

NOTE ON SOME FOSSILS FROM THE SEDIMENTARY ROCKS  
OF OMAN (ARABIA). BY PROFESSOR C. DIENER,  
*Vienna.* (With Plate 24.)

IN the year 1906 Mr. T. H. Holland, Director of the Geological Survey of India, offered me the opportunity of examining a small collection of fossils from the sedimentary rocks of Oman. In this collection were contained 32 specimens from Elphinstone inlet, which had been collected in 1872 by W. T. Blanford and considered to be of probably triassic age by F. Stoliczka, and 39 specimens of anthracolithic Brachiopoda, Bryozoa and Anthozoa from the Wadī Adi (6 miles west of Muscat), which had been collected by Mr. G. E. Pilgrim in 1905. Although my examination of these fossils has not led to any particularly new or unexpected results, a short note will be found useful, because it refers to a region whose geological structure is as yet very imperfectly known.

The materials from the two localities mentioned above are certainly of widely different age and will therefore be treated separately.

**I.—Fossils from Elphinstone inlet (coll. W. T. Blanford).**

The fossils collected by W. T. Blanford and mentioned in his report (*Rec. Geol. Surv. Ind.*, 1872, Vol. V, p. 75) were found in a dark grey limestone, near Elphinstone inlet, peninsula of Masenderam, at the entrance to the Persian Gulf ( $26^{\circ} 12'$ ;  $56^{\circ} 23'$ ). They were submitted for examination to F. Stoliczka, who suggested their triassic age, judging from the affinity of several examples of *Myophoria* to the Alpine *Myophoria chenopus* Lbe. from St. Cassian. Together with them, however, a species of *Exogyra* was noticed by Stoliczka, belonging to a type unknown in triassic beds.

Stoliczka's short note (l. c. p. 76) is all what is known about Blanford's materials. Neither detailed descriptions nor illustrations of the fossils have as yet been published.

**MYOPHORIA OMANICA nov. sp. Figs. 1, 2, 3.**

This species is represented by numerous single valves, which are never found in their original position connected by the ligament,

but invariably occur separated. Both right and left valves are known to me, but it is of course impossible to decide whether or not the complete shell was slightly inequivalve. Some slabs of rock consisting of a true lunachella of valves remind us strongly of rock-specimens from the Toren beds in the south-eastern Alps, which are entirely composed of detached valves of *Myophoria Whatelyæ* v. Buch.

The shell is ovately trigonal in outline and moderately convex. The umbones are shifted considerably towards the anterior end, faintly developed and mesogyrate. The majority of left valves seem to be curved a little more strongly than the right ones. The number of radiating ribs in front of the marginal carina is from seven to eight. The ribs are stout, well elevated, broadly rounded above and intersected by very numerous concentric striæ of growth. The marginal carina extending from the umbo backward and downward to the basal margin is higher and stouter than the ribs, and separated from the first rib by an antecarinal depression which is broader than the intercostal valleys. In this character it recalls *Myophoria vestita* Alberti (Ueberblick ueben die Trias, 1864, p. 113, Tab. II, fig. 6). The posterior area has no distinct radial ribbing, but is covered with very numerous and delicate concentric striæ.

Escutcheon small, indistinctly defined, separated from the area by a geniculation in the general slope of the shell, not by a distinct rib. The small, cordiform lunula in front of the foremost rib is distinctly convex, not excavated.

That this species is, indeed, a typical *Myophoria* is shown not only by its ornamentation, but also by the development of its hinge. I have succeeded in clearing the hinge of a left valve from the adjoining matrix. This hinge shows a very robust, triangular, central tooth, which is not divided by a median groove. The anterior lateral tooth is situated very close to the hinge margin, elevated into a rounded crest and enlarging slightly in the direction towards the umbo. Posterior lateral tooth united with the hinge margin, not individualised. Teeth not striated. The posterior groove is very narrow and united with the larger, triangular anterior groove in front of the umbo.

The shelly substance is very thin, as is obvious from a fragment of the test, which has been preserved in the example illustrated in fig. 2.

The present species has been compared to *Myophoria chenopus* Laube (Fauna der Schichten von St. Cassian, Denkschr. Kais. Akad. d. Wissensch. Wien, math. nat. Kl., 1865, p. 58, Taf. XVIII, fig. 4) by Stoliczka, but it seems to be allied still more nearly to *M. inæquicostata* v. Klipstein (Beiträge zur geologischen Kenntnis der oestlichen Alpen, p. 254, Taf. XVI, fig. 18), which is distinguished from *M. chenopus* by having the ribs straight and rounded above, not acute.

In their external shape and dimensions *Myophoria omanica* and *M. inæquicostata* do not differ considerably. Among the examples of the latter species, which have been illustrated by Bittner (Lamellibranchiaten der alpinen Trias, I. Revision der Lamellibranchiaten von St. Cassian, Abhandl. K. K. Geol. Reichsanst., XVIII Bd., p., Taf. XI, figs. 1-14), it is especially the large type from the Toren beds of Raibl which might put in a claim for a closer comparison. The width of the antecarinal depression in *M. omanica* is no distinctive character of paramount importance, as in some varieties of *M. inæquicostata* from the Cardita beds of northern Tirol, the antecarinal depression is also broader than the intercostal valleys. There is, however, another remarkable feature of distinction in the sculpture of the two species, and this is the irregularity of strength in the ribs of *M. inæquicostata*. In this species the marginal carina and two or three preceding ribs are the strongest, whereas in our Arabian form this difference in the development of ribs has not been noticed. There are also some differences in the shape of the area, which is radially depressed, and of the broadly lanceolate escutcheon, which is equally depressed in *M. inæquicostata*.

The outlines of the two species appear to differ considerably, if the large specimen of *M. omanica* illustrated in fig. 1, is taken as prototype of the Arabian species. But this specimen is somewhat distorted and deformed. If we try to reconstruct the outlines of the specimens preserved in the slab of rock, which has been illustrated in fig. 3, they seem to agree pretty well with some of Bittner's illustrations. It is worth noticing the statement of this eminent author, that neither v. Klipstein's nor v. Hauer's nor Laube's illustrations of *Myophoria inæquicostata* give an exact side of the shape of this species.

The differences enumerated above are certainly sufficient to

distinguish the two species, but otherwise their very close affinity cannot be denied.

EXOGYRA sp. ind. aff. CONICA d'Orb. Fig. 4.

A single right valve of an *Exogyra*, which has been compared to *E. conica* d'Orbigny. It is, indeed, this species of middle cretaceous age to which it seems to be most nearly allied. Among the specimens illustrated in Coquand's "Monographie du genre *Ostrea*" (Marseilles, 1869) it agrees best with the small example illustrated in Pl. LIII, fig. 4. It is strongly convex and divided into two halves of nearly equal size by an angular ridge, which is marked very distinctly in the apical region, but becomes flattened gradually towards the ventral margin of the shell. The beak is twisted spirally very strongly.

Sculpture nearly reticulate, concentric wrinkles intersecting numerous ribs, which are directed obliquely. The ribbing is stronger than in the majority of examples of *Exogyra conica*.

This valve of a typical *Exogyra* of cretaceous affinities occurs on a slab of rock together with numerous casts of undeterminable bivalves of very different shapes and with the ventral valve of a brachiopod, recalling *Terebratula* or *Waldheimia*.

## II.—Fossils from the Wadi Adi, 6 miles south-west of Muscat (coll. G. E. Pilgrim).

In the great mass of siliceous limestones of the "Oman series" forming the backbone of the mountain range, which runs in a general S. E.—N. W. direction from Jebel Jaalan at the Ras el Hadd corner of Arabia to the base of the Massandim peninsula, fossils were found by Mr. G. E. Pilgrim in two bands in the Wadi Adi, some six miles south-west of Muscat. One of those two bands consisted of a black, compact limestone and contained corals and silicified brachiopods. The other was of a paler colour tinged with red, containing numerous brachiopods, especially of the genus *Productus* with *Orthoceras* and encrinites. Interbedded were some thin layers of a yellow, slaty shale, containing *Bryozoa*. The general character of this fauna was considered by its discoverer as indicative of

anthracolithic age "corresponding perhaps to the middle *Productus* limestone of the Salt Range."

The majority of the fossils are in a very bad state of preservation. Some slabs of rock are made up almost entirely of the shells of a small *Spirigera* or *Spirigerella* with a strong median septum in the ventral valve, but it is impossible to determine the species. Among the class of Bryozoa *Fenestella* is probably represented, whereas the presence of other genera is rather doubtful. A small rock-specimen contains sections recalling *Syringopora* or *Aulopora*. A second one of larger dimensions consists of some cylindrical or dendroid coralla, belonging perhaps to the family of *Monteculiporidæ*. As a satisfactory examination of these remains is rendered impossible by their state of preservation, I have deemed it preferable to abstain from an approximate identification of such specimens as are unfit for description or illustration. In fig. 8 a slab of rock is represented containing remains of *Fenestella* and of a cylindrical coral recalling *Stenopora columnaris* Schloth. from the permian zechstein.

PRODUCTUS cf. INDICUS Waagen. Figs. 5-6.

1884. *Productus indicus* Waagen, Salt Range Fossils, Palæont. Indica, ser. XIII, Vol. I. *Productus* limest. Foss. p. 687, Pls. LXX, LXXI, fig. 1.

Five fragmentary casts of ventral valves are available for examination. None of them is well preserved, but from a combination of their characters a fairly good idea of their shape and sculpture can be formed. They certainly belong to the group of *Productus costatus* Sow., but it is not possible to arrive at a safe determination of the species. In their characters of distinction they seem to agree best with *Productus indicus* Waag., but the differences between this species and *P. subcostatus* Waag. are so insignificant that it is rather difficult to distinguish the two forms, if one is not dealing with typical examples which have been found in a satisfactory state of preservation.

The valves are of moderate size, agreeing in this respect with the specimen illustrated by Waagen on Pl. LXX, fig. 3. They are strongly but irregularly convex, the apical region of the shell being distinctly flattened. There is a distinct sinus in the middle extending from the front to the vicinity of the apex. The dorsal valve, which

in all my specimens is covered by the rocky matrix, follows the direction of the ventral one and is strongly concave, as is obvious from sections of the two valves in weathered examples. The commencement of the trail is indicated by an obtuse geniculation. The wings have been broken off in all my specimens.

The sculpture agrees more closely with the ornamentation in *Productus indicus* than in *P. subcostatus*. The radial ribs are of irregular strength, although the irregularity is marked somewhat less strongly than in typical examples of *P. indicus*. No prominent ribs have been noticed in the region bordering the broken off wings. The regular concentric folds extend over a space of 30 to 35 mm. from the apex.

Impressions of spines are distributed irregularly and in small number over the surface of my casts. In one of my specimens a long, erect spine has been noticed rising near the border of the radial and reticulate patterns of sculpture.

HEMIPTYCHINA cf. SPARSIPLICATA Waag. Fig. 7.

1882. *Hemiptychina sparsiplicata* Waagen, Salt Range Foss., Palæont. Ind., ser. XIII, Vol. I, Productus limest. Foss. p. 366, pl. XXVII, figs. 4-6.
1892. *Terebratula himalayensis* var. *sparsiplicata* Rothpletz, Die Perm-Trias- und Juraformation an Timor und Bötti, Palæontographica, Vol. XXXIX, p. 85, Pl. X, fig. 10.
1897. *Hemiptychina sparsiplicata* Diener, Himal. Foss., Palæont. Indica, Vol. I, Pt. 3, Permocarb. fauna of Chitichun No. I, p. 76, Pl. XII, figs. 1, 2.

A fairly well preserved cast of a representative of *Terebratulidæ* must, according to its external shape, be grouped either with *Hemiptychina* Waagen or with *Dielasma* King. As an examination of its apical region did not lead to the discovery of any traces of dental plates in the ventral valve, I have decided in favour of an identification with *Hemiptychina*.

My specimen is of an elongately oval shape, with moderately inflated valves and with a comparatively small apical angle. The front line having been injured by weathering, traces of marginal indentations are but indistinctly developed. The specimen might therefore perhaps with equal reason be referred to *Hemiptychina sublævis* Waag., the two species being linked together by a number of transitional forms.

## LONSDALEIA sp. ind.

Some slabs of a black limestone are rather rich in sections of cylindrical, straight corallites reaching a diameter of 5 to 8 mm. They stand rather far apart from each other, being united only at the places where one takes its origin from the other by germination.

The internal structure of the corallites has been destroyed so completely that no details can be seen in thin sections. On the weathered surface of the rock the calices show numerous septa, alternately long and short, radiating from a large central columella. The columella is comparatively thick, occupying about one-third of the diameter of the entire calix. Traces of dissepimenta have been noticed. The periphery of the corallite is formed by a distinct though thin external wall.

As far as we are able to judge from our insufficient materials, this coral might be referred to the group of *Lonsdaleia indica* Waagen et Wentzel (Salt Range Foss. Palæont. Ind., ser. XIII, Vol. I, p. 897).

## SUMMARY.

As has been suggested by Mr. G. E. Pilgrim, the fossils from the Wadi Adi are indicative of an anthracolithic age, corresponding probably to the anthracolithic horizon which has been discovered by J. Morgan's expedition in Persia,<sup>1</sup> or to one of the horizons of the Salt Range Productus limestone.

The fossils collected by Mr. Blanford in the rocks near Elphinstone inlet exhibit rather conflicting characters. The leading fossil, a typical *Myophoria*, belongs to a group of forms which has been found up to the present exclusively in triassic beds. A species of *Exogyra*, nearly allied to *E. conica* d'Orb. which does not, however, occur together with *Myophoria omanica*, points to a younger age (probably lower cretaceous). True *Exogyra* have as yet never been noticed in triassic strata.

It is difficult to give a decided opinion as to the stratigraphical horizon of the limestone from Elphinstone inlet, considering the scarcity of fossil remains, but there is some probability of its representing several mesozoic horizons of different age, *Myophoria* indicating a triassic, *Exogyra* a jurassic or cretaceous age for some of the beds.

<sup>1</sup> J. Morgan, Mission scientifique en Perse, Etudes géologiques, Ptie. IV. Mollusques foss., par H. Douvillé, Paris, 1904.

**EXPLANATION OF PLATE.**

Fig. 1 *a, b, c, d.*—*Myophoria omanica*. Left valve of a large specimen, showing the hinge-teeth.

Figs. 2, 3.—*Myophoria omanica*.

Fig. 4.—*Exogyra sp. ind. aff. conica* d'Orb.

All these specimens from Elphinstone inlet (coll. Blanford).

Fig. 5 *a, b.* } —*Productus cf. indicus* Waag.

Fig. 6 *a, b.* } —*Productus cf. indicus* Waag.

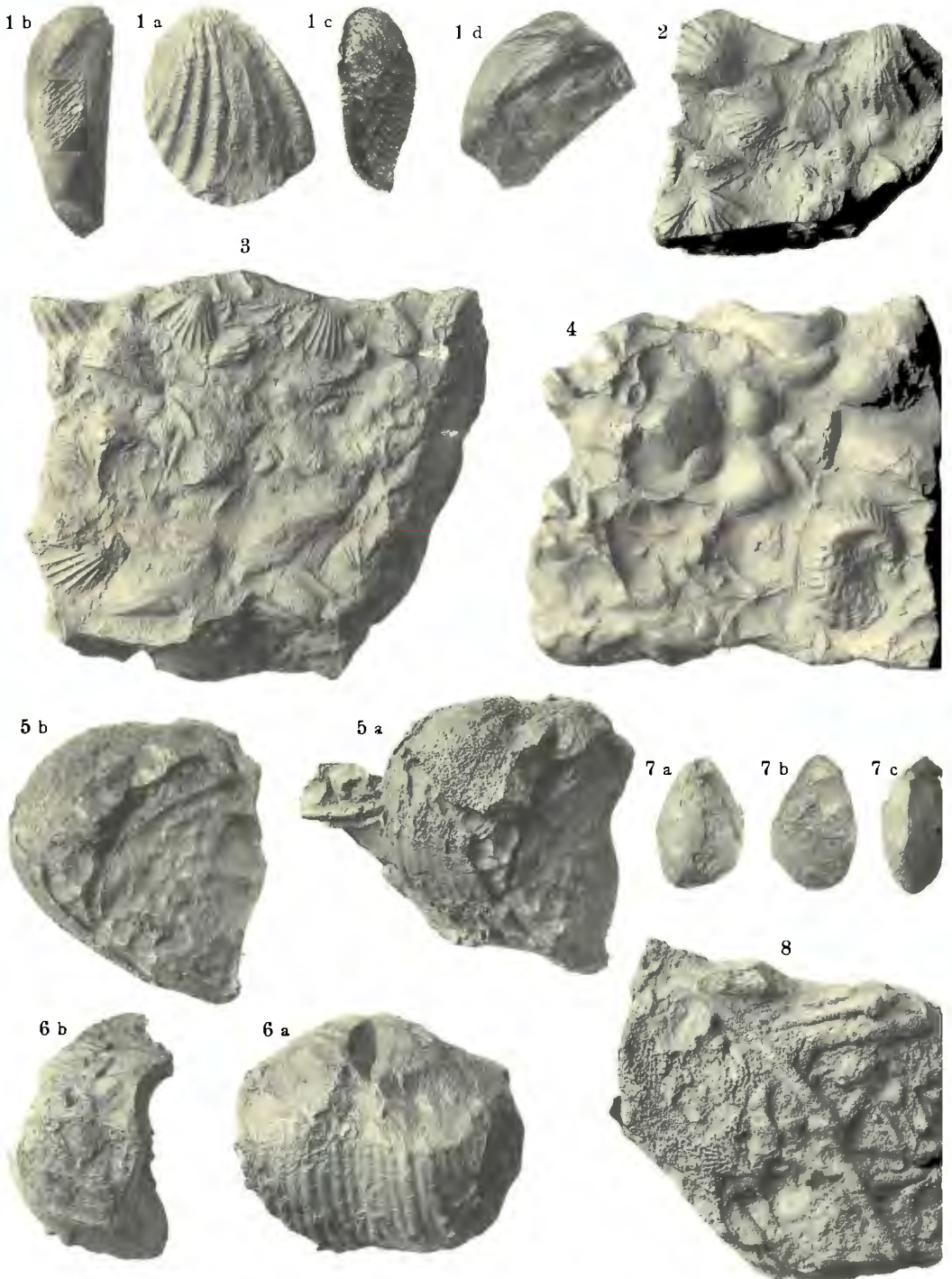
Fig. 7 *a, b, c.*—*Hemiptychina cf. sparsiplicata* Waag.

Fig. 8.—Rock-specimen with casts of *Fenestella* and *Stenopora* (?)

All these specimens from the anthracolithic series of the Wadi Adi (coll. Pilgrim).

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Phototypie M. Jaffé, Vienna

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