CHAPTER 2

A. PREVIOUS WORK

Literature on the Rann of Kutch is scanty, and there is almost none on its inundation problem. Old reports in the various Gazetteers provide mostly eye-witness accounts of travellers that are of little scientific value. Some workers like Oldham, Mac Murdo, Wynne etc., who investigated the geology and seismic phenomenon of the Kutch region as a whole, have briefly dealt the subject of the evolution of the Rann. Though their account hardly gives details of the inundation problem, the author has preferred to summarize their

work on the Rann to provide a suitable background for the present study.

Historically, as stated in the Bombay Gazetteer, the Rann of Kutch exists since ancient times. For more than two thousand years it was known as 'Kranya', and during this period many changes occurred, and a greater part of the Rann subsided and got flooded by sea water more than once. Alexander the Great in 325 B.C. found the Rann, a great lake that was fit was navigation, and it seems quite probable that for a thousand years thereafter, much of the water of the Indus, crossed the Rann on its way to the sea. Bombay Gazetteer also reports that "on the northern shore of the Patcham island about 80 feet above present Rann level, traces of an old sea in a patch of concrete, full of marine shells, and near Phagwada near Patcham, pieces of iron and ship nails were thrown up by the 1819 earthquake." A perusal of most of these old reports leads one to conclude that even during historical times the Rann was a part of the sea and that flourishing ports once occupied places that are now barren.

MAC MURDO

Mac Murdo (1823), a British Army officer, during his posting at Bhuj, prepared excellent eye-witness

accounts of certain phenomena of the Rann. His observations of the Kutch earthquake of 1819, which changed the Rann morphology considerably, is one of the few eye-witness accounts. He observed that the rivers in valleys and those with sandy beds, which generally remained dry, got filled with water for a period ranging from a few minutes to half an hour. At many places, he states, (1823, p.990) "spots of ground in circles of from twelve to twenty feet diameter threw out water to considerable height, and subsided in a slough." He found that the earthquake had raised an earthen mound about 50 miles long in an east-west direction and a mile wide, with a steep face on the south side but no perceptible slope on the north. There cannot be a doubt at all that the Rann land during the shock sent forth vast quantities of water and mud. This elevated portion in the Rann he called Allah-Bandh - the Mound of God.

ALEXANDER BURNS

Describing a subsequent earthquake Burns in 1827 (cf. Railway Report, 1946) has stated that bundhs built across the Kori Creek were burst and water started flowing through the old established channel, cutting

for itself a passage through Allah Bundh, which resulted from the earthquake described by MacMurdo. He travelled up the channel from Lakhpat to Allah Bundh and reported that rivers at Lakhpat upto twelve miles upstream were two to three fathoms deep. On going further up for two miles, the depth increased and he entered a vast inland lake amidst which the remaining tower of Sindree stood like a rock. At Allah Bundh, the channel, he states was about 35 yards wide and 3 fathoms deep and fresh water was flowing. Four months later he visited the locality again and found great changes. The river and lake were deeper by two feet and the sheet of water entirely salty. This visit was made during the monsoon season when the south-westerly winds had blown the sea-water upon the fresh-water.

D'COSTA

The Railway Report (1946) refers to the accounts of D'Costa of the Great Trigonometrical Survey of India who visited Sindree in 1836 by boat from Lakhpat and found water continuously over the whole way overlying the salt in places, three to four feet thick and could barely see the ruins of the Sindree Fort.

BURNES

Burnes (1839) a traveller, has claimed that his is the first account of the Rann. He has written (1839, p.308), "I am not aware of any other account having been published." About the Rann he says (Ibid,p.308), "it is not saturated with water, except at certain periods, that it has no weeds or grass except on the islands, that it has a 'bed', which instead of being slimy, is hard, dry and sandy, of such a consistency as never to become clayey ..... a vast expanse of flat, hardened, sand-encrusted with salt sometime an inche deep." Burnes (Ibid, p.325) quotes from MacMurdo's papers, "The Rann has every appearance of the sea having shortly withdrawn from it."

He has also stated (Ibid,p.308)., "Previous to the battle of Jarra in 1762, the eastern branch of the Indus commonly called Phurraun, emptied itself into the sea, by passing the western shores of Cutch." Following the battle of Jarra, rulers of Sindh built dams across the Phurraun so that no water of the Indus entered the area of the Rann. However, at intervals of some years, when the monsoon was particularly strong, or when there was an exceptional flood from some other cause, these dams were swept away, and the Rann was flooded to a greater

degree than during the usual years of inundation (Ibid, p.310). At one place, he has stated (Ibid, p.319), "that the people of Kutch believe that the Rann was once a bay with harbour along its edges." According to him (Ibid, p.321) the 1819 earthquake is said to have spewed up great quantities of mud and water and pieces of iron and ships nails along the edges of the Rann, especially in the southern part.

Commenting on the 1819 earthquake he wrote (Ibid, p.311) "that a large lake formed on the south side of the Allah Bundh, completely submerging the small village of Sindree in about eighteen feet of intensely saline water. The land in the vicinity is so flat that the lake extended as far as the eye could see both east and west. It was later determined to be more than thirty miles in diameter. The earthquake made numerous cracks and fissures in the Run, and I state on the authority of eye witness, that immense quantities of black muddy water were ejected from these openings for a period of three days, and that water bubbled out of the wells of the tract bordering the Run, called Bannee, till it overwhelmed the country in some places with six and even ten feet of water."

LYELL

From his observations of Rann, Lyell (1855,p.346) has described it as "that singular flat region called the Rann of Cutch, near the delta of the Indus which is 7000 square miles in area. It is neither land nor sea, but is dry during a part of every year, and again covered by salt water during monsoons. Some parts of it are liable, after long periods to be overflowed by river water." He has further stated (Ibid,p.463) "during the monsoon when the sea runs high, the salt water driven up from the Gulf of Kutch and the creeks at Lakhpat overflows a large part of the Rann."

FRERE

Frere (1870,p.188) has described the Rann as "many square miles of barren ground covered with a solid cake of hard transparent ice-like salt, from a couple of inches to in some cases two feet in thickness." In his words (Ibid,p.84), "the surface (of the Runn) is apparently for all practical purposes, a dead level. When the surface is dry, so imperceptible is the slope, that a shower of rain falling on the hard, polished surface, neither sinks in nor runs off, but lies like a vast slop , on the plain, and may sometimes be seen moving along with the wind, till it gradually dries up by evaporation."

In his view (Ibid, p.193), "the Rann of Kutch was a gulf of the sea, with surrounding coastal towns, a few recognizable relicts of which still exist." Commenting on the earthquake of 1819, he observed the water level going down at the time of the earthquake and attributed this to a general rise of land north of the Allah Bundh. He also mentions mud volcanoes on the coast of Sindh.

Frere made some good observations on the Rann salts. Regarding their origin he wrote (Ibid, p.188), "various theories put forward to account for these thick sheets of solid salt, on a perfectly level surface of dry sand and clay, the most probable and most consistent with observed facts appears to be, that it is formed by the gradual evaporation of the intensely saline salt water which is always present in the sub-soil, and which cozes to the surface by capillary attraction or under pressure, from rain in the upper country, and from high tides in the creeks which intersect the plains where the sheets of salt are found." He also observed that the salt sheets generally occurred in the western part of the Rann.

Commenting on the apparent flatness of the Rann, he (Ibid, p.196) stated that regardless of the method of deposition of material on a delta there will always be some relief, but that Rann has no surface relief. He believed that (Ibid,p.196) "the constant recurrence of surface agitation from earthquakes, especially during the time when the surface is annually covered with a couple of feet of water, supplies exactly the kind of cause which would account for the uniformity of the level. We have evidence that under the action of an earthquake mounds of such sandy soil as that of Rann melted down, as it were, into the water which then covered the Runn, and that in place of the mound there is now the usual, firm, smooth level of the rest of the Rann. There seems no reason why the same sort of process, frequently repeated, should not obliterate all traces of creeks and water courses, and reduce the Rann to the surface which we now find. The Rann is, in fact, a great basin subject to frequent earthquake agitation."

WYNNE

In his Memoirs Wynne (1872) has compiled some of the best observations on Rann and the 1819 earthquake. On the evolution of the Rann, the following extract from

his works is of interest. He has stated, "formerly a considerable area of the river Indus called the Koree, traversing the delta found its way to the western extremity of Cutch and its annual inundations watered the low ground north of Lackput, then called Sahra, a fertile rice producing country." Shortly after the battle of Jarra, fought on the heights overlooking the Rann, south-east of Lakhpat in 1764, the construction of a bundh across the Koree, stopped fresh water reaching it elsewhere and the Sahra became a sandy desert. Wynne believed that the entire plain was a delta of the Indus. He wrote (Ibid, p. 28), "to whatever causes the great plains of Sind and western India are due, that of the Rann may also be ascribed. Its origin may be traced further back than the formation of the deltas of the Indus and other neighbouring rivers." Wynne did not agree with the idea that the Rann is a raised sea-floor, because, according to him, the surface is too smooth to be so. He stated (Ibid, p.28), "the surface of the Rann differs much from that beneath the neighbouring sea as shown, by the Coast Survey Chart, on which are marked descents of 84 feet within less than a mile, besides various inequalities which do not exist in the Rann."

Wynne has given a detailed account of the various earthquakes that visited the Kutch during the 19th Century. A summary of his account is given below.

In 1819 a very severe earthquake took place. It was felt all over the Kutch State, and caused serious loss to life and property. This earthquake brought about great changes in the Rann area. A large portion of the Rann near Lakhpat and some smaller areas to its north were suddenly depressed.

Sindree which was the custom post of Kutch government was submerged under a depth of 16 feet of water. The bed of the Koree was said to have been raised for two to six miles by this earthquake. This earthquake gave rise to the slightly elevated land, north of Sindree, later known as "Allah Band".

In the year 1844, there was again a series of earthquake shocks, lasting for about one month and these earthquakes further raised the elevated lands around Allah Band.

During another severe earthquake of 1845, the sea rolled up the Kori, overflowing the country westwards. The water went beyond 40 miles from the mouth of the Kori and eastwards to Sindree lake.

In the year 1864 another earthquake took place, but it was felt chiefly in western Kutch only.

OLDHAM

Thomas Oldham (1883), who gave a catalogue of Indian earthquakes, described the 1819 earthquake of Kutch in some detail. His inspection of the Rann led him to find that during the earthquake of June 20, 1819, numerous jets of blackish, muddy water were thrown out from fissures, and cones of sand 6 and 8 feet high were thrown up. The local inhabitants, perhaps mistook this phenomenon to be a volcanic activity. They told Oldham that, "the volcano called Denodur burst into action, and the shocks ceased." Oldham, when he visited the hill found no evidence of volcanism, either old or new.

ROWLAND

The Railway Report (1946) mentions the work of Rowland who carried out in 1897 a detailed survey of the tract between Lakhpat and Moghalbin (now in Pakistan) in the north-western extremity of the present day Rann. In this connection, he studied the Rann of Kutch also, and wrote as under.

"Previous to the earthquake of 1819, the eastern Nara, one of the mouths of the Indus River, flowing through the rich alluvial plain discharged its water into the ocean, through what is known as the Khori Creek. The immediate effect of the earthquake was to form a large depression in this plain, while a corresponding uplifting of the ground intercepted and changed the course of the river. The mouth of the river no longer fed from above by sweet water, became purely tidal and began to silt up, while the whole of the depressed land coming under the salt water influence, was converted into a salt marsh. The gradual recession of the sea water is a very marked feature in this case." Rowland's report on the silting of the Kori Creek was further corroborated by a later survey made by him. Inquiries made by him at Lakhpat also showed that as a result of silting of the creek, the sea-port of Lakhpat was further shifted about two miles to the south and two new creeks, the Adyand and Sugand creeks, were formed which, according to him, are said to be cutting northwards at an alarming rate.

Rowland in his survey has also made the following remarks regarding the outflow of water from the Rann basin. "The most searching local enquiries could obtain

no evidence of an outward flow of water from the Rann basin trough the Kori Creek. The natural configuration of the ground, together with the side extent of the Rann depression, are sufficient to explain this, while at the same time there are evidences on record of an easterly flow of the Rann waters and of their escape via Little Rann."

GULES

According to the Railway Report (1946), Gules who carried out a reconnaissance survey of the Lakhpat-Badin (now in Pakistan) route in January 1906 described the Rann as follows:

"The Rann presents a level and featureless floor of sand as far as the horizon in all directions the whole way. In the monsoon it is said to be covered with sea-water to a depth of two to three feet. The flooding of this part of the Rann is independent of tides and is due entirely to the wind."

SIVEWRIGHT

In his description of the Rann, Sivewright (1907, p.531) has quoted an Arab historian of 1361 A.D. who described the Rann area as a marsh where "no bird even

flapped its wings over it, not even a miserable noxious weed." In his reflections on the history of Kutch, he explained features present during Alexander's military raid into India. "At that time (325 B.C.)", he writes (Ibid, p.518), "seven islands lay off the western coast of Hindusthan. These islands, as such, have long ceased to exist; they are now joined up together with the mainland. Five of these one time islands are now collectively called Cutch." Sivewright has also quoted an explorer of about third Century A.D. who wrote about the shore line between Kutch and Sindh to the north (Ibid,p.529): "The sea in both (the big and little Rans) is shallow, with continual eddies, and eddies in shoal with water extending a great way from shore, so that vessels are frequently aground before they come within sight of land."

Of the nature of soil, Sivewright (Ibid, p.533) described the silt of the lesser Rann as follows. "This silt, when wet, became clayey. Whereas the silt of the Greater Ran is unmistakably an Indus valley deposit; that of the lesser Ran is as easily recognized as the black cotton soil of its source of origin in Kathiawar." On the gradient of the Rann, Sivewright (Ibid, p.527) stated emphatically that the Rann has a west slope rising

six inches per mile from the sea to at least twenty miles inland and according to him the wind blew the water downhill to the sea and during the southwest (wet) monsoon, all the creeks and rivers entering the Rann from higher ground were flooded, but the sea was not observed to rise more than four feet at the most.

IMPERIAL GAZETTEER

In the Imperial Gazetteer of 1908, the origin of the Allah Band has been discussed. It is written that (Ibid,p.77), "early observers speak of it as an upheaval of the surface. But from the north side there is little sign of any rise in the land; and a few years after its formation (1826), the flood waters of the Indus, keeping their former course, forced their way through the dam. These two considerations would seem to show that the apparent height of the bank, as seen from the south, is to some extent due to the fall in the level of the land in that direction."

R.D. OLDHAM

R.D. Oldham (1917) was of the view that the Rann is a filled up tectonic basin. On the basis of a geodetic traverse of Indo-Gangetic plain, he believed

that the entire area from the Himalaya to the high lands of central India was a tectonic basin filled with alluvium brought down from the mountains.

In a later work, he classified the Rann according to the type of vegetation and the type of land surface. He wrote (1926, p.81), "Three types of surfaces are recognised in the Rann. The first as runn gives its name to the whole tract; the second known as 'dhoi' or 'bet', is a sandy soil free from salt, bearing a growth of grass and occasional stunted trees and bushes, is found around the margins of the 'runn' and rising, as islands of various sizes from the surrounding tract of rann; the third known as 'Kalar' may be regarded as a transition between Rann and dhoi; it is less impregnated with salt than the rann and bears some scattered vegetation. The distinction between rann and dhoi is evidently due to the fact that all vegetation on the former is killed by periodic flooding, which keeps the surface soil impregnated with salt." According to him, though the Rann is deoivd of vegetation, "the location of rann areas and bet areas changes over a period of years." (Ibid, p.98).

Commenting on the 1819 earthquake (Ibid, p.93), he claims that apparently the earthquake raised an earthen mound about fifty miles long in an east-west direction and a mile wide, with a steep face on the south side but no perceptible slope on the north. The mound, he said, was at first about thirty feet high, but in subsequent weeks minor shocks reduced its height to ten feet. Oldham has also quoted the views of Suess (1892) and Wynne (1869), to support his belief that there was no real uplift on the north, but that all movement was down on the south.

WADIA

Wadia (1926, p.169) in his text book on Indian geology has given a summary of the geology of Kutch and about the Rann he has written, "it is quite probable, however, that large parts of the country which at the present day are long dreary wastes of black saline mud and silt, (the Rann) is underlain by a substrata of the peninsular gneisses together with Puranas." He further says that "the Rann of Kutch, another tract of the Indo-Gangetic depression, which owes its present condition to the geological process of the Pleistocene age. The

tract is a saline, marshy plain scarcely above sea-level, dry at one part of the year and covered by water at the other part. It was once an inlet of the Arabian sea, which has now been silted-up by the enormous volume of detritus poured into it by the small rivers discharging into it from the east, north and north-east. From November to March i.e. the period of north-east or retreating monsoons, the Rann is a barren tract of salt encrusted mud. During the other half of the year it is flooded by waters of the river that are held back by the rise of sea by the south-west monsoon gales.....if depression does not take place, the greater part of the surface of Rann will be gradually raised by silts brought by the rivers in each flood and in course of time converted into an arable tract, above the reach of the sea, a continuation of the alluvial soil of Gujarat."

SATYANARAYANA

Satyanarayana (1947, 1951) at the request of then North Western Railway authorities conducted a rapid reconnaissance soil survey of the Rann of Kutch with the object of assessing the suitability of the area for agricultural purposes. He divided the area into 3 broad

categories: (1) The Banni slightly high level ground compared to the Rann (2) Salt area which is over-run by sea-water at certain times of the year and with a standing deposit of salt crust and (3) The flood plain, which is flooded annually by rivers discharging into the Rann. The flood water, according to him, due to the prevailing winds, gets mixed with sea-water and the resulting salt water stays on the ground for a considerable period due to slow surface drainage.

Satyanarayana also conducted some soil profile observations and commented that though the profiles from the different areas exhibit some differences in detail, a number of common features were also observed. All the profiles showed high salt contents injurious for crops and varying amounts of gypsum in the profile. The gypsum concentrated, according to him, occur at a lower depth in the areas inundated by river water while in the areas reached by sea water the maximum quantity is found in the top 12". He noticed a fairly high water table and occurrence of gley horizons. Thus the soils show the characteristics of ground water soils and also of saline nature.

Satyanarayana's work was based mostly on heavy mineral analysis and other physical properties of soil. It was found that minerals of the sediments were of heterogeneous origin and that trap basalts contributed the major portion in the south, while the granites, sedimentary and metamorphic rocks of Rajasthan and Kutch contributed to the soils in the north. The mechanical analysis showed a bimodal nature of the sediments, probably indicating a dual nature of sediment transport i.e. by traction and suspension. Features like increase of heavy percentage up the profile as also the increase of the coarser grades of the traction load indicated a shallowing of the Rann, while similar increase of the finer grades of the suspension load probably pointed to a maturing of the soils of the surrounding plain.

PLATT

Platt (1962) has published an informative paper on the Rann of Kutch, wherein he has reviewed the observations of the various previous workers. He has also attempted to derive scientific information out of the early reports of the numerous workers. He agreed with many of Frere's (1870) observation, and concluded that the material of the Rann is Recent alluvium, the

source being the drainage basin of the Indus River, and less importantly the Luni and Banas. According to Platt (1962,p.98), "the space where this sediment collected was a bay about twenty-three centuries ago. The energy to bring the sediment was supplied by the Indus River, and the energy to smooth the surface was supplied by frequent earthquakes, some of which have been severe. No need has been found to call upon extraordinary processes. The Runn of Cutch is extraordinary, however, because it has been observed to change from marine bay to alluvial plain in a geologically short time, and without any complications from Pleistocene changes in sea level."

GLENNIE

Glennie (1970,p.136) writes that, "like the coastal sebkhas of Persian Gulf, the surface of the Ranns of Kutch is at, or slightly above, sea-level. During three months of the South-west Monsoon, storm tides, aided by the wind, force water from the Arabian Sea over the flat surface of the Ranns. Rainfall is fairly low, so that as the waters recede and evaporate, they leave behind a crust of halite, and gypsum crystals grow in the clays and sands. The few rivers (wadis)

which flow into the eastern ends of the Ranns carry only limited fresh-water and sediment for about one week during the monsoon. For the rest of the year they are dry. The result is that an area of about 30,000 km^2 (about the same size as The Netherlands) is subjected to annual flooding with the succeeding formation of evaporites." He further writes (Ibid,p.140), "in constrast to the coastal sebkhas of the Persian Gulf, the sediments of the Ranns of Kutch are poor in carbonate minerals. This is thought to reflect an influx of sediment from the Arabian Sea, which in the vicinity of the Indus Delta, is rich in fluvial sand and clays."

SHRIVASTAVA

As a part of the activities of the O.N.G.C. Shrivastava (1971) conducted a geological survey of the Recent sediments in the Rann. According to him, the structure of entire Kutch basin of Mesozoic to Recent sedimentation is primarily controlled by WNW-ESE trending parallel set of faults, block movements along which have formed a number of horsts and half-grabens. He states that the Great Rann and the Banni occupy the sites of half-grabens while the islands of Pachham, Khadir and Bela and the Kutch mainland form the horsts.

He has further stated that in the last 2000 years, silting accompanied by a slight elevation of land, has converted the marine embayments into dry salt covered mud flats slightly above the tidal range of the Arabian Sea. He has also delineated the sedimentary environments and subenvironments. According to his statement, during annual SW monsoon, the western and central portions of the Great Rann are flooded not only by surface run off from the mainland but also by waters driven up the creeks from the Arabian sea by storm tides. The lagoon at Sindree is over-flooded by sea and sheets of sea-water are blown over the Great Rann. According to him, tidal waters carry with them a load of sediments brought from the Indus delta region and that coarser sediments are deposited in inlet channel and at their heads, whereas the finer and muddier sediments are carried further and spread over flooded areas. When the sea-water floods the outer Rann in monsoon, the inner parts of both Ranns and Banni are flooded at the same time by river waters. The coarser fluviatile sands and silts are deposited at the mouths of the rivers while the finer sediments are carried further into the Ranns to mingle with the sediments of the intertidal flats.