PLATE 1

Fig. 1. Flaser and linsen structures in wadden-like tidal deposits (subfacies IVc). Bed 33 and underlying bed, F. cucumiformis Zone, section X at Serraduy. The length of the handle of the hammer is 55 cm. Detail of the channel of Pl. 2, Fig. 3.

Fig. 2. Angular unconformity in the dark grey marls of the Ager Formation south of Merli, F. corbaricus Zone, Ypresian. The bases of the white and the black v's indicate the maximum extension of the unconformity visible in the outcrop.

Fig. 3. Irregular and undulating bedding planes in a coral reef (subfacies VIIIId). Beds M-47 and M-48, uppermost part of lower half of F. corbaricus Zone, section M, northeast of Benure. The reef is overlain by nodular reef channel limestones (subfacies IXb). The length of the handle of the hammer is 55 cm.

Fig. 4. Irregular bedding in a coral reef (subfacies VIIIId). The larger and smaller nodules are coral colonies. The interspaces consist of limestones containing detrital reef material (foraminifera, molluscs, fragments of corals, etc.). Bed A-59, upper part of F. corbaricus Zone, section A, 2 km east of Llimiana. The length of the handle of the hammer is 55 cm.

Fig. 5. Vertical rock wall at the middle of the photograph: reeval deposits of beds A-29 – A-39, lower part of F. corbaricus Zone, section A. Slightly receding part in the lower half of the wall consists of coral–algal reefs; fore-reef deposits of Lithothamnium ridges occur in the upper half. Palaeoslopes with dips of up to 30° can be observed in these fore-reef deposits. The bases of the white v and the right black v indicate the uppermost part and the lowermost part of such a palaeoslope, respectively; the basis of the left black v indicates another palaeoslope.

Fig. 6. Coral–algal reef (subfacies VIIIIC). The larger nodules (up to ca. 20 cm) are coral colonies, the small ones (0.5–2 cm) are Lithothamnium colonies. This reef correlates with the beds A-29a – A-29e (lower part of F. corbaricus Zone) and is situated some tens of metres east of section A. Box of measuring-tape is about 5.5 cm long and high.
Fig. 1. Giant-sized megacross-bedding (subfacies Va) exposed along the River Isábena at Serraduy. Bed 43, lower part of *F. ellipsoidalis* Zone, section X. This large sedimentary body cuts into wadden-like tidal deposits (belonging to the *F. cucumiformis* Zone). A distinct angular unconformity separates both subfacies. Right of the middle of the picture a horizontally layered lag deposit separates the giant ripple from the tidal deposits. At the bottom left the erosive base of bed 21 has been indicated by a white v and a black v.

Fig. 2. Giant-sized megacross-bedding (subfacies Va) exposed in small valley perpendicular to the River Isábena at Serraduy. The base of the giant ripple has been indicated by two white v's. The angular unconformity between the giant ripple and the underlying tidal deposits is clearly visible. The basal nodular limestones of subfacies VIc and VId occur just at the bottom of the picture. *F. cucumiformis* Zone and *F. ellipsoidalis* Zone, section X.

Fig. 3. Large channel with flaser and linsen structures in the lower part of the wadden-like tidal deposits (subfacies IVc). The upper boundary of this channel has been indicated by a dashed line. *F. cucumiformis* Zone, section X. The length of the handle of the hammer is 55 cm. For a detail see Pl. 1, Fig. 1.

Fig. 4. Channel filled with sands and clayey sands cutting into muddy sediments. Wadden-like tidal deposits (subfacies IVc), *F. cucumiformis* Zone, section X. The length of the handle of the hammer is 55 cm.
PLATE 3

Fig. 1. Flute marks and deep straight groove marks which have been affected with the flute marks. Differences up to 45° with respect to the general current direction. Current direction from the left to the right. Subfacies IVe, *F. cucumiformis* Zone, section H, northwest of Tendruy. Magnification approximately 0.54 ×.

Fig. 2. Various types of flute marks: small-scale flute marks (at the top) and larger ones (at the bottom); they are often developed as longitudinal furrows and ridges, sometimes they are pillow-like. Narrow groove marks are sharp, the wider ones have a more rounded profile. Current direction from the left to the right. Subfacies IVe, *F. cucumiformis* Zone, section H, northwest of Tendruy. Magnification approximately 0.44 ×.

Fig. 3. Parallel lamination with some burrow activity. Upper right most obvious burrow with v-shape. Subfacies IIIb, upper part of *F. corbaricus* Zone. This bed correlates with bed A-69 and is situated some tens of metres east of section A. Magnification approximately 0.73 ×.

Fig. 4. Polished surface of colony of brain coral (*Leptoria*) with bore-holes of pelecypods which still contain the shells. From a coral reef (subfacies VIIId) in the upper part of the *F. corbaricus* Zone (bed A-51a) of section A, 2 km east of Llimiana. Full-size.

Fig. 5. Grazing trail in tidal deposits of subfacies IVb. Bed. F-52, *F. cucumiformis* Zone, section F’, near small pass north of Aransis. Magnification approximately 0.5 ×.
PLATE 4

Fig. 1. *Linthis hovelacquei* Cotteau. Characteristic echinoid of subfacies XIIb. Bed 56, lower part of *F. corbaricus* Zone, section X, Serraduy. Magnification 1.5 x.

Fig. 2. *Ditremaster cf. alarici* (Tallavignes). Echinoid occurring in subfacies XIIa and facies XI. *F. ellipsoidalis* Zone, section W, south of Soperún. Magnification 1.5 x.

Fig. 3. *Schizaster aff. vilanovai* Cotteau. Characteristic echinoid of subfacies XIIb. Bed K-19, *F. ellipsoidalis* Zone, section K, 2 km west of Guardia de Tremp. Magnification 1.5 x.

Fig. 4. *Lithothamnium* colony from *Lithothamnium* ridge (subfacies VIIIb). Bed X-18, *F. ellipsoidalis* Zone, section W, south of Soperún. Full-size.

Fig. 5. *Patallophyllia* sp. Characteristic solitary coral of subfacies XIIc. Bed H-108, lower part of *F. corbaricus* Zone, section H, near Sant Adria. Magnification 2 x.

Fig. 6. *Patallophyllia* sp. Large specimen. Bed 216, *F. moussoulensis* Zone, section U, southwest of Arén. Magnification 2 x.


Fig. 9. Spine of *Porocidaris serrata* d’Archiac. Bed 275, *F. moussoulensis* Zone, section V, 5 km west of Arén. Magnification 2 x.
PLATE 5

Fig. 1. Thin section of slightly sandy argillaceous limestone of facies XIV with Assilina, Nummulites and Discocyclina. Internally the calcite of the large Assilina test has largely been transmuted into chert. Also the chambers of this foraminifer have been filled by chert, thus forming a continuous piece of chert. Sample O-37, lower part of F. corbaricus Zone, section O, 5.5 km south of Puente de Montaña. Magnification 10 ×. Fig. 1a. Plain light. Fig. 1b. Nicols crossed.

Fig. 2. Microfacies picture of subfacies VIde. Silty and clayey limestone with molluscs and green algae (Halimeda). The molluscs occur often as fragments. The large gastropod belongs to the Cerithidae. The green algae are not shown on the photograph. Arrow indicates stratigraphic top of the photograph. Thin section. Magnification 10 ×.

Figs. 3–5. Successive stages in the silicification of tests of the foraminifer Assilina. All specimens: subfacies XIVa, bed O-43, lower part of F. corbaricus Zone, section O, 5.5 km south of Puente de Montaña. Thin sections. Nicols crossed.

Fig. 3. Assilina sp. with isolated globules of chert. Magnification 38 ×.

Fig. 4. Assilina sp. with many globules of chert. Magnification approximately 21 ×.

Fig. 5. Assilina sp. with a continuous piece of chert in which the different globules can still be recognized. Magnification approximately 35 ×.
Fig. 1. Microfacies picture of subfacies IIIc. Slightly sandy limestone (packstone) with many miliolids, alveolinids and specimens of Orbitolites (imperforate foraminifera association), and containing bird's-eyes and pseudomorphs of gypsum crystals. A large pseudomorph of gypsum with straight crystal boundaries and distinct angles can be seen in the lower half of the photograph. The gypsum has been replaced by a mosaic of many small calcite crystals, which are smaller along the border of the former gypsum crystal than in the centre. Thin section of sample P-5, *F. cucumiformis* Zone, section P, north of Benabarre. Plain light.

Fig. 2. The same as Fig. 1, but with two pseudomorphs of gypsum crystals and a part of a third pseudomorph. Nicols crossed.

Fig. 3. Microfacies picture of subfacies VIe. Pure limestone (packstone) with many internodes and fragments of internodes of the udotecean alga *Ovulites* and with foraminifera (rotaliids, miliolids, valvulinids, etc.). Thin section of sample O-99, lower part of *F. trempinus* Zone, section O, ca. 5 km south of Puente de Montañana. Plain light.

Fig. 4. Microfacies picture of subfacies XIa. Pure limestone (packstone) with mixed imperforate–perforate foraminifera association: alveolinids, miliolids and nummulites. At the middle left an axial section of *Fasciolites (Fasciolites) pasticillatus* (Schwager, 1883) (number 1). At the top left a tangential section of *F. (F.) dollioliformis* (Schwager, 1883) (number 2). Thin section of sample B-33, lower part of *F. corbaricus* Zone, section B, near Sant Miguel de la Vall; nicols not completely crossed.

Magnification of all figures 10 ×. Large arrow indicates stratigraphic top of the photograph.
PLATE 7

Fig. 1. Microfacies picture of subfacies Xa. Pure limestone (packstone) consisting of reef debris. At the bottom a fragment of a coral colony, at the middle right a fragment of a Lithothamnium colony; between these fragments a piece of Halimeda (indicated by a white v). Further also miliolids, an alveolinid, specimens of Orbitolites and mollusc fragments can be observed. Thin section of sample A-39b, lower part of F. corbaricus Zone, section A, 2 km east of Llimiana. Plain light.

Fig. 2. Microfacies picture of subfacies IXa. Pure limestone (grainstone) with an imperforate foraminifera association, many fragments of the red alga Lithoporella, fragments of echinoids, etc. Internodes of the red alga Corallina are frequently observed in this subfacies, but are not on the photograph. The large, slightly meandering fossil with small rectangular compartments in the centre of the photograph is a complete specimen of Lithoporella. Thin section of sample K-36, basal bed of upper part of F. corbaricus Zone, section K, 2 km west of Guardia de Tremp. Plain light.

Fig. 3. Microfacies picture of subfacies XIIIb. Pure limestone (packstone) with many fragments of fossils. Two specimens of Biflustra occur (indicated by white v's) which show geopetal structures. Imperforate foraminifera: Microfasciolites and Orbitolites. Thin section of sample L-75, upper part of F. corbaricus Zone, section L, northwest of Moró. Plain light.

Fig. 4. Microfacies picture of subfacies XIIIa. Slightly sandy limestone (packstone) nearly entirely consisting of fossil fragments. Perforate foraminifera association. Many fragments of various species of cheilostomatous and cyclostomatous bryozoans of which the most obvious examples have been indicated by white v's. At the top left a specimen of the cheilostomatous bryozoan Beisselina. Fragments and spines of echinoids frequently occur. Thin section of sample P-64, lower part of F. corbaricus Zone, section P, north of Benabarre. Plain light.

Magnification of Figures 1, 3 and 4: 10 x. Magnification of Figure 2: 28.5 x. Large arrow indicates stratigraphic top of the photograph.
PLATE 8

Fig. 1. Microfacies picture of subfacies XIVa. Sandy and silty limestone (packstone) with many nummulites and round to oval cross-sections through the tubes of *Ditrupa* (four specimens). Further also fragments of echinoids and of molluscs. Thin section of sample J-60, upper part of *F. corbaricus* Zone, section J, Guardia de Tremp. Nicols not completely crossed.

Fig. 2. Microfacies picture of subfacies XIVb. Silty and clayey limestone (packstone) with internodes of *Conocrinus doncieuxi* Roux, 1978 (two specimens at the middle left), pelecypods, fragments of pelecypods, a small gastropod (in the centre), *Discocyclina* (at the top left), a cross-section through the lunulitiform cheilostomatous bryozoan *Lunulites* (at the bottom right; indicated by a small arrow), etc. Thin section of sample 209, *F. ellipsoidalis* Zone, section U, southwest of Arén. Nicols not completely crossed.

Fig. 3. Microfacies picture of subfacies XIVb. Sandy and clayey limestone (packstone) with internodes of *Conocrinus doncieuxi* Roux, 1978 (four specimens; three in the lower half of the picture, and one at the middle left), many fragments of perforate foraminifera (*Assilina*), fragments of echinoids, of oysters (a large fragment occurs just below the large arrow) and of cheilostomatous bryozoans. Thin section of sample 302, basal bed of *F. corbaricus* Zone, section X', La Fuente del Oro (north of La Puebla de Roda). Nicols not completely crossed.

Fig. 4. Microfacies picture of subfacies XIVc. Clayey limestone (packstone) with many molluscs, pelecypods as well as gastropods, which often occur as fragments. Many remains of cheilostomatous bryozoans (some have been indicated by a white v; *Beisselina* has been indicated with a small arrow), fragments and spines of echinoids, ostracods, etc. Thin section of sample 384, lower part of *F. corbaricus* Zone, section Z, south of Campo. Nicols not completely crossed.

Magnification of all figures 10 ×. Large arrow indicates stratigraphic top of the photograph.
P. A. M. GAEMERS, Leidse Geologische Mededelingen, deel 51, ENCLOSURE I
Map of the area studied with the geographical names used in the text.
Horizontal section, east-west running along the southern side of the Tremp Basin.
Two north-south horizontal sections in the eastern part of the Tremp Basin.
# LEGEND FOR ENCLOSURES 5 and 6

1. alveolitid bezoarchon
2. facies symbols
3. subfacies types
4. thickness in m
5. samples
6. Dunham's limestone classification
7. lithology with characteristic fossils
8. fossils
9. sedimentary structures
10. facies
11. distribution of alveolitids
12. distribution and amount of larger benthonic foraminifera
13. additional remarks

## FACIES SYMBOLS (column 2) (also used in enclosures 2 and 3)
- facies I: deposits of swamps and rivers
- facies II: lagoonal deposits
- facies III, IV, A, B, C: beaches and shallow tidal deposits
- facies IV D: deeper tidal deposits
- facies IV E: shallow turbiditic deposits
- facies V: shallow marine deposits with imperforate foraminifera
- facies VI: back-reef, reefs, reef channels and fore-reef
- facies IX A: off-reef shoals
- facies XI: pure limestones with imperforate and perforate foraminifera
- facies XII: marls and clayey limestones with imperforate and perforate foraminifera
- facies XIII: fore-reef detrital limestones (pure limestones of the deeper fore-reef)
- facies XIV: deeper marls and impure limestones with perforate foraminifera
- facies XV: marls and clayey limestones with Turritella community

## DUNHAM'S LIMESTONE CLASSIFICATION (column 6)
- mudstone
- wackestone
- packstone
- grainstone
- boundstone

## LITHOLOGY (column 7)
- regularly, distinctly bedded limestone
- massive limestone
- irregularly, indistinctly bedded limestone
- nodular limestone
- dolomite
- dolomitic limestone
- fine, calcareous sandstone
- medium and coarse sandstone
- poorly sorted sandstone
- siltstone
- sandy siltstone
- clayey fine sandstone
- clayey siltstone
- clayey and sandy siltstone
- marl

## MINERALS (column 8)
- pyrite
- glauconite
- hematite and other iron oxides
- muscovite
- biotite
- chert (mainly in nummulitids)
- pyrite in fossils

## SEDIMENTARY STRUCTURES (column 9)
- high-angle megacross-bedding
- the same, with "strike"
- the same, with "dip"
- the same, with height in cm
- mega herringbones
- low-angle megacross-bedding
- trough-shaped megacross-bedding
- herringbones of the same
- high-angle small-scale cross-bedding
- small herringbones
- megacross-bedding with opposite small ripples
- low-angle small-scale cross-bedding
- current ripples
- wave ripples
- parallel laminations
- ferruginous structure
- large channel (size of meters)
- the same, with length direction
- the same, with width in cm
- the same, with depth in cm
- small channel (size of decimeters)
- shallow channel (size of meters)
- small shallow channel (size of decimeters)
- flute cast
- groove cast
- erosional surface
- rain imprints
- fixing upwards in fossil debris
- fixing upwards of sediment
- bioclastic structure
- load casts
- slump structures
- convolute laminations
- root traces
- vertical burrows
- Callianassa-like burrows
- limestone concretion
- pseudomorph

## FOSSILS (column 10)
- plant remains
- redalians
- Lithothamnium
- Coraline
- Lithoporella
- Actinaria
- Halimeda
- Dasyacanthaceae
- other algae
- planktonic foraminifera
- sessile foraminifera
- Rhophax

## DISTRIBUTION AND AMOUNT OF LARGER BENTHONIC FORAMINIFERA (column 12)
- 0 - 1 specimens
- 1 - 3 specimens
- 3 - 10 specimens
- 10 - 30 specimens
- 30 - 100 specimens
- 100 specimens

(The counts were always made in or recalculated for a standard area of 6 cm²)
Vertical sections, mainly from the southern side and central part of the Tremp Basin.
Vertical sections from the northern side of the Tremp Basin.