979	4	1.39	0.203	0.219	0.221	0.222
27	3.30	0.991	3	1.10	0.160	0.173	0.175	0.175
28	3.33	1	1	0	0	0	0	0

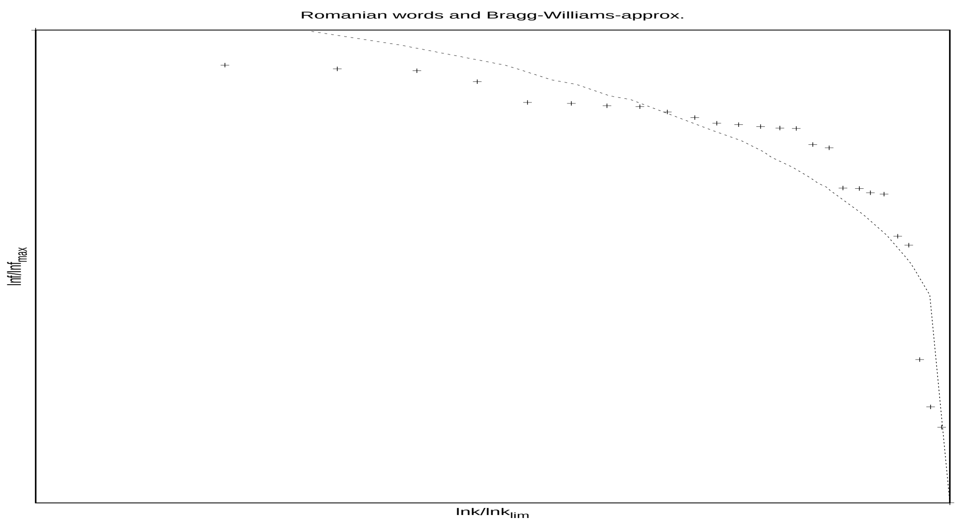

FIG. 4. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Romanian language with the fit curve is Bragg-Williams in presence of little magnetic field.

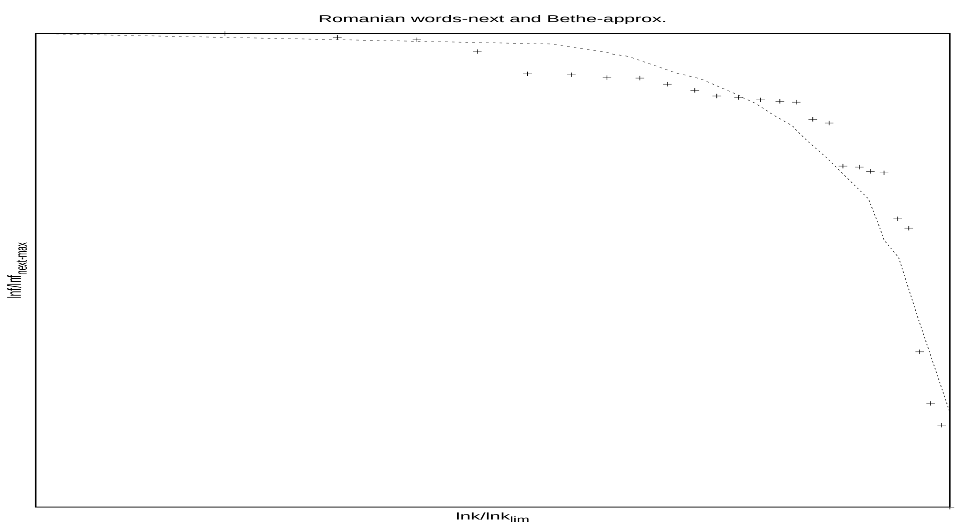

FIG. 5. Vertical axis is $\frac{lnf}{lnf_{next-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Romanian language with the fit curve being Bethe-Peierls curve in presence of four neighbours.

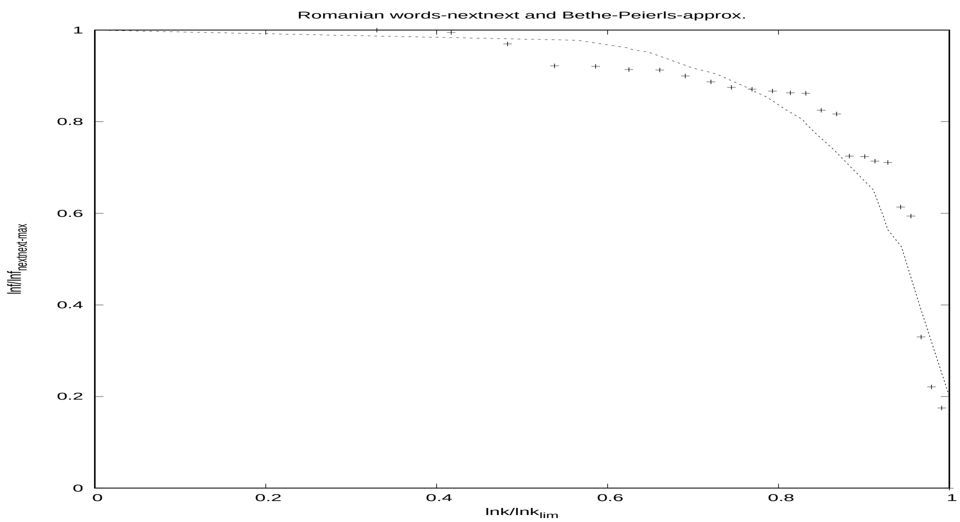

FIG. 6. Vertical axis is $\frac{lnf}{lnf_{nextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Romanian language with the fit curve being Bethe-Peierls curve in presence of four neighbours.

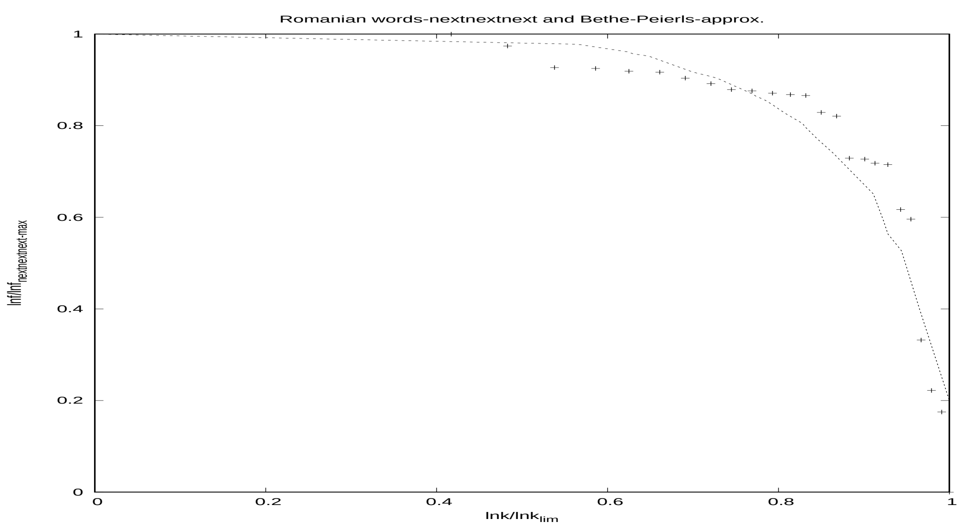

FIG. 7. Vertical axis is $\frac{lnf}{lnf_{nextnextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the Romanian language with the fit curve being Bethe-Peierls curve in presence of four neighbours.

As matching of the plots in the figures fig.(4,5,6,7), with comparator curves i.e. the magnetisation curves of Bragg-Williams or, Bethe-Peierls approximations, is with large dispersions and dispersion does not reduce over higher orders of normalisations, $\frac{lnf}{lnf_{max}}$ and

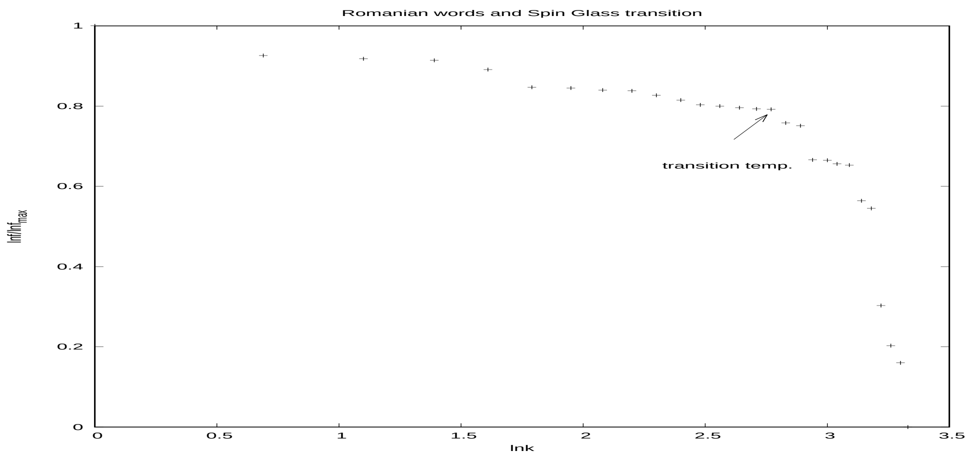

FIG. 8. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is lnk. The + points represent the words of the Romanian language.

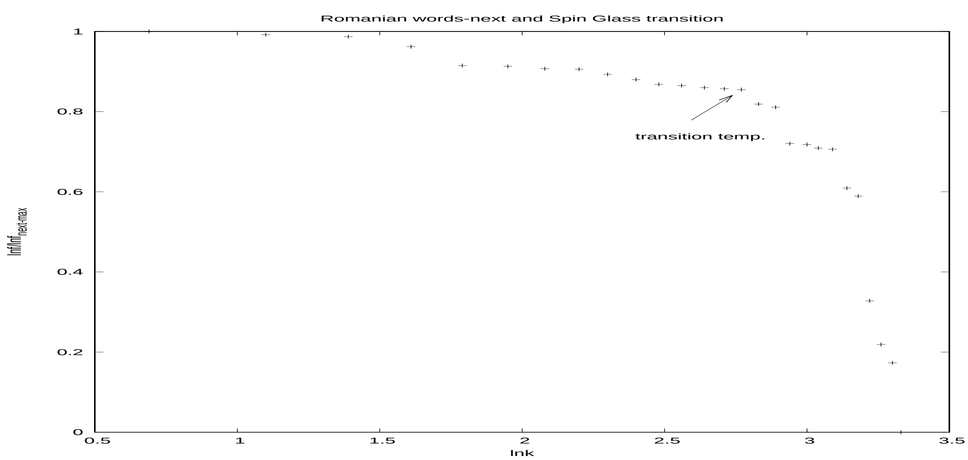

FIG. 9. Vertical axis is $\frac{lnf}{lnf_{next-max}}$ and horizontal axis is lnk. The + points represent the words of the Romanian language with.

$\frac{lnf}{lnf_{next-max}}$ are drawn against lnk in the figures fig.(8,9) to explore for the possible existence of a magnetisation curve of a Spin-Glass in presence of an external magnetic field, underlying Romanian words.

In the figure 9, the points has a clearcut transition, above transition the line is almost horizontal, below transition pointsline rises sharply like the branch of a rectangular hyperbola. Hence, the words of the Romanian language, better be described, to underlie a Spin-Glass magnetisation curve, [13], in the presence of magnetic field.

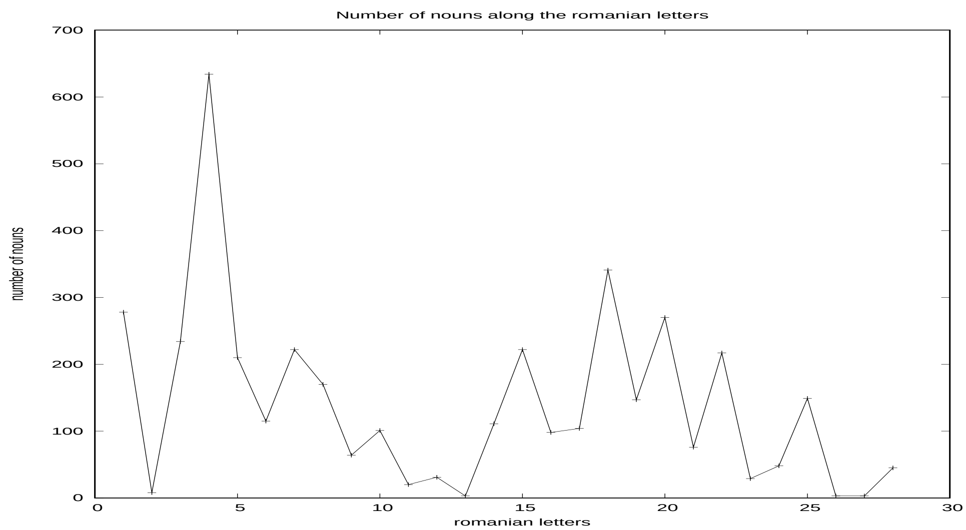

FIG. 10. Vertical axis is number of nouns and horizontal axis is respective letters. Letters are represented by the number in the alphabet or, dictionary sequence, [1].

IV. ANALYSIS OF NOUNS

We take the Romanian-English dictionary,[1]. Then we count the nouns, one by one from the beginning to the end, starting with different letters. The result is the following table.

A	Ă	B	C	D	E	F	G	H	I	Î	J	K	L	M	N	O	P	R	S	Ș	T	Ŧ	U	V	W	X	Z
278	8	234	634	210	115	222	170	64	101	20	31	3	111	222	98	104	341	147	270	76	217	29	48	149	3	3	45

Highest number of nouns, six hundred thirty four, start with the letter C followed by nouns numbering three hundred forty one beginning with P, two hundred seventy eight with the letter A. To visualise we plot the number of nouns again respective letters in the dictionary sequence,[1] in the figure fig.10. For the purpose of exploring graphical law, we assort the letters according to the number of nouns, 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 nouns. The limiting rank is maximum rank plus one, here it is twenty eight and the limiting number of nouns 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 below and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.11.

We then ignore the letters with the highest and then next highest number of words, tabulate in the adjoining table below and redo the plot, normalising the lnfs with next-to-maximum $lnf_{nextmax}$, and starting from $k=2$ in the figure fig.12. Normalising the lnfs with next-to-next-to-maximum $lnf_{nextnextmax}$, we tabulate in the adjoining table below and starting from $k = 3$ we draw in the figure fig.13.

k	lnk	lnk/lnk_{lim}	f	lnf	lnf/lnf_{max}	lnf/$lnf_{next-max}$	lnf/$lnf_{nextnext-max}$
1	0	0	634	6.45	1	Blank	Blank
2	0.69	0.212	341	5.83	0.904	1	Blank
3	1.10	0.337	278	5.63	0.873	0.966	1
4	1.39	0.426	270	5.60	0.868	0.961	0.995
5	1.61	0.494	234	5.46	0.847	0.937	0.970
6	1.79	0.549	222	5.40	0.837	0.926	0.959
7	1.95	0.598	217	5.38	0.834	0.923	0.956
8	2.08	0.638	210	5.35	0.829	0.918	0.950
9	2.20	0.675	170	5.14	0.797	0.882	0.913
10	2.30	0.706	149	5.00	0.775	0.858	0.888
11	2.40	0.736	147	4.99	0.774	0.856	0.886
12	2.48	0.761	115	4.74	0.735	0.813	0.842
13	2.56	0.785	111	4.71	0.730	0.808	0.837
14	2.64	0.810	104	4.64	0.719	0.796	0.824
15	2.71	0.831	101	4.62	0.716	0.792	0.821
16	2.77	0.850	98	4.58	0.710	0.786	0.813
17	2.83	0.868	76	4.33	0.671	0.743	0.769
18	2.89	0.887	64	4.16	0.645	0.714	0.739
19	2.94	0.902	48	3.87	0.600	0.664	0.687
20	3.00	0.920	45	3.81	0.591	0.654	0.677
21	3.04	0.933	31	3.43	0.532	0.588	0.609
22	3.09	0.948	29	3.37	0.522	0.578	0.599
23	3.14	0.963	20	3.00	0.465	0.515	0.533
24	3.18	0.975	7	1.95	0.302	0.334	0.346
25	3.22	0.988	3	1.10	0.171	0.189	0.195
26	3.26	1	1	0	0	0	0

As matching of the plots in the figures fig.(11,12,13) with comparator curves i.e. the magnetisation curves of Bragg-Williams or, Bethe-Peierls approximations, dispersion reduces over higher orders of normalisations and the points in the figure fig.13 go along the Bethe-peierls linewith four nearest neighbours with very little dispersion. Hence the nouns of the Romanian language can be characterised by Bethe-Peierls line with four nearest neighbours . But to be certain, we draw $\frac{lnf}{lnf_{max}}$ against lnk in the figure fig.14 to explore for the possible existence of a magnetisation curve of a Spin-Glass in presence of an external magnetic field, underlying Romanian nouns. We note that the pointslines in the fig.14, does not have a clear-cut transition point. Hence, nouns of the Romanian language is not suited to be

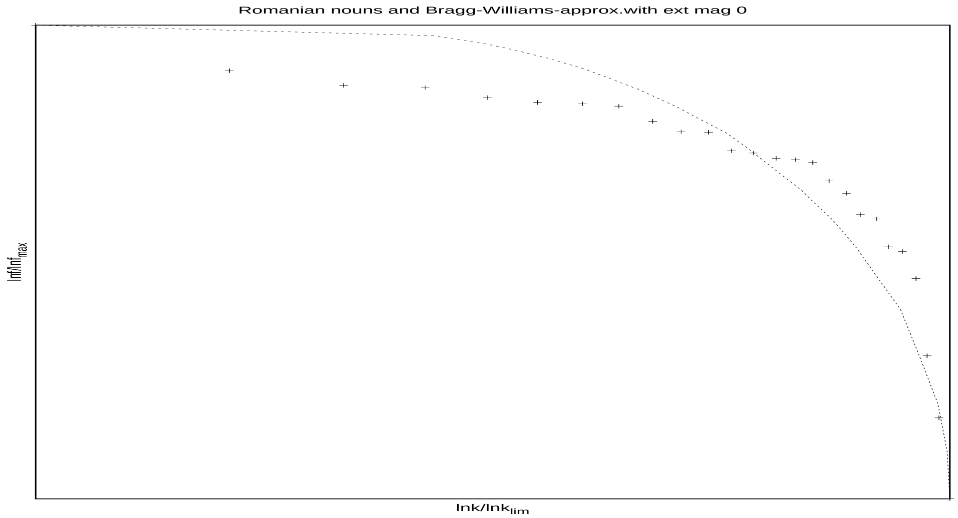

FIG. 11. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the nouns of Romanian language with fit curve being Bragg-Williams curve in absence of magnetic field.

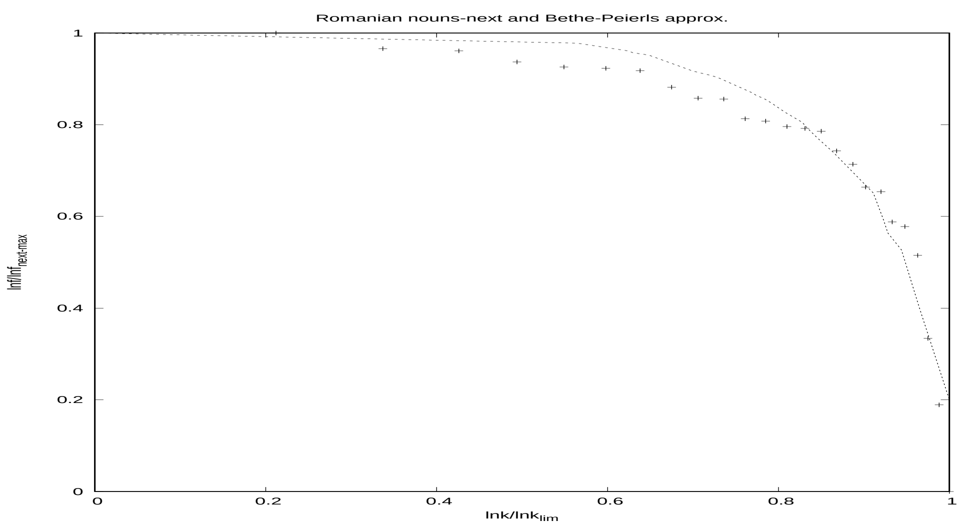

FIG. 12. Vertical axis is $\frac{lnf}{lnf_{next-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the nouns of Romanian language with fit curve being Bethe-Peierls curve with four nearest neighbours.

described by a Spin-Glass magnetisation curve, [13], in the presence of an external magnetic field.

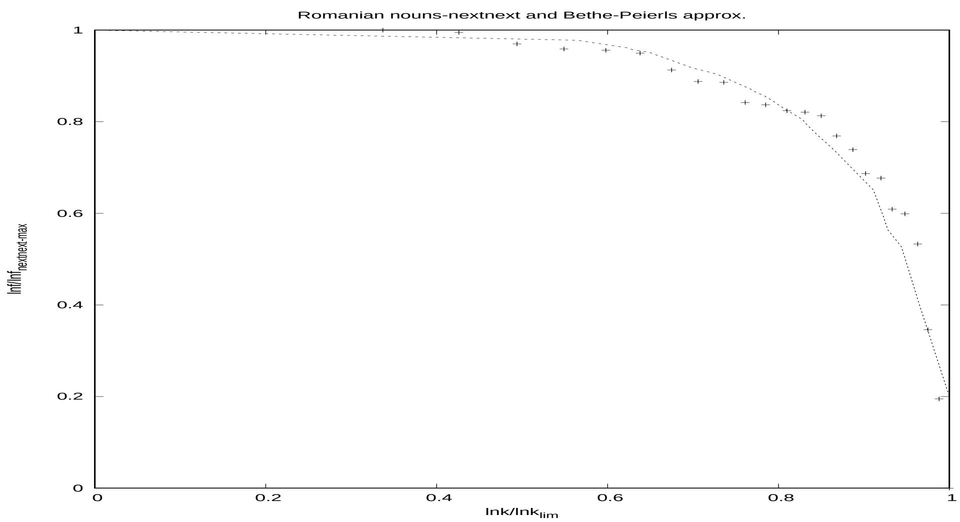

FIG. 13. Vertical axis is $\frac{lnf}{lnf_{nextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the nouns of Romanian language with fit curve being Bethe-Peierls curve with four nearest neighbours.

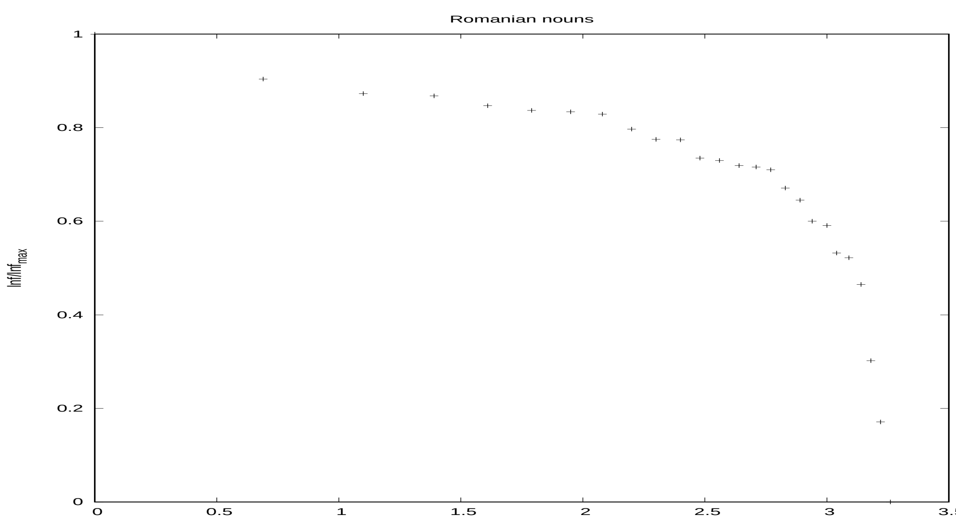

FIG. 14. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is lnk. The + points represent the words of the Romanian language.

A. conclusion

From the figures (fig.11-fig.13), we observe that there is a curve of magnetisation, behind nouns of the Romanian language. This is magnetisation curve in the Bethe-Peierls approximation with four nearest neighbours.

Moreover, the associated correspondance is,

$$\frac{lnf}{lnf_{next-to-next-to-maximum}} \longleftrightarrow \frac{M}{M_{max}},$$

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [15]. As temperature decreases, i.e. lnk decreases, f increases. The alphabets which are recording higher entries compared to those which have lesser entries are at lower temperature. As Romanian expands, the alphabets like..., which get enriched more and more, fall at lower and lower temperatures. This is a manifestation of cooling effect, as was first observed in [16], in another way.

V. ANALYSIS OF ADJECTIVES

We take the Romanian-English dictionary,[1]. Then we count the adjectives, one by one from the beginning to the end, starting with different letters. The result is the following table.

A	Ă	B	C	D	E	F	G	H	I	Î	J	K	L	M	N	O	P	R	S	Ș	T	Ŧ	U	V	W	X	Z
117	7	41	125	79	61	57	38	6	114	20	7	1	31	63	115	34	67	37	84	9	39	4	21	52	0	0	9

Highest number of adjectives, one hundred twenty five, start with the letter C followed by adjectives numbering one hundred seventeen beginning with A, one hundred fifteen with the letter N. To visualise we plot the number of adjectives again respective letters in the dictionary sequence,[1] in the figure fig.15. For the purpose of exploring graphical law, we assort the letters according to the number of adjectives, 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 adjectives. The limiting rank is maximum rank plus one, here it is twenty eight and the limiting number of adjectives 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 below and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.16.

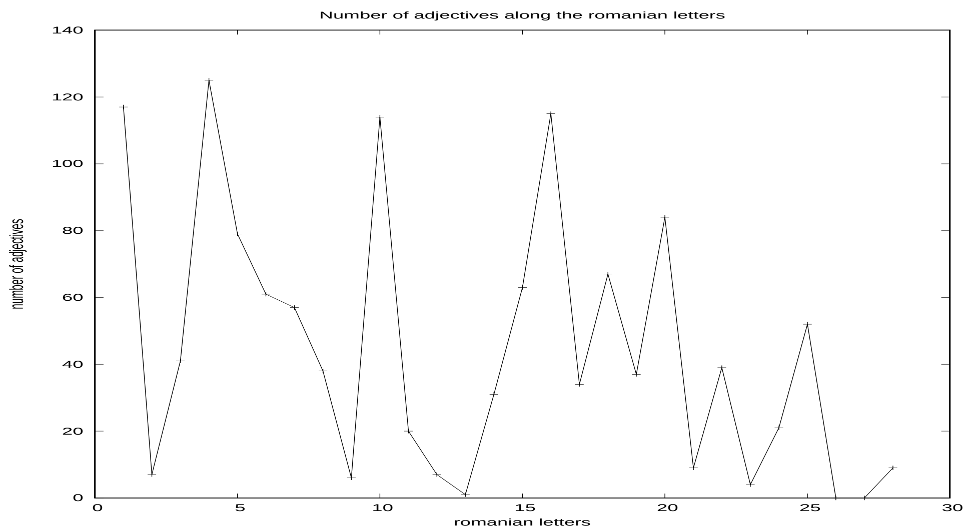

FIG. 15. Vertical axis is number of adjectives and horizontal axis is respective letters. Letters are represented by the number in the alphabet or, dictionary sequence,[1].

k	lnk	lnk/lnk_{lim}	f	lnf	lnf/lnf_{max}
1	0	0	125	4.83	1
2	0.69	0.217	117	4.76	0.986
3	1.10	0.346	115	4.745	0.982
4	1.39	0.437	114	4.736	0.981
5	1.61	0.506	84	4.38	0.907
6	1.79	0.563	79	4.37	0.905
7	1.95	0.613	67	4.20	0.870
8	2.08	0.654	63	4.14	0.857
9	2.20	0.692	61	4.11	0.851
10	2.30	0.723	57	4.04	0.836
11	2.40	0.755	52	3.95	0.818
12	2.48	0.780	41	3.71	0.768
13	2.56	0.805	39	3.66	0.758
14	2.64	0.830	38	3.64	0.754
15	2.71	0.852	37	3.61	0.747
16	2.77	0.871	34	3.53	0.731
17	2.83	0.890	31	3.43	0.710
18	2.89	0.909	21	3.04	0.629
19	2.94	0.925	20	3.00	0.621
20	3.00	0.943	9	2.20	0.455
21	3.04	0.956	7	1.95	0.404
22	3.09	0.972	6	1.79	0.371
23	3.14	0.987	4	1.39	0.288
24	3.18	1	1	0	0

In the plot fig.(16, the points match nicely with the magnetisation curve in the Bragg-Williams approximation in presence of little magnetic field. Hence, adjectives of the Ro-

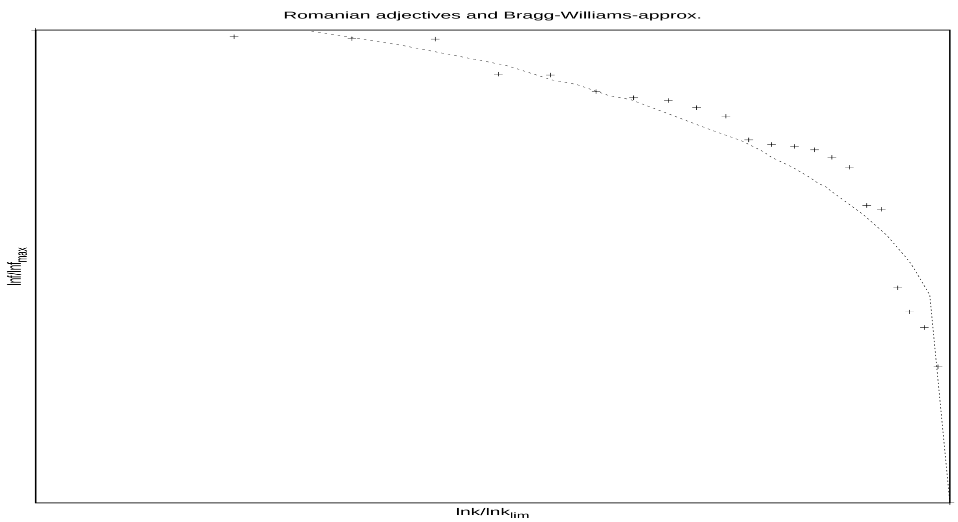

FIG. 16. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the the adjectives of Romanian language with fit curve being Bragg-Williams curve with little magnetic field.

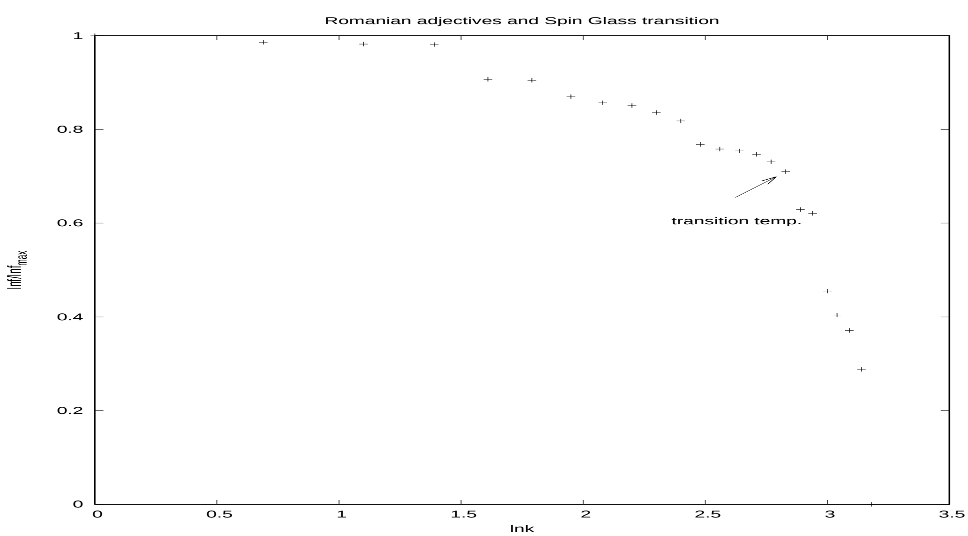

FIG. 17. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is lnk. The + points represent the adjectives of the Romanian language.

manian language can be charcterised by the magnetisation curve in the Bragg-Williams approximation in presence of little magnetic field. Again, to be sure we draw $\frac{lnf}{lnf_{max}}$ against lnk in the figures fig.17 to explore for the possible existence of a magnetisation curve of a Spin-Glass in presence of an external magnetic field, underlying Romanian adjectives. We note that the points in the fig.17 does not have a clear-cut transition point for the adjectives.

A. conclusion

From the figures fig.16 we observe that there is a curve of magnetisation, behind adjectives of Romanian. This is the magnetisation curve in the Bragg-Williams approximation in presence of little magnetic field. Moreover, there is an associated correspondance is,

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

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [15]. As temperature decreases, i.e. lnk decreases, f increases. The alphabets which are recording higher entries compared to those which have lesser entries are at lower temperature. As Romanian expands, the alphabets like..., which get enriched more and more, fall at lower and lower temperatures. This is a manifestation of cooling effect, as was first observed in [16], in another way.

VI. ANALYSIS OF VERBS

We take the Romanian-English dictionary,[1]. Then we count the verbs, [17] one by one from the beginning to the end, starting with different letters. The result is the following table.

A	Ă	B	C	D	E	F	G	H	I	Î	J	K	L	M	N	O	P	R	S	Ș	T	Ŧ	U	V	W	X	Z
163	0	43	199	209	68	51	32	15	55	174	9	0	36	50	23	29	126	112	109	12	62	10	26	32	0	0	32

Highest number of verbs, two hundred nine, start with the letter D followed by verbs numbering one hundred ninetynine beginning with C, one hundred seventy four with the letter Ǐ. To visualise we plot the number of words again respective letters in the dictionary sequence,[1] in the adjoining figure, fig.18.

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 eight 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 below and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.19.

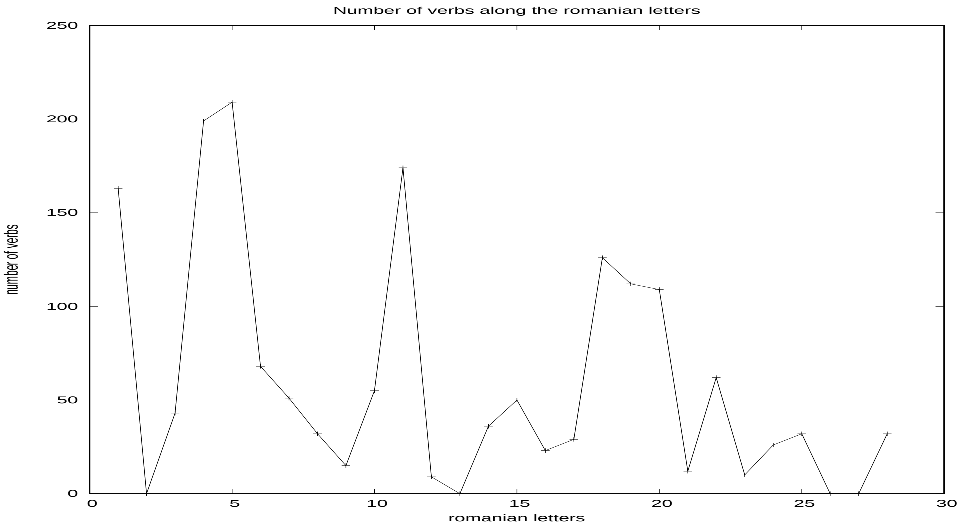

FIG. 18. Vertical axis is number of verbs and horizontal axis is respective letters. Letters are represented by the number in the alphabet or, dictionary sequence, [1].

k	lnk	lnk/lnk_{lim}	f	lnf	lnf/lnf_{max}
1	0	0	209	5.34	1
2	0.69	0.220	199	5.29	0.991
3	1.10	0.350	174	5.16	0.966
4	1.39	0.443	163	5.09	0.953
5	1.61	0.513	126	4.84	0.906
6	1.79	0.570	112	4.72	0.884
7	1.95	0.621	109	4.69	0.878
8	2.08	0.662	68	4.22	0.790
9	2.20	0.701	62	4.13	0.773
10	2.30	0.732	55	4.01	0.751
11	2.40	0.764	51	3.93	0.736
12	2.48	0.790	50	3.91	0.732
13	2.56	0.815	43	3.76	0.704
14	2.64	0.841	36	3.58	0.670
15	2.71	0.863	32	3.47	0.650
16	2.77	0.882	29	3.37	0.631
17	2.83	0.901	26	3.26	0.610
18	2.89	0.920	23	3.14	0.588
19	2.94	0.936	15	2.71	0.507
20	3.00	0.955	12	2.48	0.464
21	3.04	0.968	10	2.30	0.431
22	3.09	0.984	9	2.20	0.412
23	3.14	1	1	0	0

As matching of the plot in the figures fig.(19, with comparator curve i.e. the magnetisation curve of Bragg-Williams in absence of magnetic field, is with less dispersion, verbs of

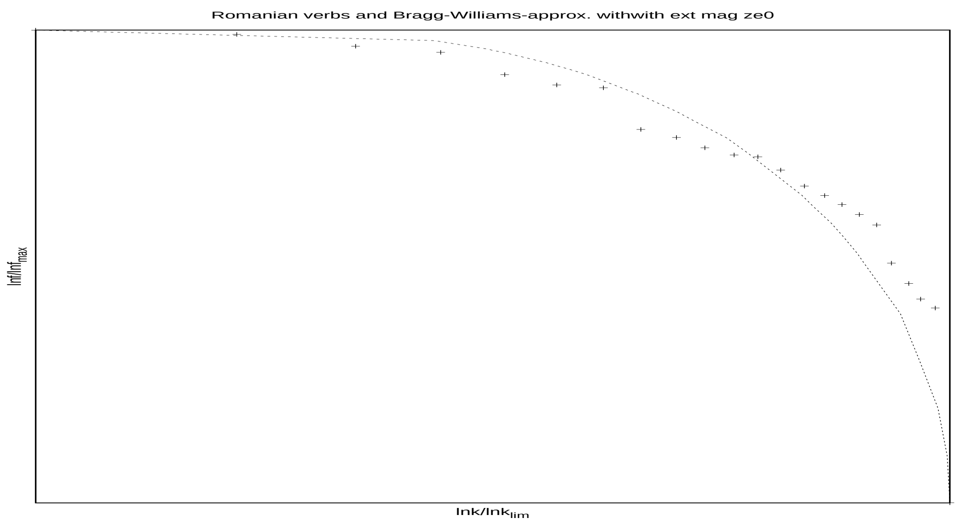

FIG. 19. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the verbs of Romanian language with fit curve being Bragg-Williams curve in absence of magnetic field.

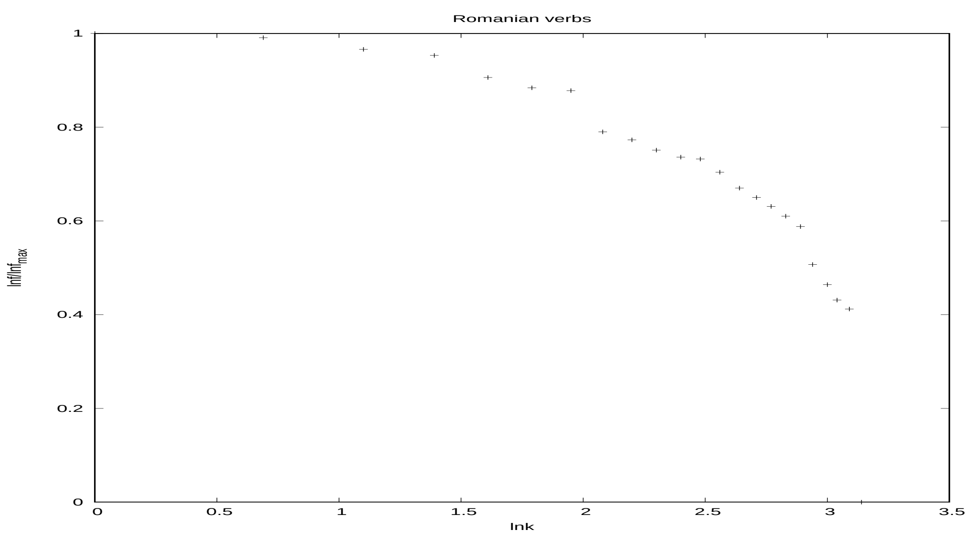

FIG. 20. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is lnk. The + points represent the words of the Romanian language.

the Romanian language can be characterised by Bragg-Williams curve in absence of magnetic field. Still to be sure, we plot $\frac{lnf}{lnf_{max}}$ against lnk in the figures fig.(21 to explore for the possible existence of a magnetisation curve of a Spin-Glass in presence of an external magnetic field, underlying Romanian verbs.

We note that the points in the fig.21, does not have a transition point. Hence, verbs of the Romanian language is not at all suited to be described by a Spin-Glass magnetisation curve, [13], in the presence of an external magnetic field.

A. conclusion

From the figure fig.19, we observe that there is a curve of magnetisation, specifically the magnetisation curve in Bragg-Williams approximation in absence of magnetic field, behind verbs of Romanian language.
Moreover, there is an associated correspondance,

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

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [15]. As temperature decreases, i.e. lnk decreases, f increases. The alphabets which are recording higher entries compared to those which have lesser entries are at lower temperature. As Romanian expands, the alphabets like..., which get enriched more and more, fall at lower and lower temperatures. This is a manifestation of cooling effect, as was first observed in [16], in another way.

VII. ANALYSIS OF ADVERBS

We take the Romanian-English dictionary,[1]. Then we count the adverbs, one by one from the beginning to the end, starting with different letters. The result is the following table.

A	Ă	B	C	D	E	F	G	H	I	Î	J	K	L	M	N	O	P	R	S	Ș	T	Ŧ	U	V	W	X	Z
34	0	3	13	29	3	2	5	0	4	17	2	0	2	5	10	4	7	2	3	1	9	0	5	2	0	0	0

Highest number of nouns, six hundred thirty four, start with the letter C followed by nouns numbering three hundred forty one beginning with P, two hundred seventy eight with the letter A. To visualise we plot the number of adverbs again respective letters in the dictionary sequence,[1] in the figure fig.21. For the purpose of exploring graphical law, we assort the letters according to the number of nouns, 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 nouns. The limiting rank is maximum rank plus one, here it is twenty eight and the limiting number of nouns is one. As a result both

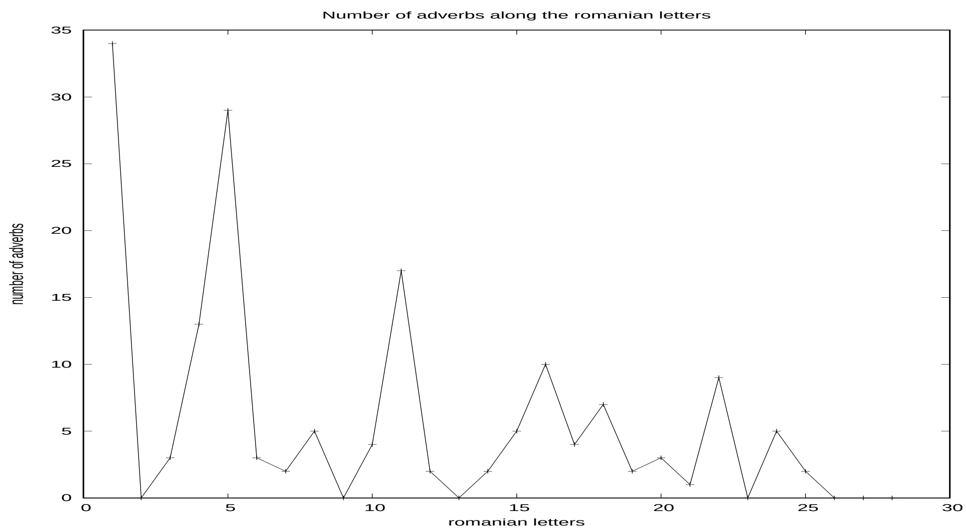

FIG. 21. Vertical axis is number of nouns and horizontal axis is respective letters. Letters are represented by the number in the alphabet or, dictionary sequence, [1].

$\frac{lnf}{lnf_{max}}$ and $\frac{lnk}{lnk_{lim}}$ varies from zero to one. Then we tabulate in the adjoining table below and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.22.

We then ignore the letters with the highest and then next highest number of words, tabulate in the adjoining table below and redo the plot, normalising the lnfs with next-to-maximum $lnf_{nextmax}$, and starting from $k = 2$ in the figure fig.23. Normalising the lnfs with next-to-next-to-maximum $lnf_{nextnextmax}$, we tabulate in the adjoining table below and starting from $k = 3$ we draw in the figure fig.24.

k	lnk	lnk/lnk_{lim}	f	lnf	lnf/lnf_{max}	lnf/$lnf_{next-max}$	lnf/$lnf_{nextnext-max}$
1	0	0	34	3.53	1	Blank	Blank
2	0.69	0.278	29	3.37	0.955	1	Blank
3	1.10	0.444	17	2.83	0.802	0.840	1
4	1.39	0.560	13	2.56	0.725	0.760	0.905
5	1.61	0.649	10	2.30	0.652	0.682	0.813
6	1.79	0.722	9	2.20	0.623	0.653	0.777
7	1.95	0.786	7	1.95	0.552	0.579	0.689
8	2.08	0.839	5	1.61	0.456	0.478	0.569
9	2.20	0.887	4	1.39	0.394	0.412	0.491
10	2.30	0.927	3	1.10	0.312	0.326	0.389
11	2.40	0.968	2	0.69	0.195	0.205	0.244
12	2.48	1	1	0	0	0	0

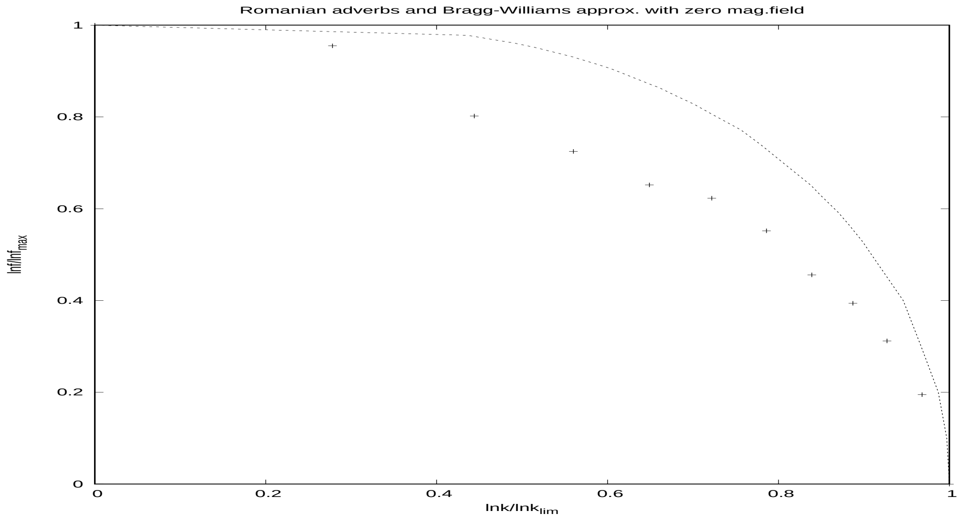

FIG. 22. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the adverbss of Romanian language with fit curve being Bragg-Williams curve in absence of magnetic field.

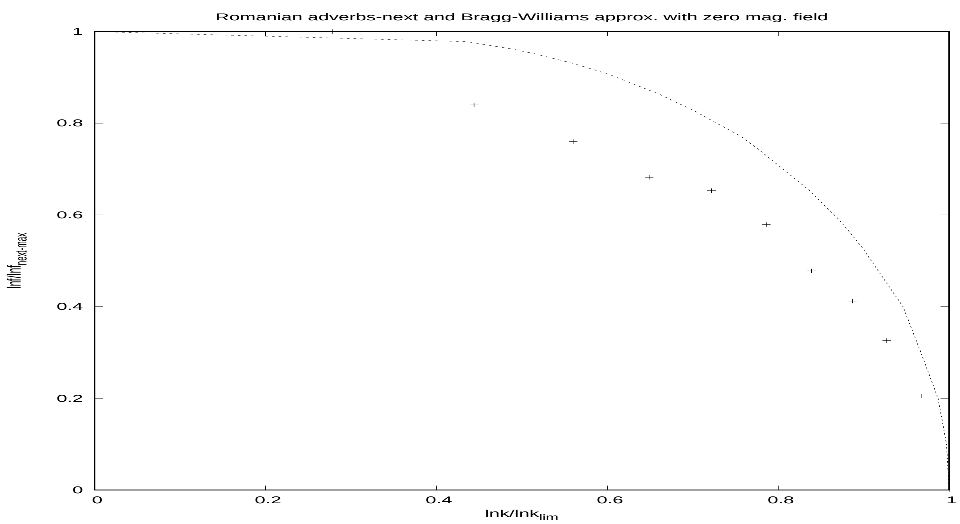

FIG. 23. Vertical axis is $\frac{lnf}{lnf_{next-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the adverbs of Romanian language with fit curve being Bragg-Williams curve in absence of magnetic field.

As matching of the plots in the figures fig.(22,23,24) with comparator curve i.e. the magnetisation curve of Bragg-Williams with zero external mag. field, dispersion reduces over higher orders of normalisations and the points in the figure fig.13 go along the magnetisation curve of Bragg-Williams with zero external mag. field Hence the adverbs of the Romanian language can be characterised by magnetisation curve of Bragg-Williams with zero external

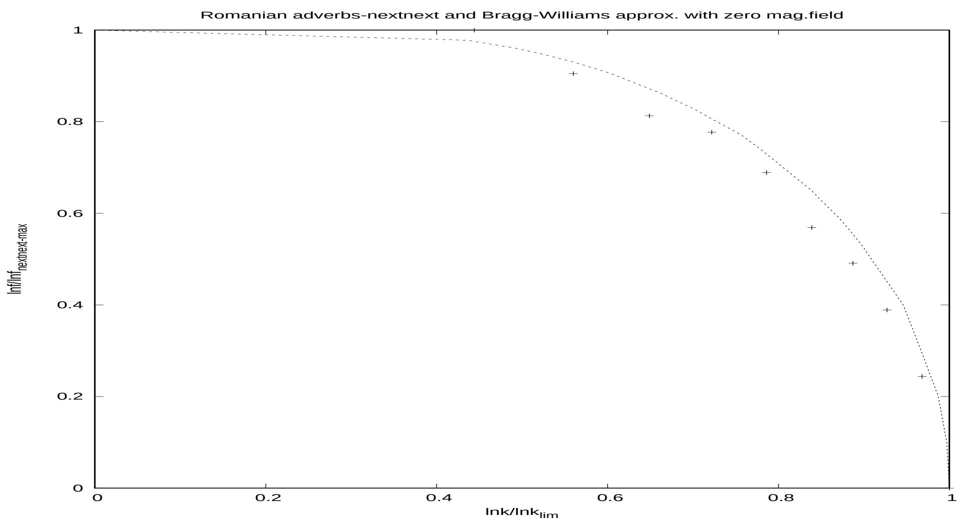

FIG. 24. Vertical axis is $\frac{lnf}{lnf_{nextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the adverbs of Romanian language with fit curve being Bragg-Williams curve in absence of magnetic field.

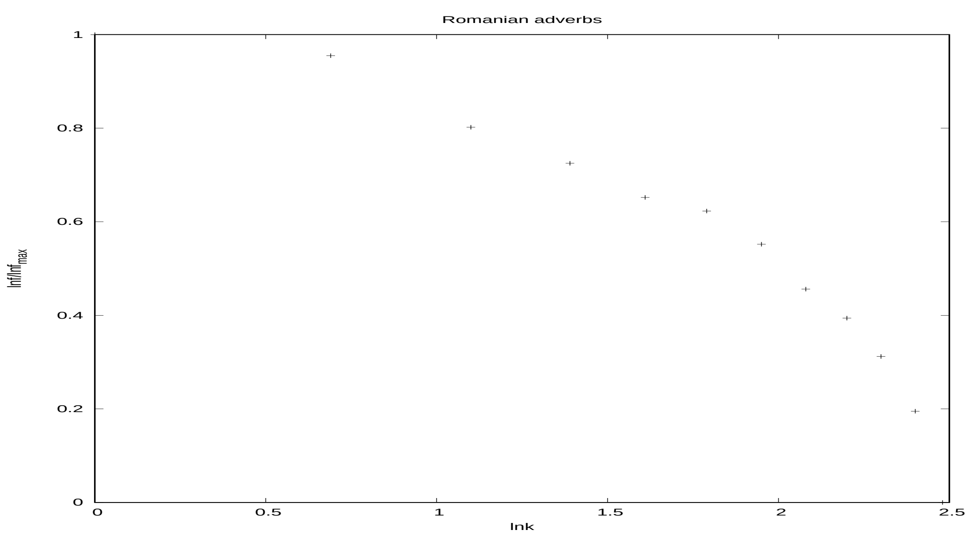

FIG. 25. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is lnk. The + points represent the words of the Romanian language.

mag. field. But to be certain, we draw $\frac{lnf}{lnf_{max}}$ against lnk in the figure fig.25 to explore for the possible existence of a magnetisation curve of a Spin-Glass in presence of an external magnetic field, underlying Romanian nouns. We note that the points in the fig.25, does not have a clear-cut transition point. Hence, adverbs of the Romanian language is not suited to be described by a Spin-Glass magnetisation curve, [13], in the presence of an external magnetic field.

A. conclusion

From the figures (fig.22-fig.24), we observe that there is a curve of magnetisation, behind adverbs of the Romanian language. This is magnetisation curve in the Bragg-Williams approximation with zero external magnetic field.

Moreover, the associated correspondance is,

$$\frac{lnf}{lnf_{next-to-next-to-maximum}} \longleftrightarrow \frac{M}{M_{max}},$$

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [15]. As temperature decreases, i.e. lnk decreases, f increases. The alphabets which are recording higher entries compared to those which have lesser entries are at lower temperature. As Romanian expands, the alphabets like..., which get enriched more and more, fall at lower and lower temperatures. This is a manifestation of cooling effect, as was first observed in [16], in another way.

VIII. DISCUSSION

The words of the Romanian language underlie a Spin-Glass magnetisation curve, [13], in the presence of magnetic field. Moreover we have observed that there is a curve of magnetisation, behind nouns of the Romanian language. This is magnetisation curve in the Bethe-Peierls approximation with four nearest neighbours. We have also concluded that there is a curve of magnetisation, behind adjectives of Romanian. This is the magnetisation curve in the Bragg-Williams approximation in presence of little magnetic field. We reached a conclusion that there is a curve of magnetisation, specifically the magnetisation curve in Bragg-Williams approximation in absence of magnetic field, behind verbs of Romanian language. At the end, we have surmised that there is a curve of magnetisation, behind adverbs of the Romanian language. This is magnetisation curve in the Bragg-Williams approximation with zero external magnetic field.

We sum up noting that the Abor-Miri language also seems to be better suited, [3], to be described to underlie a Spin-Glass magnetisation curve, [13], in the presence of magnetic field. We end reminiscing,

"Aag gibon khuje pabi,
chhute chhute aay,
..."
———Bhupen Hazarika.

IX. ACKNOWLEDGEMENT

The author would like to thank S. Sangilipandi for acquiring, on behalf of the author, Romanian-English English-Romanian Dictionary by M. Miroiu. We have used gnuplot for plotting the figures in this paper.

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