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A NOTE ON THE UMRAPUR SECTION, KHADIR ISLAND, DISTRICT KUTCH (GUJARAT)

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ABSTRACT

The paper gives a brief account of the Bathonian-Callovian rocks in the neighbourhood of the village of Umrapur (Khadir Island). The stratigraphic column comprises fifteen beds established on the basis of their lithology supplemented by fossils. The strata were folded into an anticline whose northern limb has been cut off by a major strike fault. Two restricted exposures of a diabase prophyry dyke are encountered at about 8 km to the north-east of the village.

The bulk of the fossil collection, made bed by bed, comprises bivalves numbering more than nine hundred. Their systematic study is in progress. Forty forms hitherto identified include six new species. The occurrence of twelve examples of a new species of *Pronoella* (*Gythemon*) in Bed No. 2 extends the vertical range of the subgenus upward into the Bathonian. The Bed no. 9 is of Lower Callovian age. Naturally, the beds below it, Nos. 1 to 8, and older one above ones with higher Numbers (10 to 15) are successively younger than it.

INTRODUCTION

Of late, the members of the Banaras Hindu University team, engaged for long in the study of numerous exposures of Habo beds in the Mainland of Kutch, extended their researches to parts of "island belt" comprising Pachham, Khadir, Bela and Chorar Islands[2] (Fig. 1) to the north. Very recently Rai (1972) completed his investigations of the jurassics of Western Bela Island while Kacker (1977) of those in the vicinity of the village of Mouwana in the eastern part of Bela Island. To the west of this island lies the Khadir Island and the village of Umrapur[3] (23°54′30″ N : 70°27′28″ E) is situated in its easternmost part. It is under Bhachau taluk for administrative purposes.

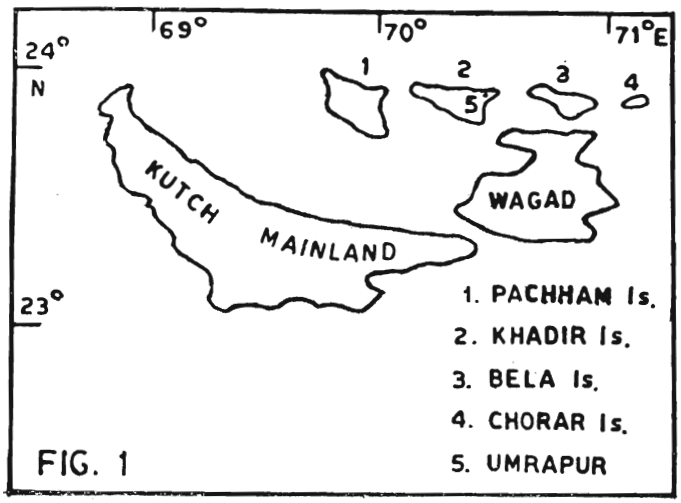

FIG. 1

Wynne (1872, pp. 103-108) made passing references to Khadir Island. Spath (1927-'33) and Cox (1940 ; 1952) recorded a very limited number of species —only one indeterminable fragment of macrocephalitid and eight bivalves respectively. Biswas (*in* Biswas and Deshpande, 1970, Biswas, 1971), proposed the new rock-unit "Khadir Formation" whose lithic sequence has been represented in a stratigraphic column (Biswas and Deshpande, 1968). Its type-section has been designated but no detailed account of the startigraphy and palaeontology has, however, been published so far. The present authors, therefore, to begin with, paid a short visit to the easternmost part of Khadir Island with the object of systematic study of fossils and to establish the litho- and bio-stratigraphy of the Jurassic rocks.

AREA OF STUDY

The area under investigation in the neighbourhood of the village of Umrapur is roughly triangular and about 15 sq. km. It falls within one inch to a mile topo-sheet No. 40 I/5 published in 1950 by the Survey of India. The relief of the area is not high ; to the east the height gradually decreases and ultimately the island merges in the Rann.

GEOLOGICAL SETTING

REGIONAL BACKGROUND

Exposures of pre-Bathonian sediments are not hitherto known from the territory of Kutch although specula-

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[2]Described as "islands" since they stand out amidst the vast plains which are inundated during the monsoon period. Out of the four "islands" Chorar falls outside the present territory of the district of Kutch.

[3]Also spelt as Amrapur.

tions in regard to the existence of palaeozoics were made by Rajnath (1934) and Poddar (1959). The former thought of the "possible extension of the Productus beds of the Salt Range to some parts of Cutch" on the basis of his find of a specimen in Bed No. 22 of Jumara dome, which is referable to Palaeozoic genus *Streptorhynchus*. Biswas and Deshpande (1968), too, consider that the chances of the occurrence of pre-Bathonian sediments in the western part of Kutch basin and in the off-shore shelf region cannot be ruled out while they preclude their occurrence in the eastern part of the basin. Thus, the oldest strata exposed in Kutch are of Jurassic age. According to Biswas and Deshpande (1968) they "directly overlie a crystalline basement, which is perhaps a part of the Precambrian basement complex".

Waagen's (1873, Introduction) four-fold division of Kutch mesozoics into 'Putchum', 'Charee', 'Katrol' and 'Oomia' groups with Ukra Beds at the top, in ascending order, had been world currency for over half-a-century when the upper part of the succession was modified by Rajnath (1932, 1942). Biswas (1971), however rejects the old four-fold classification because of "..... ..lack of precise definition of units with respect to designated type sections, mappability, and regional applicability, ... and improper use of stratigraphic terminology, ...". While recognizing three main rock-stratigraphic provinces in Kutch basin, viz. Kutch Mainland, Pachham Island and Eastern Kutch comprsiing Wagad, Khair and Bela Islands, he (Biswas, *op. cit.*) has suggested Khadir Formation for a sequence of the strata over 500 metres thick and ranging in age from Bathonian to ?Oxfordian, in the last named province. Its type section is across the Khadir Island through the village of Gadhada (23°52′06″ N : 70°22′30″ E).

The basal member of Khadir Formation, according to the geologists of the O.N.G.C., consists of "Granite-cobble-conglomerate and arkose". It has been named as Cheriyabet Conglomerate Member because of its good exposure in the small 'bet' of that name (23°56′15″ N : 70°20′15″ E) to the north of Khadir Island. There is, however, ambiguity in regard to its occurrence and contact with the basement.

Khadir Island is one of the six major east-west oriented uplifts. It is surrounded by "residual depression",[1] of the plain of Rann of Kutch. Along the northern margin of the "island belt" runs a major strike fault. It is probably of "reverse type". Both the fault and folding of sediments are considered essentially due to the influence of Aravali and Delhi lineaments (Sastri *et al.*, 1969), "The main structural style", according to Biswas (1970 ; 1971), "was set up during the major tectonic cycle in Upper Cretaceous" which started with the termination of the Mesozoic sedimentation.

[1]This term has been used by Biswas (1970, 1971) in the sense as defined by Beloussov (1962).

UMRAPUR SECTION

Sequence :

The area under investigation is much to the east of Gadhada. The details of previously established stratigraphic column of Khadir Island are also not available. Hence, to avoid confusion in Kutch stratigraphy till, at least, the details of the sections and faunas of different areas are available, the sequence near the village of Umrapur has been designated here by the local name "Umrapur Formation". It is well seen in a north-south traverse. Further, it can be divided into three members, viz. Upper, Middle and Lower. These have been further subdivided into fifteen beds essentially on lithological basis supplemented by their fossil contents. Their succession in descending order is given in Table 1.

The constituents of Bed Nos. 9 and 13 have been put together, in upward succession, for the present under respective bed because of the discontinuity of their outcrops or/and their inaccessibility. Further detailed work may necessitate the separation of at least some of them as independent beds.

Structural features :

The strata were thrown into an anticline, trending almost east-west and whose northern limb has been cut off by a major fault. The beds have gentle dips (5° to 10°). The southern flank is mostly occupied by the expanse of Bed No. 9 which also composes the marginal cliff. Bedding surfaces of sedimentary rocks vary in their smoothness and roughness. Some bedding planes (Bed No. 5) bear good oscillation ripple marks, with wavelengths ranging from 2 cm to 12 cm.

Igneous intrusions :

Only at two places, about 8 km to the north-east of the village, the basic igneous intrusions in the form of dyke are exposed. The two are probably the parts of the same dyke trending in a N 35° W—S 35° E direction but their continuity is conjectural due to lack of exposure and the presence of charred limestone occurring in between the two outcrops. The southern outcrop is across Bed No. 9 whereas the northern one cuts Bed No. 4.

The rock is almost black in colour with greyish phenocrysts. It is not very compact at the surface. Under a petrological microscope it is very fine-grained and the texture is subophitic to ophitic. At times the plagioclase laths are very big and give rise to porphyritic texture. These phenocrysts are embedded in subophitic groundmass.

Mineralogically, the rock is chiefly composed of augite (43-45%) and calcic plagioclase (42-43%) to-

Table 1—Stratigraphical Succession in the Umrapur Section

LITHOSTRATIGRAPHIC UNITS			Geol. Time
Formation	Member	Beds with Lithology	Age
UMRAPUR FORMATION	UPPER MEMBER	15 Sandstone 14 Shale 13 Arenaceous limestone with shale intercalations c. Chocolate brown, laminated, arenaceous limestone b. Ferruginous limestone studded with *Corbula* a. Brownish white arenaceous limestone 12 Shale 11 Coarese-grained, purple to maroon coloured sandstone 10 Shale	CALLOVIAN
	MIDDLE MEMBER	9 Yellow brown limestone, oolitic at places, with interbeds of shale and conglomerate d. Fossiliferous yellowish brown limestone c. Reddish brown sandstone containing rhyolite pebbles at places b. Yellow brown, oolitic limestone, at places golden ("golden oolite") a. Conglomerate containing cobbles and pebbles of rhyolite and arenaceous limestone	
		DISCONFORMITY	
	LOWER MEMBER	8 Shale 7 White siltstone grading into yellowish brown sandstone 6 Shale with ferruginous calcareous band studded with *Corbula*, *Mytilus*, gastropods, etc. 5 Sandstone with shale inbetween 4 Shale with fossiliferous band of calcarerous sandstone 3 Yellowish grey arkose and light coloured arenaceous limestone 2 Shale with fossiliferous calcareous bands rich in *Corbula* 1 Hard and compact sandstones (at times friable) Base not exposed	BATHONIAN

gether with iron oxide. At places secondary actinolite needles are encountered. The symmetrical extinction angle of plagioclase laths varies from 28° to 37°. They exhibit albite, carlsbad as well as pericline twinning in various combinations. Some of their phenocrysts show simple zoning. In one of the thin sections (Fig. 2) two columnar plagioclase crystals are together intergrown in a "cruciform" manner. This feature, although very common in staurolite, is unusual for plagioclase.

In view of the above-mentioned texture and mineral constituents, the rock may be named as diabase porphyry following American usage.

FOSSIL BIVALVES

The collection consists of over 1,000 megafossils (946 bivalves, 82 brachiopods, 15 corals, 8 gastropods and 1 cephalopod). Crinoids and bryozoans have been encountered in thin sections of rocks. The systematic study of the bivalves is in progress and their detailed account will be published later. However, 40 species hitherto identified have been assigned to 25 genera and 5 subgenera, referred to 17 families. They belong to the Bed Nos. 2, 4, 6, 9 and 13. Most of them come from Bed No. 9 although the Bed No. 2 has yielded almost double the number of individuals of bivalves obtained from it.

Out of twenty-five genera as many as seventeen (listed below) have not been hitherto reported from Khadir Island while there is no previous published record of the subgenus *Gythemon* Casey from India. *Grammatodon* Meek and Hayden, *Falcimytilus* Cox, *Eligmus* Eudes-Deslongchamps, *Camptonectes* Agassiz, *Chlamys* Bolten MS, Roeding, *Pecten* Mueller, *Eopecten* Douvillé, *Ctenostreon*

Eichwald, *Limatula* Wood, *Lopha* Bolten MS, Roeding, *Lucina* Brugière, *Neocrassina* Fischer, *Protocardia* Beyrich, *Pronoella* Fischer, *Ceratomyopsis* Cossmann, *Pholadomya* G. B. Sowerby and *Ceratomya* Fischer.

Besides these the remaining genera are an addition to the generic list of the study area.

Among the forty forms so far identified, only four, viz. *Modiolus imbricatus* J. Sow., *Bakevellia waltoni* (Lycett), *Trigonia brevicostata* Kitchin and *Corbula lyrata* J. de C. Sow., were known earlier from Khadir Island. Moreover, there is no previous published record of *Falcimytilus jurensis* (Roemer) and *Eligmus weiri* Cox from Kutch and six species have been new.

Table 2. Vertical Distribution of Bivalves

('X' indicates presence of the species in the bed against which it is marked)

S. Ny.	Name of Species	Bed Numbers				
		2	4	6	9	13
1.	*Grammatodon* (*Indogrammatodon*) sp.	×				
2.	*Falcimytilus jurensis* (Roemer)				×	
3.	*Falcimytilus* sp.	×				
4.	*Modiolus imbricatus* J. Sow.	×	×	×	×	
5.	*Modiolus* cf. *bipartitus* J. Sow.				×	
6.	*Modiolus* sp.		×			
7.	*Bakevellia waltoni* (Lycett)	×	×			
8.	*Eligmus rollandi* Douvillé				×	
9.	*Eligmus weiri* Cox				×	
10.	*Meleagrinella echinata* (Smith)				×	
11.	*Camptonectes auritus* (Schlotheim)					
12.	*Camptonectes* cf. *virdunensis* (Buvignier)				×	
13.	*Camptonectes indicus* Cox				×	
14.	*Camptonectes* (*Camptochlamys*) sp.				×	
15.	*Chlamys curvivarians* Dietrich				×	
16.	*Chlamys* sp. A new species				×	
17.	*Chlamys* sp. B new species				×	
18.	*Chlamys* sp. indet.				×	
19.	*Spondylopecten* (?) *badiensis* Cox				×	
20.	*Pecten kachhensis* Cox				×	
21.	*Pecten rochi* Agrawal				×	
22.	*Eopecten* cf. *aubryi* (Douvillé)				×	
23.	*Eopecten* sp. A				×	
24.	*Eopecten* sp. B				×	
25.	*Clenostreon proboscideum* (J. Sow.)				×	
26.	*Limatula* sp. A new species				×	
27.	*Plagiostoma* cf. *junaraensis* Cox				×	
28.	*Pseudolimea duplicata* (J. de C. Sow.)				×	
29.	*Lopha* (*Actinostreon*) *gregarea* (J. Sow.)				×	
30.	*Lopha* (*Actinostreon*) sp.				×	
31.	*Trigonia brevicostata* Kitchin				×	
32.	*Lucina* cf. *striatula* Buvignier	×				
33.	*Neocrassina* cf. *subdepressa* Blake & Hudleston				×	
34.	*Protocardia grantidieri* (Newton)	×	×	×		
35.	*Protocardia* sp. A new species	×	×	×		
36.	*Pronoella* (*Gythemon*). sp. A new species	×				
37.	*Ceratomyopsis striata* (d'Orbigny)				×	
38.	*Corbula lyrata* J. de C. Sow.	×	×	×	×	×
39.	*Pholadomya* (*Bucardiomya*) *lirata* (J. Sow.)				×	
40.	*Ceratomya* sp. A new species		×			

The vertical ranges of such forms as have been described earlier in literature are within their limits already known. However, the find of a new species of *Pronoella* (*Gythemon*), from Bed No. 2 of the present area is unique and extends the time range of the subgenus upward into the Bathonian. The vertical distribution of the bivalve species (so far identified) is given in Table 2.

The Umrapur specimens of *Corbula lyrata* J. de C. Sow. agree well with Attock examples figured by Cox (1935, Pl. 1, figs. 7-9). The dentition of this species, which was hitherto unknown, is marked by a thick triangular, anterior cardinal tooth and a weak posterior lateral in right valve. Its comparison with fig. E 154, 5 in Moore *et al.* (1969) establishes the assignment of the species to *Corbula* s. str.

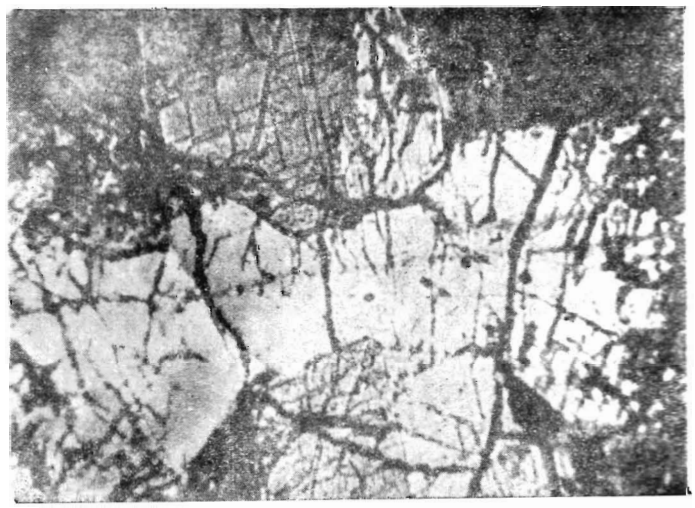

Fig. 2.

STRATIGRAPHICAL REMARKS

The reliable evidence of ammonoids, the delicate time indices, is not available for dating and correlating the beds of Umrapur section. Despite long search the authors could get only an indeterminable fragment from Bed No. 9. The bivalves have usually long geological range and hence not serviceable for the purpose. Also, in the present case their study is incomplete. Besides, in the absence of precise definition of the rock-units and their fossil contents the stratigraphical column given by Biswas and Deshpande (1968, fig. 2) is not helpful for correlation purposes.

However, the Bed No. 9, lone constituent of the Middle Member of Umrapur Formation, is an easily recognizable and marker horizon in the sequence. It forms marginal cliff facing the Rann. It consists of "golden oolite" and a conglomerate at its base. This bed can, therefore, be unhesitatingly correlated with Bed No. 20 of the lower zone of the Upper Member of

the Bela Formation (Rai, 1972). Faunistically these two beds have following fifteen forms (from among the limited material identified so far) in common :

Eligmus rollandi, *E. weiri*, *Meleagrinella echinata*, *Camptonectes auritus*, *C. indicus*, *Chlamys curvivarians*, *Ctenostreon proboscideum*, *Pseudolimea duplicata*, *Trigonia brevicostata*, *Modiolus imbricatus*, *Lopha gregarea*, *Protocardia grandidieri*, *Ceratomyopsis striata*, *Corbula lyrata* and *Pholadomya* (*Bucardiomya*) *lirata*.

Out of these the first nine species are restricted to the two beds referred to above.

Farther eastward, in the Mouwana area (Eastern Bela Island) the Bed No. 14 (Agrawal and Kacker, 1978) has strikingly similar lithology and physiography to the present Bed No. 9.

Both the Bed No. 20 of the Western Bela Island and Bed No. 14 of Mouwana area have been referred to Macrocephalus Beds of Spath in view of the occurrence of *Macrocephalites* and its subgenera. Their age is Callovian and accordingly that of the present Bed No. 9 as well.

Naturally, the beds below No. 9 are older and above ones with higher numbers successively younger than it. Spath (1933, p. 738) had suspected the presence of "Athleta" Shales in Khadir Island but under the present state of knowledge this view can neither be supported nor contradicted.

Moreover, a few words about "golden oolite" and "conglomerate" would not be amiss here. Golden oolite occurs locally. In addition to the Umrapur section it has been found at Jhura and Keera domes in Kutch Mainland (Agrawal, 1958), Pachham Island, Western Bela Island and Mouwana area. In Keera dome it is partly referred to Macrocephalus Beds and partly to Rehmanni Beds (Spath, 1933, p. 743). Arkell (1956, p. 390) assigns the latter to "early Middle Callovian". In Pachham Island golden oolite is seen in Goradongar Formation (Biswas, 1971, Table I) of Callovian age while the older formation of Kaladongar in the same region has locally the "wedges of granite-pebble-conglomerates", which has been referred to Bathonian by that author. In Western Bela Island it occurs in Bed No. 20 of Rai (1972), which, too, has conglomerate. Mouwana Bed No. 14 has golden oolite and also similar conglomerate (Agrawal and Kacker, 1978).

Evidently, the golden oolite does neither appear to mark any definite horizon in the stratigraphy of Kutch in general nor restricted to the same horizon in various parts of Kutch.

The Granite-cobble-conglomerate Bed is reported to occur at the base of the Bathonian rocks of Khadir Island (Biswas and Deshpande, 1968, p. 4). Besides its good exposure in Cheriya bet, the type area, this basal member is mentioned to be "exposed for the most part along the foot of the Khadir cliffs at the northern edge of the island facing the Rann". However, in the present area the conglomerate containing cobbles or/and pebbles of igneous rock and arenaceous limestone occurs at a much higher horizon (Bed No. 9) than the lowest exposed bed. Lithologically it appears almost similar to the one referred to above. The oldest (exposed) bed of the sequence is composed of hard and compact sandstone.

In Western Bela Island as also in Mouwana area no conglomerate bed is known to occur at the base. In fact, lithologically similar conglomerate is found in the basal part of Bed No. 20 (Rai) and Bed No. 14 (Agrawal and Kacker) of these two areas respectively, which have been equated with Umrapur Bed No. 9. Below them are exposed thick sediments. The present authors, therefore, are not inclined to agree with Biswas (1971, p. 225) in considering (i) the said conglomerate as (exposed) basal member in Khadir, and that (ii) it directly overlies a crystalline basement.

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