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Cherrapunjee: An Example of Human Impact on Environment

Dr Sukanya Sharma[†]

Abstract

Palynological studies in Cherrapunjee located in Meghalaya, India have concluded that the modern grasslands of Cherrapunjee are the result of anthropogenic activity in the recent past leading to the deterioration of the primary dense forest. The forest humus was removed after extensive deforestation by human activity. Human presence in the area is indicated by Oryza Sativa, the common domesticated rice variety and Plantago lanceolata, which is a common weed of cultivated land. Like many other regions of the world, this human activity is thought to be agriculture, mainly shifting cultivation. But shifting cultivation is also practised in Garo Hills, Nagaland, and Arunachal Pradesh where pollen profiles of the recent past do not indicate the complete disappearance of the primary dense forest. In fact, indigenous shifting cultivators across Northeast India never uproot the large trees because the root foliage holds the soil. Within six months after the plot is abandoned, the primary forest bounces back to its original form.

This study hypothesises that human activity other than agriculture was responsible for the deterioration of the primary dense forest of Cherrapunjee. The study is based on the assumption that the whole process of erecting megaliths and iron smelting technology in the area resulted in the complete destruction of the primary forest on the flat top surface of the plateau where Cherrapunjee is located.

Keywords: Megaliths; Anthropogenic Impact; Environment; Iron Production; Meghalaya; India

[†]Professor & Head Education, Department of Humanities & Social Sciences, Indian Institute of Technology, Guwahati, Email: sukanya@iitg.ac.in

Introduction

Cherrapunji, located in Meghalaya, is a plateau, the formation of which is linked to the structural evolution of the Shillong plateau. The Kernel of the plateau comprises the oldest rocks in the State that is, the gneissic complex along with the Shillong group of rocks (Biswas, 1990). The altitudinal range varies between 600 m to 1600 m in the Cherrapunjee Plateau (Figure1:Height Map&Figure 2: 3d view). The upper part of the plateau, around and above 1000 MSL, is deforested, severely eroded and overgrown by grass. Only the small patches of broadleaved hill forest (sacred groves) remain (Prokop and Suliga, 2013). At present, the kernel of Gneissic rock lies exposed in most parts of the plateau's surface with patches of grasses present in certain pockets only (Figure 3). The most striking feature on this barren surface of the plateau is the menhirs, dolmens, and cists boxes. Palynological studies in Cherrapunjee have concluded that the modern grasslands of Cherrapunjee are the result of anthropogenic activity in the recent past leading to the deterioration of the primary dense forest. The forest humus was removed after extensive deforestation by human activity. The landscape is characterised by either exposed bedrock or the remains of lateritic cover, armoured by a surface layer of coarse gravely residual debris with very sparse grass cover (Shankar et al., 1991). The underlying, weathered regolith permits very low infiltration and subsurface runoff but speeds up overland flow and soil erosion (Soja and Starkel, 2010). According to palynologists, long-term human intervention in these globally extreme pluvial conditions has destroyed the dense vegetation cover and thick soil of the primary ecosystem (Ramakrishnan, 2001). Soil pH ranges between 4.6 and 6.1, and soil texture is predominantly sandy loam.

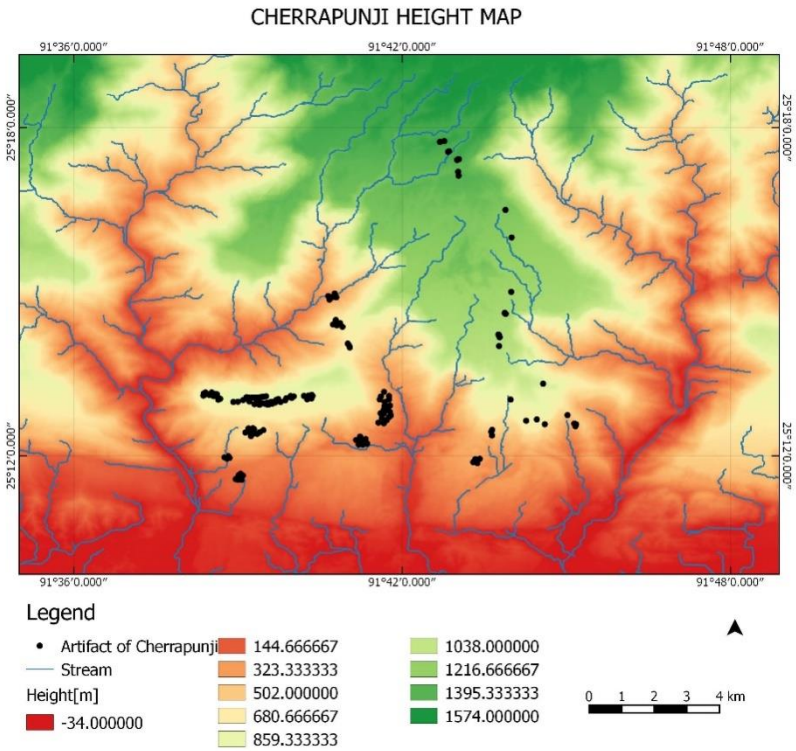

Figure 1: Height Map
Source: Author

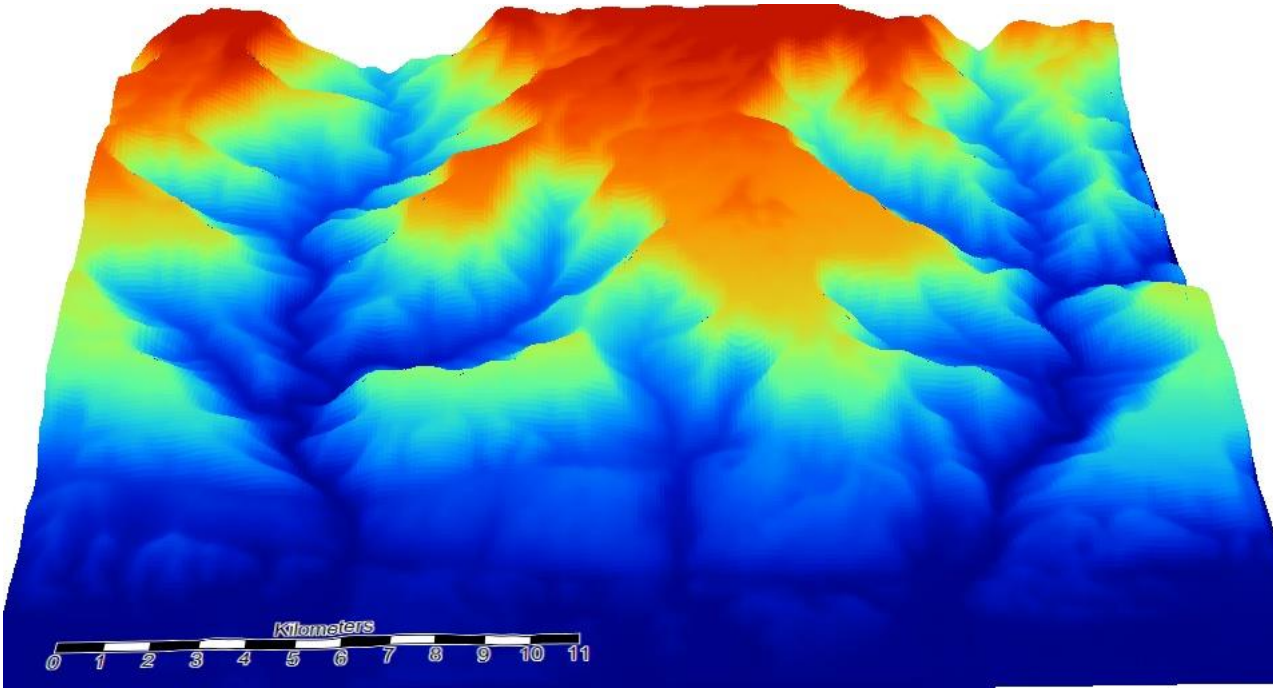

Figure 2: 3d View
Source: Author

Figure 3: Meghalaya Plateau, Patches of Grasses Present in Certain Pockets Only
Source: Author

The study area is located between 25.1546 - 25.3237 latitude and 91.5712 - 91.820 longitude covering an area of approximately 469.04 square kilometres.

A dataset of 65 surface pollen samples from Cherrapunjee analysed by the palynologists to explore the relationship between the modern pollen assemblage and contemporary

vegetation patterns (Basumatary et al., 2013) revealed the occurrence of subtropical pine forest along with broad-leaved taxa with scattered patches of Pandanus during the recent past. Due to large scale deforestation and massive soil erosion (wettest area), the flora gradually converted into grassland under a xeric climate.

According to ethnographers (Gordon, 1914) and palynologists (Basumatary, 2013, Bera et al., 2009; Kumar et al., 2006). Cherrapunjee lost its forests cover as a result of over-exploitation by shifting cultivators. But shifting cultivation is a common method of cultivation used by many other communities of Northeast India where the forests have survived. In the neighbourhood are the Garos, who still practice shifting cultivation, but a similar study by the palynologists has confirmed the primary forests' existence even today (Basumatory and Bera, 2013).

This study begins with assumptions and ideas, followed by a critical discussion on the impact of humans on the Cherrapunji environment.

Assumptions and Ideas

The dominant global discourse identifies agriculture as the most significant single cause of deforestation and severe forest degradation across the world. In fact, shifting cultivation is identified as a primary cause of deforestation in the tropics (Allen and Barnes 1985; Amelung and Diehl, 1992; Cropper and Griffiths, 1994; Ehrhardt-Martinez, 1998; Myers, 1993, Mather and Needle, 1998; Ranjan and Upadhyay, 1999; Rerkasem, 1996). Following the global discourse, the barrenness of Cherrapunjee today is ascribed to over-exploitation by shifting cultivators in the past (Basumatary et al., 2013 pp. 69; Bera et al., 2006; Kumar et al., 2006). But the question here is, if in Garo hills, under the same humid tropics with high rainfall, shifting cultivation did not or has not caused barrenness, why in Cherrapunjee did this happen? Instead, can it be another anthropogenic activity that might have caused this barrenness?

In a study conducted by Mitri and Marak (2015), it was stated that iron production had altered the forest cover of Khasi-Jaintia Hills. 16kgs of charcoal isrequired for producing 1 kg of refined iron. This was based on an experimental study undertaken by the National Metallurgical Laboratory, Jamshedpur, to understand the quantity of Iron: Slag ratio production per unit. In the middle of the 19th century, British records documented the annual export of pig iron from Khasi Hills as 45,000 *maunds*valued at about INR67,500 in those days (Hunter, 1879; Oldham, 1854). The study by Mitri and Marak (2015) had stated that annually260000 – 450000 trees were felled, covering an area of 236.36 – 409.09 sq. km. for producing1800000 kgs of pig iron, which was the estimated quantity of annual exports of iron from Khasi Hills and this had altered the forest cover in the Khasi and Jiantia Hills. But in the Vindhya-Kaimur ranges of hills in the central part of India covered today by extensive forests, evidence of a similar iron-producing technology dated to the 2nd millennium BC have been found. The Asurs and Agharias, modern inhabitants of the area also practice iron smelting. The extensive forest of the area has remained and been considered a resource supporting the iron industry for so many centuries (Tripathi, 2014).

These examples clarify that only shifting cultivation or iron production cannot cause the complete disappearance of the forests. This study attempts to identify a third anthropogenic activity in the area responsible for altering the landscape. This study hypothesises that megalith erection, an activity heavily dependent on wood, was responsible for the depletion of the forest cover on the plateau. A combination of anthropogenic activities resulted in the complete disappearance of the forests.

Discussion:

Modification of the immediate environment is fundamental to human culture (Renfrew and Bahn, 2008: p. 274). Using the raw material available in their surroundings like stone, wood, metals etc. human beings create, innovate, and build artefacts to fulfil their primary necessities of food, clothing and shelter. Humans adapt to their specific environments through culture, but this unique capacity in the human species depends on learning. Culture is not inherited

through our genes, but people learn and acquire culture through symbolic learning based on our linguistic capacity and the ability to use and understand symbols. The human ability to symbolise helps them learn and create meanings and transmit these meanings to one another effectively. Societies throughout the world have drawn upon important cultural symbols to distinguish their community from others. For example, the Egyptian Pyramids may be understood as cultural symbols of power and majestic, while the Buddhists' stupas are cultural symbols of a religious order propagating peace and non-violence. The proliferance of these symbols on the landscape energises the transmission of the meaning they generate to the succeeding generations, for which communities are seen to be investing extra in building these cultural symbols. However, building them might be a massive investment of human and material resources. The building of the pyramids is considered one of the factors for the downfall of the Egyptian civilisation. It is said that the massive building projects of the fourth dynasty**,** also known as the age of pyramids had exceeded the capacity of the treasury and populace and, therefore, weakened the kingdom at its roots. The Rapanui Islanders of Polynesia built the *moai* — giant statues that impersonated the forefathers and became a symbol of power and prestige on the small island. As wood was over-exploited for the purpose, the forest depleted, resulting in heavy soil erosion leading to the downfall of agriculture. Also, without timber boats, the only medium of transport was not available. Famine and civil wars was resulting in the disappearance of one of the highest developed cultures in the Pacific Ocean. Today 90% of the landscape of Rapa Nui is grasslands and the planted forests of *Eucalyptus* trees. These are extreme examples of modifications of the immediate surroundings by a cultural habit, but all forms of cultural habits leave traces on the landscape.

The introduction of agriculture is supposed to have caused irreversible changes to the landscape by depleting the original forest cover. Natural areas decline in extent as forested lands are converted into agricultural areas to meet human population demands (Santos, 2015; Rudel, 2005). Out of all the different cultivation methods, shifting cultivation is considered the most harmful practice followed. It is branded as a wasteful form of cultivation which should be replaced (Slater, 1996).

Shifting cultivation is practised by many communities in the vicinity of Cherrapunjee, like in Garo Hills, Meghalaya, Nagaland, Arunachal Pradesh etc. where pollen profiles do not indicate such drastic change in the landscape and the flora. In a study on the relationship of palynoassemblage, vegetation, and climate in Garo Hills using Bat Guano from Siju Cave and forest surface samples of moss cushion and soil collected from the immediate vicinity of the cave it was observed that both contain pollen indicating tropical riparian forest intermixed with evergreen and deciduous elements under warm and humid climatic condition. Among the arboreals, the samples principally reflect the proximity of riparian taxa like Duabanga, Syzygium, Careya, and Ficus in the palynoassemblage that grows along the edge of the river Simsang. The associated evergreen and deciduous elements like Mesua, Elaeocarpus, Garcinia, Schima, Dillenia, Albizia, and Sapotaceae are also seen. The presence of evergreen taxa and Piperaceae and Euphorbiaceae, is also recorded (Nair et al., 2010). The observed palynoassemblage also reflects this in the sediments from both inside and outside of the cave. The occurrence of Dendrophthoe (epiphytic plants) pollen in the palynoassemblage is significant and reflects the existence of a primary forest (Basumatory and Bera, 2013). This is significant as even now in Garo Hills, shifting cultivation is the most dominant method of cultivation used by the farmers.

In Cherrapunjee, the presence of pollen grains of evergreen elements such as Castanopsis, Elaeocarpus, Ericaceae, SchimaandSymplocos in the palynoassemblage are indicative of the existence of primary dense forest in the recent past. Pinus and broad leaved elements, namely Alnus, Betula and Quercus, also indicate the same. The predominance of broad-leaved taxa

such as Alnus, Betula, Myrica and Quercus, Castanopsis, Lauraceae, Magnoliaceae, Moraceae and Schima in the palynoassemblage was significant and strongly indicative of the undisturbed forest occupying the region (Upadhaya et al., 2003; Mishra et al., 2004). Due to extensive anthropogenic activity and seasonally extreme rainfall, the region was converted to grassland under a more xeric climate (Basumatary et al., 2013). Laitkynsew, a locality in Cherrapunjee, is enriched with evergreen forest consisting of Lauraceae, Mesua and Schima, along with patches of Pandanus and Rhizophoraceae, indicating high precipitation under the influence of coastal habitation. However, in another adjacent locality, the Duwan Sing Syiem Bridge, the palynological data shows that primary subtropical pine forests with broad-leaved taxa are gradually being replaced by Combretaceae, Ilex and Schima as indicated by their continuous presence in the sediments. Interestingly, the palynologist assigns the absence of Pandanus pollen as an unexplained regional factor (Basumatary et al., 2013).

Different parts of the Pandanus plant are used to provide a myriad of end products throughout the Pacific Islands, especially on atolls. The trunk and large branches are commonly used for building materials in house construction and ladders. They are also used as an aid in making strings. Trunks and branches may be burnt for fuelwood. From dried prop or aerial roots skipping ropes, basket handles, string or cordage are made. Maybe 'the unexplained regional factor' behind the disappearance of Pandamus from Duwan Singh Siem Bridge area, otherwise also known as Mawdok, is the process of erecting megaliths. In the process of erecting megaliths, long, thick ropes are required for tying the megalith quarried to a wooden sledge (Figure 4). Further long ropes are required for dragging the sledge with the megalith (Figure 5). After the megalith reaches its point of erection, it is made to stand vertically by pushing the bottom into the ground, but it has to be supported for a period of time by wooden poles and ropes (Figures, 6, 7 and 8) till the soil in which its bottom is buried becomes hard enough to hold it.

The pollen data established the fact that the undisturbed primary evergreen forest was destroyed by anthropogenic activity in Cherrapunjee. In the study on the iron smelting technology of Khasi hills (Prokop and Suliga, 2013) it was stated that smelting was performed in bloomery furnaces and the only fuel used for smelting was charcoal the best variety of which was produced from local oak species, but in cases where there was a lack of a hardwood other kinds of trees were used for carbonisation. Iron production is a fuel-thirsty technology (Hamphris, 2010), and the impact of the technology on the environment and change in land-use patterns have been studied across the world (Van Grunderbeek & Doutrelepont 1988; Hamphris 2010). As per the study by Prokop and Suliga, (2013), the Cherrapunjee site is one of the main centres of iron production in the area.

Following Mitri and Marak (2015), these figures help to state that iron production during that time was a primary occupation of the people of the area. In an ethno-experimental smelt study on issues of technological style, *chaînesopératoires,* and the role of the individual in the bloomery iron production was carried out in Buramba (central Rwanda) had twenty men working in the process starting from charcoal production, Tuyere production, air supply, ore collection and preparation, construction of furnace, smelting, smithing the bloom, production of slag, processing of ore to the preparation of iron. A dedicated skilled labour force is one of the highest requirements for a successful iron smelting technology, and this can increase the population density of the place, leading to further depletion of resources likeland and water. When there are more mouths to feed, and less land available, over-exploitation of the land for agriculture is the logical outcome.

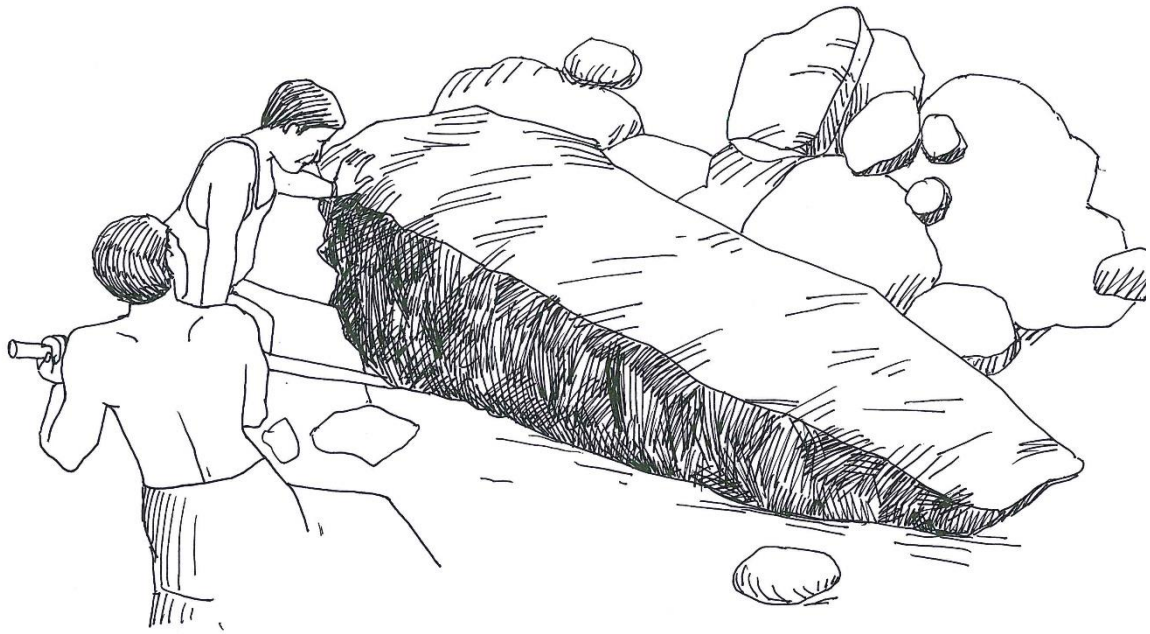

Figure 4: Megalith Quarried to a Wooden Sledge
Source: Author

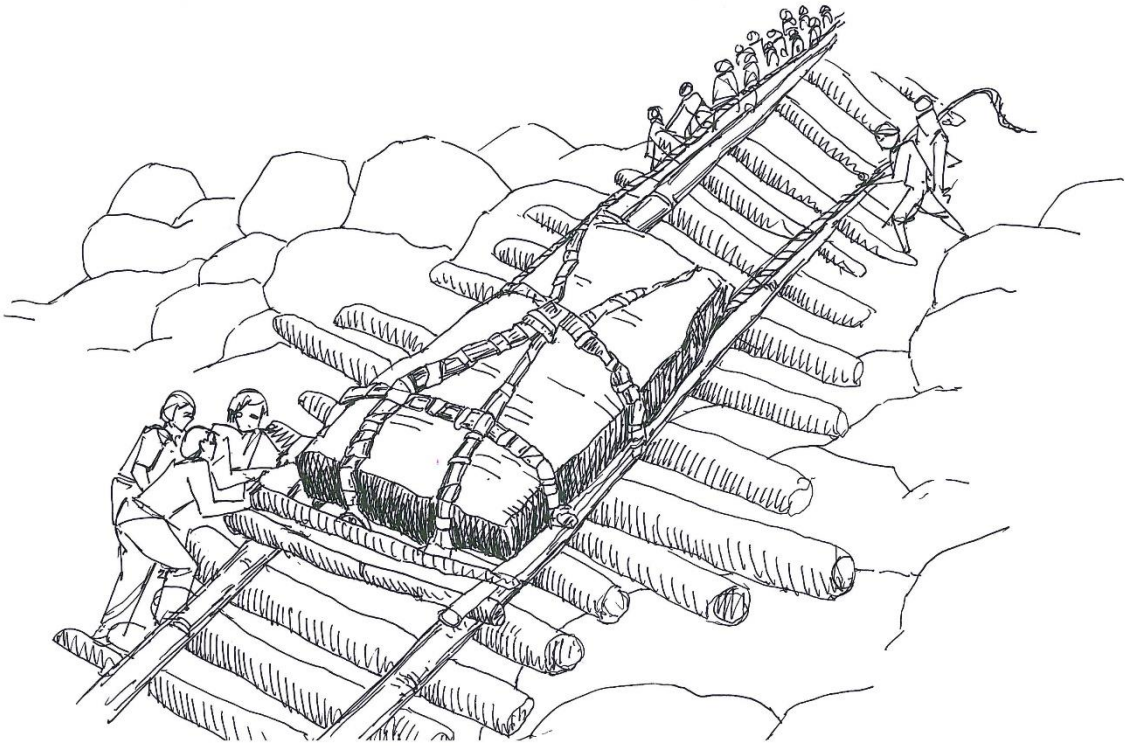

Figure 5: Dragging the Sledge with the Megalith
Source: Author

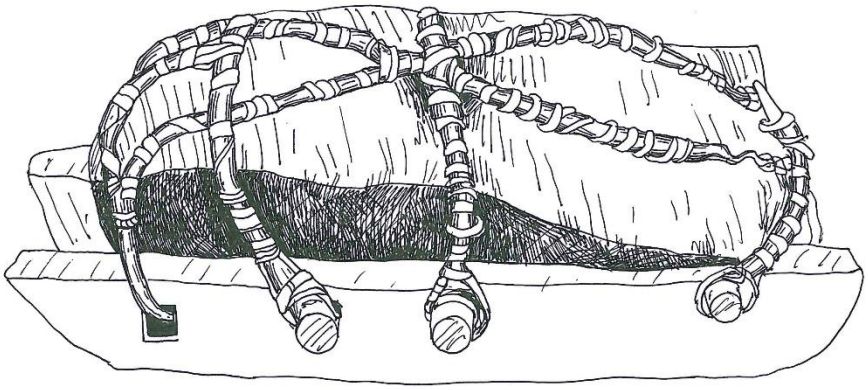

Figure 6: Megalith
Source: Author

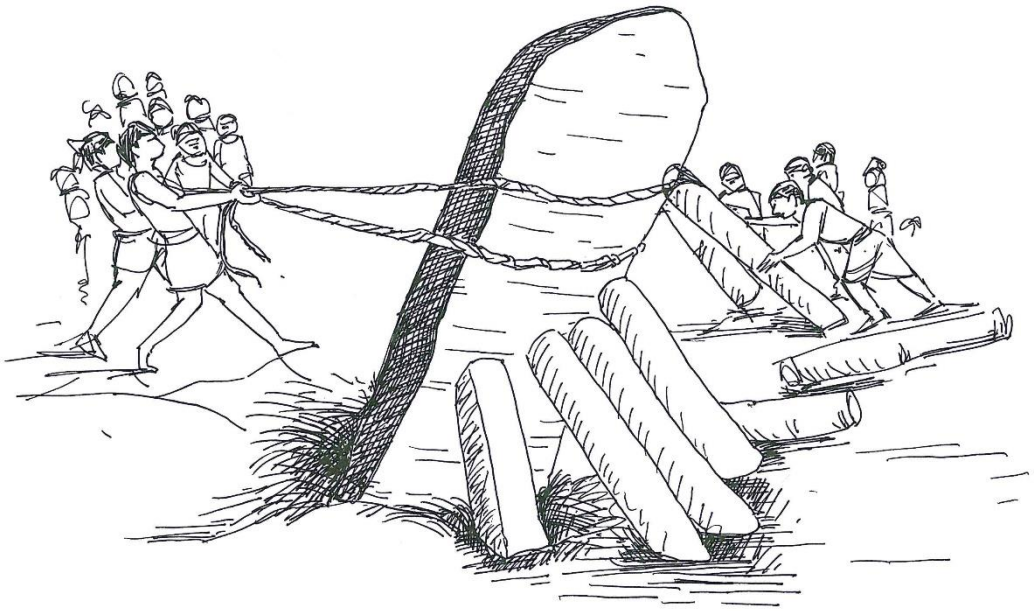

Figure 7: Towards Erection of Wooden Poles and Ropes
Source: Author

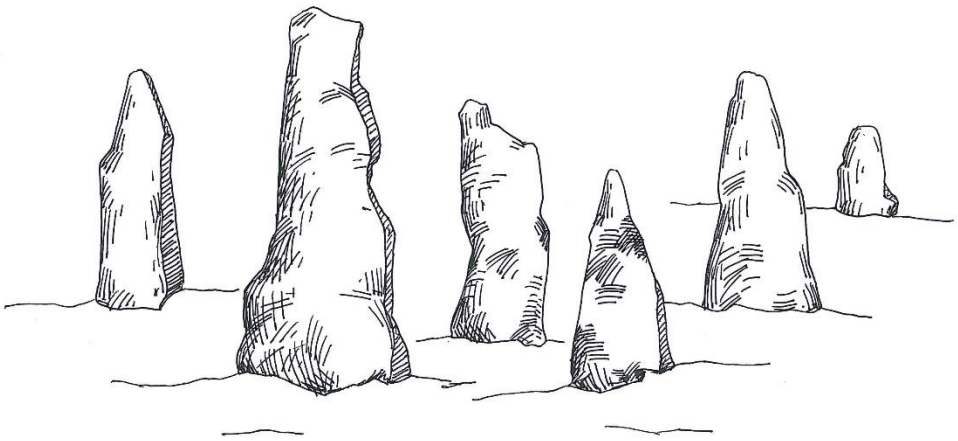

Figure 8: Erected Megaliths
Source: Author

Erection of Megaliths

> The Khasis say that these great stones were brought sometimes from considerable distances. After being hewn, the stones were laid on large wooden trolleys and dragged across country by means of ropes of cane, of which plenty can be had from the War country on the southern side of the district, and then placed in position by means of ropes and levers. It seems little short of marvellous that these stones, which sometimes weighed many tons, were placed in position by such primitive means, especially when we consider the great trouble there was to re-erect one of the fallen stones at Stonehenge lately. Nowadays comparatively small stones only are erected, which are generally hewn and erected on the spot, so that there is no necessity for any conveyance.
>
> (Gurdon, 1914: p. 154, 155)

This might be the second cultural factor coupled with iron production, which might have brought down the forest of Cherrapunjee. The denudation of the forest can also be caused by the method of breaking boulders for building menhirs, dolmens, cists etc., which can lead to significant scale erosion of the soil. After breaking the boulders the megaliths are crafted and dragged to the site of erection.

For this purpose, the megalith is levered to a wooden sledge designed according to the weight of the stone. It is then lashed with a cane and creepers. Wooden rollers are placed on the path of the sledge, which is pulled to the point of erection by several hundreds of men. When the stone reaches its destination, a hole is dug for the erection of the stone. The sledge is tilted, and the stone is placed in the hole, but often further pieces of thick wooden planks are required to lift it gradually from the ground by pushing logs underneath. The earth is filled in the hole and beaten down around the foot of the stone, but till the soil is firm, the megalith is supported by wooden posts from all the sides.

For the dolmens and the cists boxes, the size of the timber used for building the sledge might be smaller, or maybe a stronger sledge is made for carrying multiple pieces, but wood rollers on the path and ropes to tie and drag are equally important. This recreation of the erection procedures, besides using the information from Major Gordon's ethnographic account, has also been done by using information through personal communication of people participating as the audience in the December 1993 "Naga week" held at Kohima, Nagaland, where megalithic stone dragging was enacted. In the whole process, good quality timber is required for building the sledge, the rollers and also for lifting the menhirs and supporting it till it holds ground. Bouncers use strong branches of trees to clear the tract from any obstruction during the dragging process and also to push back the menhir on to the track if it derails. They are also required to balance the menhir, the dolmens and the cists boxes initially. Large amounts of strong ropes are required in the whole process. In the pollen data from the Duwan Singh Siem Bridge area of Cherrapunjee, otherwise also known as Mawdok, Pandanus pollen is absent and the palynologists explain this as an unexplained regional factor (Basumatary et al., 2013). Interestingly, different parts of the Pandanus plant are used throughout the Pacific Islands, especially on atolls to aid in making strings. Trunks and branches may be burnt for fuelwood. From dried prop or aerial roots skipping ropes, basket handles, string or cordage are made. Maybe 'the unexplained regional factor' behind the disappearance of Pandamus from Duwan Singh Siem Bridge area, otherwise also known as Mawdok, is the process of erecting megaliths. In the process of erecting megaliths, ropes are an inherent necessity as mentioned above.

The sledge, the rollers can be used only once. Maybe small pieces can be reused, but a large amount of the material becomes unusable. Like iron production, there is heavy wood consumption in this process.

A Comparison

In India, the Megalithic culture first introduced iron (Wheeler, 1976). This was stated because of the plethora of iron objects which occurred in the cist and cairns excavated in South India and North India (Bannerjee, 1966; Wheeler, 1976). The most commonly reported megaliths are the cairns, cists, dolmens and menhirs which were reported from the north of Baluchistan, located in the westernmost province of Pakistan; within India, these megaliths are found in Kashmir, Rajasthan, Bihar, Uttar Pradesh—all geographically located in the northern part of Indiaand in Kerala, which is located in South India. Till 1966, fourteen Megalithic sites were excavated in India and iron occurred prolifically in all the sites (Bannerjee, 1966). Chronology of the megaliths has been a contentious issue in Indian Archaeology. In 1947 when Wheeler excavated Brahmagiri, he found evidence of the megalith occurring just above the Neolithic, and that evidence has sought to establish 200AD as the upper limit with a beginning at least at about 200BC, which receded further backwards to about 300BC. But with further excavations in South India, Central India and North India, the lower limit of the culture was further revised, and today it is broadly considered to have begun by 1000BC. In Meghalaya, it is now dated to 353 BC–AD 128 (Prokop and Suliga, 2013), a very comparable datewith the rest of India.

P.R.T Gurdon (1914) in his book *The Khasis* while writing about the similarity of the Khasi memorial stones mentions Lord Avebury's "Prehistoric Times" Fergusson's work, and Waring's collection of plates of stone monuments, where there are numerous illustrations of menhirs and dolmens to be found in other parts of the world, which may be said to resemble those of the Khasis in appearance. In the same book, he talks of the megaliths of Belgaum (in Karnataka now but then in Bombay Presidency), of the Ho Munda stones of Chota Nagpur Plateau, which are also similar to the Khasi megaliths. Of course size variations prevail, and like Wheeler had expressed when he first reported Brahmagiri that innumerable numbers of them are found extensively distributed all

over the landscape (Wheeler, 1976); it is the same situation in Vidarbaha, in Orissa, Uttar Pradesh, Bihar, Assam, Meghalaya, Nagaland and now Mizoram too. There are regional variations like the toppikkal or the hood stones from South India and the menhir being necessarily accompanied by a table stone designated as the female ancestress in Meghalaya. The *mawkjat-mawlynti,* stones of Cherrapunjee, are also called stones of the path and are erected on the path leading to the *mawbah*or the clan cists, but they are built along forest trails or pathways. Similarly, in the Lower Periyar Valley of Kerala, a study on the distribution pattern of the megalithic monuments revealed that the megalithic monuments are positioned along regular pathways (Jaseera, 2016). But here, they have iron tools recovered in the cists boxes but no sites indicating iron tool production. While in sites like Raipura, where evidence of iron tool manufacturing has been excavated, there are no megaliths (Tripathi, 2014). Whereas in the Vidarbha region, where megalithic sites are spread across four districts, Nagpur, Bhandara, Gadchiroli and Chandrapur, the main evidence of iron smelting has been found only come from Naikund.

P.R.T. Gordon (1914) had, commented that the forest in the hills had not survived as the wood was being used for fuel for iron smelting (Gurdon, 1914:4). But in the light of the evidence from Raipura and the ethnographic data from the Vindhya-Kaimur ranges of hills in the central part of India bordering the middle Ganga plain, Gurdon's observation stands to be questioned. In the Vindya-Kaimur hills, the iron technology is dated from 14C to the early centuries of the second millennium BCE. An indigenous iron technology has continued with the ethnic communities like the Agarias and the Asurs, natives of this region. They have been engaged in traditional iron production for generations. Bloomery iron process of smelting is pursued by these ethnic communities (Tripathi, 2014). It is still a surviving tradition in the region. The design of the ancient furnace recovered during the Raipura excavation is almost similar to the furnaces used by the ethnic communities till recent decades. It suggests a close similarity between the traditional and the ancient smelting apparatus. Tripathi (2014) reports extensive forest as a resource supporting the iron industry for so many centuries in the Vindhya-Kaimur Hills. The bloomery process of smelting reported by Prokop and Suliga (2013) from Meghalaya is similar to the process reported by Tripathi (2014).

From these comparisons, it is clear that till now, there are no sites where there is evidence of iron production and megalith erection happening together, side by side for so many generations. This was an exception in Cherrapunjee.

P.R.T Gurdon (2014: p. 154) begins the description of the Khasi Memorial Stones by the line "[p]robably one of the first objects which strikes the eye of a visitor to the Khasi Hills is the very large number of monoliths, table-stones,and cromlechs that are to be met with almost everywhere in that country." The impact of the erection of these stones has evaded the observations of these ethnographers and subsequent workers in the region. In Meghalaya, the last megalith was erected in 1890 (Roy, 2010), and iron production was recorded till 1864 or little beyond that (Gurdon, 1914; Hunter, 1879; Hooker, 1854; Oldham, 1854). Both these two wood thirsty cultural activities can be the anthropogenic activity identified by the palynologist as the reason behind the deterioration of the primary dense forest in Cherrapunjee.

The Concluding Story

At present, in the approximately 500 sq km area studied on the Gneissic rock's kernel, the menhirs represent an era when codifying human thoughts, beliefs, behaviour, joy and sorrow in stone was the norm. Rectangular shaped stones, the average height of which ranged between 10ft to 3ft, were erected in memory of the ancestress from whom the family originated; they were erected for marking the village entrance, for punishing an offender of discreet love, in pathways with sitting stones, for commemorating a victory and many others. They were carved in sandstone and granite, perhaps with iron chisels. The chisel marks are

still prominent in the body of the stone, speaking of a tireless effort by some human beings to shape it so that it keeps radiating or broadcasting the message for which it stands. Reading these stones, generations knew that revering the ancestress was important, on the landscape, the menhirs mark villages, and the maternal uncle has a substantial role in the family as he has been given the tallest stone amidst comparatively shorter nephew stone by his side and that adultery was an offence. The megaliths in Cherrapunjee jutting out from the ground almost in every open space available today give a feeling of timelessness, enduring traditions that have governed the land. But was it ecocide that the people committed by erecting the megaliths? Maybe 2000 years ago, these stones controlled the society, the landscape in which people produced iron billets from cores they mined locally and smelted on furnaces using the trees in their surroundings as fuel. There were miners, smelters, blacksmiths, traders, and transporters walking on the landscape of Cherrapunjee. They broke hard rocks which challenged their strengths, sat beside blazing furnaces absorbing the heat, the glare of the burning coal and carried the heavy finished products to the markets around. According to the British records, they went to the valley which today is Bangladesh. Was it something like the iron township of Bhilai, in Central India today, an industrial atmosphere which had to be managed? Did the megaliths work as instruments of this management to help maintain order in society?

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Conflict of Interest

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