



Tourist Guide and Map, Aizawl and the Graphical Law

*¹Anindya Kumar Biswas

¹Department of Physics, North-Eastern Hill University, Mawkynroh-Umshing, Shillong, Meghalaya, India.

Abstract

We study the names of the places in the Tourist Guide and Map, Aizawl, designed, cartographed, printed and published by Indian Map Service, Jodhpur, Rajasthan, India, in the year 2016. 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 Tourist Guide and Map, Aizawl, can be characterised by the magnetisation curve, $BP(4, \beta H=0)$, in the Bethe-Peierls approximation of the Ising Model, in the presence of four nearest neighbours and in the absence of external magnetic field, $H=0$.

Keywords: Aizawl, Map, Ranking, Magnetisation, Ising Model, the Bethe-Peierls approximation

Introduction

Aizawl is the capital of Mizoram, a state in the north-eastern part of India. We look into one tourist map of this state. This is the Tourist Guide and Map, Aizawl, designed, cartographed, printed and published by Indian Map Service, Jodhpur, Rajasthan, India, and distributed for the North-East Region by the United Publishers, ^[1], way back in the year 2016. We study the names of the places on this map. We count the number of the names of the places in the Tourist Guide and Map, Aizawl, one by one, to 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 existence of a magnetisation curve under each language. We have termed this phenomenon as the Graphical Law. Then, we moved on to investigate, in ^[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, ^[82].

We describe how the graphical law is hidden within the names of places appearing in the Tourist Guide and Map, Aizawl, ^[1], 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. In the section III, we describe analysis of the names of the places of the Tourist Guide and Map, Aizawl, ^[1]. The section IV is Acknowledgment. The last section is Bibliography.

Magnetisation

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 $L = 1/N \sum_i \sigma_i$ 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 $\mu \sum_i \sigma_i$ 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, [83], for the lattice of spins, setting μ to one, is $-\epsilon \sum_{n,n} \sigma_i \sigma_j - H \sum_i \sigma_i$, where n.n refers to nearest neighbour pairs. The difference of energy, ΔE , if we flip an up spin to down spin is, [84], $2\epsilon\gamma\bar{\sigma} + 2H$, where γ is the number of nearest neighbours of a spin. According to Boltzmann principle $\frac{N_-}{N_+}$ equals $\exp(-\Delta E/k_B T)$, [85]. In the Bragg-Williams approximation, [86], $\bar{\sigma} = L$, considered in the thermal average sense. Consequently,

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

Where, $c = H/\epsilon\gamma$. $T_c = \epsilon\gamma/k_B$, [87]. T/T_c is referred to as reduced temperature. Plot of L vs T/T_c or, reduced magnetisation 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 FIGURE 12.12 of the book, [84]. 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.

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, [83], [84], [85], [86], [87], due to Bethe-Peierls, [88], reduced magnetisation varies with reduced temperature, for γ neighbours, in absence of external magnetic field.

$$(\ln \gamma / (\gamma - 2)) / (\ln (\text{factor} - 1) / D) = T/T_c \quad (2)$$

Where, $D = \text{factor}^{((\gamma-1)/\gamma)} - \text{factor}^{(1/\gamma)}$ and $\text{factor} = (1 + \frac{M}{M_{max}}) / (1 - \frac{M}{M_{max}})$. For $\gamma=4$ i.e. for four nearest neighbours, $\ln \frac{\gamma}{\gamma-2}$ is 0.693.

In the following, we describe datas generated from the Equation 1 and the Equation 2 in the table, Table-1, 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, $\beta H=0$) represents reduced temperature in the Bethe-Peierls approximation, for four nearest neighbours, computed from the Equation 2. The data set is used to plot Figure 1. Empty spaces in the table, Table-1, mean corresponding point pairs were not used for plotting a line.

Table 1: Reduced magnetisation vs reduced temperature datas for Bragg-Williams approximation, in absence of and in presence of magnetic field, $c=H/\gamma\epsilon=0.01$, and Bethe-Peierls approximation in absence of magnetic field, for four nearest neighbours.

BW(c=0)	BW(c=0.01)	BP(4, $\beta H=0$)	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	0

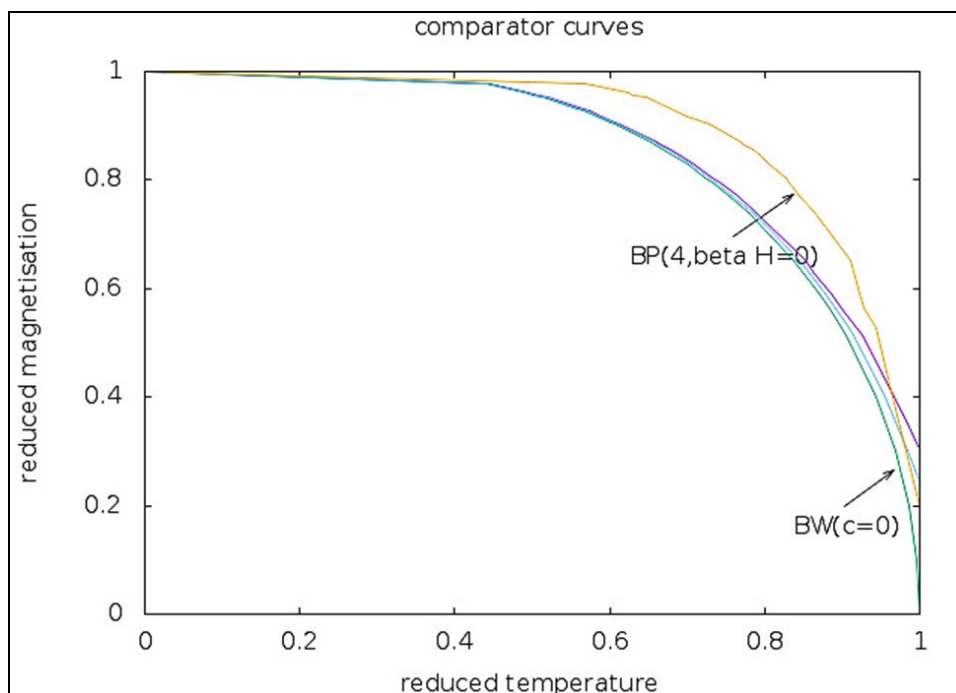


Fig 1: Reduced magnetisation vs reduced temperature curves for the Bragg-Williams approximation, in the absence (broken line) of, $BW(c=0)$ and the presence (inner in the top) of, $BW(c=0.01)$, the external magnetic field, $c=\frac{H}{T^2}=0.01$, and the Bethe-Peierls approximation in the absence of external magnetic field, for four nearest neighbours (outer in the top).

Analysis of the Names of the Places in the Tourist Guide and Map, Aizawl:

Counting one by one the names of the places in the Tourist

Guide and Map, Aizawl, ^[1], starting with different letters, leads us to the table, Table-2.

Table 2: The number of the names of the places of Aizawl along the English letters, in the Tourist Guide and Map, Aizawl

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
21	25	31	22	3	5	18	10	8	4	17	10	31	12	0	11	1	24	33	23	5	9	1	0	4	10

Largest number of places in Aizawl, are with names starting with the letter S. Next comes the places with names starting with the letter C, followed by places with the names starting

with the letter B,... To visualise we plot the number of names of the places, ^[1], against the respective starting English letters, in the figure, Figure2.



Fig 2: Vertical axis is the number of the names of the places, in Aizawl, ^[1], and horizontal axis is the respective letters, the names are starting with. Letters are represented by the sequence number in the English alphabet.

For the purpose of exploring graphical law, we assort the letters according to the number of names of the places beginning with, in Aizawl, in the descending order, denoted by f and the respective rank, denoted by k . k is a positive integer starting from one. The lowest value of f is one. The corresponding rank, k , denoted as k_{lim} is eighteen. As a result both $\frac{\ln f}{\ln f_{max}}$ and $\frac{\ln k}{\ln k_{lim}}$ varies from zero to one. Then we

tabulate in the adjoining table, Table-3, and plot $\frac{\ln f}{\ln f_{max}}$ against $\frac{\ln k}{\ln k_{lim}}$ in the figure, Figure3. We then ignore the letter with the highest number of names of places starting with, tabulate in the adjoining table, Table-3, and redo the plot, normalising the $\ln f$ s with next-to-maximum $\ln f_{n-max}$, and starting from $k=2$ in the figure, Figure4. This program then we repeat up to $k=6$, resulting in the figures up to Figure8.

Table 3: The names of the places in the Tourist Guide and Map, Aizawl: ranking, natural logarithms, normalization.

k	lnk	$\frac{\ln k}{\ln k_{lim}}$	f	lnf	$\frac{\ln f}{\ln f_{max}}$	$\frac{\ln f}{\ln f_{nmax}}$	$\frac{\ln f}{\ln f_{2nmax}}$	$\frac{\ln f}{\ln f_{3nmax}}$	$\frac{\ln f}{\ln f_{4nmax}}$	$\frac{\ln f}{\ln f_{5nmax}}$
1	0	0	33	3.497	1	Blank	Blank	Blank	Blank	Blank
2	0.69	0.239	31	3.434	0.982	1	Blank	Blank	Blank	Blank
3	1.10	0.381	25	3.219	0.921	0.937	1	Blank	Blank	Blank
4	1.39	0.481	24	3.178	0.909	0.925	0.987	1	Blank	Blank
5	1.61	0.557	23	3.135	0.896	0.913	0.974	0.986	1	Blank
6	1.79	0.619	22	3.091	0.884	0.900	0.960	0.973	0.986	1
7	1.95	0.675	21	3.045	0.871	0.887	0.946	0.958	0.971	0.985
8	2.08	0.720	18	2.890	0.826	0.842	0.898	0.909	0.922	0.935
9	2.20	0.761	17	2.833	0.810	0.825	0.880	0.891	0.904	0.917
10	2.30	0.796	12	2.485	0.711	0.724	0.772	0.782	0.793	0.804
11	2.40	0.830	11	2.398	0.686	0.698	0.745	0.755	0.765	0.776
12	2.48	0.858	10	2.303	0.659	0.671	0.715	0.725	0.735	0.745
13	2.56	0.886	9	2.197	0.628	0.640	0.683	0.691	0.701	0.711
14	2.64	0.913	8	2.079	0.595	0.605	0.646	0.654	0.663	0.673
15	2.71	0.938	5	1.609	0.460	0.469	0.500	0.506	0.513	0.521
16	2.77	0.958	4	1.386	0.396	0.404	0.431	0.436	0.442	0.448
17	2.83	0.979	3	1.099	0.314	0.320	0.341	0.346	0.351	0.356
18	2.89	1	1	0	0	0	0	0	0	0

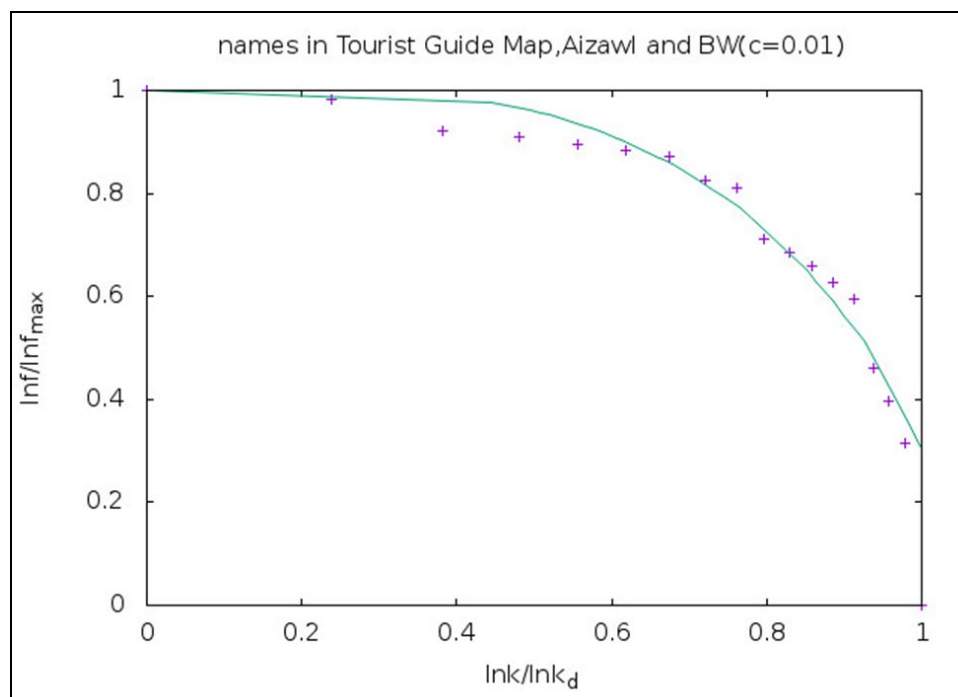


Fig 3: The vertical axis is $\frac{\ln f}{\ln f_{max}}$ and the horizontal axis is $\frac{\ln k}{\ln k_{lim}}$. The + points represent the names of the places in the Tourist Guide and Map, Aizawl,^[1] with the fit curve, BW($c=0.01$), being the Bragg-Williams curve of the Ising Model, in the presence of external magnetic field, $c = \frac{H}{T\epsilon} = 0.01$.

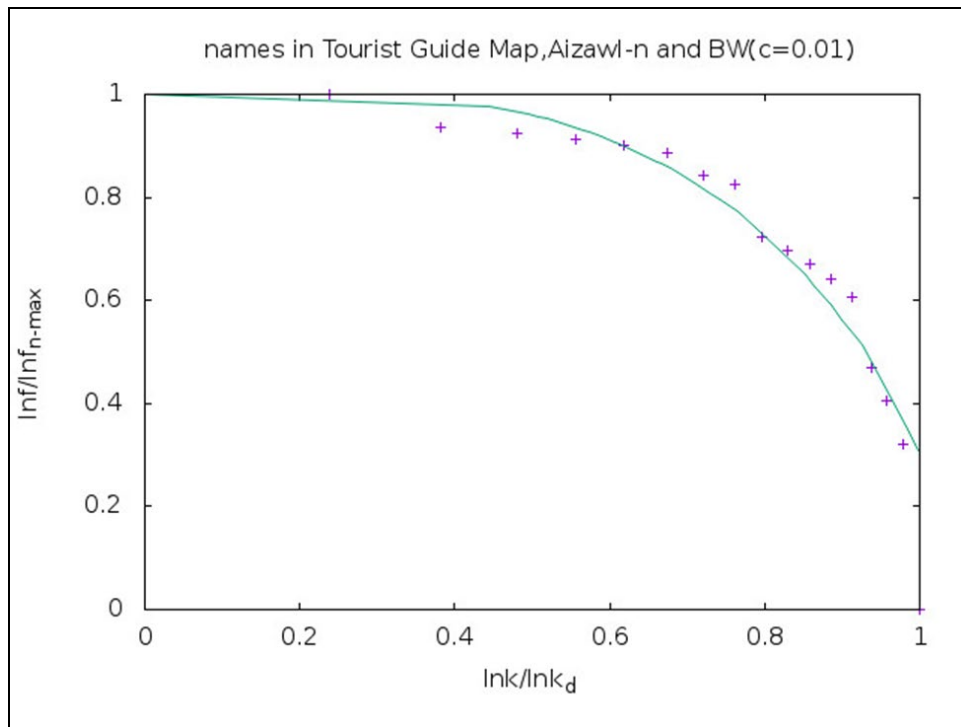


Fig 4: The vertical axis is $\frac{\ln f}{\ln f_{\max}}$ and the horizontal axis is $\frac{\ln k}{\ln k_d}$. The + points represent the names of the places in the Tourist Guide and Map, Aizawl, ^[1], with the fit curve, BW(c=0.01), being the Bragg-Williams curve of the Ising Model, in the presence of external magnetic field, $c = \frac{H}{T} = 0.01$.

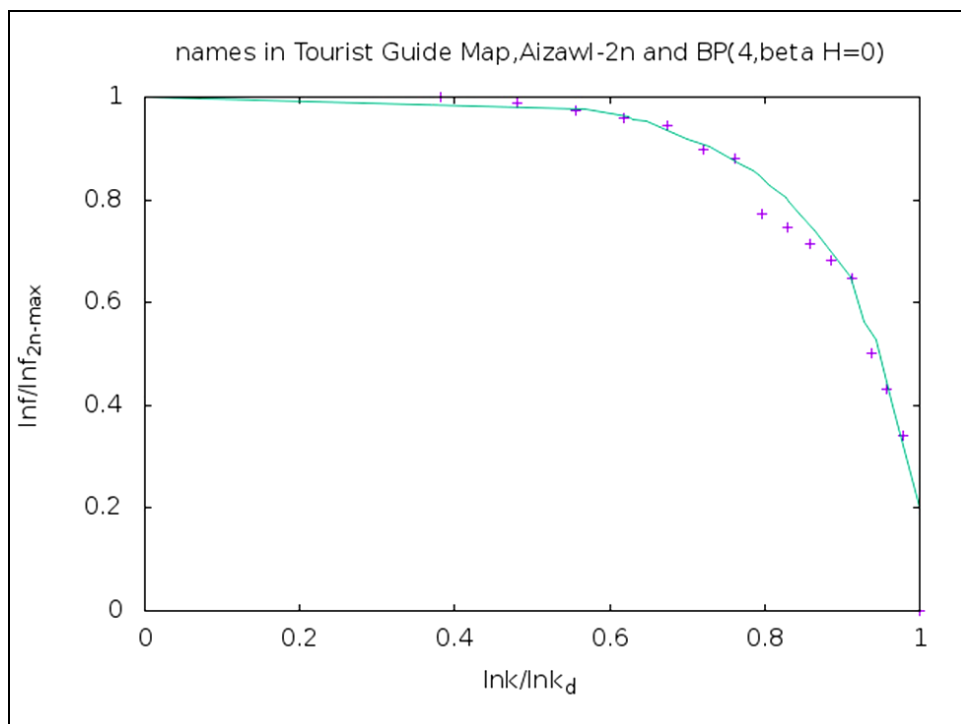


Fig 5: The vertical axis is $\frac{\ln f}{\ln f_{\max}}$ and the horizontal axis is $\frac{\ln k}{\ln k_d}$. The + points represent the names of the places in the Tourist Guide and Map, Aizawl, ^[1], with the fit curve being the Bethe-Peierls curve, BP(4, $\beta H=0$), of the Ising Model, in the presence of four nearest neighbours and in the absence of external magnetic field, $H=0$.

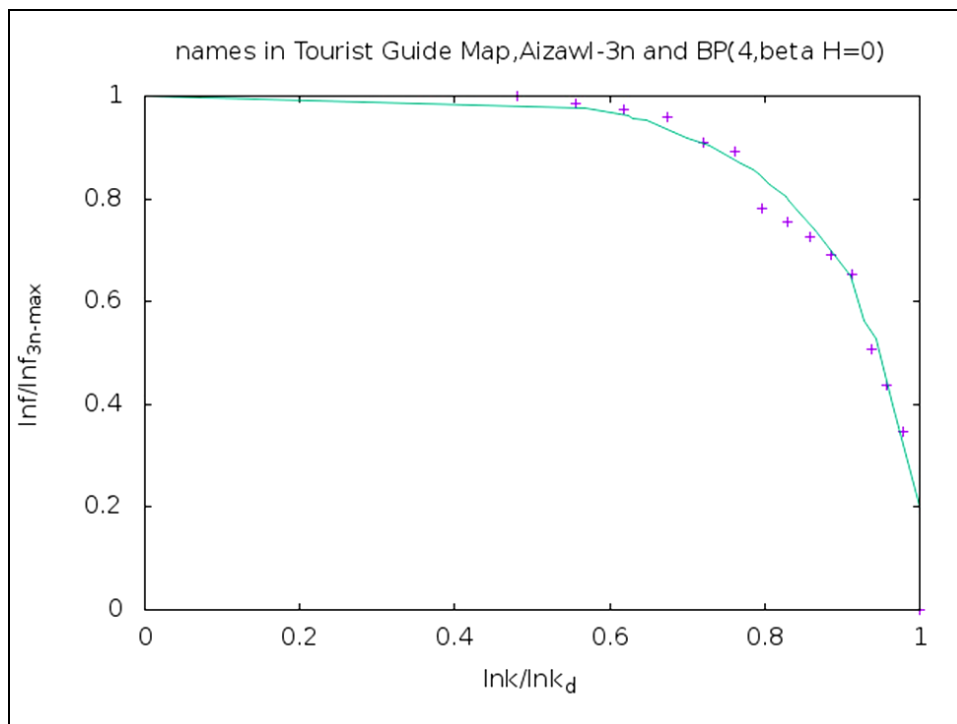


Fig 6: The vertical axis is $\frac{\ln f}{\ln f_{3n-\max}}$ and the horizontal axis is $\frac{\ln k}{\ln k_{\lim}}$. The + points represent the names of the places in the Tourist Guide and Map, Aizawl, ^[1], with the fit curve being the Bethe-Peierls curve, BP(4, $\beta H=0$), of the Ising Model, in the presence of four nearest neighbours and in the absence of external magnetic field, $H=0$.

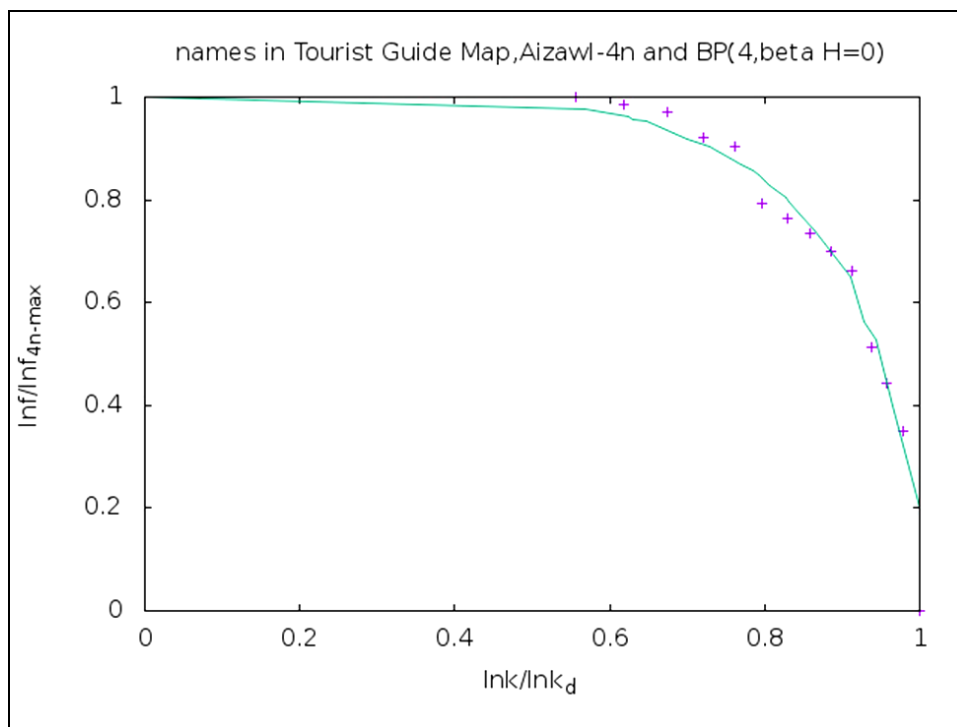


Fig 7: The vertical axis is $\frac{\ln f}{\ln f_{4n-\max}}$ and the horizontal axis is $\frac{\ln k}{\ln k_{\lim}}$. The + points represent the names of the places in the Tourist Guide and Map, Aizawl, ^[1], with the fit curve being the Bethe-Peierls curve, BP(4, $\beta H=0$), of the Ising Model, in the presence of four nearest neighbours and in the absence of external magnetic field, $H=0$.

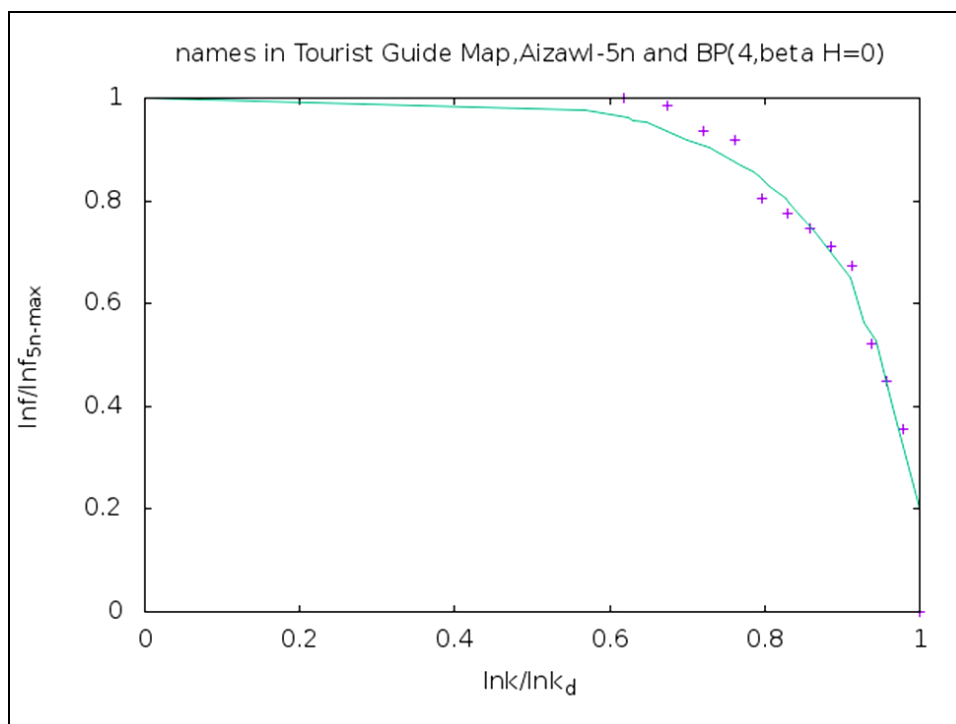


Fig 8: The vertical axis is $\frac{\ln f}{\ln f_{5n-\max}}$ and the horizontal axis is $\frac{\ln k}{\ln k_{\text{lim}}}$. The + points represent the names of the places in the Tourist Guide and Map, Aizawl, ^[1], with the fit curve being the Bethe-Peierls curve, BP(4, beta $\beta H=0$), of the Ising Model, in the presence of four nearest neighbours and in the absence of external magnetic field, $H=0$.

Conclusion

From the figures, Figure3-Figure8, we observe that there is a curve of magnetisation, behind the names of the places, in the Tourist Guide and Map, Aizawl, ^[1]. This is the magnetisation curve, BP(4, beta $\beta H=0$), in the Bethe-Peierls approximation of the Ising Model, in the presence of four nearest neighbours and in the absence of external magnetic field, $H=0$. Moreover, the associated correspondence is,

$$\frac{\ln f}{\ln f_{5n-\max}} \leftrightarrow \frac{M}{M_{\text{max}}} \text{ and } \ln k \leftrightarrow T,$$

k corresponds to temperature in an exponential scale, ^[90].

Acknowledgment

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

References

1. Tourist Guide and Map, Aizawl, designed, cartographed and published by Indian Map Service, "Pushkar Estate", Sector 'G', Shastri nagar, Jodhpur-3(Rajasthan), India;© Government of India, Copyright 2016; 978-93-83535-42-2; distributed for the North-East Region by the United Publishers.
2. Biswas Anindya Kumar, Graphical Law beneath each written natural language, arXiv:1307.6235v3[physics.gen-ph].
3. Biswas Anindya Kumar, A discipline of knowledge and the graphical law, IJARPS Volume 1(4), p 21, 2014; viXra: 1908:0090[Linguistics].
4. Biswas Anindya Kumar, Bengali language and Graphical law, viXra: 1908:0090[Linguistics].
5. Biswas Anindya Kumar, Basque language and the Graphical Law, viXra: 1908:0414[Linguistics].
6. Biswas Anindya Kumar, Romanian language, the Graphical Law and More, viXra: 1909:0071[Linguistics].
7. Biswas Anindya Kumar, Discipline of knowledge and the graphical law, part II, viXra:1912.0243 [Condensed Matter], *International Journal of Arts Humanities and Social Sciences Studies*, Volume 5 Issue 2 | February 2020.
8. Biswas Anindya Kumar, Onsager Core of Abor-Miri and Mising Languages, viXra: 2003.0343[Condensed Matter].
9. Biswas Anindya Kumar, Bengali language, Romanisation and Onsager Core, viXra: 2003.0563[Linguistics].
10. Biswas Anindya Kumar, Little Oxford English Dictionary and the Graphical Law, viXra: 2008.0041[Linguistics].
11. Biswas Anindya Kumar, Oxford Dictionary of Social Work and Social Care and the Graphical law, viXra: 2008.0077[Condensed Matter].
12. Biswas Anindya Kumar, Visayan-English Dictionary and the Graphical law, viXra: 2009.0014[Linguistics].
13. Biswas Anindya Kumar, Garo to English School Dictionary and the Graphical law, viXra: 2009.0056[Condensed Matter].
14. Biswas Anindya Kumar, Mursi-English-Amharic Dictionary and the Graphical law, viXra: 2009.0100[Linguistics].
15. Biswas Anindya Kumar, Names of Minor Planets and the Graphical law, viXra: 2009.0158[History and Philosophy of Physics].
16. Biswas Anindya Kumar, A Dictionary of Tibetan and English and the Graphical law, viXra: 2010.0237[Condensed Matter].
17. Biswas Anindya Kumar, Khasi English Dictionary and the Graphical law, viXra: 2011.0011[Linguistics].
18. Biswas Anindya Kumar, Turkmen-English Dictionary and the Graphical law, viXra: 2011.0069[Linguistics].
19. Biswas Anindya Kumar, Webster's Universal Spanish-English Dictionary, the Graphical law and A Dictionary of Geography of Oxford University Press, viXra: 2103.0175[Condensed Matter].
20. Biswas Anindya Kumar, A Dictionary of Modern Italian, the Graphical law and Dictionary of Law and

- Administration, 2000, National Law Development Foundation", viXra: 2107.0171[Condensed Matter].
21. Biswas Anindya Kumar, Langenscheidt's German-English English-German Dictionary and the Graphical law, viXra: 2107.0179[Linguistics].
 22. Biswas Anindya Kumar, Essential Dutch dictionary by G. Quist and D. Strik, the Graphical law Classification, viXra: 2108.0040[Linguistics].
 23. Biswas Anindya Kumar, Swahili, a lingua franca, Swahili-English Dictionary by C. W. Rechenbach and the Graphical law, viXra: 2108.0101[Linguistics].
 24. Biswas Anindya Kumar, The French, Larousse Dictionnaire De Poche and the Graphical law, viXra: 2109.0080[Linguistics].
 25. Biswas Anindya Kumar, An Arabic dictionary: "al-Mujam al-w'\{a\}fi" or, "adhunik arabi-bangla abhidhan" and the Onsager's solution, viXra: 2109.0119[Condensed Matter].
 26. Biswas Anindya Kumar, Langenscheidt Taschenwörterbuch Deutsch-Englisch/Englisch-Deutsch, Völlige Neubearbeitung and the Graphical law", viXra: 2109.0141[Linguistics].
 27. Biswas Anindya Kumar, Lyngkhai Bawansuk, The Graphical law behind the NTC's Hebrew and English Dictionary by Arie Comey and Naomi Tsur, viXra: 2109.0164[Linguistics].
 28. Biswas Anindya Kumar, Oxford Dictionary of Media and Communication and the Graphical law, viXra: 2109.0202[Social Science].
 29. Biswas Anindya Kumar, Oxford Concise Dictionary of Mathematics, Penguin Dictionary of Mathematics and the Graphical law, viXra: 2112.0054[Social Science].
 30. Biswas Anindya Kumar, An Arabic dictionary: "al-Mujam al-w'\{a\}fi" or, "adhunik arabi-bangla abhidhan" and the Onsager's solution Second part, viXra: 2201.0021[Condensed Matter].
 31. Biswas Anindya Kumar, The Penguin Dictionary Of Sociology and the Graphical law, viXra: 2201.0046[Social Science].
 32. Biswas Anindya Kumar, The Concise Oxford Dictionary Of Politics and the Graphical law, viXra: 2201.0069[Social Science].
 33. Biswas Anindya Kumar, A Dictionary of Critical Theory by Ian Buchanan and the Graphical law, viXra: 2201.0136[Social Science].
 34. Biswas Anindya Kumar, The Penguin Dictionary of Economics and the Graphical law, viXra: 2201.0169[Economics and Finance].
 35. Biswas Anindya Kumar, The Concise Gojri-English Dictionary by Dr. Rafeeq Anjum and the Graphical law, viXra: 2201.0205[Linguistics].
 36. Biswas Anindya Kumar, A Dictionary of the Kachin Language by Rev.o.Hanson and the Graphical law, viXra: 2202.0030[Linguistics].
 37. Biswas Anindya Kumar, A Dictionary of World History by Edmund Wright and the Graphical law, viXra: 2202.0130[History and Philosophy of Physics].
 38. Biswas Anindya Kumar, Ekagi-Dutch-English-Indonesian Dictionary by J. Steltenpool and the Onsager's solution, viXra: 2202.0157[Condensed Matter].
 39. Biswas Anindya Kumar, A Dictionary of Plant Sciences by Michael Allaby and the Graphical law, viXra: 2203.0011[Mind Science].
 40. Biswas Anindya Kumar, along the side of the Onsager's solution, the Ekagi language, viXra: 2205.0065[Condensed Matter].
 41. Biswas Anindya Kumar, along the side of the Onsager's solution, the Ekagi language-Part Three, viXra: 2205.0137[Condensed Matter].
 42. Biswas Anindya Kumar, Oxford Dictionary of Biology by Robert S. Hine and the Graphical law, viXra: 2207.0089[Physics of Biology].
 43. Biswas Anindya Kumar, A Dictionary of the Mikir Language by G. D. Walker and the Graphical law, viXra: 2207.0165[Linguistics].
 44. Biswas Anindya Kumar, A Dictionary of Zoology by Michael Allaby and the Graphical law, viXra: 2208.0075[Physics of Biology].
 45. Biswas Anindya Kumar, Dictionary of all Scriptures and Myths by G. A. Gaskell and the Graphical law, viXra: 2208.0093[Religion and Spiritualism].
 46. Biswas Anindya Kumar, Dictionary of Culinary Terms by Philippe Pilibossian and the Graphical law, viXra: 2211.0061[Social Sciences].
 47. Biswas Anindya Kumar, A Greek and English Lexicon by H.G.Liddle *et al* simplified by Didier Fontaine and the Graphical law, viXra: 2211.0087[Linguistics].
 48. Biswas Anindya Kumar, Learner's Mongol-English Dictionary and the Graphical law, viXra: 2211.0101[Linguistics].
 49. Biswas Anindya Kumar, Complete Bulgarian-English Dictionary and the Graphical law, viXra: 2212.0009[Linguistics].
 50. Biswas Anindya Kumar, A Dictionary of Sindhi Literature by Dr. Motilal Jotwani and the Graphical Law, viXra: 2212.0015[Social Sciences].
 51. Biswas Anindya Kumar, Penguin Dictionary of Physics, the Fourth Edition, by John Cullerne, and the Graphical law, viXra: 2212.0072[History and Philosophy of Physics].
 52. Biswas Anindya Kumar, Oxford Dictionary of Chemistry, the seventh edition and the Graphical Law, viXra: 2212.0113[Chemistry].
 53. Biswas Anindya Kumar, A Burmese-English Dictionary, Part I-Part V, by J. A. Stewart and C. W. Dunn *et al*, head words and the Graphical Law, viXra: 2212.0127[Linguistics].
 54. Biswas Anindya Kumar, The Graphical Law behind the head words of Dictionary Kannada and English written by W. Reeve, revised, corrected and enlarged by Daniel Sanderson, viXra: 2212.0185[Linguistics].
 55. Biswas Anindya Kumar, Sanchayita and the Graphical Law, viXra: 2301.0075[Social Science].
 56. Biswas Anindya Kumar, Samsad Bangla Abhidhan and The Graphical Law, viXra: 2302.0026[Linguistics].
 57. Biswas Anindya Kumar, Bangiya Sabdakosh and The Graphical Law, viXra: 2302.0060[Linguistics].
 58. Biswas Anindya Kumar, Samsad Bengali-English Dictionary and The Graphical Law, viXra: 2304.0047[Linguistics].
 59. Biswas Anindya Kumar, Rudyard Kipling's Verse and the Graphical Law, viXra: 2304.0207[Social Science].
 60. Biswas Anindya Kumar, W. B. Yeats, The Poems and the Graphical Law, viXra: 2305.0008[Social Science].
 61. Biswas Anindya Kumar, The Penguin Encyclopedia of Places by W. G. Moore and the Graphical Law, viXra: 2305.0147[Archaeology].
 62. Biswas Anindya Kumar, The Poems of Tennyson and the Graphical Law, viXra: 2305.0157[Social Science].
 63. Biswas Anindya Kumar, Khasi-Jaintia Jais(Surnames) and the Graphical law, viXra:2307.0135[Social Science].
 64. Biswas Anindya Kumar, Age, Amplitude of

- accommodation and the Graphical law, viXra:2311.0110[Physics of Biology].
65. Biswas Anindya Kumar, Dictionary of Ayurveda by Dr. Ravindra Sharma and the Graphical law, viXra:2401.0030[General Science and Philosophy].
 66. Biswas Anindya Kumar, The Practical Sanskrit-English Dictionary by Vaman Shivram Apte and The Graphical Law, viXra:2402.0041[Linguistics].
 67. Biswas Anindya Kumar, The Langenscheidt's Pocket Russian Dictionary and The Graphical Law, viXra:2402.0049[Linguistics].
 68. Biswas Anindya Kumar, The Scholar Dictionary Portuguese and The Graphical Law, viXra:2402.0044[Linguistics].
 69. Biswas Anindya Kumar, The Langenscheidt's Pocket Japanese Dictionary and the Onsager's solution, viXra:2402.0052[Condensed Matter].
 70. Biswas Anindya Kumar, Langenscheidt's Pocket Chinese Dictionary and The Graphical Law, viXra:2403.0066[Linguistics].
 71. Biswas Anindya Kumar, Oxford Hindi-English Dictionary and The Graphical Law, viXra:2403.0129[Linguistics].
 72. Biswas Anindya Kumar, Concise Urdu to English Dictionary and The Graphical Law, viXra:2404.0006[Linguistics].
 73. Biswas Anindya Kumar, The Standard Urdu-English Dictionary by Abdul Haq and The Graphical Law", viXra:2404.0034[Linguistics].
 74. Biswas Anindya Kumar, The Urdu-Hindi Shabdakosh by Muhammad Sajjad Osmani, Sudhindra Kumar and The Graphical Law, viXra:2404.0114[Linguistics].
 75. Biswas Anindya Kumar, The Hadronic Resonance Masses and The Graphical Law, viXra:2404.0141[High Energy Particle Physics].
 76. Biswas Anindya Kumar, A Dictionary of British Surnames by P. H. Reaney and the Graphical Law, viXra:2408.0099[Social Science].
 77. Biswas Anindya Kumar, Dictionary of Sports by Dr. S.K.Srivastava and Ms. Tanvangi Singh and the Graphical Law, viXra:2409.0014[Social Science].
 78. Biswas Anindya Kumar, Dictionary of American Family Names by Elsdon C. Smith and the Graphical Law, viXra:2409.0049[Social Science].
 79. Biswas Anindya Kumar, Political Map of Northeast India and the Graphical Law, viXra:2409.0092[Social Science].
 80. Biswas Anindya Kumar, Dictionary of Computers Edited by Pankaj Dhaka and the Graphical Law, viXra:2409.0132[General Science and Philosophy].
 81. Biswas Anindya Kumar, Swedish Dictionary and the Graphical Law, viXra:2409.0165[Linguistics].
 82. Biswas Anindya Kumar, Tourist Guide and Map, Meghalaya and the Graphical Law, viXra:2410.0002[Social Science].
 83. Ising E.1925: Beitrag zur Theorie des Ferromagnetismus, Z.Physik 31:253-258.
 84. Pathria R. K.1993: Statistical Mechanics, Pergamon Press, 400-403. ISBN: 0 08 018994 6 Flexicover.
 85. Kittel C.1994: Introduction to Solid State Physics, Fifth edition, thirteenth Wiley Eastern Reprint, Wiley Eastern Limited, New Delhi, India: p438. ISBN: 0-85226-469-0.
 86. Bragg W. L. and Williams E. J. 1934: The Effect of Thermal Agitation on Atomic Arrangement in Alloys, Proc. Roy. Soc. A, 145, p. 699. DOI: <https://doi.org/10.1098/rspa.1934.0132>.
 87. Chaikin P. M. and Lubensky T. C. 1998: Principles of Condensed Matter Physics, p. 148, first edition, Cambridge University Press India Pvt. Ltd, New Delhi. ISBN 10: 81-7596-025-6 Paperback.
 88. Huang K. 1987: Statistical Mechanics, second edition, John Wiley and Sons(Asia) Pte Ltd. ISBN: 9971-51-295-5
 89. Gun A. M., Gupta M. K. and Dasgupta B., Fundamentals of Statistics Vol 1, Chapter 12, eighth edition, 2012, The World Press Private Limited, Kolkata.
 90. Borgnakke S. and Wylen V. 1998: Fundamentals of Thermodynamics, fifth edition, John Wiley and Sons Inc.: 206-207.