apart from volatile agents—is limited to silica. Where the diopside masses have been engulfed as inclusions in the igneous gneiss, the rock is traversed by felspathic veins derived from the fluid magma.

The writer wishes to record his indebtedness to Dr. Harker, F.R.S., for encouragement and critical discussion during the progress of these studies.

EXPLANATION OF PLATES IX AND XI.

PLATE IX.

FIG. 1.—Forsterite Marble, Sleaford Bay. The minerals shown are calcite (turbid), dolomite (limpid). The dark grains are forsterite, showing 010 cleavages. Near the centre is a basal section of edenite. Magn. 28 diameters.

FIG. 2.—Forsterite Marble, Sleaford Bay. Constituents: forsterite, with serpentinous decomposition, calcite, dolomite. Twinning lamellæ in dolomite are seen in relation to the rhombohedral cleavages, in the clear grain below on the left. Magn. 28 diameters.

PLATE XI.

FIG. 1.—Diopside Rock, Sleaford Bay. The dark bands are diopside, and the white are quartz veins. The reticulation of the latter is clearly marked.

FIG. 2.—Diopside-Microcline Rock. The clear central area is microcline. In the upper half of the section are basal sections of scapolite showing 110 cleavages at right angles, and diopside. Magn. 28 diameters.

Echinoidea from Western Persia.

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(PLATE XII.)

THE Geological Department of Glasgow University has recently received from Dr. W. R. Smellie and Mr. J. V. Harrison some fossils collected by them which throw further light on the age of the limestones of the Persian arc at the north-western end of Luristan, about 100 miles north-east of Baghdad. The locality, Gilan, is on a tributary of the Diala, about 30 miles south-east of Kasr-i-Shirin, a well-known station on the main road from Baghdad to Teheran. The geology of this part of the Persian frontier has been investigated by J. de Morgan (*Miss. Sci. Perse*, vol. iii, pt. i, *Étud. Géol.*, 1905, pp. 71–112), who has given a geological map (*ibid.*, pl. xix) of an area about 60 miles south-east of Gilan. De Morgan has identified there a folded series of Cretaceous and Eocene limestones, with lacustrine and gypsiferous Miocene beds. The locality at which the fossils were collected by Messrs. Smellie and Harrison is in line with the strike of the rocks in the area of de Morgan's map.

Dr. Smellie's collection was made at Iman-Hasan, near Gilan, from a limestone on the summit of an anticlinal inlier, which is unconformably covered by limestones referred to the Eocene. The fossils include various echinoids, molluscs, brachiopods, corals, and bryozoa. The echinoids give the best evidence of correlation. His collection includes the following echinoids:—

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CRETACEOUS ECHINOIDEA FROM PERSIA.

1. *Rhabdocidaris morgani* Gauthier, 1902 (Miss. Sci. Perse, vol. iii, pt. iii, p. 145, pl. xx, figs. 3-6). Originally obtained by de Morgan from the Upper Senonian in Luristan; the exact locality of the type has been lost. Dr. Smellie's specimen is a well-preserved segment from the Lower Senonian Limestone. He also collected an uppermost interambulacral plate.

2. *Cidaris husseini* Cotteau & Gauthier, 1895 (ibid., vol. iii, pt. ii, p. 82, pl. xiii, figs. 10-12). This species is based on spines which were obtained by de Morgan at Dèrrè-i-Chahr. Dr. Smellie's collection includes six broken spines.

3. *Salenia cossiaza* Cotteau & Gauthier, 1895 (ibid., p. 83, pl. xiii, figs. 13-19). Specimens obtained by de Morgan at Dèrrè-i-Chahr, Endjir-Kuh, and Aftab.

Dr. Smellie's specimen is small and well preserved; diameter 12 mm., height 8 mm. Its characters are illustrated by Pl. XII, Figs. 1a and 1b.

4. *Codiopsis smellii* n.sp. (Figs. 2a-c.)

Diagnosis.—Test sub-hemispherical; base slightly contracted. Horizontal section almost circular but slightly pentagonal.

Apical disc.—Periproct pentagonal. Each genital plate has a large pore near the outer edge, and a granule near the edge of the periproct. Each ocular plate bears four large granules and lines of small granules.

Ambulacral areas.—Each pore zone includes 27 pairs of small round pores in a straight vertical series except at the base, where the pairs are in arcs and the pores are smaller and closer. Near the peristome each column has a vertical series of three tubercles which become smaller towards the peristome. The rest of the ambulacral area has very few granules; each ambital plate has three granules arranged in a triangle.

Interambulacral areas.—About three times the width of the ambulacral. About eight plates in each column. At the base of each column three large tubercles occur in a transverse row; of these the adambulacral tubercle is the largest. The plates are ornamented by numerous granules, which are elongated vertically and form two parallel vertical broken ridges. Some of the elongated granules are perforated. Between the vertical ridges is a row of round granules, three in each plate; the middle granule is the largest. Some granules have a distinct mamelon; in others the boss consists of a flat topped ring with a central pit. These pitted granules probably bore the "mamelons radioliformes" of Cotteau (Pal. franç., Terr. Crét., Ech., vol. vii, 1866, p. 774). Dimensions:

	Length.	Breadth.	Height.
No. 3 . .	1.2 mm.	1.2 mm.	7 mm.
No. 4 . .	1.3 mm.	1.25 mm.	7 mm.

Distribution.—Collected by Dr. W. R. Smellie at Iman-Hasan, Lower Senonian Limestone.

Figures.—Fig. 2a, an interambulacrum, $\times 4$ dia. Fig. 2b, an ambulacrum, $\times 4$ dia. Fig. 2c, apical disc, $\times 4$ dia.

Affinities.—*C. lorini* and *C. doma* differ from this species by the absence of the vertical arrangement of the epistroma. In this respect the new species most resembles *C. arnaudi* Cott. (op. cit., 1866, p. 786) from the Lower Senonian of southern France, in which, however, it is less developed. Amongst recently established species *C. texana* Whitney from the Buda Limestone, Texas, 1916 (Bull. Amer. Pal., vol. v, pp. 91–3, pl. xx, fig. 2), described as nearly related to *C. doma*, differs by having more of its lower pores in arcs and its ornamentation of “fine longitudinal undulating ridges”. *C. mortenseni* Lambert (Ann. Univ. Lyon, vol. i, fasc. 30, 1911, p. 176, pl. xvi) is more tubercular, having tubercles on the upper as well as on the lower surface. *C. libanoticus* de Lor., 1901 (Notes pour servir Et. Ech., 1901, p. 27; cf. R. Fourteau, 1913, Bull. Inst. Egypt, vol. vii, p. 57, pl. vi, fig. 6) closely resembles *C. lorini* Cott. var. *alpina*; but Fourteau’s figure shows no sign of the vertical epistroma of *C. smellii*.

5. *Pyrina orientalis* Cotteau & Gauthier, 1895 (op. cit., p. 68, pl. xi, figs. 1–8). De Morgan obtained his specimens from Derrè-i-Chahr and Endjir-Kuh.

Dr. Smellie’s specimen from Gilan has the dimensions—length 24 mm., breadth 20 mm., height 15 mm.

6. *Echinoconus douwillii* Cotteau & Gauthier, 1895 (ibid., p. 70, pl. xi, figs. 9–13). De Morgan’s specimens are from Derrè-i-Chahr and Aftab.

Dr. Smellie collected two specimens (Nos. 5 and 6):—

	<i>Length.</i>	<i>Breadth.</i>	<i>Height.</i>
No. 5 . .	27 mm.	24 mm.	19 mm.
No. 6 . .	25 mm.	22 mm.	16 mm.

No. 5 shows well the arrangement of the pores near the peristome in oblique triplets (Fig. 3).

7. *Hemiaster parthicus* Gauthier, 1902 (ibid., p. 137, pl. xx, figs. 1 and 2). De Morgan’s specimen was obtained in Luristan; the exact locality is unknown.

In Dr. Smellie’s specimen (No. 6*d*) the dorsal keel is broken, and the apical disc is hidden by the interambulacral areas which have been pressed over it.

Dimensions.—Length 28 mm., breadth 27 mm., height 18 mm.

Dr. Smellie has sent with the echinoids a few molluscs which include some young oysters, the *Lopha morgani* Douvillé. The brachiopoda include *Terebratula brossardi* Th. & Pér.

The age of this fauna is unquestionably Senonian, and apparently Campanian. It corresponds with the fauna of the “echinoid limestone” of de Morgan, who placed it in the Mastrichtian, but at the base of that division. The evidence of the echinoids is in favour of the horizon being pre-Mastrichtian, but still Senonian.

The second fauna was collected by Mr. J. V. Harrison in the same district, at the locality of Tang Diarah, near Gilan. The fossils include some echinoids, most of which have been rather distorted.

The collection includes the following species:—

1. *Schizaster vicinalis* Agassiz & Desor, 1847; Gauthier, 1902 (op. cit., p. 172, pl. xxiii, fig. 4). Obtained by de Morgan from the Upper Eocene at Mollah Ghiavan. Mr. Harrison's specimen is from the Upper Eocene at Tang Diarah. It is somewhat distorted.

Dimensions.—Length 48 mm., breadth 44 mm., height 25 mm.

2. *Schizaster rimosus* Desor, 1847; Gauthier, 1902 (ibid., p. 174, pl. xxiii, fig. 5). De Morgan's specimens are from the Upper Eocene at Mollah Ghiavan.

Mr. Harrison's specimen from Tang Diarah is poorly preserved. This species resembles *S. vicinalis* in many ways. It is distinguished therefrom by its unpaired and paired anterior ambulacral grooves being narrower, and by the posterior petals being relatively a little longer.

3. *Ditremaster nux* (Desor), 1853; Gauthier, 1902 (op. cit., p. 164, pl. xxi, figs. 9-11). De Morgan collected many specimens from the Upper Eocene at Mollah Ghiavan. Mr. Harrison's specimens from Tang Diarah have the following dimensions:—

	<i>Length.</i>	<i>Breadth.</i>	<i>Height.</i>
H ₃ . . .	24 mm.	22 mm.	19 mm.
H ₄ . . .	27 mm.	23 mm.	21 mm.
H ₇ . . .	15 mm.	13 mm.	11 mm.

These dimensions do not agree with those of de Morgan's specimens which are as broad as they are long; but Mr. Harrison's specimens are somewhat crushed. They may belong to the oval variety of *D. nux* mentioned in Pal. franç., Terr. tert., vol. i, p. 422.

4. *Euspatangus ghiavanensis* Gauthier, 1902 (op. cit., p. 156, pl. xxi, figs. 1 and 2). This species was originally obtained by de Morgan from the Upper Eocene at Mollah Ghiavan. Mr. Harrison's specimens are from Tang Diarah. *Dimensions*:—

	<i>Length.</i>	<i>Breadth.</i>	<i>Height.</i>
H ₁₂ . . .	30 mm.	26 mm.	13 mm.
H ₁₃ . . .	22 mm.	20 mm.	10 mm.
H ₈ . . .	24 mm.	21 mm.	10 mm.

The age of this fauna is unquestionably Upper Eocene. Some Middle Eocene echinoids are known from the Pusht-i-Kuh area, but none of those Middle Eocene species is present in Mr. Harrison's collection.