

ON THE PRESENCE OF AUVERSIAN BEDS IN THE KANOJ-SEHE SECTION, KUTCH,

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ABSTRACT—The presence of definite Auversian beds in Kutch has been established on the basis of microfossils.

Kutch, on the western coast of India, is famous for the sequence of marine Tertiary beds. These have been described by Wynne and Fedden (1872), Blanford (1867) and subsequently by Nuttall (1925, 1926 & 1931). However, the detailed classification and correlation of the Tertiary beds have exhaustively been carried out by Tewari (1957) and his associates on the basis of microfossils, specially foraminifers and ostracods, followed by Sengupta (1959, 1964), and others. He noted the occurrence of the Laki Stage, referable to Lower Eocene (Ypresian), succeeded unconformably by the Kirthar Stage, assigned to Middle Eocene. The latter beds have been generally considered of Lutetian age supported by the occurrences of various species of *Nummulites* and *Discocyclina*, *Alveolina elliptica* (Sowerby), *Dictyoconooides cooki* (Carter), *Asterocyclina allicostata* (Nuttall), *Halkyardia minima* var. *indica* Tewari, etc. These beds are again unconformably overlain by the rocks of the Nari Stage considered to be equivalent of Lattorfian and Rupelian ages (Oligocene). These are partly marine and partly continental in nature. The next sequence of rocks made up of clays, marls and shales, is referred to the Gaj Stage of Lower Miocene including both the Aquitanian and

Burdigalian and finally there are the rocks of Manchar Stage, which are esturine at their base succeeded by terrestrial and fresh water beds.

It is evident that from the marine Tertiary sequence of India, rocks of definite Auversian age have not so far been recognised, though marine rocks of Priabonian age have been described and recorded by Rao (1941), and subsequently designated as Tapti Series by Eames (1952) from the Tapti river section and Rakhi nala Zindapir section, Baluchistan. This paper deals only with the rocks of middle Eocene.

The basal part of the Kirthar Stage comprises creamish-earthy to white foraminiferal limestone which have yielded :

- Nummulites acutus* (Sowerby)
- Nummulites obtusus* (Sowerby)
- Nummulites beaumonti* d'Archiac & Haime
- Nummulites atacicus* Leymerie
- Nummulites gizehensis* (Forskal)
- Nummulites djokdjokartae* (Martin)
- Assilina mamillata* (D'archiac)
- Discocyclina* (*Discocyclina*) *dispansa* (Sowerby)
- Discocyclina* (*Discocyclina*) *sowerbyi* (Nuttall)
- Alveolina elliptica* (Sowerby)

DISTRIBUTION OF SMALLER FO

	AGE	AQUITANIAN				18
	Bed No.	22	21	20	19	
<i>Textularia pseudogramen</i> Chapman & Parr			C		R	
<i>Clavulinoides lakiensis</i> Haque						
<i>Clavulinoides lakiensis</i> Haque var. <i>kutchensis</i> n. var.						
<i>Quinqueloculina laevigata</i> (Reuss)					C	
<i>Quinqueloculina panamensis</i> Cushman					A	
<i>Quinqueloculina ranikotensis</i> Haque						
<i>Triloculina elliptica</i> Galloway & Heminway					C	
<i>Triloculina porvaensis</i> Hantken						
<i>Triloculina turqida</i> Cushman					A	
<i>Pyrgo subsphaerica</i> (d'Orbigny)					R	
<i>Pyro weisneri</i> Parr					A	
<i>Nodosaria facile</i> Franzanau						
<i>Nonionella africana</i> Ley Roy						
<i>Nonionella agrawali</i> n. sp.						
<i>Discorbis bertheloti</i> (d'Orbigny) var. <i>floridensis</i> Cushman						
<i>Rectoeponides dalmatina</i> De Witt Puyt						
<i>Rectoeponides rajnathi</i> n. sp.						
<i>Cibicides lobatulus</i> (Walker & Jacob)			C			C
<i>Cibicides refulgens</i> Montfort						
<i>Rotalia</i> cf. <i>mexicana</i> Nuttall						
<i>Rotalia floscula</i> Todd & Post						
<i>Rotalia stellata</i> Reuss var. <i>tuberculata</i> n. var.						

AUVERSIA N BEDS IN KANOJ-SEHE SECTION, KUTCH

DISTRIBUTION OF SMALLER FORAMINIFERA IN KANOJ—SEHE AREA, KUTCH

No.	AQUITANIAN				RUELIAN				LATTORFIAN			AUVERSIA N						
	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5
	C			R		C			C	C							R	
									C									
				C						C								
				A							C							
				C														
											R							
				A														
				R														
				A														
												C	R	C				R
									C									
									A	A		C						
													A	C				
	C				C	R	R	R		C	C	A	A	A	A	C	A	C
										C								
										C					A			R
												C	C	C	C	A	A	A

MIFERA IN KANOJ—SEHE AREA, KUTCH

PELIAN		LATTORFIAN			AUVERSIAN						LUTETIAN				
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
		C	C							R					R
		C													
			C												
				C											
				R											
					C	R	C		R						
		C									R				
		A	A		C	A	C			A					
						R		R							
			C	C	A	A	A	A	C	A	C				
R	R		C												
			C												
								A			R		R		
					C	C	C	C	A	A	A	A	A	C	C

DISTRIBUTION OF SMALLER FORAMINIFERA

AGE	AQUITANIAN				RUPE		
	Bed. No.	22	21	20	19	18	17
<i>Ammonia becarii</i> (Linne') var. <i>hatatatensis</i> (Takayanagi)							
<i>Globigerina</i> cf. <i>augustumbilicata</i> Bolli							
<i>Globigerina praebulloides oclussa</i> Blow & Banner							
<i>Globigerina yeguansis pseudovenezuelana</i> Blow & Banner							
<i>Globigerina</i> sp. A							
<i>Globigerina</i> sp. B							
<i>Globorotalia (turborotalia) centralis</i> Cushman & Bermudez							
<i>Globorotalia (turborotalia) increbescens</i> (Bandy)							
<i>Cycloloculina annulata</i> Heron Allen & Earland							
<i>Globigerapsis indica</i> n. sp.							
<i>Globigerinatheka kutchensis</i> n. sp.							
<i>Halkyardia minima</i> (Liebus) var. <i>indica</i> Tewari							

Legend A = Abundant

C = Common

R = Rare

DISTRIBUTION OF SMALLER FORAMINIFERA IN KANOJ-SEHE AREA, KUTCH—(Contd.)

AGE	AQUITANIAN				RUPELIAN				LATTORFIAN			AUVERSIAN					
Bed. No.	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6
												A	A R	C C R	R		
													C	R C	C		C
													C			R	R C R

RAMINIFERA IN KANOJ-SEHE AREA, KUTCH—(Contd.)

RUPELIAN				LATTORFIAN			AUVERSIAN						LUTETIAN				
18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
							A	A	C				R				
								R	C	R							
									R							C	
												C		R			
								C	R	C			C	R		C	C
									C			R					
									C					A		R	R
												R					
													C				

Dictyoconoides cooki (Carter)
Asterigerina indica Tewari & Kumar

Linderina kutchensis Tewari

Gypsina globulus (Reuss)

Asterocyclina sp.

Heterostegina sp.

Actinocyclina sp.

Amongst the smaller foraminifers following have been identified :

Cibicides lobatulus (Walker & Jacob)

Globigerina cf. *G. angustiumbilocata* Bolli

Globigerina praebulloides occlusa Blow & Banner

Globorotalia (Turborotalia) increbscens (Bandy)

Cycloloculina annulata Heron-Allen & Earland

Nodosaria facile Franzanau

Globigerinatheka kutchensis n. sp.

Globigerapsis indica n. sp.

Rotalia stellata var. *tuberculata* n. var.

Rotalia floscula Todd & Post

Ammonia beccarii var. *hatatensis* (Takyangi)

Discorbis bertheloti var. *floridensis* Cushman

Rectoeponides rajnathi n. sp.

Textularia pseudogramen Chapman & Parr

Bucella sp.

Eponides sp.

Operculina sp.

Globigerina sp.

The basal kirthar is about 48 metres thick and outcrops at a distance of about 3 kilometres east of Narainsarowar (23° 41': 68° 32'). The upper part of middle Eocene section comprises of *Cibicides* bed of earthy coloured foraminiferal limestone which is overlain by compact cream coloured limestone succeeded by white *Nummulites djokdjokartae* limestone bed. It is further succeeded by an earthy soft friable limestone which are overlain by *Globigerina* bed comprising of yellowish-white compact foraminiferal limestone and *Alveolina* marl. In general the lithology is more or less same throughout the section.

These horizons have yielded almost similar larger foraminiferal assemblage, but a distinct smaller foraminiferal fauna, as is evident by the given faunal chart.

The above illustrates that middle Eocene, so far referable to Lutetian alone, incorporates the Auversian which has been recognised on the basis of the occurrence of species of *Globigerina*, *Globorotalia (Turborotalia) increbscens* (Bandy), *Globigerina* cf. *G. angustiumbilocata* Bolli and *Globigerapsis indica* n. sp. These are known only from the Auversian beds of Tanganyeka and Trinidad (Eames, Banner *et al.*). It is also interesting to note that the genus *Globigerinatheka* has never been recorded to occur below Auversian. Besides these the occurrences of other planktonic foraminifers such as *Globorotalia (Turborotalia) increbscens* (Bandy), *Globigerina* cf. *G. angustiumbilocata* Bolli also supports the same view. This view is further strengthened by the absence of *Halkyardia minima* var. *indica* Tewari in the Auversian and its abundance in the Lutetian.

This sequence of Tertiary rocks also includes rocks of the Nari Stage of Lattorfian, Rupelian ages which, however, were not indicated in the geological map of Wynne and Fedden (*op. cit.*).

The Tertiary sequence is rich in the occurrence of the glauconite, which suggests a marine, shallow water nature of the Kirthar Stage.

During the middle Eocene, it has been observed that the sea was deepest during Lutetian time, attaining an approximate depth of about 200 metres, as evinced by the presence of abundant planktonic foraminifers like *Globorotalia (Turborotalia) centralis* Cushman & Bermudez, *Globigerina praebulloides occlusa* Blow & Banner, *Globigerapsis indica* n. sp., *Rotalia stellata* var. *tuberculata* n. var., *Cycloloculina*

annulata Heron-Allen & Earland etc. However, approaching Auversian times, it has become comparatively shallower as evinced by the considerably smaller percentage of planktonic foraminifers and increase in the number of benthonic forms as *Cibicides lobatulus* (Walker & Jacob), *Ammonia beccarii* (Linne), and *Discorbis bertheloti* d'Orbigny. It can be summarised now that a sea was of hard rocky substratum, not deeper than 60-70 metres.

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