Chapter-II

TECHNOLOGY AND INDIGENOUS KNOWLEDGE SYSTEM

The Khasi-Jaintia have a unique indigenous knowledge system of extraction of iron and limestone and the smelting of iron. With regard to limestone the Khasi-Jaintia usually extracted the stone and the processing of the lime was done by the plains people in Sylhet. This chapter would discuss the indigenous knowledge system and technology used by the Khasi-Jaintia and includes two sections: One, Technology and Indigenous Knowledge System of Extraction and Smelting of Iron and, Technology and Indigenous Knowledge System of Extraction of Limestone. The first section deals largely with the processes of extraction and instruments, furnace, bellows and fuel used for smelting the iron ore as well as the structure of the smelting house. The use of iron and iron products, tools and other implements, as well as manufacture of canons, firearms and gunpowder will also be discussed. The second section identifies the various location of the limestone quarries and discusses the process of extraction, structure of the kiln or Pajwa, transportation of limestone and present day practices.

Technology and Indigenous Knowledge System of Extraction and Smelting of Iron:

The use of iron in the Khasi-Jaintia Hills was perhaps simultaneous with that of the Gangetic valley, if not earlier, but the date has not yet been ascertained. In India the use of iron was associated with Lothal and in some other sites of the Harrapan culture but in neither sites was iron discovered. However, by the latter half of the Second Millennium BC, iron was discovered in some parts of Rajasthan and also in the Karnataka region. By 1000 BC iron implements like arrow heads and spearheads were found buried alongside with the dead in the Gandhara region of Pakistan. Further excavation reveals that about 800 BC onwards the people of the Vedic age were able to penetrate deeper into the upper Gangetic plains by
clearing the forest with the help of iron axes. One of the earliest metal discovered from this region known as Shyama or Krishna ayas (black metal) dates back to Seventh Century BC.\(^\text{104}\)

No authentic records inform us regarding the process of working the iron ore in ancient India. But it is believed that the blacksmith filled the furnace, heated by wood and charcoal, with iron ore sand and with the aid of long pincers, turn the lump of iron from side to side till it becomes completely red hot. With the use of a hammer, the glowing metal is shaped into a ball of lump iron. The blacksmith in ancient India would fashion iron implements like iron ploughshare, axe, iron utensil, knife, razor, sword etc., for everyday use of the people.\(^\text{105}\) Iron works in the Khasi-Jaintia Hills is said to have developed since very early times. To understand the Khasi-Jaintia indigenous system of extraction, smelting of iron as well as the lime-making process carried out in the plains of the Surma valley, it would be interesting to map out those processes in early societies of India and elsewhere. Iron, generally is extracted from ore deposited on upper or lower surface of boulders or under the earth’s crust. There are two major types of iron ore, haematite and magnetite. Haematite is so called as it is blood red in colour while magnetite\(^\text{106}\) gets its name from being naturally magnetic. Besides these, the other types of ore are turgite, goethite, limonite, siderite, pyrite, pyrrholite, ilmentite, greenalite and chmosite.\(^\text{107}\)

It is generally believed that Homo Sapiens started to make stone tools about 2.5 million years ago. But slowly and gradually, a shift took place in which they began to adopt and move from their nomadic culture to pastoral life and finally adopted the sedentary way of living in which tools had become more refined and advanced. With the discovery of copper, bronze and eventually iron, human beings were able to gain control over nature. With iron tools they were able to penetrate deeper into unknown land by clearing the thick forests, brought more land under settlement and cultivation which led to expansion of their habitation. Use of iron tools led to surplus production, as a consequence of which markets expanded

beyond their settlements which in turn, led to the outcome of cultural exchange among
different settlements, thus enabling a society to sustain the economy in times of crisis and to
cope with the growing population.

When humankind had mastered the art of iron technology it took them to new heights
and a more refined civilization than had been achieved before. As a consequence, this led to
the emergence of towns, markets, urban centres which in turn paved the way for the rise of
new cities, kingdom and empires. Thus, iron was one of the staple minerals for the foundation
of a powerful nation and along with the contribution of other economic factors it had brought
mankind from savagery to civilisation. In fact, by the middle of the eighteenth century, the
iron industry in Great Britain was one of the major industries that had sparked a revolution in
the field of technology as it had changed the mode of production from the domestic workshop
to the factory system which contributed to the development of the Industrial Revolution in
the early nineteenth century.

Through the help of physical anthropologists, geneticists, archaeologists, chemists
and human palaeontologists, it had been proved that early humans had developed the art of
making stone tools from the site originating at Olduvai in East Africa. Olukoya Ogen points
out that it was the Nok Culture situated south of the Sahara desert that first used iron. With
the help of radiocarbon dating on the remains of iron slag, the remnants of the forms of
smelting of iron and other artefacts, it revealed that iron was used within the period of 1000
BC and 200 BC. Then it spread out to other parts of the country and the rest of the world.108
This approximates the time when iron was used in India. Bridget and Raymond Allchin
identify West Asia as the place where iron artefacts first used by man were discovered. The
artefacts were made of meteoric iron and this may be termed as the commencement of the
Iron Age which probably began before c. 1300 BC.109 Yet the question of the origin of the
iron culture is still a subject of debate especially among the Afro-Asian scholars.

The question of which group of people made the first use of iron, how iron was discovered and from which part of the world iron smelting technology developed is still debatable. Historians like Stanley B. Alpern and others were of the opinion that iron smelting could have happened many times all over the world. Alpern assumed that African iron works in all probability originated in the northern part of the continent and was perhaps, the first place where iron smelting took place.\textsuperscript{110} He claims his support with the help of some Egyptologists, that the ancient Egyptians had learnt the art of procuring and smelting iron from the African tribes that occupy the sub-Saharan region. After decades of research most of the scholars agree that iron was developed further in the same region by the Hittites.\textsuperscript{111}

In the case of India, Iron Age dawned with the coming of the later Vedic culture in the Upper Gangetic basin in 1000-600 BC. Through archaeological excavation that was carried in the entire northern plains and the Ganga valley, it has been found that about nearly seven hundred cities and towns had once flourished in this region. The artefacts right from household articles like clay bowls and dishes that were found, indicate the occurrence of iron and these artefacts were commonly known as Painted Grey Ware (PGW). It was during the later Vedic culture that iron was manufactured and used for making weapons.\textsuperscript{112} Scholars differ in opinion regarding the traces of the development of iron in India; scholars like Patrick Gurdon maintain that there is no evidence of iron use in India before 250 BC while Wheeler believed that the Indians received the knowledge of metallurgy around 500 BC with the invasion of the Achaemenids.\textsuperscript{113} However, most scholars believe that the iron industry developed in its earliest form from South Rajasthan around 1300 BC. By 1000-800 BC traces of iron was discovered in western Karnataka, Malwa and Central India. By 800-500 BC use of iron became widespread in the Middle Ganga Valley and its Delta areas.\textsuperscript{114} Indian historians tried to associate the art of iron works in India as being of indigenous origin and that the art of metallurgy coincide with the disappearance of the Chalcolithic period. By 600

\textsuperscript{111} S.B. Alpern, 45-46.
\textsuperscript{112} R.S. Sharma, 63.
\textsuperscript{113} B. Allchin and R. Allchin, 309.
\textsuperscript{114} B. Allchin and R. Allchin, 345.
BC to 100 BC development of agriculture in the plains of the Ganga-doab region accelerated the use of iron throughout India and during this period, the iron ploughshare was frequently used in the monarchical states of Vatsa, Kosala and Magadha.¹¹⁵

However, N.R. Banerjee maintained that the art of iron works came from outside India and to support his claim he stated that the iron-ore deposits in India was limited and that in the northern part of the country its deposits end at Patiala. Secondly, he supported his argument by claiming that the majority of the historians, archaeologists and other scholars put forth the *priori* assumption that the art of metallurgy first came from Anatolia plateau and spread throughout the region till the end of the Hittite empire.¹¹⁶ In India by 6th century BC iron works had been carried out on a large scale throughout the Indian subcontinent especially in the region of the Indus, Ganges as well as the Brahmaputra river valleys. It was during this period that Indian maritime activities, trade and cultural contacts with the west was lucrative and it was perhaps due to their constant contact with the Persians, Greeks and others that the Indian might have learned from them the art of metallurgy.

With regard to the distribution of iron ore, the Geological Survey of India reports that the pre-industrial iron smelting was practised throughout the entire country as traces of iron slags have been discovered from the Indus to the Brahmaputra in the east and also to the south. The report mentions that ore of the Khasi-Jaintia Hills fall on the category of titaniferous magnetic iron and the ore of Upper Assam falls under the category of clay iron, an impure limonite. In short the iron-smelting in India evolved in a very complex process as the central region of the country had already developed the art of metallurgy than the border land which was supposed to have acquired the art of smelting from the outside world through their contacts. Therefore, the GSI Report construed that the Indian art and technique of iron-smelting was indigenous and that use of iron in Anatolia did not have any impact on the Indians.¹¹⁷

¹¹⁷ D.K. Chakrabarti, 172-83.
On the other hand, it was only recently that scholars started to take interest in studying the art of metallurgy of the indigenous people of the Indian sub-continent. In the case of those of North East India, scholars have not taken the iron industry into account as it was generally believed that, like all ethnic societies, their technology though primitive, share the same techniques and methods of production of iron tools. Despite the lack of archaeological evidence to prove the early existence of the industry, in recent times, with the help of scientific technology, it has been proven that the Khasi-Jaintia iron industry existed since very early times. In March 2013, two Polish scholars Pawel Prokop and Irebeusz Suliga, through radiocarbon dating along with chemical analysis experiment carried out tests on the discarded iron-ore, locally known as *eit-nar* or slag iron found deposited in the areas where most of the smelting houses formerly existed. Their findings have enabled historians and archaeologists to authenticate that iron smelting in the Khasi-Jaintia Hills of Meghalaya was around or more than a two thousand year old industry. This authentication of the date is strengthened by the presence of *wijkite, fayalite*, glass and metal iron, together with spinels such as *hercynite* in the slag, indicating that it was an acid product of a bloomer iron-making process. Thus, based on the recent archaeological findings, there is no denying the fact that the technology and knowledge of processing of the iron-ore is of indigenous origin. Furthermore, the geological structure and topography of the Khasi plateau suggests the presence of iron-ore throughout the entire Khasi-Jaintia Hills. Interestingly, it is important to note that even though the Khasi-Jaintia remained secluded from their neighbours, they maintained a close relationship in commercial activities with their neighbouring plains of Sylhet and Brahmaputra valleys.

The origin of the process of smelting is also embedded in myths and legends which indicate a local origin. This is based on the assumption that the form of ‘historical consciousness’ embedded in myths ‘reflect the kind of society from which it emanates.’

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According to one such Khasi-Jaintia myth, a blacksmith called Syrmoh started the process of smelting iron ore and another tradition says that it was the Iaw-Shi-Bdi, a woman who brought this science of excavation and smelting from the plains and imparted it to the natives of Jowai and it spread throughout the entire Khasi-Jaintia Hills. This so called ‘embedded history’, as Thapar puts it, implies that this science of extraction and smelting was totally indigenous. Records and accounts of British officials like Henry Yule, Thomas Oldham, William Cracroft, Thomas C. Watson, Jos D. Hooker, William Griffith, P.R.T. Gurdon, memoirs of Robert Lindsay and other secondary sources state that the technology was indigenous.

The British Government in 1860 sent their agent to study the feasible condition for the setting up of an iron industry, but the reports revealed that deposition of ore was less and that the quality of ore was not uniform. Therefore, no European capitalist invested in this industry which remained with the Khasi-Jaintia. The iron industry of the Khasi-Jaintia was the earliest iron smelting site of present North East India. No written accounts of iron extraction and smelting were available prior to the advent of the British since the Khasi-Jaintia had no knowledge of writing. Therefore, the knowledge and technique of extraction and smelting of iron was practically and orally transmitted from one generation to another. It was only when the British took control of the Hills that written accounts were available in detail on the subject regarding how the Khasi-Jaintia carried on the processes of extraction and smelting of iron as well as of other economic activities. British officials like Captain Yule, Oldham and others had shown in their records that this industry was indigenous to the Khasi-Jaintia since early times and that the abundance of iron-ore in the region made possible the establishment of an iron industry. It was in part the search and location of iron ore that the Khasi-Jaintia moved west from their first settlement to the Jaintia Hills.

No accurate date can be ascribed as to the antiquity of the iron industry or that trade that it generated. However, recently in 2013-2014, an archaeological excavation was carried on at a site Lawnongthroh located on the northern slopes of the Khasi-Jaintia Hills lying

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between 25°72-235”N and 91°26-35”E. By the step-trench technique method few iron objects were recovered along with broken potsherds and other clay pots.* This site revealed the existence of a Neolithic culture in the state of Meghalaya. Through the process of carbon-dating system (C\textsuperscript{14}) the objects and tools have been approximately dated to 1220-1020 BC. Therefore, it is reasonable to say that the Khasi-Jaintia have had knowledge of the excavation, smelting and production of iron implements of sorts for many centuries.

It is worth mentioning here that the use of iron was found in the neighbouring plains of Assam where iron-ore is extracted from the riverbeds deposited along with clay. They wash the clay and carried the ore to the smelting house. The process of extraction and smelting was in fact almost the same as the neighbouring Khasi-Jaintia, but there was a difference in the quality of the ore. The Khasi-Jaintia iron-ore is more flexible and discharges more waste in the form of iron slag whereas the iron from Assam is less flexible and does not release the waste. As a result, the Khasi-Jaintia iron was in high demand and it replaced iron from Assam in the markets.\textsuperscript{122} The Khasi-Jaintia derived the ore mostly from the decomposed granite stone that lay scattered throughout the entire northern Shillong plateau.\textsuperscript{123}

Ore in common parlance means any material of natural conglomerates; rocks which might have formed millions of years ago due to volcanic action and other natural activities. The Oxford English Dictionary’s definition of an ore is, ‘a naturally happening of solid material containing a valuable or useful metal in such quantity and in such chemical mixture as to make its extraction profitable’.\textsuperscript{124} In cultural terms, an ore can be highlighted as a mineral where people make an effort to extract metal from it so as to enable them to sustain their economic activities which will profit an individual or the society as a whole. The principal sites in the Khasi-Jaintia hills for mining operations were situated at places like Mylliem, Nongkrem, Laitlyngkot, Nogundee and the region around Cherra-poonejee.

\* see Appendix-VI


Yule, recorded in 1842 that in the eastern corner of India, all the inhabitants of the Khasi-Jaintia Hills carried on the extraction of iron-ore through the entire Shillong plateau since very early times. In these villages one may notice the traces of former excavation and the way it has changed the topography of the region which is evident even today. Almost all the open mines appear to have been excavated in a similar manner.

Iron ore deposits in Khasi-Jaintia Hills have been identified by many British officials after proper investigation and survey. David Scott, Thomas Jones, Thomas Oldham, Thomas C. Watson have observed that iron ore deposits were mostly found in the upper section of the Khasi-Jaintia Hills. In 1829 Scott remarked that in the southern region of the Khasi-Jaintia foothills there were large deposits of fine ore flint which occurred at the top of the earth crust in the shape of a small rounded lump of nodule iron-ore and beautiful agates of various descriptions, quarts crystallisations and hard boulder-stone were found alongside with the ore. The ore, though thin in its composition, is found throughout the entire foothills of Pandua. Similarly, in 1834, Lt. Colonel T.C. Watson, after surveying the geographical condition and the geological structure of the Sanitary Station of Cherra-ponjee sent a report to the English East India Company detailing the possibility for the establishment of an iron and steel factory on an extensive scale. William Cracroft in 1834 observed that the iron ore deposit in the Khasi-Jaintia Hills was formed million years ago due to volcanic activities. Later on the lava got accumulated together and formed the sandstone rock.

In 1842, Henry Yule, the British engineer, also mentioned that while conducting a Geological Survey of the Khasi-Jaintia Hills, he observed that the upper plateau of the Khasi-Jaintia Hills, the structure of the rocks as well as its surrounding, indicate the presence of

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127 T.C. Watson,’Chirra-Punjii, and a Detail of some of the favourable circumstances which render it an Advantageous Site for the Erection of an Iron and Steel Manufactory on an extensive scale’ *J.A.S.B.*1834. 25-33.
iron-ore and that the process of extraction of iron ore was carried throughout the entire section of the upper part of the Shillong plateau since very early times. However, a detailed as well as an authentic report on the deposition of iron ore was given by Thomas Oldham, the Superintendent of the Geological Survey of India, in 1854. In the report on the Geological Structure of the Khasi-Jaintia Hills he stated that most of the iron ore was found deposited on sandstone rocks which were clearly visible with naked eyes possessing magnetic elements. Besides, iron ore was also found deposited on the upper strata of the granite rocks which get accumulated at a lower depth.

**The methods and procedure for extraction of iron ore** throughout the Khasi-Jaintia Hills as reported and observed by the British officials like Yule, Cracroft, Oldham, Jones, Scott, and others were found to be almost similar. This suggests that the technique for extraction of iron ore throughout the Khasi-Jaintia Hills was carried on by a uniform technology. Interestingly, among the British officials, Yule had provided the most detailed account on the system of extraction of iron ore with exact specification and dimension of the bellows, furnace, smelting house, the materials used, and most importantly, mentions women as labourers, in a statement of expenditure, which gives us a clue to the role of women in these processes. He was also in agreement with Scott who in 1829 described the Khasi-Jaintia system of extraction of the iron ore as ‘simple but a tiresome and arduous task’. At first the top soil is cleared and the ore which was mostly deposited on top of these rocks were dug by a long iron rod. Then the earth is cut to create a drain or channel so as to enable them to draw water from springs found in hilltops where the ore was deposited; the ore was then thrown into the channel to be carried by the water downward till it reaches the dam, which was about at least three feet high. The particles are carried away by the flowing water and the ore which is heavy gets deposited at the bottom end of the channel. The ore, in the form of black sand, was collected and carried to the smelting house.

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129 H. Yule, 853.
Yule’s account gives us a clear picture on the technique of extraction of iron ore.* He maintained that for carrying the earth which contains the iron ore and other components, from the top of the mountain, to pass through a distance of another eighty yards a proper canal was dug out for the purpose. The canal leads to a flat surface of the earth where two posts were fixed at opposite ends and a dam raised with a stick blocking the ore which gets congregated at the bottom of the dam. As the iron-ore gets deposited, the level of the dam was raised to a height of one foot to block the ore that had been carried along the stream while the lighter particles were carried off by the water and the ore, in the shape of fine black sand crust,. A man with a long iron fork would be engaged for clearing the channel, to remove the soil and the stone that blocked the canal so as to allow only the ore to get deposited at the bottom.\textsuperscript{132}

\textbf{Table 2.1} Statement of Expense and Profit in Excavation of a Good Mine for a Season of Twenty Days\textsuperscript{133}

<table>
<thead>
<tr>
<th>Expenditure</th>
<th>Rate</th>
<th>Period</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three men (excavators)</td>
<td>@ 4 annas</td>
<td>20 days</td>
<td>Rs. 15</td>
</tr>
<tr>
<td>Two men (washer)</td>
<td>@ 1 1/2 annas</td>
<td>30 days</td>
<td>Rs. 5</td>
</tr>
<tr>
<td>Two lads employed in cleaning the channel and watching the dam</td>
<td></td>
<td>20 days</td>
<td>Rs. 2</td>
</tr>
<tr>
<td>Rent</td>
<td></td>
<td></td>
<td>Rs. 10</td>
</tr>
<tr>
<td>Profit</td>
<td>Average value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work of three mean</td>
<td>Rs. 27 each</td>
<td></td>
<td>Rs. 18</td>
</tr>
<tr>
<td>Deduct</td>
<td></td>
<td></td>
<td>Rs. 35</td>
</tr>
<tr>
<td>Annual profit</td>
<td></td>
<td></td>
<td>Rs. 45.60</td>
</tr>
</tbody>
</table>

Similarly, Joseph Dalton Hooker, a botanist as well as P.R.T. Gurdon, a Government official, who travelled extensively through the entire Khasi-Jaintia Hills, observed that in place like Mairang, Nongkhlaw, Nongspung, Laitlyngkot, Nongkynrih, Nongkrem, Smit, Nongum, the Khasi-Jaintia adopted almost the same technique of extraction. Therefore, judging from the present topographical condition of the places mentioned above it may be

\textsuperscript{132} H. Yule, 853-54

\textsuperscript{*} See Appendix-VII.

\textsuperscript{*} See Appendix-VIII

\textsuperscript{133} H. Yule, 854-55.
construed that the technology which the Khasi-Jaintia adopted for the extraction of iron-ore, was unscientific as it had changed the topography of the areas and this had a repercussion on the agricultural production and also led to the deforestation of the surrounding environment.* Table 2.1 shows the statement of expense and profit in excavation a good mine for a season of twenty days, as provided by Yule.

The table cited above clearly reveals the extent of labour exploitation through minimum cost even in what Yule considers ‘a good mine’ in terms of economic benefit. Besides it exposes two vital factors when viewed from a gender perspective: *firstly*, it reveals the role and contribution of women in the process of excavation; *secondly*, the gender discrimination in terms of wage and period of labour.

There are generally **three types of technology in iron smelting**: *One*, wrought iron with little or no carbon, that is about 0.08% or lower; *two*, cast iron with up to 7% of carbon, which leave it hard but brittle, *and lastly*, steel, with up to 1.7% of carbon, which makes it hard but not brittle.134 The Khasi-Jaintia were not aware of such technologies but instead produced iron in their own indigenous way. The technology for producing iron was as follows: the Khasi-Jaintia furnace was made from rock preferably limestone as it can withstand the heat; instrument used to supply air were simple bellows made from cow skin; and finally the fuel for burning the ore was charcoal and other instruments like hammer, anvil etc., were tools used by the Khasi-Jaintia in the process of manufacture of iron.

Almost all the accounts left by the British officials and travellers like Yule, Watson, Cracroft, Robert Lindsay, Hooker, Oldham, W.J. Allen, A.J. Moffatt, Mills and others mentioned that the smelting technique adopted by the Khasi-Jaintia were almost the same throughout the entire range of the upper section of the Khasi-Jaintia Hills. As mentioned earlier the extracted ore which was carried to a nearby smelting house were in almost all cases supervised by a master along with some helpers, numbering four to six, including some women and they worked together to produce lumps of iron. The Khasi-Jaintia technology of

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134 N.R. Banerjee, 1-3.
smelting ore is usually done by heating or burning the ore in the furnace.\textsuperscript{135} As regards the structure of the smelting house, Cracroft, further elaborated by pointing out that in most cases the smelting house of the Khasi-Jaintia generally comprised of three apartments. The roofs of these houses were covered with grass or thatch; walls were made of bamboo cane and plastered with clay mixed with lime. The interior was generally oval in shape, about fifteen by thirty feet in breadth and length. This central room was used for smelting iron.\textsuperscript{136}

The process and technique for smelting of iron ore was according to the following procedure: At first the ore which was in the form of sand was washed with water which would be repeatedly done three to four times till only the ore is left. Then, the blacksmith would dip a stick of fern or wild reeds that grow abundantly on the slopes of the hills, which in local dialect is known as sop tyrkhang in water and mixed with the powdered ore as much as the reeds would hold. He would then push it from the top or from the opening of a small rounded dome furnace where they melted along with coke or charcoal and then would later turn into a lump of iron. The lump of iron was then collected and carried by women in a conical basket by using a strap made from bamboo. They tied the strap around the conical basket or the Khoh, the centre of which was placed on their forehead to support the weight of the basket and then carried to the plains near the Pandua hills.\textsuperscript{137} Cracroft, on the other hand, noticed that the blacksmith instead of using the fern leaf for mixing the ore and charcoal, would use a long iron spoon to collect the ore and push a piece of the damp charcoal along with the iron-sand, guiding it down through a channel that links to the furnace which fuses the charcoal and the iron sand into a lump of iron. Then with a pair of iron tongs they would take it out and beat it with a heavy wooden sledgehammer on a large stone which acts as an anvil.\textsuperscript{138}

In most of the smelting house, the main fuel for igniting was charcoal and sometimes coke, which they got from the coal mines situated in the vicinity of the smelting house. It is to be noted that while using charcoal it becomes less effective in removing the oxygen and

\textsuperscript{135} T.C. Watson, 32.
\textsuperscript{136} W. Cracroft, 150.
\textsuperscript{137} T. Jones, 284.
\textsuperscript{138} W. Cracroft, 150-51.
unwanted chemical substance. The use of coke as an agent for ignition proved to be more effective as it removed most of the oxygen and other unwanted particles; on the other hand, the furnace which was made from the limestone absorbed all the impurities. Watson observed that had the Khasi-Jaintia people made full use of coke which was easily available from the nearby coal mines they could have produced a higher quality of iron and steel and this would have further reduced the price of smelting, enabling them to earn more profit. Thus, charcoal was the most commonly used fuel for ignition in the process of smelting and the best charcoal was obtained from the Khasi-Jaintia pine known as Diengsai, similar to the oak tree. Surprisingly, it is also important to note that despite the abundance of coal near the region where the smelting houses were established, the Khasi-Jaintia blacksmiths did not use coal as a fuel for combustion and this reveals that the entire process was indigenous, a technology of their own.

Yule mentions that the bellows made in the shape of cylinders and consisted of two in number were made from cow-skin. The function of the bellows was to supply the air which will ignite the charcoal to a high temperature. The bellows were worked by a man or woman, with a leg on each, moving slowly and rhythmically backwards and forwards one foot after another. Again it is only Yule who mentions that the bellows were worked by women as well, whereas other reports were silent on this. In most cases the bellows were placed in front of the fireplace with their nozzles pointed downward and fused in a tube which went underground so that nobody would tumble over the tube that supplied the air to the hearth. The distance that the air travels from the bellow to the fireplace was about ten feet.

The furnace was constructed with stones, mostly limestone, and it was plastered with clay to maintain the temperature. Some furnaces were constructed with granite stone in which the fire was conducted on the side of an upright stone like the head of a grave with a

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139 T.C. Watson, 32
140 H. Yule, 854-55.
141 H. Yule, 854-55.
142 W. Cracroft, 150.
143 T.C. Watson, 32.
tiny arched opening close to the ground. Yule maintains that the furnace was twenty inches in diameter and above the furnace a chimney was placed which was above five feet to six feet high. In almost all the smelting houses the furnace was located at the centre of the room. As most of the smelting houses were located in the upper section of the Khasi-Jaintia Hills and since smelting of ore was done only during summer time, the central room was chosen for installing the furnace. During monsoon times heavy rain might affect the health of the workers, therefore, the central room is more preferable as it keeps them warm and prevent them from getting soak from the rains.

Several local tools and instruments were used during the process of smelting of iron. *U Narsuh* was a long iron bar with wooden handle used in steering up charcoal in the furnace. *U sdei*, was a rough axe for splitting iron block, *Ka Jingthap*, an iron bat for heating the red iron mass, *Ka Nap* or a pair of iron pincers, *Jingking*, an iron chisel were largely used. A trough, *Ka Phah*, was used in which dry bracken is smeared with mixture of water and ore. The tools that were used for forging were as follows: *Tyrnem*-hammer, *Kakhur* or a rake for arrangement of charcoal, *Nar-kti* and *Nar bsap*, long rods of iron with wooden handle, *Khuoh* a hooked poker, *Ka nap* or Pincer, *Nar shit* or rod of thin iron, and *Ryning* or anvil. The size of the Khasi-Jaintia hammer head was approximately six to seven inches in thickness, and the handle one foot or one and a half feet long. Since the hammer is heavy the blacksmith would just lift the hammer up and would not use strength while performing the work. The vertical drop of the hammer enabled the blacksmith to shape the lump of the iron into different shapes and sizes. On the other hand the anvil, made from solid hard granite stone and round in shape with a flat surface on the top was generally used. At the same time the anvil also served as a tool for sharpening the tools like knives, arrow heads etc.

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144 J.D. Hooker, *Himalayan Journals Notes of a Naturalist in Bengal, the Sikkim and Nepal Himalayas the Khasia Mountains, etc.* New Delhi. Todays & Tomorrow Printer and Publishers. 1974. 305. *See Appendix-IX.*
145 H. Yule, 855.
146 W. Cracroft, 150.
148 T. Oldham, 74.
Iron products, tools and other implements which the Khasi-Jaintia blacksmith usually produced for sale, both for internal and external markets were Isbad or a pure steel, narkii or rods and nariew or pig iron.\textsuperscript{149} Besides these three important products, the other iron tools and iron implements which they fashioned from the iron were the spade, hoe, nail, clamp, carpentry tools, fishing hooks, sword, spears, arrowheads, knives of various sizes, and cleavers. These goods when bartered with their neighbouring states fetched them valuable goods which were not available locally.

The Khasi-Jaintia spear length is normally six feet. The arrow heads are of two types: one, the U sop or Plain-headed arrow used for archery which is the most popular pastime of the Khasi-Jaintia and the other, Pliang or thorny-headed arrow used for hunting.\textsuperscript{150} The wait or the cleaver enabled the Khasi-Jaintia to clear the thick forests and marshy lands where they made settlements and provided grassland for cattle. The cleaver and adzes were used for squaring and smoothening the planks in building houses. The rough axe and the hammer of the Khasi-Jaintia were useful in cutting grey sandstone; with these tools, the stonecutter could square the stones used for construction of walls. These stones were found in large numbers throughout the upper part of the Cherra-poonee and Shillong plateau; the slabs or layers of which were six inches to two feet thick and could be easily split into square blocks by the wedge and hammer. The state Government recently employed the Khasi-Jaintia stonecutter to erect a monolith from grey sandstone in memory of the late David Scott. It is ten feet long, three feet wide and two and a half feet in thickness. The same grey sandstone was used by the Khasi-Jaintia for their traditional tombstone, the height of which were twenty-five to twenty six-feet and which have stood the test of time.\textsuperscript{151}

It is interesting to note that prior to the advent of the British, the Khasi Syiem and Jaintia Rajas were in fact well accustomed with the art of manufacturing weapons and the making of gunpowder. Gurdon observed that the art of making gunpowder was carried on by the people of the villages of Mawsynraw, Cherra-poonee in the eastern parts of the Khasi-

\textsuperscript{149} H. Bareh, 421.
\textsuperscript{150} P.R.T. Gurdon, 24.
\textsuperscript{151} T.C. Watson, 29-30.
Jaintia Hills and Kynshi village to the west of the Khasi-Jaintia Hills. The gunpowder was produced by mixing the saltpeter, Sulphur and charcoal where they were pulverized together inside the barrel of a mortar. Some of these weapons were the two cannons which are still to be seen at Jaintiapur which is now in Bangladesh. The length of these canons is nine feet, the circumference in the middle, three feet two inches while the diameter of the bore is three inches.152 At Langkyrdem and Kyndiar similar old cannons of the same specimen was discovered. It is believed to have been captured by the Syiem of Nongkrem from the Jaintia Raja. Cannonballs were also discovered. A short cannon of a different type is also seen in the house of the Syiem of Mylliem.153

By the time the British arrived in Sylhet, the Jaintia Rajas had expanded their territorial jurisdiction up to the plains of Sylhet and it was during this period that cannons and firearms of a different type were made at Jaintia hills. These firearms which belong to the Jaintia Raja are displayed till date at the Shiva temple where the priest used to bless them once in a year at Nartiang. These indigenous firearms are of two types: Suloi-Khyndew, a type of early modern European musket gun which consists of a long barrel of about six to seven feet in length and could be adjusted according to the requirements and an iron rod would have to insert the gun powder for firing in the required. The other, suloi-tynsad which is akin to the musket gun which works by using pressure to force the gunpowder to position near the trigger. While firing it would have to be positioned near the shoulder and the trigger pressed to ignite. The gunpowder was a mixture of lead, tiny iron balls and other chemical ingredients carefully rolled into the size of a round pebble. The size of the cannons were of an extraordinary shape with a large barrel which worked either by applying heat or by lighting a fire from the base of the cannon. The shells for the cannons were made from fire clay and mixed with iron in an oval shape for long range distance.154* The change in technology is clearly evident with the coming of the British from the use of a mix of saltpeter, sulphur and charcoal prior to the arrival of the British, to lead, tiny iron balls and other chemical ingredients in the making of gunpowder.

152 P.R.T. Gurdon, 24-25.
154 H. Bareh, 423-25. * See Appendix-X.
It was probably the commercial contact with the Mughals that acquainted the Khasi-Jaintia people with the firearms and other weapons. Therefore, the Khasi-Jaintia in order to strengthen their position and to guard their territories started making small arms and weapons with the iron they themselves produced. The Khasi-Jaintia applied their own knowledge to make arms, canons, guns and gunpowder. Later on they came into contact with the Europeans merchants like the Greek, Dutch, French and the Armenian and this enabled the Khasi-Jaintia people to improve the art of manufacturing firearms, canons etc. This compelled John Willes the Acting Collector of Sylhet to report to the authority at Calcutta about the possession of firearms by the Khasi-Jaintia and to prevent any French traders from establishing close ties with them.  

Table 2. II Dimensions of the Cannons at Rungpore

<table>
<thead>
<tr>
<th>Description</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length from end of handles to sight on the breech</td>
<td>5ft. 10 inches.</td>
</tr>
<tr>
<td>Ditto from breech to muzzle</td>
<td>12ft. 3 ½ inches.</td>
</tr>
<tr>
<td>Measurement round the breech</td>
<td>5ft 7 inches.</td>
</tr>
<tr>
<td>Ditto round the muzzle behind the ornamented ring</td>
<td>5 ft. 1 inch.</td>
</tr>
<tr>
<td>Diameter of bore</td>
<td>0.6 ½ inches.</td>
</tr>
<tr>
<td>Total length of the gun</td>
<td>17ft. 3 ½ inches.</td>
</tr>
<tr>
<td>Thickness of metal</td>
<td>07 ¾ inches.</td>
</tr>
</tbody>
</table>

By the late 1780s one of the first Collector of Sylhet province William Makepeace Thackeray, reported to authorities at Calcutta regarding the threat posed by the Jaintia Rajas. On meeting the Jaintia Raja, Robert Lindsay noticed their artillery and guns when they gave him a royal salute as he entered the boat of the Raja. A Survey Report conducted by the State Bank of India under the Lead Bank Scheme, “Survey report on United Khasi and Jaintia Hills district Shillong, December 1970” shows that prior to the advent and the annexation of the Hills by the British besides the iron tools, lime, oranges the Khasi-Jaintia also exported home-made guns to people of Sylhet district and to the plains of Kamrup. The report further mentioned that the plains of Kamrup and the Sylhet valley totally depended on the supply of

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iron by the Khasi-Jaintia. A story mentioned that fish hooks were bartered for a cow.\textsuperscript{158} Thus, it may be stated that the Khasi-Jaintia adopted their own technique in manufacturing weapons, firearms and other guns which resemble those of the plains and even that of the Europeans.

Again, another specimen of Khasi-Jaintia arms was the cannons at Rungpore, which was made during the sovereignty of the Bohikhowa Bur Phokun Raja; it was cast entirely from Khasi wrought iron and remarkably finished. Its dimensions are shown in Table 2. II. The dimensions indicate that the cannons made by the Khasis were solid and comparatively large in size.

**Limestone Quarries and Indigenous knowledge system of extraction:**

From the accounts, reports of Thomas Terraneau, W.J. Allen, B.C. Allen, Thomas Oldham, Thomas Jones and others it is brought out that Khasi-Jaintia people carried the process of quarrying and extraction of limestone but the process of lime making was carried on by the locals from the plains. Along with the manufacturing of lime almost all the villages situated near the banks of the river Surma, were engaged in the limestone trade. Of them, two villages Chattack and Chunamganj emerged as important trade centres as they became the nodal points for the supply of lime to Sylhet. As a result all Indian, Armenian and European merchants set up their factory depots to hoard the lime that was supplied to them by their agents. As mentioned in the earlier accounts and reports by the British officials, the limestone was drawn from the Khasi-Jaintia Hills quarries which were leased to them by the Khasi Syiems and Jaintia Rajas for a specific time period.\textsuperscript{159} These centres grew into important urban centres or townships.

Limestone, another mineral of economic value, constitutes one of the major economic activities carried by the Khasi-Jaintia. Even though all the limestone quarries belonged to the Khasi-Jaintia, the limestone trade was mostly in the hands of the foreigners since the Khasi-

Jaintia leased the quarries for extraction of the stone while the business and trade transaction was done by the non-Khasi-Jaintia, the *dkhar*. Sylhet limestone was acquired from the Khasi-Jaintia foothills at the foot of the Cherra-ponjee Plateau, which is known as the Pandua-Laur region, present day East and South West Khasi-Jaintia Hills. It is from the Jaintia Hills that the limestone trade can be said to have commenced since the rule of the Mughals.

The extraction of limestone was carried throughout the whole year. However, the quarries were mostly worked during the dry season since most of the quarries were situated in areas where outbreak of malaria, cholera and other diseases frequently occurred. However, in case of occurrence of malaria or any other malady, most of the workers would abscond from the quarries and the villages and return back only after they were convinced that the disease had disappeared. Here, it is important to note that, even during the period of outbreak of any such disease the supply of lime to Sylhet remained unaffected; this was possible because the lime merchants due to previous experience would store surplus lime at their depots which enabled them to meet the required demands.\(^{160}\) The largest quarry of the Pandua foothills was situated at Tungwai village. Limestone from this village and also from the neighbouring quarries like Teriaghat and Lacat,\(^ {161}\) which were surrounded by orange groves were sent to Chattack. It is from this region of the Khasi-Jaintia hills that we get the limestone which is ‘of the purest alabaster lime and appeared, in quantity, equal to the supply of the whole world’.\(^ {162}\) Thus, almost all the inhabitants of the villages living in the foothills of Pandua and Laur region were busy in their mercantile activities.

The process of extraction of limestone which was adopted by the Khasi-Jaintia, right from the middle of the eighteenth century till the twentieth century, was in fact a simple traditional method: firstly, the top soil was removed and when the limestone makes its appearance they would dig out the limestone with iron rods and then thrash the stone into an irregular piece of medium stone size which they would then carry to the riverbanks; then

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\(^{160}\) W.J. Allen, 48-49.
\(^{161}\) T. Oldham, 55.
transported them to all the kilns which were situated near the river banks. The weight of stone that was mined from the quarries varied in size and form, from $\frac{1}{2}$ to $1 \frac{1}{2}$ maunds each. At the same time, the large size stones were positioned next to the fire till they gradually reduced in size; then they were broken on the spot to further smaller size equivalent to a man’s fist.\(^\text{163}\)

For transporting the limestone from the quarries situated in the hills to the sites where the kilns were set up in the plains, the Khasi-Jaintia would use riverine transportation which commences with the onset of monsoon rains with effect from last week of April every year. This continued as long as the rivers and streams were filled with water to the brim, which enabled the small boats or canoes to ply down the swift rapid rivers that descend from the hills to the plains of the Surma at a lighting speed and dangerous level which at times led to death while bringing the stone to the kilns that were situated near the riverbed.\(^\text{164}\) By the end of October, the water level would come down drastically and the once busy riverine transportation almost comes to a standstill. The big rivers and streams would turn into little nullahs that even the light canoes which usually flow on shallow depth and draw only a few inches of water, are frequently left stranded in the middle of their course.\(^\text{165}\) The stone was then brought down to the banks of the river by the Khasi-Jaintia people and they were carried by the local lime traders or Beparies to their kilns that were situated on both sides of the banks of river Surma.\(^\text{166}\)

\textbf{As regards the structure of the kiln or Pajwa,} both W.J. Allen and T. Terreneau (1830) observed that most of the limestone kilns were usually constructed near the river banks for security against fire. The first step in the process of making kiln or pajwa\(^\text{167}\) was to dig out a hole in the shape of an upside-down cone which is approximately not less than ten feet deep. Then, stones were laid on top of one another till the structure reaches a height of about five feet from the surface of the ground. The upper section of the kiln or pajwa would then

\(^{163}\) T. Terraneau, 61-62.
\(^{164}\) D.R. Syiemlieh, 37.
\(^{165}\) D.R. Syiemlieh, 51
\(^{166}\) T. Terraneau, 61.
\(^{167}\) Pajwa are limestone kilns.
be covered with straw and plastered with mud.\textsuperscript{168} The standard size of almost all the kilns is made to hold a minimum of seven to a maximum quantity of eight hundred \textit{maunds} of lime. But due to pressure for maintaining a high temperature, the lime workers would keep piling the kilns with reeds and wood to reduce the consumption capacity of the kilns from seven hundred or eight hundred to five hundred or six hundred \textit{maunds}.\textsuperscript{169}

The process of manufacturing of lime was prepared through three principal processes: limestone preparation, calcinations and hydration. It was the calcination process which was an art of the earliest methods of manufacturing lime. In this process, the limestone was dried by exposure to strong heat; then the limestone would be covered with dry grass and wood which acts as fuel to reduce the stone to lime. The burning is done in enclosed walls forming essentially a pot shaft kiln which they still practice till date.\textsuperscript{170} Once the limestone was kept inside the kilns, the process of ignition commence right underneath the centre of the kilns where the limestone rocks were placed. In 1831 Terraneau mentions that the processes of lime-making depended on the weather. During hot and dry weather the process for lime making would take only four days and five nights. The fuel which was used during good weather was locally known as the \textit{null} or reeds which were usually placed on the bottom of the kilns and at the centre of the openings. The outer-course of stone was protected by a plastering of mud at a thickness of 1½ to 2 inches. The reeds were of course soon consumed, but not before the clay becomes nearly half burnt. As soon as crack appeared in the outer wall of the kiln the limestone workers would again coat it with mud to the thickness of 4 to 5 inches. The limestone workers would need to check that the ventilation of the upper parts of the kiln was free so as to enable the workers to detect whether the stone had received sufficient heat for burning. The process is almost complete after the end of the fourth day or on the fifth night when the outer coating crack for the second time and when the ventilation from all sides of the kilns do not emit any smoke.\textsuperscript{171}

\begin{footnotes}
\item[168] B.C. Allen, 150.
\item[169] T. Oldham, 56.
\item[171] T. Terraneau, 61-62.
\end{footnotes}
After the fourth or fifth day the stone would turn radiant due to the heat. Through the small opening that was created from the upper surface where the kilns were constructed, the lime burners would observe and notice that the stones had turned white with small yellowish patches. This yellowish colour indicates that the process of calcinations is complete.\textsuperscript{172} B.C. Allen mentioned that the process of lime-making in bad weather took twelve to fourteen days since most of the kilns used reeds as fuel and they would have to refuel it every now and then which resulted in the failure of the kilns to maintain the required heat for converting the stone into powder lime.\textsuperscript{173} The fine white powder of lime would fall down along with loose fitting stone which was then crushed into powder and packed in bags to be carried to Sylhet and transported to Calcutta.\textsuperscript{174} The lime in this case was removed both from the opening of the bottom of the kilns as well as from the upper mouth of the kilns, whereas, in the Report of Oldham, lime was removed from the upper section of the kilns only. However, despite the availability of coal in large deposits along with the limestone tract as mentioned by Oldham in his Geological Report on the Structure of the Khasi-Jaintia Hills, coal was never used during the process of manufacture of lime, as in the case of smelting of iron ore. Instead, they used wood or reeds. Most of the firewood and reeds were collected from the foothills of the Pandua and the Laur region as well as from Jaintia and Cachar.\textsuperscript{175}

The reeds or \textit{null} and the dry wood used as fuel for the kilns were procured from the marshy regions and brought down to the river \textit{ghats} or river port by rafter. To save time and cost of transportation the reeds were sometimes tied up in a bundle together with logs of about three to four feet long and would be made to flow downwards to where the kilns were set up. On reaching the kilns the lime maker would collect the reeds and dry them near the kilns till they are completely dry. The reeds which are tied together were then cut into two or three pieces each and allowed to be burnt. Terraneau noticed that about eight hundred to eight hundred twenty \textit{maunds} of wood were used for igniting a kiln with a capacity of consuming seven hundred \textit{maunds} of stones. However, it is important to note that it depends on the season.

\textsuperscript{172} T. Terraneau, 62.
\textsuperscript{173} B.C. Allen, 149.
\textsuperscript{174} T. Terraneau, 63-64.
\textsuperscript{175} T. Jones, 283.
and the weather condition regarding the consumption of reeds; if the weather is fine and dry, then there would be equal proportion regarding consumption of reeds and the amount of the stone burnt. The only stage where consumption would be at its peak was at the beginning of setting the kilns ablaze so as to meet the required heat for burning the stone into lime. The reeds that act as a fuel for burning the stone were generally brought down to the river banks before the onset of rain. During the rainy season which usually starts in April, wood is used as a substitute and the kilns are temporarily protected with slender separable roofs. Teraneau further points out that Paharpunji, which is the nearest quarry below the Pandua hills, is where limestone deposits are of an immense potential for economic gain but the best quality was that of the Laur region. The wood was generally supplied by the Tandars or wood merchants who usually sign an annual contract with the Lime merchant. Most of the wood is procured from Banscandi, Dudpattli and other parts of Cachar. Around 1000 maunds of wood were valued at Rs. 30/- to Rs. 40/- when landed at the kilns.

A kiln that uses reeds which come in bundles of ten to twelve to thirteen feet long, with the circumference of two and a half to three feet, would require two thousand to two thousand five hundred bundles of reeds to be fed for a kiln that will consume seven hundred maunds of stones. The same type of kiln will need about eight hundred to eight hundred twenty maunds of wood to be used for igniting a kiln with a capacity of consuming seven hundred maunds of stones. Whether the reeds or wood was used as the fuel for burning the stones, the process or the method adopted was the same; they would have to constantly feed into the kiln so that it will be able to sustain the required temperature and this will continue for four days or five days. However, it had been noticed that kilns that use firewood consume less in comparison with the kilns that use reeds.

Recently through field study conducted at Shella, Ishamati, Bhologanj, Nongtrai, Hat Mawdon and other places of the southern War Khasi-Jaintias found that the limestone they produce were assigned different names according to the processes and the fuel they adopt

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176 T. Terraneau, 62-63.
177 T. Terraneau, 61.
178 T. Terraneau, 62-63.
while burning the stones. One such variety is *Shun-Kpu* or powder lime otherwise known as the slaked lime which is used mostly for construction purposes. Another type of lime, *Shun-maw* or the un-slaked lime, in the shape of rough stone of different sizes, was generally used for whitewashing of buildings. Another type of lime was *Shun-diewtong* which is processed by the burning of coal and *Shun-Dieng* which was processed through the burning of firewood and wild reeds. Thus, the system for smouldering of limestone differs not only from place to place but it also depends on the process of the fuel they used for burning the limestone.

In the present times, the system of extraction of limestone continues to be carried on by the same technique that was used by their forefathers two hundred years ago. For instance, the same technique and process of extraction and mining of limestone that had been carried out prior to the advent of the English on both sides of the riverbank persist till date in the Shella village. In the post-independence era, the limestone commercial activities continues to flourish with the people of southern Khasi-Jaintia Hills and Bangladesh, then known as East Pakistan, as the Governments of both the countries permitted free entry of merchants on either side. After Independence the Indian Government and the East Pakistan Government permitted free export of material for any trader if the material was below Rs. 500/- but if the material was above Rs. 500/- they would have to pay tax according to the Government rules and norms fixed by them.179

It can be said that the system of processing the limestone continues with the same technology. But the fuel for ignition was different depending upon the availability of the sources of fuel. For instance the limestone process near the borders of Bangladesh used firewood and reeds, whereas, the limestone processor in and around Cherra-poonjee preferred coal. At present the limestone merchants in order to accelerate the speed of production of lime used explosive material like nitrate mixture, safety fuse, ordinary detonator and electric detonators which have had a devastating impact on the surrounding areas and have changed the topography of the areas due to excessive use of such materials.

The village people of Shella make use of these explosives but they use it in a very limited way. Thus, they have been able to preserve the environment to a certain extent. The Shella limestone workers at present, adopt the following technique: firstly, they would dig a one foot deep hole with an iron shovel or *u Nar samsuloi*, then they would fill the hole with ammonium nitrate connected to a fuse and ignite it with the help of a battery. Another method is when they would just fill the hole with the explosives powder and with the help of an iron rod or *u Nar Kynsahsuloi* push it inside the hole for detonation which would then be blasted. The limestone acquired by this process appear in the shape of a big lump of stone which was then broken into pieces by a *u Tyrnem* or hammer and then carried off by boat to the nearby kiln and to Chattack. The natives who work on the quarries use the basket or *ka Khoh kit maw* for carrying the stone while the Bengali workers and the Garos use the round basket which they usually carry on the head for the transportation of the limestone to Chattack.

Regarding the process of burning the limestone some changes have taken place with slight modification of the kilns. At present the limestone workers have better store rooms to stock the coal, charcoal, firewood and wild reeds which were used as fuel for burning stone. The floor of the kilns and their walls were covered with tiles and the roof is either cemented or tin is used to cover the roof of the kiln. Firewood which was once the principal agent for ignition the kilns or *pajwas* has been replaced by coal. However, due to lack of financial aid as well as lack of better means of communication, coal as a fuel cannot permanently replace the wood or charcoal.

During a recent field study at Ishamati the *pajwas* or the kilns* were in the shape of a semi-circle which comprises of two to four stratum of stone which was laid in the form of a circle or in some kiln laid in an oval shape. The depth of the inner part of the kilns was approximately 12 to 14 feet dug in a conical shape and the upper section from the mouth of the kiln was raised to a height of 12 to 15 feet in the rounded conical shape. The outer layer of the stone was plastered by the clay locally known as *dew-byrtha* or *dew-mutha*. The two stratum look like two halves of a giant washing basin. At the upper part of the plate, a small opening was arranged to allow the passing of the fluid and smoke.
However, no kiln or *pajwa* were cemented as they cannot withstand the heat. The burning of limestone continue for five to six days till the spark of fire comes out from the small openings* which indicate that the process of lime-making is almost over and time to be extinguished. Thereafter, the process of removing and packing the lime in plastic sacks or tin container takes place.

It may be stated that as the Khasi-Jaintia society being matrilineal, women took active part in trade and other economic activities. In the process of extraction of iron ore, both men and women were actively involved. Scott as well as Hooker observed that the Khasi women were employed for two purposes: primarily, to clean the ore, and secondly, during the process of smelting it was the women who mixed the ore with charcoal so as to form a lump of iron in the size and shape of an irregular horseshoe. When the ore and the charcoal got amalgamated these lumps of iron were ignited in the furnace, half of the impurities were removed, which resulted in the loss of half the weight.  

180 In 1842 Yule had clearly stated in his account that it was the female workers who transported the iron ore from the extraction sites by using the *khoh* or the conical basket. 181 However, it is important to note that the iron that was extracted were sometimes not carried to the smelting house but the women would carry the ore which was not smelted to other villages and sold the ore on market day.  

Besides, their participation in the iron industry the Khasi-Jaintia women were allowed the freedom of occupation of their choice. Besides their involvement in the iron industry the Khasi-Jaintia women were also actively involved in other economic activities like cotton plantation which grew on the banks of the river *Kopli* and which they would supply to the Assamese traders. 183 It is said that the women of Ri-Bhoi district had acquired the knowledge of silkworm rearing and the making of the silk cloth locally called *ryndia*. In the western

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* See Appendix-XI.
* See Appendix-XII.
180 D. Scott, 253-54.
181 Yule, 853-54.
182 Home Political Department (Henceforth H.P. D.), *Report on the Administration of Khasyah&Jynetah Hills from G. D. Showers to the Secretary to the Government of Bengal*, 22nd September 1862, Political Branch-A No. 59-61, National Archives, New Delhi, 19.
183 H.D.P., 20.
section and also in the upper part of the Khasi-Jaintia Hills the women participated in raising crops like potatoes, cauliflower, radish and horticulture fruits like pears, peach, pomegranates, etc. The Khasi-Jaintia women in the southern region were engaged in raising the cash crops like oranges, bay leaf, pineapples, black pepper, cinnamon etc. whereas, the women in the upper section of Shillong were engaged in the agricultural activities and some were employed in the traditional indigenous iron and limestone industry.

In retrospection it can be construed that iron was a metal of the Khasi-Jaintia people that had contributed tremendously to the economy and had great impact on their culture. However, besides iron-ore and limestone excavation, coal, copper, zinc, sillimanite, gold and lead were also carried out since very early times. When Khasi-Jaintia iron was brought to the plains of Sylhet and the Brahmaputra valleys, it was further forged by the blacksmith of the plains for making nails, clamps, bolt for making boats. The best ore is found on the Khyrim region and Nongkrem produce fine iron implements. The iron is known to be of excellent quality since it was more flexible and could be shaped into many tools and implements. The Bengali blacksmiths of Sylhet prefer the Khasi-Jaintia iron to that of the English. The estimate export of iron from Khasi Hills was twenty thousand maunds annually. The Khasi iron was also used by Europeans traders for constructing big boats. For instance, British official like make use of Khasi iron for construction of two ships—the Augusta and Snow Eliza which set sail in June 1783 and in March 1784 respectively from the Sylhet port to Calcutta for the transportation of lime and other commercial goods of the frontier district. However, by the 1860s the Khasi-Jaintia iron industry had started to decline; the cheap English iron had replaced the Khasi-Jaintia iron both in the internal and external markets. British economic policy was to buy cheaper and sell dearer. The hills people were now confined mainly to lime trade, wax, oranges, bay leaves and other products from the hills.

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186 D.R. Syiemlieh, iii.
The iron-smelting technology has had a tremendous impact on almost all the societies of the world. Iron became an important commodity for the Khasi-Jaintia and it enabled them to expand their trading commercial activities with the plains people of Surma and Brahmaputra valleys. However, one peculiar aspect of this iron trade is that the Khasi-Jaintias rulers were not able to make use of the iron in the process of expansion of their kingdom or states as arms manufactured for warfare were very limited.

It is interesting to note that symbolism in iron goods is gendered. Iron, in general, symbolises strength and the physical aspects of iron were related to male in other parts of the world. However, in Khasi-Jaintia society, iron was related to both male and female. This can be clearly drawn from the label given to iron products. As for instance u Nar rod which was used to construct pillars for laying a strong foundation, is given a male connotation while ka wait, used for clearing the forest denote a female character and katari mainly used by women for household work. Though the Khasi-Jaintia woman is stated to be more emancipated as an upholder of matrilineal society, yet their space in society is delineated as confinement within the household, the kitchen in particular, through concepts such as these.

From the above discussion it may be stated the Khasi-Jaintia have a unique indigenous knowledge system of extraction of iron and limestone and smelting of iron, an ore largely found at Mylliem, Nongkrem, Laitlyngkot, Nogundee and the region around Cherra-poonjee. The findings of Polish scholars like Pawel Prokop and Irebeusz Suliga reinforce the thesis that smelting of iron was an indigenous knowledge system of nearly or more than two thousand years old. The process of extraction or smelting, however, was not written down as the indigenous people did not have a script of their own and so it was handed down practically and orally from generation to generation. British officials, Henry Yule in particular, provided with the most detailed account on the system of extraction and smelting of iron ore with exact specification and dimension of the bellows, furnace, smelting house, the materials used, and most importantly, the role of women in these processes. However, in the making of gunpowder a change in technology is clearly evident with the coming of the British from the use of a mix of saltpetre, sulphur and charcoal to lead, tiny iron balls and other chemical ingredients.
However, by the 1860s the Khasi-Jaintia iron industry had started to decline as cheap English iron replaced Khasi-Jaintia iron both in the internal and external markets, and the indigenous people, perforce had to trade in lime, wax, oranges, bay leaves and other products from the hills as an alternative. Thus slowly and gradually the iron industry and its trade which once formed as an important industry had ceased as a subsistence industry. The smelting of iron though is carried on in a few places like Mylliem, Nongkrem, Nongkhynrih and Nongspung even today.

On the other hand, lime extraction particularly from Pandua foothills, Tungwai, Teriaghat Lacat and other villages continued even in the post-Independence era with the same traditional technology. A significant outcome of limestone trade was the emergence of the two villages of Chattack and Chunamganj as important trade centres or the nodal points for the supply of lime to Sylhet, which in turn led to the growth of urban centres or townships. Consequence of the economic valued of these two items of minerals it led to the widening of markets beyond the hills. The advent of the Europeans compelled the Chiefs of the Khasi-Jaintia Hills to manage and control the commercial activities at the foothills of Pandua and Laur region. The expansion of trade and market both in the Sylhet plains and in the plains of the Brahmaputra valley resulted in the development of better means of transport and communication and growth of urban centres which shall be discussed in detail in next chapter.