II THANGTONG GYALPO AS AN ARCHITECT AND BLACKSMITH

The extraordinary personality of Thangtong Gyalpo can hardly be done justice in a work like this. The more one examines the bridges, temples and artefacts that are still available, the more one comes to appreciate the work of the great Drubthop. Since Thangtong Gyalpo is accomplished at various fields, only single aspect of him can be focussed in this book. Therefore, in the current work, only the art of the iron chain bridges and their effect on Tibet and Bhutan and in further course for the suspension bridge building in the world is illustrated, with slight references to Thangtong Gyalpo as a whole.

Thangtong Gyalpo is associated with many locations and places, and in the wider context with the foundation of numerous monasteries and lhakhangs. In Bhutan, for example, the Badong Lhakhang located at high elevation on a hill north of Wangdi Phodrang, next to the old connecting path between Wangdi and Punakha is one of them. Another example of his impressive construction is the Shar Chitog Khar Lhakhang, located high above the tributary of the Dang Chhu with a unique altar of the Buddhas of the three times .

In Tibet, the large monastery of Chakzam Chuwo Ri (*lCags zam Chu bo ri*) that Thangtong Gyalpo founded in 1444, located at the southern bridgehead of his famous 'Chakzam' across the Yarlung Tsangpo river, above it's confluence with the Kyichu river (*sKyid chu*) became his main seat. Later, the monastery of Chakzam Chuwo Ri became the main monastery of the Chakzampa school as well as the seat of the Chakzampa Tulkus.

Two of his constructions, where it is undoubtedly confirmed that Thangtong Gyalpo had conceived them as a philosopher and architect and where he even lent a hand himself at their construction will be examined here more closely. They are,

the Dungtsi Lhakhang in Bhutan and the Kumbum at Chung Riwoche in Tibet.

Dungtsi Lhakhang in Paro

After crossing the Phari Dzong, Thangtong Gyalpo entered Bhutan and went immediately to one of the geomantically the most significant 'power place', the Taktsang cave in Paro valley. As he proceeded on to Paro, he saw a particular place that was occupied by an evil demon. According to the legends, this demon at one point looked like a black snake and at another like a nine-headed tortoise. The monster was responsible for misfortune, illnesses and famines in the locality. Thangtong Gyalpo subdued the demon with his supernatural powers and built a chörten above the entrance to the cave called Dungtsi Lhakhang.

The Dungtsi Lhakhang is like a realised Buddhist philosophy within a building. The chörten in its outer architecture is shown as a three dimensional cosmic diagram, a Mandala. The square ground floor of the Dungtsi Lhakhang, which is provided with a set off at each of the four corners symbolises the element earth; the Bumpa, the cylindrical rotunda, the element water; the rising tower with thirteen rings, the element fire; the recumbent sickle with the solar circle, the element air; and the flaming drop at the pinnacle, the element ether. The tower-like pinnacle sticking out from the building also reaches as a column down to the lower floors, which represents Meru, *the axis mundi.*

The square foundation and the Bumpa were built unlike a normal chörten and without a hollow cavity, but were setup as a ritual room, which means that the foundation is single storied and the Bumpa, divided by a ceiling, which is two storied. The Dungtsi Lhakhang is neither a chörten nor a lhakhang, but both. The two storied Bumpa is equipped with two ritual circumambulation paths, Korlam (s*Kor lam*) and the four niches inside the inner wall represent the four cardinal points. The concept of how to divide the Bumpa into

two floors was similar to those in the Kumbum Chörten in Jonang and Gyang Bumoche in Tibet.

Three floors show the Buddhist path to enlightenment. At the ground floor, the life of the people, laymen as well as monks and saints are represented. After the death, one is said to wander in the Bardo, the intermediate state for 49 days, which is between death and rebirth. This is allegorised in the basement of the Bumpa. On the upper floor of the Bumpa, the Yidams are represented with their female partners in Yab Yum position. As with all tantric Buddhist sanctuaries, it is part of the ritual to first circumambulate the Dungtsi Lhakhang clockwise, that is to begin with the left side, while proceeding with the circumambulation set the 108 prayer wheels in motion that are fixed to the walls of the temple. This 'circumambulation' is also continued inside until the upper floors. If one follows this system on the mural paintings as well, one is practically introduced to the complete pantheon of the deities of the Drukpa Kagyü school.

Towards the eastern side of the ground floor (to the left of entrance) on the inside of the outer walls among others (only the well-known and important deities are mentioned) the Buddhas, the Bodhisattvas, Pälden Lhamo, Mahākala and the heavenly palace of Zangdog Pelri are represented. At the southern wall, we find Buddha, Padmasambhava and Amitāyus. As for the western wall, Avalokiteśvara and other Bodhisattvas are depicted. On the northern face, the great masters of the Kagyüpa School along with Thangtong Gyalpo are represented. At the mortar-built internal square outside the eastern wall bear ten wrathful deities with a repeat of Thangtong Gyalpo. At the southern wall apart from the Buddhas and Lamas, 16 Arhats are depicted. The western wall depict dharma-protectors along with the 21 Tārās and on the northern face beside portraying high Kagyüpa Lamas, a 4-armed and a 6-armed Mahākala are also illustrated. If one

proceeds through the door of the outer wall, one meets the 35 Confession Buddhas and on the shaft of the internal column bears 21 forms of Avalokiteśvara[30]

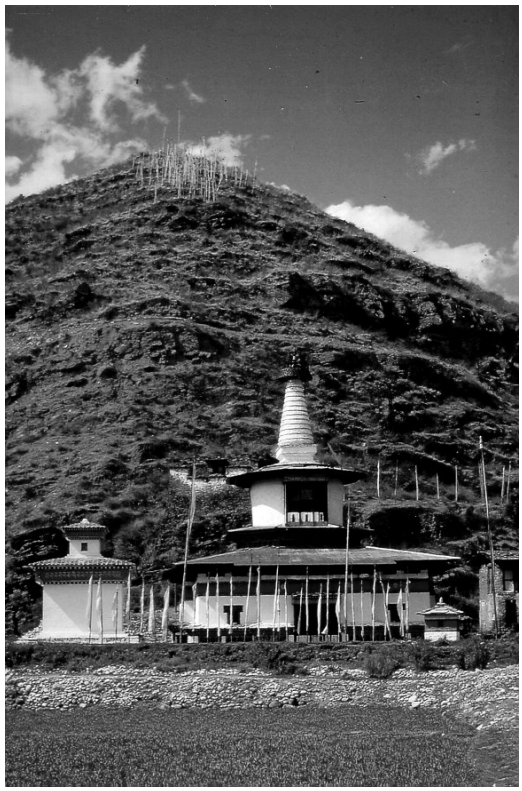

Fig. 16: The Dungtsi Lhakhang: The philosophy of Mahāyāna Buddhism realised in a building.

In the basement of the Bumpa, there are protectors of the teaching, and at the shaft bears the wrathful deities of the Tibetan Book of the Dead. Finally at the upper floor of the

[30] Gerner, Bhutan 1981, p.120/121.

Bumpa, Yidams, personal protective deities, statues of Maitreya, the Adi-buddha, Thangtong Gyalpo and Milarepa are found.

The Dungtsi Lhakhang is Thangtong Gyalpo's first creation of a chörten that includes a representation of the Buddhist system of teaching according to the tantric teachings expounded through pictures for laymen and monks alike. The concept, by which one apprehends Buddhism by watching pictures, while carrying on the circumambulation was introduced at the Chung Riwoche Kumbum in Tibet.

The people of Bhutan have a special reverence for the Dungtsi Lhakhang. Today, this Lhakhang is popularly used for conducting ceremonies for deceased in helping them on their way through the Bardo. These rituals that often last for several weeks are sponsored by the relatives of the deceased. The monk conducting these ceremonies sits in front of a small altar on the eastern side of the ground floor, while some other members who also supply the monk with food reside in the simple cottages beside the temple.[31]

Chung Riwoche

Chung Riwoche Kumbum Chörten (*mChod rten bKra shis sgo mang gCung Ri bo che*) is located in the region of Latö, about 100 kilometres to the west of Lhatse, in a sharp river bend on the left bank of the Yarlung Tsangpo. This Chörten is a masterpiece of Thangtong Gyalpo, which was planned as a three-dimensional Mandala, now established as a Kumbum, a form that is common in Latö.

When Thangtong Gyalpo completed the construction of the Dungtsi Lhakhang in Paro, he was about 50 years old. When he was around 65 years, he began the construction of Chung Riwoche. However, according to Thangtong Gyalpo's own information, the inspiration goes back much further to 1354 when Dolpopa Sherab Gyaltsen begun the construction of the first big Kumbum Chörten (*sKu 'bum mchod rten*) in Jonang (*Jo nang*) above Phuntsholing (*Phun tshogs gling*). The

---

[31] Gerner Bhutan 1981, p.119/120.

construction of the Gyang Bumoche Kumbum *(rGyang Bu mo che sku 'bum*) began at around 1420 at Lhatse. From 1427 to 1439, Thangtong Gyalpo constructed the Gyantse Kumbum (*rGyal rtse sku 'bum*) outside the area of Latö, followed by the construction of the Kumbum Chung Riwoche in 1449.

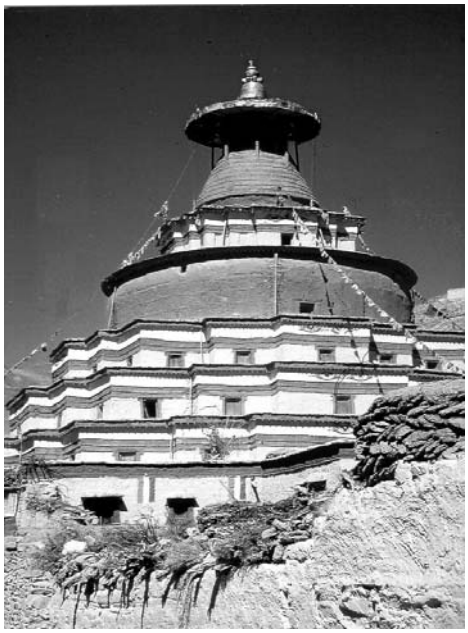

Fig. 17: Thangtong Gyalpo's masterpiece, the Kumbum Chörten at Chung Riwoche, Tibet.

According to Thangtong Gyalpo's autobiographical notes, he assisted the construction of the Jonang Kumbum in his former incarnation. It was also recorded that he was an assistant at the construction of the Gyang Bumoche Kumbum as well. Later, he applied the same concept to his Dungtsi Lhakhang in Bhutan. Finally in Chung Riwoche, he finalised his own conceptual ideas and, as a matter of fact, the various Kumbums at Jonang, Gyang Bumoche and Chung Riwoche in Tibet as well as the Dungtsi Lhakhang in Bhutan used similar forms while from other Kumbum

Chörten, like the Kumbum of Gyantse, he attempted divergent philosophical concept and construction details, as exemplified by the internal circumambulation paths, Korlam. The similarities become clear if we consider the Bumpa: Only the Kumbum Chörtens of Jonang, Chung Riwoche and Dungtsi Lhakhang have the Bumpa split into two floors.

Like no other building or iron chain bridge is the preparations and the construction of the Chung Riwoche Kumbum described in greater detail in the biography (*rNam thar*) by Gyurme Dechen. Furthermore, Roberto Vitali could investigate the construction precisely before the end of the recent restoration work in 1988.

In 1448, Thangtong Gyalpo returned to the place at the Yarlung Tsangpo that he had named Päl Riwoche (*dPal Ri bo che*) in 1436, where he had established an iron chain bridge across that river. At first, he persuaded the local and regional rulers to establish a centre for the spread of Buddhist doctrine, at the place where the crossing of the river could be done with the use of an iron bridge. He received the approval from the authorities with a promise of support through supply of money, material, workers and artists. According to Vitali: "The lord of La-stod Lho accepted his proposal and offered craftsmen, wood and workers from his fief [khri.skor]" and Vitali continues with the translation from the biography of Gyurme Dechen:

> He went to dPal Ri.bo.che and many workers of Byang Khri-zhabs (the La.stod Byang prince) arrived in order to lay the foundation of the mchod.rten bkra.shis sgo.mangs (sic) in the earth-female-snake year corresponding to 1449. The master and his disciples worked as well with earth and stones. Due to the effort of all, many stones and much earth was put together. When the mchod.rten was completed up to the bum.pa [bell], it collapsed three times. Then they planned to expand the mchod-rten foundations to make it more magnificent in appearance. At every layer of the foundation's walls, grains were always found. The monks and workers were discouraged. Grub thob chenpo said, 'We are part of this impermanence. This is a sign for the community. What we are

> doing is for the benefit of dharma and sentient beings. If we do not succeed in this life, we will succeed in the next. It may be finished before my death. If it is not done, then there will be natural disasters such as storms, poverty, crop failures and excessive rain. The elements will fight each other; strife and unknown diseases will strike causing death. To avoid such misfortunes, willingly or unwillingly, you people must be patient and work hard, because this mchod rten is connected with the happiness of humanity and its building will cause deliverance to Sukhavati heaven.' After saying these words, the people felt encouraged and placed great trust in him in order to finish the work.[32]

In 1456, Thangtong Gyalpo completed the huge work. In the biography of Gyurme Dechen, he recorded the consecration rites of the chorten:

> Grub.thob chen.po completed the construction of the mchod.rten with a golden umbrella when he was ninety six in the fire-male-rat year corresponding to 1456. Then he gave empowerments to his spiritual son Nyi-ma bzang.po, who had originated from the three spokes of Grub.thob chen.po's rdo.rje, and consecrated the great mchod.rten.[33]

Even the description of the construction of the Chung Riwoche Kumbum is filled with legends and miracles exhibited by Thangtong Gyalpo, listing construction workers, striking and rebelling up to accidents that struck himself: At one point while breaking stones he was completely 'buried' alive by heavy stones. All workers thought that Thangtong Gyalpo was dead. But when they tried to dig out the 'dead' master after three days, he appeared more robust than ever before.

The Chung Riwoche Kumbum consists of nine floors with 84 chapels, including the ground floor. At the base floor, a Korlam is arranged, in the four floors on top of that twenty

---

[32] Vitali 1990, p.123/124.
[33] Vitali 1990, p.125.

chapels. The Bumpa is divided into two floors with a Korlam as in the Jonang Kumbum and Dungtsi Lhakhang in Bhutan, and in the roof construction, four small temple niches are arranged again. Like the Jonang Kumbum, the Chung Riwoche Kumbum is equipped with the same number and equally big temple niches at every floor, unlike the Gyantse Kumbum, which features large temple niches in each of the cardinal directions. Moreover, the temple niches in Gyantse are equipped with sculptural figures; the niches in Chung Riwoche are dominated by paintings. These paintings clearly show their own style, the Latö school, which was also founded along the lines of the Jonang Kumbum. This is very much in contrast with Gyantse, where clear influence from Nepal and China led to results that are more elegant. The Latö-style distinguishes itself through squatty athletic-like figures and by distinct thick, black edge lines.

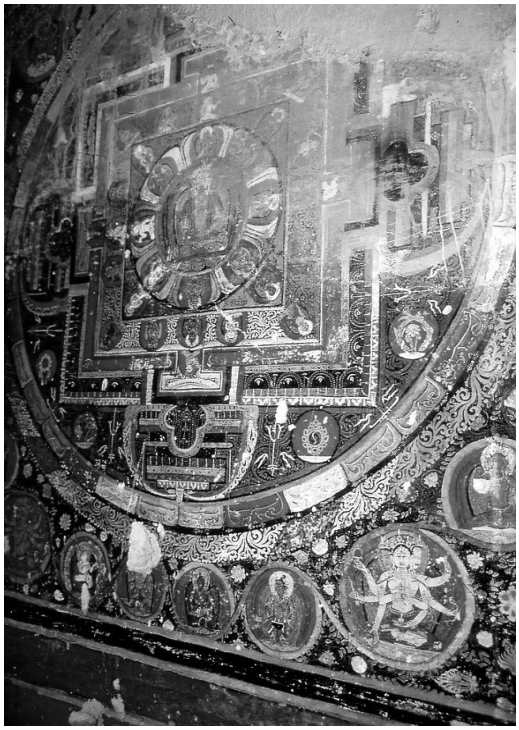

Fig. 18: Wall painting of the Kumbum Chörten at Chung Riwoche, partly destroyed during the Cultural Revolution.

Production of iron and steel

With the melting of iron and the forging of steel, Thangtong Gyalpo intervened even more in the craft activities. Moreover, it must be understood that the production of iron from iron ores in China, Tibet and Bhutan still needed no furnaces until the 20th century, but was processed in domestic workshops. On 14 December 1882, Karl Zittel writes about the iron production in China in the newspaper 'Allgemeine Zeitung'.

> The Chinese iron industry since thousands of years is pursued most intensely in the districts of Tay yang and Lo-ping. More than 100 million people receive their ironware

> needs from the cities of Föng-tai-shien, Ping-ting-tschou and their surroundings. One cannot think of an easier and cheaper iron production than here. The farmer digs the ore in his own field and makes it to the nearby smeltery; and fuel material of the highest quality is found everywhere. Furnace operation can begin with a capital of 100 German marks. The Chinese people do not know anything about furnaces or other costly facilities. People search a place for themselves, where the loess rises in two or three steady terraces. Then they dig some cavities into the walls and the establishment is ready. After clay, cabbage and ore are gathered, a plane square is pounded on the ground of the terrace, surrounded by mud walls, a small hut for the bellow attached to a side and on it the ground is supported by fist-sized Anthracit pieces. Then one puts up about 150 self-manufactured 15 inch high and at the top 6-inches-wide smelters which are loaded with a mixture by ore, small pieces of coal and of iron enriched slag. All gaps between the crucibles are filled with small Anthracit pieces, then above that Anthracit layers are spread and a new layer of crucible is added in the same way and yet again loaded with Anthracit. At the top, one prepares a roof from remains of used crucible, and now the fire is fanned by means of the bellow and is kept alive, until it finishes through natural draft. Once the ore has melted, the crucibles are poured out according to demand either directly in forms, or the contents are prepared to wrought iron by slow cooling.[34]

In Bhutan, the past still seems to be even closer. Phuntsho Rapten in the 23 June 2001 issue of *Kuensel* writes:

> The metallurgy of Chakor La at Geynekha in Thimphu and Barshong at Khaling in Tashigang used to be the main sources of iron ore for the Bhutanese blacksmiths. Literally, Chakor La means: 'Hill surrounded by iron ore'. The people of Geynekha up to 1950 paid taxes in the form of pig iron. Barshongpas (the people of Barshong) also paid taxes in the form of iron, which was used for forging swords during the rule of the Jakar Dzongpon, Pema Tenzin.

---

[34] Zittel 1882, p.1.

> A suitable depth compared to height of an at least one story traditional Bhutanese building must be dug into the earth to extract iron ore. The iron ore is found mixed with blackish earth. The people work on the earth with spades and pick axe. The pig iron ore is carried in a bamboo basket from the place where it was extracted to the place where the stove stands. The furnace varies from household to household, according to wish but is normally square in shape. On different corners of the furnace, a round hole is dug to let the molten iron flow out. Above the main fire hole, a tier of hard wood is piled up. On top of that, the earth with the enclosed iron ore is spread out and the process is repeated until the furnace is filled up. The fire is burning uninterruptedly. It lasts possibly from one week up to ten days or even one month to finish the process of the iron melting. It all depends on the size of the furnace. The molten iron, which is collected in different holes, is only soft iron, called Nyencha. Then these iron balls are put in charcoal and are heated up incessantly to make the iron harder (to produce i.e. steel). Swords and other household appliances are made from this iron. Different varieties of iron can be melted, while one uses different kinds of wood. One reaches a better quality of the iron if it is burnt with Sisi shing (oak) , Sokey shing or Thom shing. A medium quality is reached if the iron is burnt with Etho metho, Tar shing, Tsu-tsu and simple qualities are produced from Choka shing or Mur shing.[35]

The manufacturing methods used up to the recent time are strongly alike. The essential difference consists of the fact that the iron ore in China was melted with coal, while in Bhutan different species of wood was used to secure differing quality of iron.

The details on the iron ore locations and the export to Tibet by Thangtong Gyalpo differ a lot. According to sources, 18 different places are identified, where iron was melted and forged. Others speak of 1084 'plumbs' of iron that Thangtong Gyalpo was supposed to have brought across the border to

---

[35] Rapten 2001. p.6.

Phari Dzong in Tibet and still other sources speak of 7500 horse loads of iron that Thangtong Gyalpo transported from Paro to Tibet.

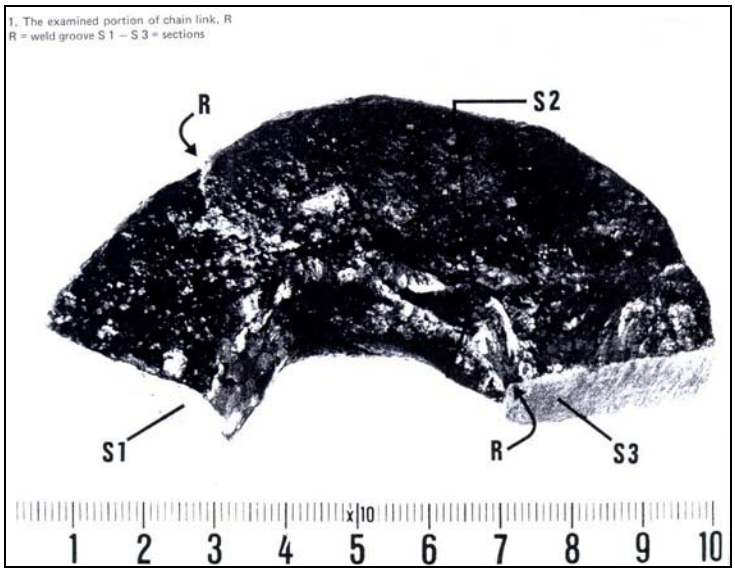

Fig. 19: Detail of the investigation illustrations of the ETH Zürich, Switzerland. Source: Epprecht 1979.

The production of iron was already known in Central Asia by 1200 BC. The art of the iron treatment and the production of bridges from iron chains, however, was the speciality of Thangtong Gyalpo. The production of steel could only be done by heating up the iron repeatedly, then forging rectangle sticks from this steel, form the sticks to chain links and finally, in a welding procedure at about 1,400 degrees, i.e. with almost liquid iron, have them diagonally overlap. If the iron or the steel becomes too hot during this procedure, it will be useless. Thangtong Gyalpo also perfected this art of crafting with additions like arsenic as a flux while doing the fire welding, which was possibly the last working step to the chain links at the site. By this procedure, he reached such an extraordinary steel quality that they were not only highly

strain proven but in many places still free of corrosion, even up to this day.[36]

In the middle of 1970s, a chain link of a bridge by Thangtong Gyalpo was brought to Europe form Bhutan to be examined thoroughly. The chemical investigation proved that it contained wrought iron similar to the hammered iron kinds from the Romans era with only about 2 percent of other alloys and with only 0.012 percent of carbon content.

Later in a more detailed metallographic investigation at the Confederate Technical College (Eidgenössische Technische Hochschule ETH) in Zürich, in the winter of 1978/79 provided precise information about the different dispersion of the carbon in the forged cross-cuts and the use of arsenic for welding together of the single chain links.

In summary, the report of the ETH ascertains:

> Finally it can be said that the iron chains of the Bhutanese suspension bridges were produced of forged iron. The chain links were created obviously from iron rods which were forged before from smaller iron malice with different carbon concentration. Afterwards the iron rods were forged to chain parts by heating up the iron in coal fire. In this way the iron was able to absorb carbon and thus become harder iron (steel). Then the chain links were possibly on site, closed by a fire welding technology which is unknown today and at which a thin film of slightly melted iron that contains the arsenic is coating the surface. Otherwise this technique is only known to have used by Roman for making their swords.[37]

---

[36] In 2004, Uli Barnickel, metal sculptor and blacksmith, help conduct the investigation of the Rinchen and Puntsholing Chakzam and examined the blacksmith's technology in particular.
[37] Epprecht 1979, p.150.

In the iron chain bridges of the Himalayas, there are five different types of chain links, as well as blacksmith's work that can be distinguished clearly:

Chain type 1: Outside length is 25 to 35 cm, outside width 8 to 10 cm, iron cross-cuts approximately 2.0 cm x 3.5 cm, no plane surfaces, relatively coarse blacksmith work. This kind of chain links, which today are kept and revered at the Sili Gonpa seems to have been used only at the chains of the former bridge across the Wang Chu near the village of Changshi.

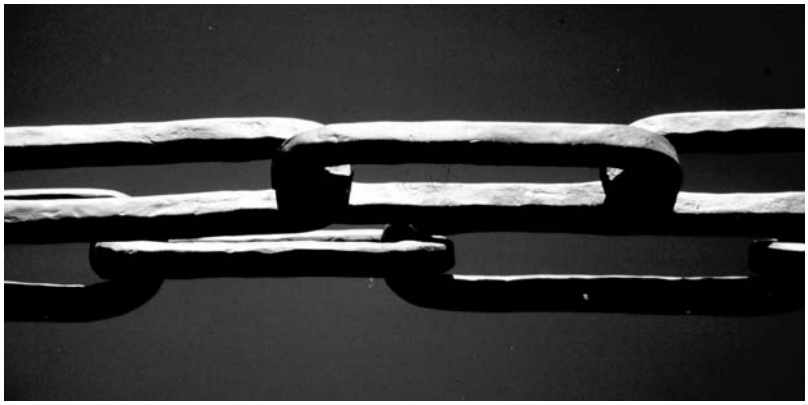

Fig. 20: Original iron chains of Thangtong Gyalpo without any corrosion even after 555 years.

Chain type 2: Outside length is 15 to 40 cm, outside width 5 to 8 cm and iron cross-cuts approximately 1.7 cm x 2.5 cm. The long sides of the chain links are precisely parallel and the chain links are completely smooth and have been forged elegantly. This kind of chain links seems to have been used in all bridges or the chains of bridges, which directly go back to Thangtong Gyalpo.

Chain type 3: Outside length is 15 to 40 cm, outside width 5 to 8 cm and iron cross-cuts of approximately 1.5 cm x 2.5 cm. The chain links have been forged to a more rectangular cross-cut, single limbs are almost like flat iron and above all, the long sides are not parallel, but have partly been drawn

inwards. The chain links were used in Tholing in Tibet and in Tamchok in Bhutan.

Chain type 4: Outside length is approximately 20 to 35 cm, outside width 5 to 8 cm and iron cross-cut of about 1.5 cm to 2.5 cm. The chain links have not been forged from rectangle steel, but from round steel. This kind of chain only exists in Nepal.

Chain type 5: Anchor cables from ship constructions: Outside length is 15 to 20 cm, outside width 8 to 10 cm and iron cross-cut of about 3 to 4 cm. Anchor cables were used only in the 20th century in Nepal for building suspension bridges.

The size of the chain links all together varies, partially in dependence with the spans of the bridges between 15 to 40 cm in length and approximately 5 to 8 cm in width and iron cross-cuts of approximately 1.2 x 2.5 cm to 2.0 x 3.5 cm. With the relatively large range of variation in the dimensions, the forging work shows a close uniformity with the chains from chain links of type 2.

In the literature, all iron chain bridges in Tibet and Bhutan are practically ascribed 'rightly or wrongly' to Thangtong Gyalpo. Unambiguously, through the comparison of the biographical information and the technical details, an 'original type' consisting of two chains, where a bridge rail is hung in between and also with the enhancement of two other chains can be attributed to Thangtong Gyalpo. Hence, the question of whether Thangtong Gyalpo has invented the iron chain bridges is pertinent. There are references to older bridges in the Tibetan literature. Tsering reports about an iron chain bridge, which was supposed to have been built by the Tibetans during the war against the Tang dynasty, possibly in the year 821 for crossing the lower Yellow river. Likewise, the third Karmapa, Rangjung Dorje (*Rang 'byung rdo rje*) who lived from 1284 to 1330 is said to have constructed an iron chain bridge across the Sog-chu. Tsering

cites Tibetan sources; however, there are no references about bridge constructions or their dimensions.[38]

Since 1200 BC, the production and forging of iron was known in China. One must assume that at least smaller bridges or footbridges made from iron chains were already in existence before Thangtong Gyalpo.

Thangtong Gyalpo's extraordinary merit lies in the fulfilment of the prophecies of Avalokiteśvara. Among others, he also developed the art of blacksmithery to the highest level through 'welding together' single chain links with the aid of arsenic, which enabled him to create bridge steel, free of corrosion. Even more so commendable was the mastering the art of building the 'gigantic' span bridges. Along with it, he was also greatly successful in building suspension bridges, in addition to the development of the bridge building as a whole to a new height in the 15th century.

---

[38] Tsering, T. 2001, p.59.