## CHAPTER II

## P R E V I O U S  W O R K

In the past, geological investigations in Kutch have been conducted in relation to the following aspects:-

(1) Seismicity of the region.

(2) Nature and origin of the Rann.

(3) Structure, stratigraphy and economic aspects.

The author does not propose to go into the details of previous work concerning the studies of

earthquakes in Kutch and also would like to avoid lengthy references on the Rann, as these two aspects have little bearing on the present investigation. Interested reader is referred to the works of MacMurdo (1823), Burnes (1839), Lyell (1853, 1855), Blanford (1869), Frere (1870), Thomas Oldham (1883), R.D.Oldham (1926), Wadia (1926), Sen and Satyanarayan (1953), Balasundaram and Poddar (1957), Platt (1962).

In this chapter, the author has given a brief resume of the regional geology as worked out by a number of workers in the past. Such an account is essential to provide a suitable background for the present investigation.

## MESOZOIC ROCKS IN GENERAL

Kutch has been attracting geologists since early 19th Century. Most of the past investigations based mainly on the palaeontological aspects of the Mesozoic and Tertiary rocks. Besides palaeontology, a few workers have dealt with (1) the general stratigraphy and structure of the rocks of the Kutch, (2) the Deccan-trap activity and (3) the economic

aspects including minerals, coal, lignite and petroleum and ground water.

Grant (1837) was the first worker to write about the geology of the whole province. His report was accompanied by map-plates and a list of fossils. His work was of only preliminary nature but provided a suitable framework for the future investigations.

It was Blanford (1867) who gave for the first time proper ideas about the geological structure of the Kutch. He took a number of rapid N-S traverses in the region and suspected the existence of an E-W fault along the northern fringe of the Charwar-Katrol hill ranges. He also stated that the terrestrial rocks were actually intercalated with the marine Jurassic rocks.

In a preliminary note on the geology of Kutch, Wynne ( 1869 ) correlated the plant-beds of Kutch with the Rajmahal Series (Upper Gondwana) on the basis of a few forms of Ptilophyllum found common in both the formations. About the mode of occurrence of the plant bearing beds as intercalations in marine

Jurassics, Wynne believed that they "have probably been drifted into these localities from shores adjoining the seas in which the mollusca, now found fossilized in these beds, then existed."

T. Oldham (1869), however, suggested that the beds in which the well-marked Palaeozomiae (now called Ptilophyllum) occur were true intercalations terrestrial deposits, and 'decidedly younger than those containing the truly Jurassic Ammonite and other characteristic fossils, and that they constitute an upper zone, but belonging to the Jurassic period.

In 1872 Wynne completed his mapping of the Kutch and gave a detailed account of the geology of the area. (Wynne and Fedden 1872). His geological account consists of detailed descriptions of a number of important sections. His has been the most detailed and important contribution. In fact, he laid the foundations on which our present knowledge about the geology of Kutch has been built and firmly established by subsequent workers. Wynne gave the following succession for the Kutch rocks:

| FORMATIONS | SUB-DIVISIONS | | PERIODS |
|---|---|---|---|
| RECENT | Alluvium, blown sand and subrecent deposits | (m-n) | Pleistocene |
| | Upper Tertiary | F (l) | Probably both Pliocene and Miocene |
| | (Unconformity) | | |
| TERTIARY | Argillaceous Group (Fossiliferous) | E (k) | Miocene or Upper Eocene |
| | Arenaceous Group | D (j) | Eocene |
| | Nummulitic Group | C (i) | |
| | Gypseous shales | B (h) | |
| | Sub-Nummulitic | A (g) | |
| VOLCANIC TERTIARY | Stratified Traps and intertrappean beds | (e) (f) | |
| | Infra-Trappean Grits | (d) | |
| | (Unconformity) | | |
| | Upper Jurassic Group | (c) | Oolitic |
| | Lower Jurassic Group | (b) | |
| METAMORPHIC CRYSTALLINE | Syenite | (a) | |
| TRAPPEAN | Intrusive Traps | | |

Wynne divided the Jurassic rocks of Kutch into an upper and lower series. His 'upper series'

comprised the plant bearing rocks (Palaeozamia beds) and his 'lower series' the marine fossil bearing rocks of the earlier workers. He considered the 'lower series' to be equivalent to Dogger (Middle Jurassic) and both the series together to Oolitic of England.

The existing fourfold subdivision of the Jurassic rocks of Kutch into Patcham, Chari, Katrol and Umia, was put forth by Waagen (1871, 1873). He studied in detail the fossil ammonites and with the help of Stoliczka, who investigated the stratigraphical relations of the rocks in the field, suggested the above mentioned classification. Accordingly, the Patcham, Chari, Katrol and lower part of the Umia corresponded with the 'lower series' and the upper part of the Umia with the 'upper series of Wynne. (Fig. 3).

R.D.Oldham (1893), however, on the basis of Stoliczka's field notes, modified Waagen's classification and included the beds at Ukra hills (considered by T. Oldham as Cretaceous) into Umia Series (Fig. 3).

Kitchin (1900, 1903) investigated the Jurassic fauna of Kutch in detail. His studies were mainly confined to the brachiopods and lamellibranchs.

A few years later Vredenburg (1910) modified the stratigraphy given by R.D.Oldham (Fig. 3).

The most outstanding work on the Mesozoic rocks of Kutch is due to Rajnath (1927, 1932) who carried out a detailed field investigations in the north-western part of Kutch. On the basis of a study of ammonites, lamellibranchs, plant fossils (Ptilophyllum), he established a very convincing succession of the Mesozoic rocks of Kutch, somewhat different from the previous ones. Rajnath, on the basis of field evidences, restricted the term 'Umia' to only the Lower Umia of Waagen, the Upper Umia he called as Bhuj Series of Middle Cretaceous or even slightly of younger age (Fig. 3).

Spath's (1933) work, which came a year later, dealt mainly with the Jurassic cephalopods. He divided the lower part of the Jurassics into a number of fossiliferous zones (Fig. 3).

The subsequent investigations of Rajnath (1942) established a number of unconformities in the Jurassic strata of Kutch. This fact, according to Rajnath clearly indicated that the sea which had invaded Kutch, North-East Kathiawar, and Rajputana during the Upper Jurassic times oscillated very much. The presence of such forms in Kutch as are comparable to forms of Himalayitidae of Spiti Shales, indicates that to the north this sea was connected to the Tethys Sea, occupying the present position of the Himalayas. There also existed some form of connection between the Kutch sea and the sea in the south as revealed by the close faunal relationship between the Jurassics of Kutch and Madagascar.

Subsequent to Rajnath's contribution, a number of workers have followed him and investigated selected areas of Jurassic rocks. Agrawal (1948) mapped in detail the Jhura hills and worked out the structure and stratigraphy of the area. In the same year, Tewari (1948) published his account of the Habo hills. Shukla (1953) mapped the Kayia hill and agreed with Agrawal that the domes have resulted on account of basic igneous intrusions. Arkel (1956)

has ideally summarized the existing information on the Jurassic of Kutch. Poddar (1959) published a detailed account of the geology of Kutch, which in general agrees with the findings of Wynne and Rajnath. Poddar has described in fair detail the structural characters of the rocks as well.

The most recent work on the Mesozoic rocks of Kutch is that of Bernburg and Schott (1963). The two investigators have reviewed the geology and given a revised stratigraphic succession which is as under:-

| | Kutch - Kathiawar | |
|---|---|---|
| Lower Cretaceous | Albian | Wadhwan |
| | ------ Bhuj ---------- | |
| | Aptian Ukra | |
| | ---------- | |
| | (Barrem) | |
| | (Hauter) Umia | |
| | Valangi- Trigonia-Beds | |
| | nian | |
| ---------- | ------ Virgatosphinctes-Beds | |
| Jurassic | Portlandian/ Tithonian | |
| | Kimmeridgian Katrol | |
| | ---------- gap | |
| | Oxfordian ------ Dhosa Oolite | |
| | ---------- Chari Golden Oolite | |
| | Callovian (Macrocephalites) | |
| | Patcham | |
| | Bathonian | |
| | Kuar Bet | |
| | ----?---- ---?---------- | |
| | Crystalline basement in Karunjha Hills. | |

The Deccan Trap activity which took place at the end of the Mesozoic Era, is represented in the form of both distinct lava flows overlying the Mesozoic sedimentaries as well as in the form of discrete intrusions of hypabyssal nature. It is not proposed to deal with the details of previous work on these volcanic rocks and the reader is referred to excellent accounts of workers like Wynne (Wynne and Fedden,1872), Oldham (1893), Mathur and Dubey (1928), Jain and Mathur (1930), Mathur (1934), Bajpai (1935), Wadia (1939), Auden (1949), West (1959), Subba Rao (1965, 1967).

Similarly, the account of the previous work on Tertiary rocks of Kutch is not relevant to the present study. References can be made to the works of Sykes (1834), Grant (1837), Carter (1853, 1857), Wynne (Wynne and Fedden, 1872), Medlicott and Blanford (1879), Duncan and Sladden (1883), Vredenburg (1906, 1908, 1925, 1928), Nuttal (1925,1926), Wadia (1939), Krishnan (1943), Tewari (1952, 1953, 1956, 1957, 1958, 1959, 1960), Ghosh and Ghosh (1959), Gupta (1959), Lubimova, Guha and Madan Mohan (1960), Guha (1961), Poddar (1963), Sengupta (1964),

Shukla (1965), Khanna and Madan Mohan (1965), Biswas (1965), Chatterji and Mathur (1966).

Economic aspects of Kutch have been investigated from time to time. Fox (1929) was the first worker to report the occurrence of coal-seams in the Cretaceous rocks of Kutch. Taylor and Pathak (1955) investigated the ground water-resources of the area south and southeast of Bhuj. Sastri (1964) has given details of the coal-bearing reserves and the lignite deposits of Kutch. The Gujarat State Directorate of Geology and Mining has been conducting extensive Surveys for a number of minerals like bauxite, lignite, limestones, gypsum, etc. The Oil and Natural Gas Commission is at present exploring the possibilities of Petroleum and natural gas in the Kutch region.

## THE AREA IN PARTICULAR

No exclusive investigations have been done on the study area in the past, and Blanford (1853), Agrawal (1961), Bernburg and Schott (1963) have made only brief references to the area in their works. Only Wynne (Wynne and Fedden,1872), Poddar (1959), mapped this part of the Kutch in somewhat detail.

Blanford (1853), during his reconnaissance of Kutch took some traverses across Charwar and Katrol hills. In the area he identified the 'terrestrial' rocks bearing the Rajmahal flora and recognised the general structural trends. He also suspected the existence of a fault along the northern fringe of the Charwar range.

Wynne (Wynne and Fedden, 1872) described a section across the Charwar and Katrol ranges. He also recognised the fault along the northern fringe of the range. Describing the portion of the escarpment to the south of Bhuj, he writes "Still further west the lower jurassics just south of the fault become much contorted, the escarpment precipitous and its crest formed of the group, extending with low southerly inclinations through the country until overlain by the stratified traps."

In the Charwar and Katrol hill-tract made up of Middle Jurassic rocks, Wynne somehow escaped to recognise Oolitic beds. He does not write anything about these highly calcareous beds and their peculiar Oolitic nature.

Describing the terrain to the south of Charwar-Katrol ranges, he writes, "Near the village of Sairat about a mile west of Khirgreea, a slight anticlinal curvature of the Jurassic beds is seen in the neighbouring stream section, causing an exposure of some beds lower than those which overspread the country eastward. They consist of shaly clays with nodular bands, flaggy sandstones, underlying finely laminated shales, with a few carbonaceous streaks. The latter on the north side of the anticline appear to be faulted against the coarse white grits of the upper group, which are sharply contorted and abut against an outlier of soft infra-trappean grit, here containing numerous fragments of fossil wood replaced by impure carbonated lime. Just south of the village it seems to be more trappean in a small hillock which is capped by thick bedded, black, red, ferruginous sandstones."

Describing the western part of the range, he has mentioned a number of interesting structural features which he described as under (p. 189), "The

more lofty portion of the Charwar hills west of the road from Bhooj to Mandvee is formed of the southern side of the anticlinal curve, which appears to have been broader here than usual, showing a steady dip to the south-east and south, which carries the lower beds under the upper Jura group of the neighbourhoods of Meghpur and Dysera. From the broken ground west of the latter village a strong trap dyke, varying in width upto 160' extends northwards to crest of range... ..... Between the ghats on the above road and the village of Mankooa, in the plain to the north-west the great Charwar and Katrol fault becomes checked, displaced and complicated by the occurrence of numerous fractures, the effect of which has been to remove its general bearing about a mile further to the south, the lower rocks in this vicinity being greatly disturbed, contorted and traversed by dykes and intrusions of varying textures and hardness. The largest of these occurs in the main lines of fault and the lower beds in contact are intensly altered."

The westernmost of the area has been described by Wynne in the following lines, "South of Samatra,

the hills recede in that direction and a broad space is occupied by broken ground with some deep ravines. The lower beds are still much contorted along the south side of the fault which is clearly traceable, running nearly east and west, with those of the upper group on its northern side undulate at low angles. A strong dyke of light brown porphyritic trap running from the hills northwards shows several dislocation along its course and the various alteration of shales and sandstones in the country on each side of it are the same as usual in the lower portion of the Jurassic series."

Wynne (Wynne and Fedden, 1872) also noted the lateral lithological variation along the strike of beds in Charwar and Katrol hills.

Poddar (1959) mapped this area and divided the Mesozoics of the Charwar-Katrol hills into Chari, Katrol and Lower and Upper Bhuj Series. The last two units of Poddar correspond to the Upper Jurassic series of Wynne.

Agrawal (1961) described some foraminifers from the rocks of the Chari Series (Habo Series

of Agrawal) near the localities like Fakirwari and Walkhavas tank. Foraminifers identified by him include Rhabdammina, Ammodiscus, Quinqueloculina, Triloculina, Palmula, Elphidium, Rotalia, etc.

Bernburg and Schott (1963) collected some fossils from uppermost part of the Chari beds along Bhuj-Mandvi road. Fossils described by them include ammonites like Kinkeliniceras, Katroliceras, Belemnites, Mayaties, etc. According to these two authors the Kinkeliniceras sp. belongs to Upper Callovian and rest belong to Upper Oxfordian.