

A karst in Siam (Koh-Si-Chang)

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A KARST IN SIAM

(KOH-SI-CHANG)

I had been sailing from Singapore four days on the „Jutlandia“, when on a fine morning there appeared the silhouette of the islands of eastern Siam. It was a splendid morning, such as one sees in all its wondrous beauty only in the tropics, at the gates of the countries of the sunrise, or on the sea. The archipelago rose up drowsily from the sea like a huge sea-monster, the thick head portion (the high Koh-Si-Chang) pointing towards the north, the tail part (Kang-Ku), towering and declivitous, directed towards the south. From the general profile, rose up here and there, like so many rafts rocks and ridges, while the white, frothy waves of the China Sea gnawed at the foot. In wide, majestic curves we sailed round the rocky north peak (the mountain Lem-Si-Chang, 183' high) on whose projecting cliffs glowed red danger lights. On one of these rocky cliffs the Hin-Sam-Mah-Gen, barely 10' high, stands a lighthouse 25' high, of which the search-light can be seen 6 miles distant. It shows us the way to the roadstead of Koh-Si-Chang, on the north-east side of the island, where already a fleet of cargo ships and picturesque Chinese junks were waiting for a favourable opportunity to sail across the shallow Me-Nam-Barre into Bangkok.

A strait, one nautical mile in width, divides the archipelago into two groups of islands: to the east, near the east coast of Siam, the „Telegraph Island“ is largest in extent — nearly a square mile, and 204' in height (vide fig. 1). Then follow Koh-Kam-Noi (50'), Koh-Plong (34'), and Koh-Ram-Dok-Mai (54'). One can see splendidly from the northwest cape that the main island consists of a quartz-like brown stone, which is bruised and wrinkled considerably. From the mountain pressure have originated numerous systems of chains, which the breakers have, through selective erosion, considerably widened, thus producing the magnificent „surf organ“ into which the waves, lashed by the north-east monsoon, penetrate with a thundering and rumbling noise, then to glide upwards, there finally to lose their strength and

to perish. These organ pipes, which attain a height of 5—10 meters, are formed in the quartz, which in general slopes 40° to the south-west, and obviously forms the axis of a fold, the west flank of which seems to be formed by the island of Koh-Si-Chang itself.

We will now cross over to this island by ferrying across from Telegraph Island, on the west side of which the Post and Wireless Station is built near a shallow creek, to the village of Ban-Tarote on the eastern shore of the island of Koh-Si-Chang. Various difficulties

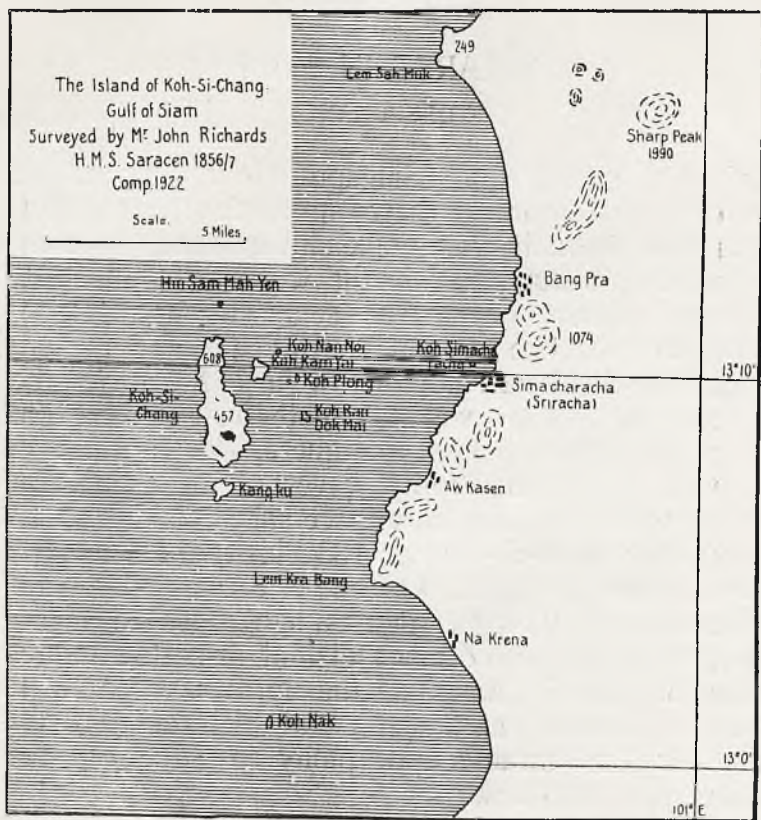


Fig. 1. — Sketch map of the Archipelago of Koh-Si-Chang.

arise when we attempt a landing: namely it becomes apparent that a completely flat submarine abrasion-terrace runs along the whole of the eastern shore of the island; this consists entirely of crystal limestone and shows the most beautiful abrasion phenomena and new shell reefs. Just as by the promontory and the sandy creek of Telegraph Island, one can notice here without difficulty marked ebb and tidal phenomena. A well-formed tidal cave has been powerfully hollowed out of the hard stone, while connected with the same, is a large number of small surf caves, especially on those parts of the coast which face the strong north-east monsoon blowing from the shore.

Already as we approach the customs-house of Ban-Tarote, which controls the exports and imports of the Kingdom of Siam, we observe a beach-terrace—deeply under-cut and hollowed out of the hard limestone — on which a small group of houses has been built.

We see the same thing further north on the beach of the village of Rai-Ban. The strand-terrace shows an abundance of limestone troughs, whirl-pool holes and caves, well scoured out by the surf, the inside, in places, being covered with a coating of crystallised limestone. Some of these are the handiwork of man, built in order to obtain in this manner excellent reservoirs for water, (both for drinking and for other purposes), which is extremely scarce throughout the island. We get a foretaste of a karst, and continue our journey with the greatest interest in the closer analysis of the landscape of Koh-Si-Chang, the most conveniently accessible karst of Siam.

One finds limestone in very many places in Siam: during my short journey of research in the interior of Siam, I often hit upon large quantities of this rock, which has the capacity of forming karsts. It generally forms cliffs, which often rise up abruptly from alluvial plains, steep and wild, forming unexpected alpine landscapes in low-lying flood land and marsh land. The extremely interesting hills of limestone cliffs of the Malay Peninsula are of this type — so far as they lie within the Siamese frontiers — as also the numerous palisade cliffs, which extend from Ratbury on the Me-Klong, on the west coast of the Gulf of Siam, right into the Bay of Bandon and as far as Sigora, and accommodate, among other things, the famous cave-temple of Petchaburi.

They flank the picturesque Bay of Prachuab Kirikan, and form many island hills in the plain of Bandon as also on the west bank of the great Tale-Sap. We find other groups of limestone hills, also cliff hills in Siam in the centre of the Plain of Me-Nam, and in the mountains of northern Siam.

Everywhere in them we find a strong formation of red earth, the formation of lapiés, frequent cave formations containing stalactites, but *dolinen-* and *polje-*formations are very rare owing to the slight topographical extent of the limestone, and the absence of high mountains.

The karst of Koh-Si-Chang is very similar.

The island is, from north to south, three nautical miles long, but from east to west is barely one nautical mile and a half wide; the northern part which I visited is covered with a variety of limestone hills, which culminate in the north in a height of 608' and in the south in 457'. The southern section, as also the northern section, consists of a range of hills with many peaks, which, owing to

the fact that they rise abruptly and steep from the seashore, make a much stronger impression than their real height would suggest. This hill-country is covered with shrub vegetation which, in its scantiness and wretchedness, its stunted growth, the large quantity of xerophile plants and varieties of thorn, both in general and in detail, strongly resembles the karst vegetation of the Mediterranean. Here also one finds on every hand varieties of macchia, which with their gray tones and their dry stunted branches, and the preponderating shrub growth, differ strongly from the otherwise luxuriant tropical vegetation of Siam, where rain is so abundant.

Between the two groups of hills, the island is much lower while it is here closed in throughout its whole width, by a terrace nearly 50 m. high, which in the west is accompanied by a narrower chain of lower hills. It appears that these hills, during the period when the terrace was formed, did not constitute an hermetical barrier between the east and west seas, so that in earlier times, when the water was about 50 meters deeper, the island, as seen today, was divided into a number of smaller islands.

The history of the changing of the sea-level can be easily seen from the island of Koh-Si-Chang owing to the fact that here, as in the Dinaric mountains, old erosion phenomena in the limestone have been wonderfully preserved. Thus the above mentioned 50 m. terrace, takes up a vast tract round Rai-Bon and includes the only fruit and vegetable gardens on the island. In its whole extent, it is covered with a layer of brick-coloured decomposed earth, a foot deep, which is in no place of such a bright red as the laterite, which is often found elsewhere in Siam. This terra rossa is extremely fertile, and in spite of the lack of water, permits of the cultivation of fine, profitable fruit-gardens and fields of vegetables, which in their admixture of herb and tree species, resemble those in the Mediterranean. I found many sea-shells in this terra rossa, which fact proves without doubt that we have here an old abrasion terrace. It seems certain that the shore in the Gulf of Siam has suffered a displacement of 50 meters.

Deeper, one finds along the whole eastern shore of the island a finely-preserved abrasion terrace, also about 20 meters above the present sea-level; along this runs, for instance, the road which connects Ban-Tarote with Rai-Ban to the north, and with Ban-Tao-Nam in the south. This terrace rises 15 meters higher than the lower terrace mentioned at the beginning of this article, on which stands the customs-house of Ban-Tarote. Thus we realise that the island of Koh-Si-Chang has risen from the sea by stages in at least three phases of development.



Fig. 2. — Northern and Central Part of Koh-Si-Chang.

The morphological detail-formation of the three terraces is extraordinarily analogous. On the surface of all three we find innu-

merable lapiés, rounded off and hollowed out, all pointing toward the sea. From these were formed submarine lapiés, chiefly by the receding waves of the sea. When these lapiés cross, — although they are usually parallel whirl-pool holes and troughs have been formed in the surfaces of all the terraces. Some of these holes are several meters large; others again are small but very numerous. On the higher terraces, the lapiés as also the troughs, are choke full of terra rossa, and are covered with, and have a hollowed and rounded surface. Finally, we find in the flanks of all the three terraces small cave formations, which date from the period after the elevation above the former sea-level and before the surface was covered with the thick layer of terra rossa. To these belongs, for instance, the „Salon Cave“, which is situated on the border of the upper terrace, whence the steep cemented, winding road leads up in steps to a height of 608'. This small cave, which it must be concluded, was formed by the breakers, rather than by subterranean drainage, has been turned into a reservoir, similar to the well near the landing stage at Ban-Tarote, by being surrounded by a low wall. The floor of the same is covered with a large number of small whirl-pool holes, which at the present day, are no longer active.

On the same level, i. e. on the 50 meters terrace, one finds excellently formed erosion phenomena south of Ban-Tao-Nam. This small settlement, which is today mainly a police camp, in which is also a school of correction where young delinquents from Bangkok are confined to work, stands on a narrow peninsula, projecting far out to the sea. The settlement is called Lem-Wat, and now little more remains but ruins and an obelisk. The splendid quays, the numerous foundations of palaces along the same, which were enclosed by artistic gardens, bear witness of a better past, since it was intended that a summer residence for the Royal family should be built on this spot. The numerous roads on the north-east side of the island, — as also the temples built here and there on projecting heights, embracing splendid views —, still bear witness to this intention. Indeed there are few spots in Siam which are so fortunately placed among the picturesque detail of the neighbouring karst scenery, the wide view of the blue sea and the mountain scenery of eastern Siam, veiled in hot mist on the far horizon near Spiracha.

Ban-Tao-Nam is a classical point for a study of the karst formations on Koh-Si-Chang.

On the shore-line which was flooded daily by the tide we had already noticed, about 500 m. west of the Asadang pier, a subterranean source of fresh karst water. It is surrounded by an artificial wall, which rises just above the level of the highest tide, thus



The Island of Koh-Si-Chang seen from Lem Wat.
In the background, to the left, the lower terrace of the Officers' House; to the right
the high terrace of the Pracheda near the Bo-Asadang.



The karst-formed bed of the dry valley by the Bo-Asadang.

preventing the fresh water from being mixed with that from the sea. At a short distance south of this spot we came upon a dry river bed with small *ponor*.

We came upon neglected paths in parks, where are beautiful „sacred“ trees in full blossom, some carefully protected by cement walls, and arrive at the commanding officer's house, which stands in a beautiful spot on a terrace 10—15 m. high. A few feet south of the same we came to the bank of a dry river-bed, the bottom of which is about 5 m. wide and is covered with numerous *lapiés*, which have been chiselled out of the white limestone, and whose nakedness glows wonderfully in the burning rays of the tropical sun. The rain water which is collected in this river-bed during the monsoon storms, after flowing a short distance disappears into a narrow *ponor* cleft, the entrance to which is easily distinguishable. This is connected with the subterranean cave formations; indeed we find at a short distance, near the coast, but about 20 m. above the same, the entrance to extremely interesting cave formations, which have been made practicable in order that the caves may serve as cool resting-places for holiday makers, who have grown weary in the heat of the sun of southern Siam. It is a narrow cave in a gap which has been formed through the widening of an almost perpendicular cleft, which runs 50—80 m. into the earth. The cleft, on an average 8—10 m. high, has two exits, of which one serves at present as a shaft for air and light, and so furnishes the cave with the necessary ventilation.

On the walls of the cave, which is now perfectly dry, there are numerous coatings of crystallised sinter, which represent the rudimentary stages in the formation of stalactites and stalagmites. We shall not be surprised to find that there is a lack of water in the cave, when we notice that near the cave, a blind karst valley has cut its way, through which the subterranean water is easily drained.

This valley, having a length of scarcely several hundred meters, with a broad bottom and steep sides, finds its exit in the sweeping sandy bay of Ow-Tong-Team, on the flat delta shore of which the sea washes a conchiferous sand in which particles of *Cardium*, *Venus*, *Strombus* and *Ostria* are to be found. However, it appears that very little karst water flows now through this blind valley. One can even notice how, near by, the rain water can be collected on the surface without great difficulty. A short distance beyond the above-mentioned dry river-bed, after passing an empty white pagoda, decorated with gold which can be seen from afar, we come to the Bo-Asadang. This well is named after, and was built in honour of Prince Asdang, the brother of the present King, Vadhira-vud Rama VI.

The whole of the population of the eastern coast of the island draws its water from this well. It consists of a cleft in the massive limestone rock (the strata of which however are very thin), in which the water has been dammed in by means of an artificial cement wall. This warm, green liquid, full of vegetable and animal matter would not be very pleasing to a european palate. The natives carry it down to the shore in two large square tins slung across the shoulders. However, the inhabitants of this arid limestone island are able to exist in the hot, dry months of the year, before the beginning of the south-west monsoon and the rainy season which accompanies it. On the shore boys and girls load small boats with this water and carry it alone several miles to their homes.

These water-boats are just such an anthropogeographical characteristic of the karst of Koh-Si-Chang, as are the mule caravans, which carry the water in the karst of the Balkans and Italy. This comparison is complete when we remember that, even as here, the whole question of house-keeping depends on economy in the use of water. Fruit growing is not so widely developed as vegetable culture, since to the latter artificial watering is better suited. The most important animals which are bred are the karst sheep, and above all, the xerophile goats.

While the fire-ball of the sun — which, throughout the day has been beating down perpendicularly on our heads — quickly sinks into the sea, immediately behind the limestone hill of Koh-Si-Chang, our glance wanders from the ruins of the Lem Wat over the karst field, its lapiés plains, sharp terrace formations, its subterranean fresh water springs, its caves, dry river-beds; its blind valleys, its terra rossa plains formed from poor macchia and heath, on which graze small herds of goats; its water caravans, which climb down from the natural reservoir of Bo-Asadang on the gray limestone rock in the mountain side, and then in low boats, propelled by female gondoliers, make for Ban-Tarote and Rai-Bon, disappearing in the sunset glow. Then we come to the conclusion that the evolution of the tropical karst is, in the main, identical with the evolution of the karsts of the Mediterranean and Central Europe; and we are convinced of the invariability of the morphological law.

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The cleft reservoir of the Bo-Asadang.



The transport of fresh water along the coast of Koh-Si-Chang.

