VASCOCERATID AMMONITES FROM THE TYPE TURONIAN

by W. J. KENNEDY *and* C. W. WRIGHT

ABSTRACT. Vascoceratid ammonites are not uncommon in the earliest mid Turonian fauna of the stratotype in Touraine, France, in marked contrast to their general scarcity elsewhere in the north-west European Cretaceous. Present are numerous *Neoptychites cephalotus* (Courtiller) (of which *N. telinga* (Stoliczka), *N. xetra* (Stoliczka), *N. telingaeformis* (Solger), *N. crassus* (Solger), *N. perovalis* Von Koenen, and *N. gourguechoni* Pervinquière are considered synonyms), rare *N. xetriformis* Pervinquière, *Fagesia rudra* (Stoliczka), and *Vascoceras* sp. juv. These occurrences are discussed in terms of the north–south correlation of Boreal collignoniceratid and Tethyan vascoceratid faunas, especially those of the Iberian Peninsula, where they characterize Zones VI–VII of Wiedmann's (1959, 1964) standard sequence.

AMMONITES belonging to the subfamily Vascoceratinae Spath, 1925 are generally scarce in the Boreal Realm, although they dominate early Turonian faunas in Tethyan areas such as the Middle East, north Africa, southern France, Spain and Portugal, the Sahara, Nigeria, and the Cameroons. Because of this dominance and the rarity of the typically Boreal Collignoniceratidae and Mammitinae, parallel zonal schemes have developed in the two regions, with only limited north–south correlations. Indeed, as Berthou (1973) and Berthou and Lauverjat (1974*a*, *b*) have now demonstrated, the earliest Turonian of Tethyan areas as defined by vascoceratids is of Cenomanian age in terms of the type areas (Juignet 1977; Kennedy and Hancock 1977).

In Touraine, the type area of the Turonian stage (see Hancock *et al.* 1977 for the most recent review of this area), vascoceratids occur not uncommonly in the fauna of the St. Cyr-en-Bourg Fossil Bed and its correlatives (Hancock *et al.* 1977, p. 155), and the purpose of this contribution is to provide the first detailed account of these elements, as part of an over-all revision of the stratigraphy and ammonite fauna of the stratotype and as a contribution to the resolution of north–south correlations during the mid-Cretaceous.

SYSTEMATIC DESCRIPTIONS

Repositories of material: these are indicated as follows: OUM—University Museum, Oxford; MNHP—Muséum d'Histoire Naturelle, Paris; SP—Sorbonne Collection, now housed in the Université Paris VI; FSR—Faculté des Sciences, Rennes; AM—Muséum d'Histoire Naturelle, Angers; CS—Château de Saumur; LE—Lecointre Collection, Château de Grand Pressigny;

Suture terminology. The suture terminology of Wedekind (1916; see Kullman and Wiedmann 1970 for a recent review) is followed here: I—Internal lobe, U—Umbilical lobe, L—Lateral lobe, E—External lobe.

[Palaeontology, Vol. 22, Part 3, 1979, pp. 665–683, pls. 82–86.]

Dimensions. All dimensions are given in millimetres, figures in parentheses being the percentage of the total diameter. D—diameter, Wb—whorl breadth, Wh—whorl height, U—umbilicus.

Suborder AMMONITINA Hyatt, 1900
Superfamily ACANTHOCERATACEAE Hyatt, 1900
Family ACANTHOCERATIDAE Hyatt, 1900
Subfamily VASCOCERATINAE Spath, 1925
Genus FAGESIA Spath, 1925

Type species. Olcostephanus superstes Kossmat, 1897 by original designation.

Discussion. Only a single representative of this genus is known from Touraine; for a full discussion see Wright and Kennedy (in preparation).

Occurrence. Fagesia is restricted to the early and early mid-Turonian. The geographic distribution includes England, France, Spain and Portugal, North Africa, the Middle East, Nigeria, Cameroons, Madagascar, southern India, Japan, California, Texas, Mexico, and the Western Interior of the United States.

Fagesia rudra (Stoliczka)

Plate 82, figs. 1–2

1865 *Ammonites rudra* Stoliczka, p. 122, pl. 60, fig. 1.
1875 *Stoliczkaia rudra* (Stoliczka); Neumayr, p. 933.
1925 *Fagesia rudra* (Stoliczka); Diener, p. 182.
1973 *Fagesia* sp. cf. *rudra* (Stoliczka); Matsumoto, p. 34 (with synonymy).

Types. Stoliczka based this species on several specimens; that which he figured as his pl. 60, fig. 1–1*b* is herein designated lectotype of the species.

Material. This universally rare species is represented by one specimen only: AM 19, from the St. Cyr-en-Bourg Fossil Bed of St. Cyr-en-Bourg (Maine-et-Loire) (Couffon Collection).

Dimensions

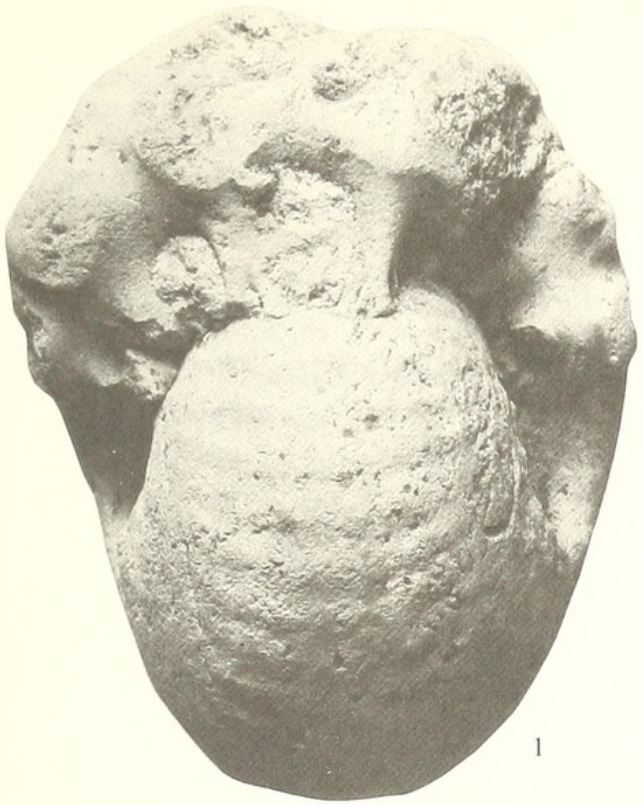
	D	*Wb*	*Wh*	*Wb*:*Wh*	*U*
AM 19	123(100)	100(81)	58(47)	1·72	23(19)
Lectotype (after Stoliczka 1865, p. 122)	170(100)	140(82)	66(39)	2·12	39(23)

Description. The specimen is a wholly septate, rather worn mould in typical tuffeau preservation. Coiling is very involute, with a deep umbilicus comprising 19% of the diameter. The umbilical wall is flat, very high, with an abruptly rounded umbilical shoulder. The whorl section is depressed, semicircular, with a whorl breadth to height ratio of 1·72.

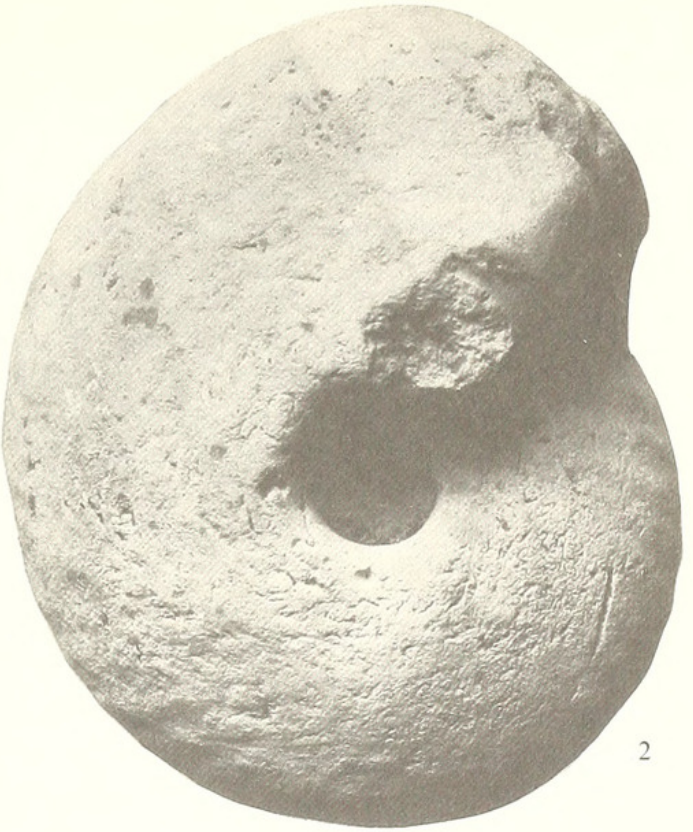
EXPLANATION OF PLATE 82

Figs. 1–2. *Fagesia rudra* (Stoliczka). AM 19, from the St. Cyr-en-Bourg Fossil Bed of St. Cyr-en-Bourg (Couffon Collection). Reduced ×0·7.

Figs. 3–5. *Neoptychites cephalotus* (Courtiller). Paralectotype CS 2, from the environs of Saumur (Courtiller Collection). Reduced ×0·7.



1



2

3 4 5

KENNEDY and WRIGHT, Vascoceratid ammonites

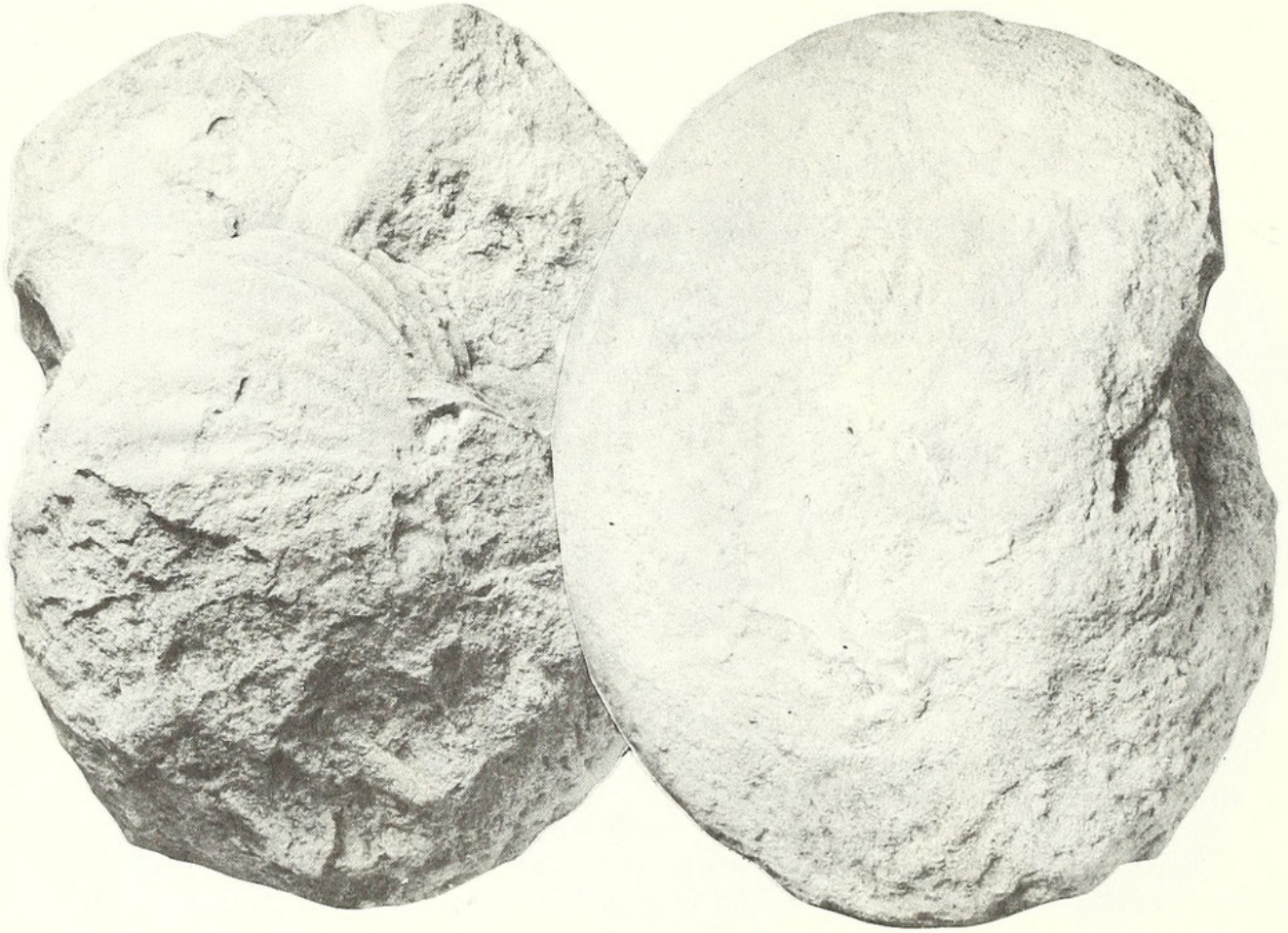
The inner flanks are smooth, but low, broad prorsiradiate ribs are visible on the outer flank, and sweep forwards across the shoulders to form a broad convexity over the venter, where they are at their maximum development. This ornament weakens progressively from 100 mm diameter onwards.

The sutures are imperfectly preserved: E is deep with a large, moderately divided median element; E/L is deeply incised and asymmetrically trifid; L deep with a narrow opening and U_2 relatively large, deeply incised, and also asymmetrically trifid.

Discussion. The small size explains the different proportions from the lectotype. Both show a similar cross-section, style, and progressive decline of ornament; whilst the sutures, so far as they are visible in our specimen, are closely similar.

Fagesia superstes (Kossmat) (1897, p. 26, pl. 6, fig. 1) is easily distinguished from the present form through the presence of much stronger ribs, which arise from umbilical bullae, whilst the crater-like umbilicus has a very different, outwards-sloping wall. Pervinquière's (1907) *F. superstes tunisiensis* and *spheroidalis* differ from the nominate form in detail, but are also easily distinguished from *F. rudra.*

F. thevestensis (Peron) (see Pervinquière 1907, p. 325, pl. 20, figs. 5*a–b*, 6*a–b*; Matsumoto 1973, p. 32, pl. 8, fig. 2*a–c*, text-fig. 2*a–c*) is only slightly depressed at a size comparable to our specimen, with a larger, shallower umbilicus, and strong ribs arising in groups from bullae when young, the bullae surviving when the ribs decline at maturity (Pervinquière 1907, pl. 20, fig. 6*a*).



TEXT-FIG. 1A, B. The holotype of *Ammonites boucheroni* Coquand, MNHP 1904-32. A crushed *Fagesia* from the Turonian of Charente.

F. boucheroni Coquand (1859, p. 967) is based upon a description without figures and in consequence subsequent authors have tended to ignore the species. The holotype, from the Turonian of Charente is preserved in the Muséum d'Histoire Naturelle, Paris (no. 1904-32), and is figured here as text-fig. 1*a–b*. Although poorly preserved it is a close ally of, if not conspecific with, *F. thevestensis*, although because of poor preservation it may best be treated as a *nomen dubium*.

F. peroni Pervinquière (1907, p. 329, pl. 20, figs. 7*a–b*, 8*a–b*), is more evolute, again with bullae, whilst losing all ornament at a very small size. *F. simplex* Barber (1957, p. 57, pl. 8, fig. 1*a–b*; pl. 29, figs. 4–5) and *F. involuta* Barber (1957, p. 27, pl. 9, fig. 3*a–b*; pl. 29, figs. 6–7) from Nigeria both have bullae and differ in other obvious respects, as do *F. catinus* (Mantell) (1822, p. 198, pl. 22, fig. 10) and *F. pachydiscoides* Spath (1925, p. 198; = Sharpe 1855, p. 29, pl. 13, fig. 1*a–b*). *F. bomba* (Eck) (1909, p. 179, pl. 17, figs. 1, 2) has a similar gross shell form to *F. rudra* but possesses umbilical bullae.

Occurrence. This is a very rare species. Three specimens are known from southern India, one from Madagascar, one described as *F.* sp. cf. *rudra* from Japan (Hokkaido), the Touraine example noted here, and a record from northern Spain (Wiedmann 1964, p. 114). Where well dated, the species appears to be limited to the late early to early mid-Turonian.

Genus VASCOCERAS Choffat, 1898

Type species. *Vascoceras gamai* Choffat, 1898 by original designation.

Vascoceras sp. juv.

Plate 84, figs. 4–6

Material. One specimen only, AM 79, from Saumur, Maine-et-Loire.

Discussion. This juvenile *Vascoceras* is specifically indeterminate, but of great interest as the only known representative from Touraine of this typically Tethyan, late Cenomanian and early Turonian genus. It most closely resembles the juvenile *Vascoceras* from Pindiga, Nigeria, figured by Barber (1957, pl. 6, figs. 2*a–b*, 7*a–b*).

Genus *Neoptychites* Kossmat, 1895
[= *Pseudoneoptychites* Leanza, 1967]

Type species. *Ammonites telinga* Stoliczka, 1865 (= *A. cephalotus* Courtiller, 1860), by original designation.

Diagnosis. Medium sized, very involute, high-whorled when adult, with a tiny crater-like umbilicus and narrowly rounded or narrow, flattened venter. Earliest whorls compressed or depressed, smooth, save for sparse constrictions and associated collar-like ribs, followed by a stage with numerous low, broad ribs. Middle to late stages typically smooth, with a constricted aperture. The body chamber may remain compressed and flat-sided throughout or may show a brief phase of marked inflation of the inner flank prior to the apertural constriction. Sutures very variable, from broad, low, little incised elements in some to deep, narrow, intricately incised bifid to trifid lobes in others.

Discussion. Over-all shell form, ontogenetic changes, lack of tubercles and the characteristic constricted aperture readily distinguish *Neoptychites* from all other vascoceratid genera. Species and varieties of *Neoptychites* have been distinguished on

differences of suture and general proportions, both features in which we find significant variation in the material of the type species and others before us. Given this range, we believe that *Betiokyites* Collignon, 1965 type species *Hemitissotia* (*Betiokyites*) *besairei* Collignon (1965, p. 56, pl. 400, fig. 1683; pl. 401, fig. 1684) should be regarded as a subgenus of *Neoptychites*. It differs from the typical form in having a flattened, subtabulate venter and suture with broad, rounded, only feebly denticulate saddles (hence Collignon's referral to *Hemitissotia*), but the over-all shell characters are those of *Neoptychites*, especially the aperture. We would note that even some *N. cephalotus* have relatively simple sutures (e.g. Pervinquière 1907, text-fig. 152). In addition to the type species, *Vascoceras pioti* (Peron and Fourtau) (Freund and Raab 1969, p. 28, pl. 4, figs. 1–9, text-fig. 6*d–g*), *N. hottingeri* Collignon (1966, p. 44, pl. 25, fig. 1–1*b*), and *N. transatlanticus* Leanza (1967, p. 201, pl. 1, figs. 7–8; pl. 3, figs. 7–8; pl. 4, figs. 5–6) may also prove to be *Betiokyites*.

Pseudoneoptychites Leanza, 1967 (type species *P. andinus* Leanza, 1967, p. 202, pl. 5, figs. 3–4, text-fig. 1) is based upon juvenile *Neoptychites sensu stricto*, of which it is a subjective synonym.

Occurrence. Neoptychites first appears relatively early in the Turonian, and has its acme in the late early and early mid-Turonian. Collignon (1965) has recorded a somewhat doubtful representative of the genus (*N. subxetriformis masiaposenis* Collignon) from the late Turonian Zone of *Coilopoceras requienianum* and *Romaniceras deveriai* of Madagascar. The geographic range extends southwards across France from Touraine to Aquitaine and Provence, northern Spain, Morocco, Algeria, Tunisia, Syria, Israel, Cameroon, Nigeria, Madagascar, southern India, the Western Interior of the United States, Texas, Mexico, Brazil, Columbia, and Venezuela.

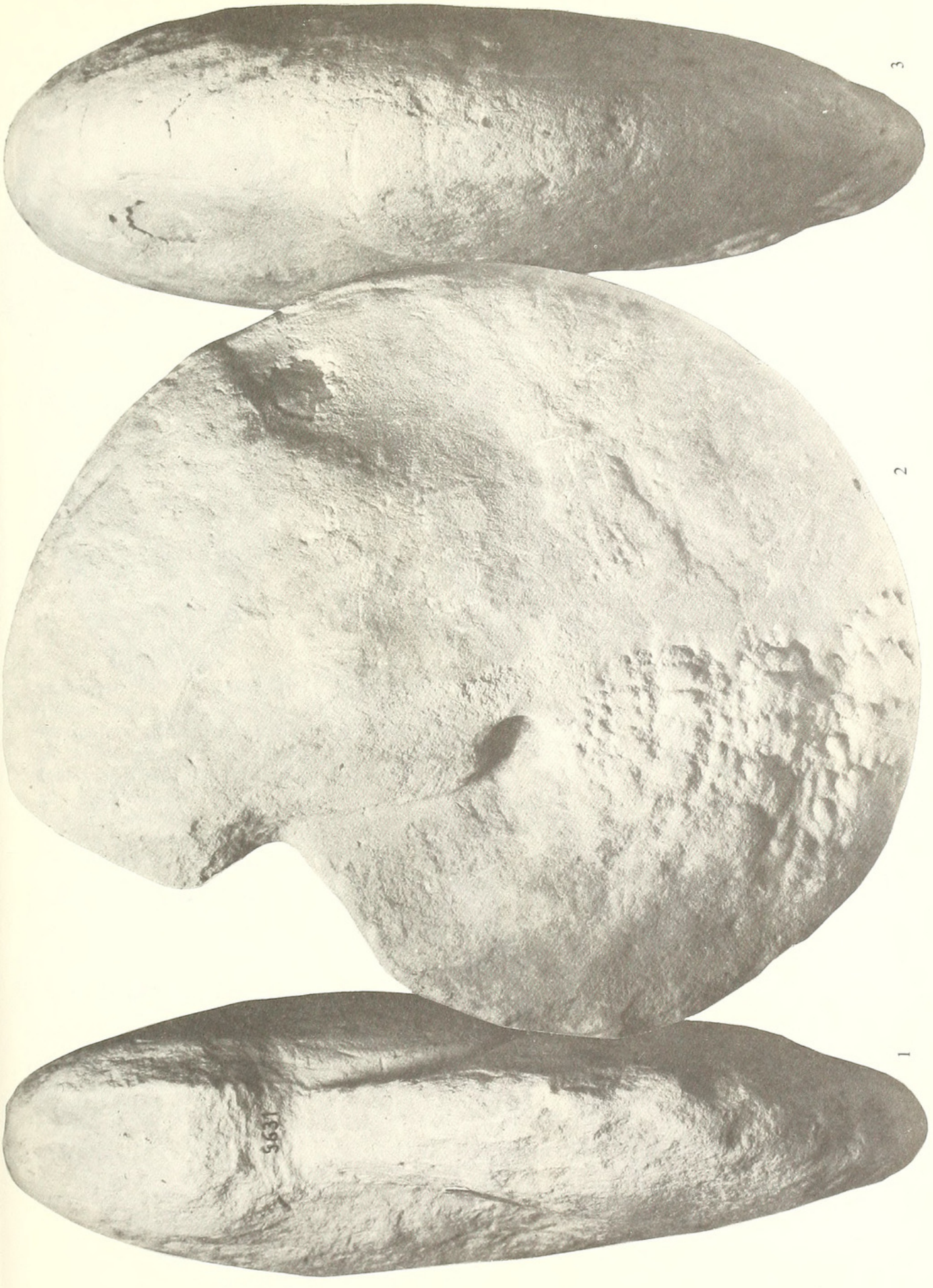
Neoptychites cephalotus (Courtiller)

Plate 82, figs. 3–5; Plate 83, figs. 1–3; Plate 84, fig. 3; Plate 85, figs. 1–5; Plate 86, figs. 5–6; text-fig. 2

1860 *Ammonites cephalotus* Courtiller, p. 248, pl. 2, figs. 1–4.
1865 *Ammonites xetra* Stoliczka, p. 124, pl. 61, figs. 1–2.
1865 *Ammonites telinga* Stoliczka, p. 125, pl. 62, figs. 1–2.
1867 *Ammonites cephalotus* Courtiller, p. 3, pl. 1, figs. 1–3; pl. 2, figs. 1–2.
1889 *Pachydiscus africanus* Peron, p. 28, pl. 17, figs. 9–10.
1895 *Neoptychites xetra* (Stoliczka); Kossmat, p. 72.
1895 *Neoptychites telinga* (Stoliczka); Kossmat, p. 71, pl. 7, fig. 1.
1896 *Neoptychites cephalotus* (Courtiller); de Grossouvre, p. 86.
1897 *Pulchellia perovalis* von Koenen, p. 10, pl. 1, fig. 3; pl. 2, fig. 6.
1903*a* *Neoptychites cephalotus* (Courtiller); Pervinquière, Fiche 5, 5*a*, 5*b*, 5*c*.
1904 *Neoptychites telingaeformis* Solger and varieties, p. 108, pl. 3, figs. 2–3, text-figs. 9–17.
1904 *Neoptychites perovalis* (von Koenen); Solger, p. 122.
1904 *Neoptychites crassus* Solger and varieties, p. 119, pl. 3, fig. 5, text-figs. 18–19.
1907 *Neoptychites cephalotus* (Courtiller); Pervinquière, p. 393, pl. 27, figs. 1–4, text-fig. 152.
1907 *Neoptychites gourguechoni* Pervinquière, p. 400, pl. 27, figs. 8, 9, text-figs. 155, 156.

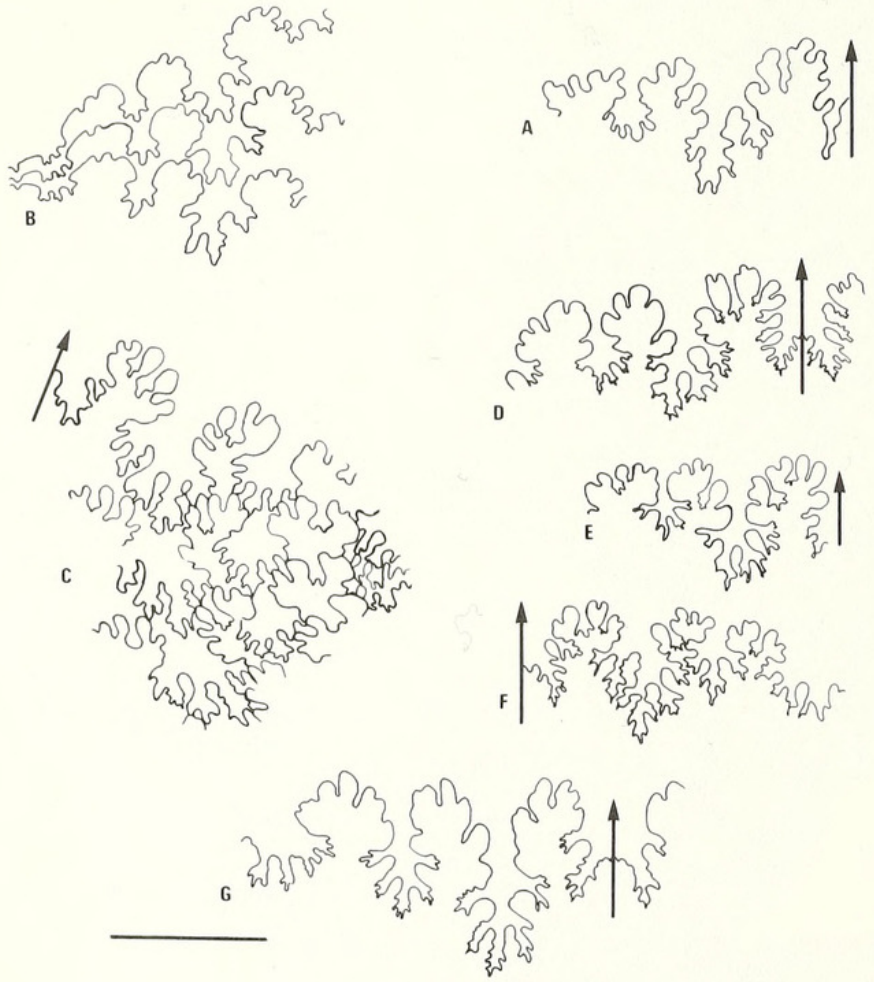
EXPLANATION OF PLATE 83

Figs. 1–3. *Neoptychites cephalotus* (Courtiller). Lectotype, CS 631, from the environs of Saumur (Courtiller Collection). Reduced ×0·8.



KENNEDY and WRIGHT, Vascoceratid ammonites

1912 *Neoptychites cephalotus* (Courtiller); Roman, p. 13, pl. 1, fig. 2.
1930 *Neoptychites cephalotus* (Courtiller); Besairie, p. 217, pl. 19, fig. 2.
1931 *Neoptychites cephalotus* (Courtiller); Basse, p. 34, pl. 4, fig. 9; pl. 11, fig. 5.
1932 *Neoptychites* sp., Riedel, p. 123, pl. 36, fig. 6.
1932 *Neoptychites perovalis* (von Koenen); Riedel, p. 123, pl. 26, fig. 7.
1932 *Neoptychites telingaeformis* Solgar var. *discrepans* Solger; Riedel, p. 123, pl. 26, fig. 5.
1934 *Neoptychites cephalotus* (Courtiller); Faraud, p. 8.
1935 *Neoptychites cephalotus* (Courtiller); Karrenberg, p. 143, fig. 4.
1940 *Neoptychites cephalotus* (Courtiller); Basse, p. 456, pl. 5, fig. 4.
1955 *Neoptychites perovalis* (von Koenen); Reyment, p. 66, pl. 10, fig. 4, text-fig. 29.
?1955 *Neoptychites telingaeformis* Solger; Reyment, p. 66 (*pars*?), ?pl. 15, fig. 1, text-fig. 30 (*non* pl. 11, fig. 4 = *Hoplitoides gibbulosus* (von Koenen)).
1955 *Neoptychites crassus* Solger; Reyment, p. 67.



TEXT-FIG. 2, A–G, *Neoptychites cephalotus* (Courtiller). Sutures of: A: the missing paralectotype (after Pervinquière 1903*a*, fig. T5; B: typical Tunisian example (after Pervinquière 1907, fig. 152); C: *N. gourguechoni* (after Pervinquière 1907, fig. 156); D: *N. telingaeformis* (after Solger 1904, fig. 11*b*); E: *N. telingaeformis palmata* (after Solger 1904, fig. 16); F: *N. telingaeformis elegans* (after Solger 1904, fig. 15); G: *N. crassus* (after Solger 1904, fig. 18). Bar scale is 2 cms.

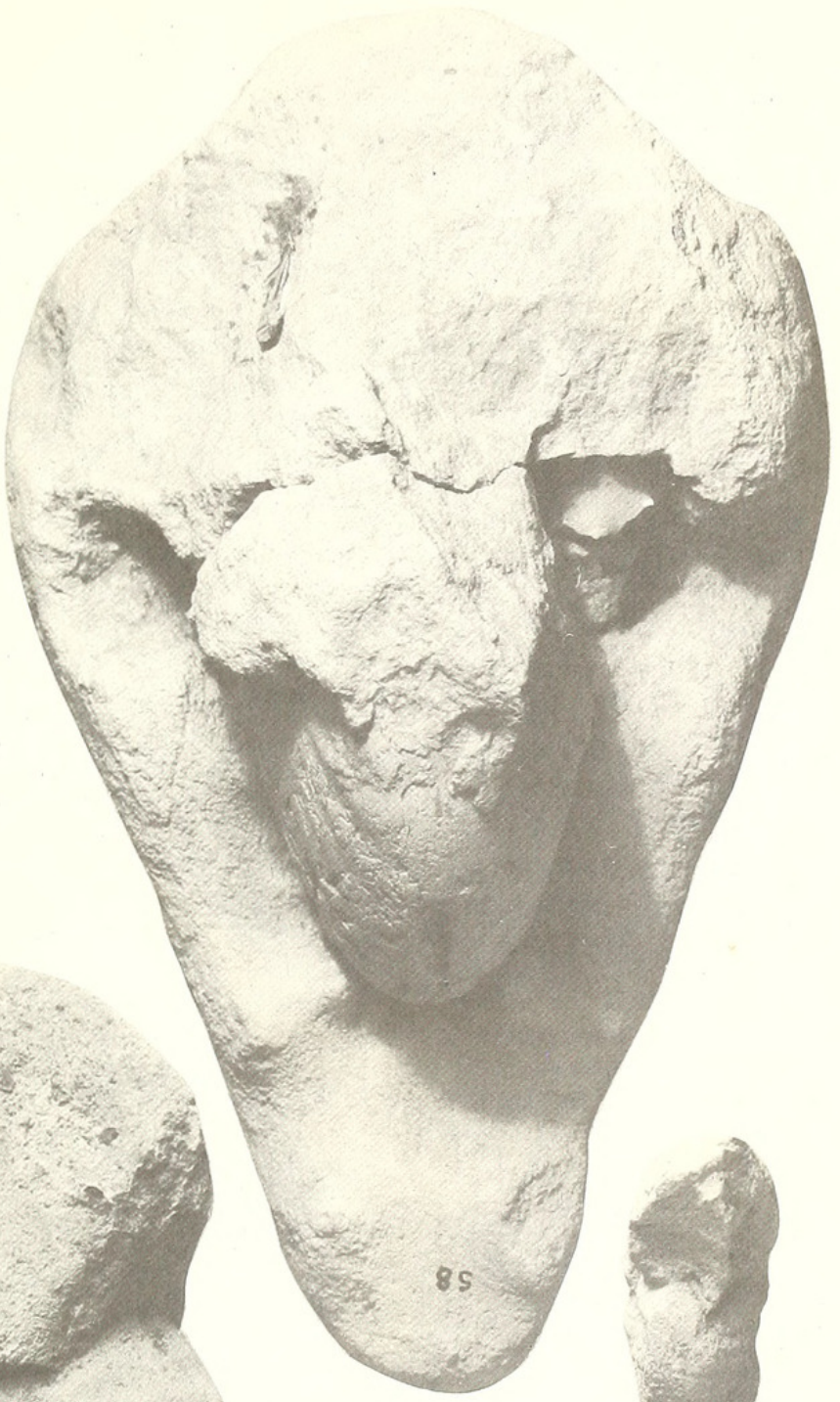
EXPLANATION OF PLATE 84

Figs. 1–2. *Neoptychites xetriformis* (Pervinquière). AM 52, from the St. Cyr-en-Bourg Fossil Bed, Saumoussay (Couffon Collection).

Fig. 3. *N. cephalotus* (Courtiller). Paralectotype CS 8, from the environs of Saumur, showing strongly ribbed inner whorls and inflation of the body chamber (Courtiller Collection). Reduced ×0·8.

Figs. 4–6. *Vascoceras* sp. juv. AM 79, from Saumur.

1



3

2

5

4

6

KENNEDY and WRIGHT, Vascoceratid ammonites

1965 *Neoptychites cephalotus* (Courtiller); Collignon, p. 58, pl. 401, fig. 1685.
1966 *Neoptychites cephalotus* (Courtiller); Collignon, p. 43, pl. 24, fig. 1.
1969 *Neoptychites cephalotus* (Courtiller); Freund and Raab, p. 48.
?1969 *Neoptychites* cf. n. *xetra* (Stoliczka); Freund and Raab, p. 49, text-fig. 10*d*.
?1969 *Neoptychites* sp. 1. Freund and Raab, p. 49, text-fig. 10*e–f*.
?1969 *Neoptychites* sp. 2. Freund and Raab, p. 50, text-fig. 10*g*.
1972 *Neoptychites* cf. *N. cephalotus* (Courtiller); Cobban and Scott, p. 90, pl. 30, fig. 9, text-figs. 49, 50.

Types. Courtiller's original description is based on a series of specimens. Pervinquière (1903*a*) reillustrated the original of Courtiller's (1860) pl. 2, figs. 1–2 (= Courtiller 1867, pl. 1, figs. 1–2) as figs. T_1, T_2. We have relocated this specimen in the Château de Saumur, and designate it, no. CS 631, lectotype of the species, CS 2 (? = Courtiller 1867, pl. 2, fig. 1) is a probable paralectotype, as are CS 8 and CS 9. We have been unable to trace the specimen which Pervinquière reillustrated as his fig. T_4 and believed to be the original of Courtiller's (1867) pl. 1, fig. 3, and presume it to be lost.

Other specimens studied. We have examined more than twenty specimens, including the following: OUMKZ 758, from the St. Cyr-en-Bourg Fossil Bed, Champigonnière Les Rochains, 7 km south of Saumur and north-east of Montreuil-Bellay, Maine-et-Loire. AM: four specimens from 'Saumoussay', Maine-et-Loire. MNHP 144, 142*a–c*; de Grossouvre Collection, Saumur, and other, unregistered Saumur region specimens in the Muséum d'Histoire Naturelle Nantes (all unlocalized), Faculté des Sciences, Rennes, Lecointre Collection, Château de Grand Pressigny and the Sorbonne. We have also studied Pervinquière's (1907) *Neoptychites* types in the Sorbonne and Muséum d'Histoire Naturelle Collections.

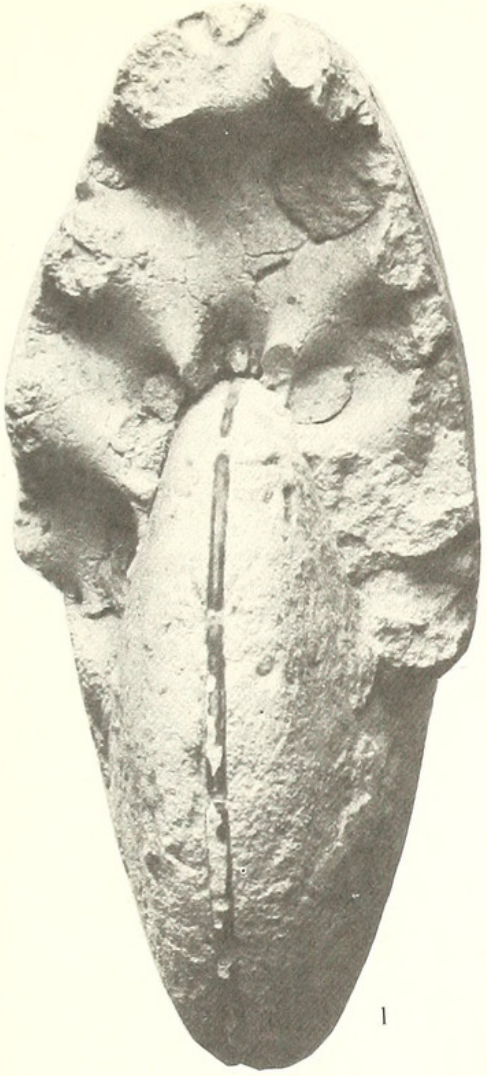
Dimensions

	D	*Wb*	*Wh*	*Wb*:*Wh*	*U*
Lectotype CS 631	181(100)	57(31)	95·5(53)	0·6	11(6)
Paralectotype CS 2	217(100)	96(44)	97(45)	0·99	23(10)
Paralectotype CS 9	111·5(100)	65(57)	62(56)	1·03	7·8(7)
MNHP 114	92(100)	22·3(24)	55(60)	0·41	—(—)
MNHP 7182 (*Ammonites santonensis*)	60(100)	31·4(52)	34(57)	0·92	2·5(4)
From Pervinquière 1907; pl. 27, fig. 3	50(100)	27(54)	27(54)	1·0	4(8)
ibid., pl. 27, fig. 2	128(100)	47(38)	63(49)	0·75	17(13)
at aperture	128(100)	26(21)	63(49)	0·41	10(8)
ibid., pl. 27, fig. 1	176(100)	71(40)	98(56)	0·72	16(9)
at aperture	176(100)	38(22)	98(56)	0·39	11(6)
Neoptychites gourguechoni (types)	44(100)	14(32)	24(39)	0·44	2(4)
	100(100)	40(40)	60(60)	0·67	6(6)

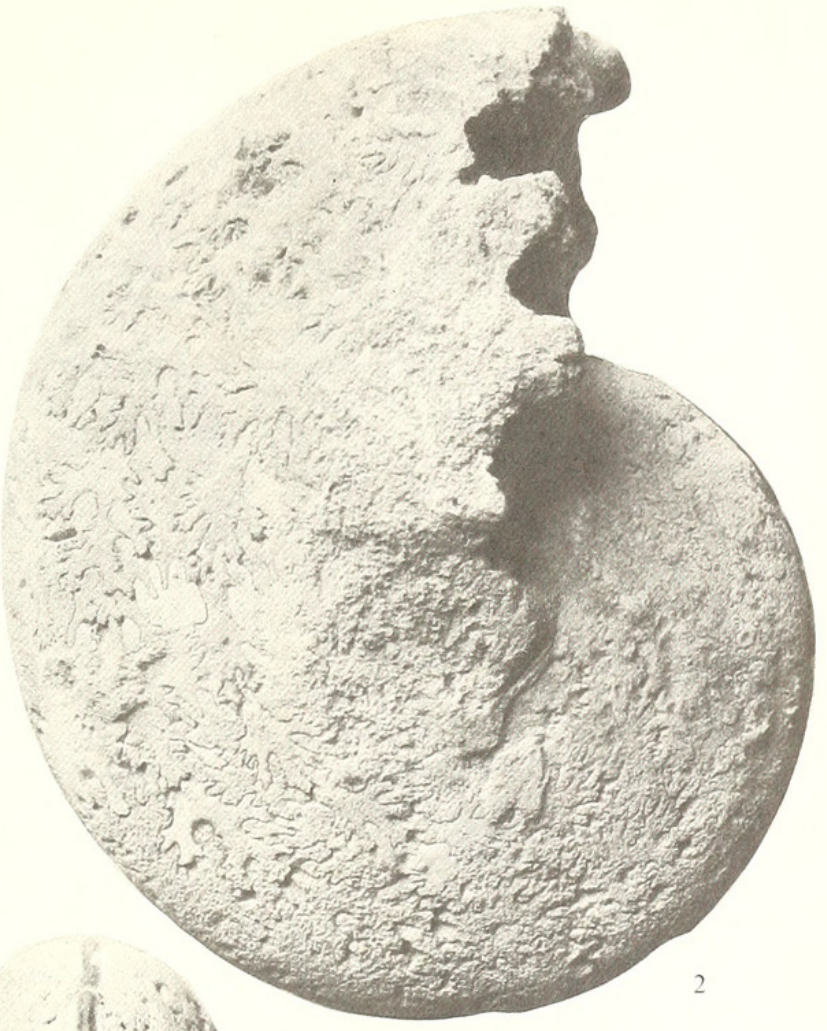
Description. This species passes through three distinctive ontogenetic stages. In the first, which extends up to 20 or 30 mm in our specimens (rather more in specimens figured by Pervinquière (e.g. 1907, pl. 37, fig. 3*a–b* and less in those figured by Solger, e.g. 1904, pl. 3, fig. 4)), the coiling is very involute, with a tiny, crater-like umbilicus. The whorls vary from compressed to depressed, with the greatest breadth at

EXPLANATION OF PLATE 85

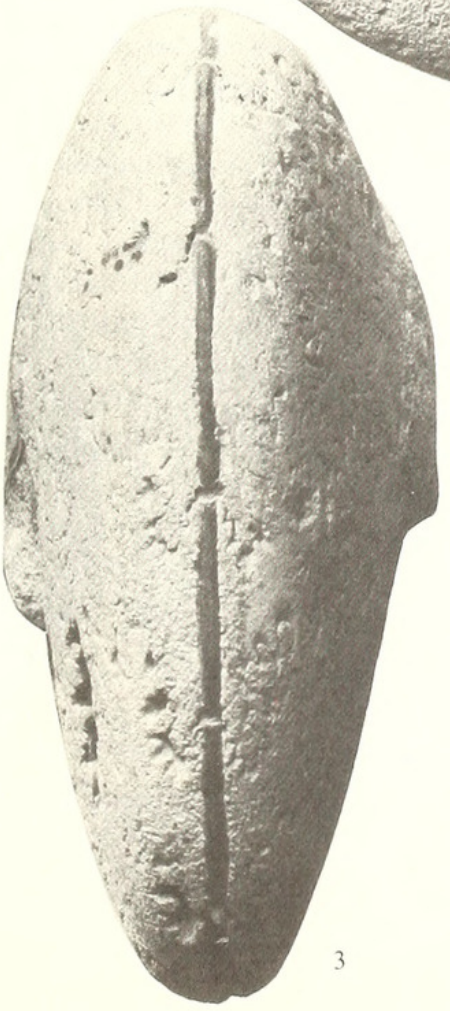
Figs. 1–5. *Neoptychites cephalotus* (Courtiller). 1–3, AM, from 'Saumoussay', a slender example resembling *N. gourguechoni*. 4–5 MNHP 142C, a strongly ribbed *xetra*-like juvenile, from Saumur (de Grossouvre Collection).



1

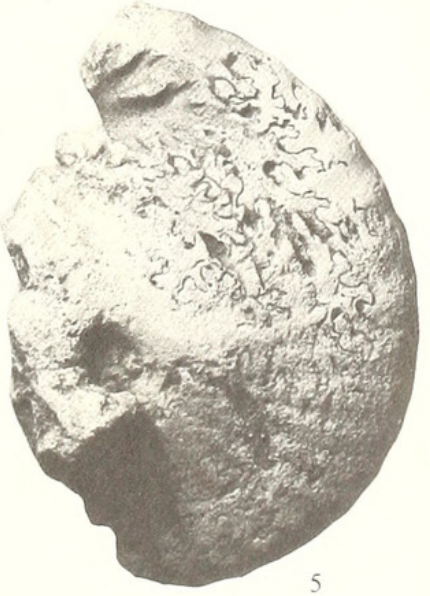


2



3

4



5

KENNEDY and WRIGHT, Vascoceratid ammonites

the rounded umbilical shoulder, the flattened to gently swollen flanks converging to the narrowly rounded venter. Moulds are smooth, except for sparse concave prorsiradiate constrictions (usually 4 per whorl) which are weakened across the venter and both preceded and followed by a parallel bar-like collar and weaker groove, the collar being weak on the umbilical shoulder but strong across the venter, the front being stronger than the rear one (Pl. 86, figs. 4–5).

In the second growth stage, which extends for as little as half a whorl in some specimens (Pl. 86, figs. 4–5) but may continue up to 100 mm diameter in others (Pl. 84), the ribs are long, broad, and prorsiradiate, weak at the umbilical shoulder but strengthening as they pass forwards across the flanks to reach their maximum development over the venter.

In the third stage, from 50–60 mm onwards (Pl. 86, figs. 1–3; Pl. 86, figs. 4–5), all ornament is lost and the whorls become almost triangular with concave outer flanks and a narrowly rounded venter.

This form extends on to the early part of the body chamber in all specimens. In the larger individuals known (e.g. Pl. 83, figs. 1–3; Pl. 84, fig. 3; Stoliczka 1865, pl. 62, fig. 1*a–b*) it extends to the aperture, which is markedly oblique, constricted, with a blunt, spout-like ventral area and a pinched mid-flank region (Pl. 83, fig. 1). In other specimens, the last part of the body chamber before the constricted aperture inflates markedly at mid-flank (Pl. 85, fig. 3) giving the shell an extraordinary fusiform profile when viewed ventrally. The suture line is deeply incised, with plump, rounded folioles in most specimens from Touraine before us, although other individuals referred to the species show great variation in this respect (text-fig. 2).

Discussion. The many specimens of *Neoptychites cephalotus* from the environs of Saumur all appear to come from the level of the St. Cyr-en-Bourg Fossil Bed, as confirmed by the recent detailed records of Amedro and Badillet (1978). These show the species, especially the inner whorls, to be very variable. On the basis of this variation and the range of adults before us, we confirm the conventional view (de Grossouvre 1896, Pervinquière 1907, Karrenberg 1935, Reyment 1955, Wright 1957, Collignon 1966, etc.) that the Indian *N. telinga* is a junior subjective synonym. Pervinquière (1907) suggested that *Pachydiscus africanus* Peron (1889, p. 28, pl. 17, figs. 9–10) is based on a juvenile of *N. cephalotus*, and with this we are also in agreement. *Ammonites santonensis* d'Orbigny (1850, p. 212) is a *Prodrome* species, the surviving specimen of which is a juvenile *N. cephalotus* (Pl. 86, figs. 4–5). D'Orbigny's original description is brief: '*18. *Santonensis*, d'Orb., 1847. Espèce à tours enroulés comme chez l'*A. tumidus*, munie de côtes simples à tours complétement embrassants. Saintes (Charente-Inférieure), Saint Germain près de La Flèche (Sarthe).' The specimen is no. 7182 in d'Orbigny's collection, and is said to be from Saintes, although in a Tuffeau preservation. It is our view that this description is inadequate to define the species, and under the terms of Opinion 126 of the *International Commission on Zoological Nomenclature* (1936) we regard the name as unavailable under the terms of the *Code*.

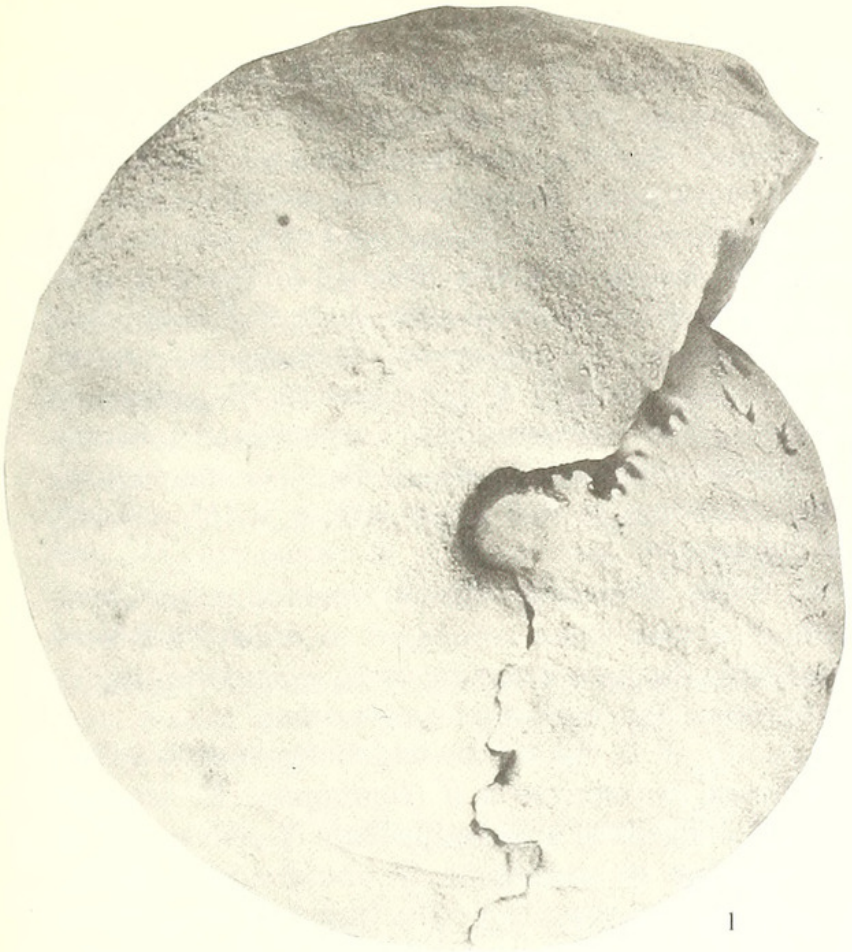
N. xetra (Stoliczka) (1865, pl. 61, figs. 1*a–b*, 2–2*a*), lectotype, herein designated, the original of Stoliczka's pl. 61, fig. 1–1*a*, from the Utatur Group near Odium, has strongly ribbed inner whorls like those of one of Courtiller's paralectotypes, or the

---

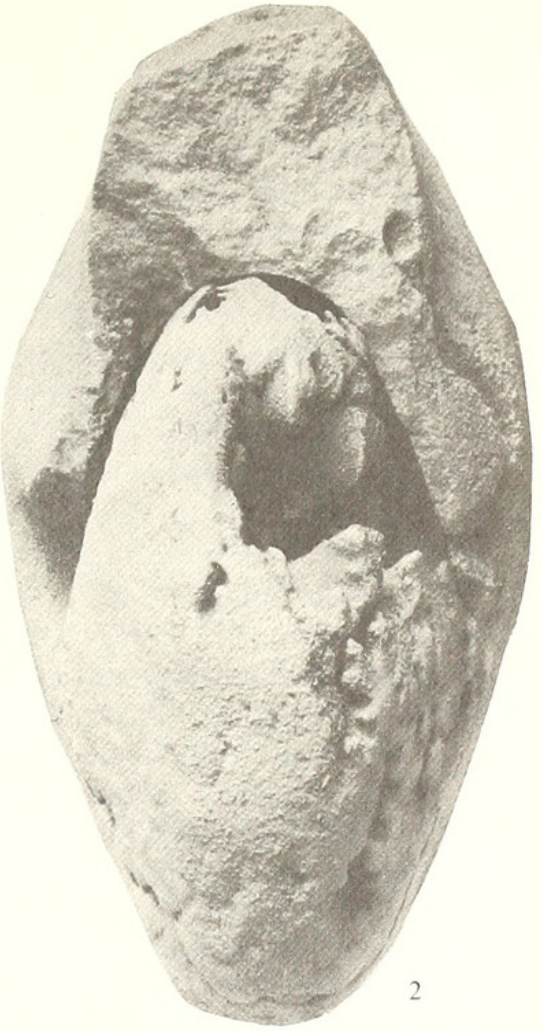
EXPLANATION OF PLATE 86

Figs. 1–3. *Neoptychites xetriformis* (Pervinquière) a specimen in the Lecointre Collection Chateau de Grand Pressigny; 1 and 3 are lit from below to accentuate ornament. Note constricted aperture in 2 and 3.

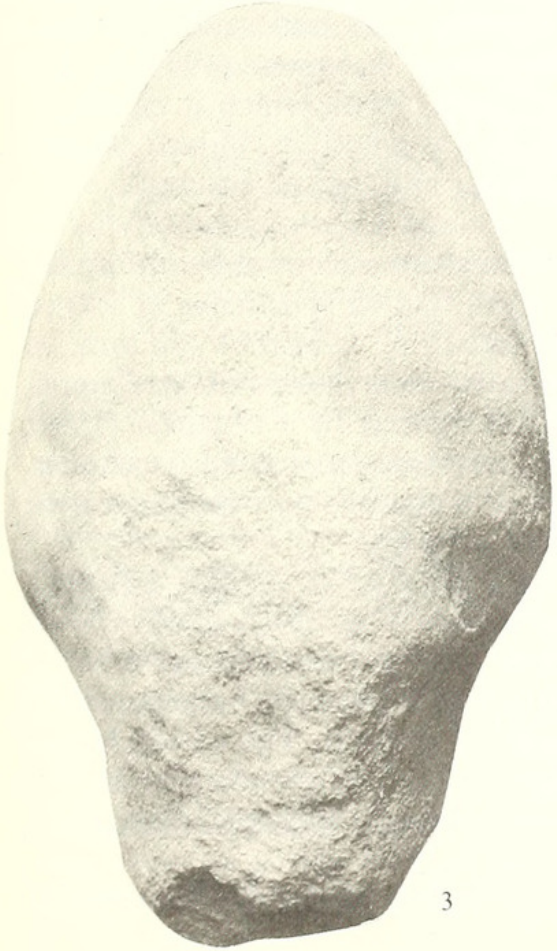
Figs. 4–5. *N. cephalotus* (Courtiller). The holotype of *Ammonites santonensis* d'Orbigny; MNHP 7182 (d'Orbigny Collection), said to be from Saintes, but in a Tuffeau preservation, and probably from the Turonian Calcaire à Céphalopodes north of the town.



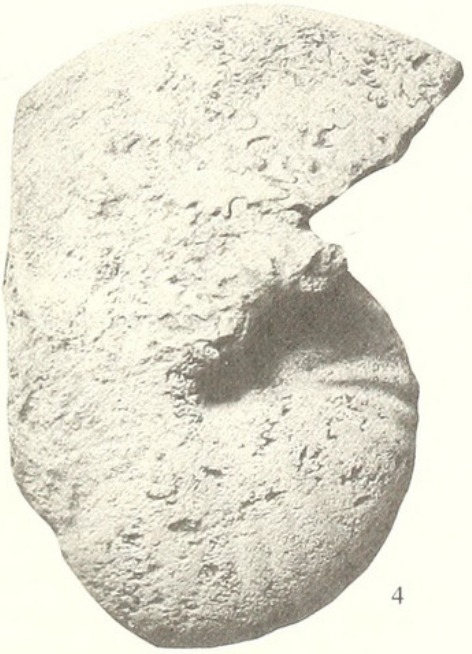
1



2



3



4

5

KENNEDY and WRIGHT, Vascoceratid ammonites

juveniles shown here as Pl. 86, figs. 4–5. When adult it is more inflated than the lectotype of *N. cephalotus*, but no more so than the paralectotype S.2, illustrated as Pl. 84, figs. 1–3. It loses its ornament in the same way as *N. cephalotus* (although adult at only 135 mm), and we would regard it as a junior subjective synonym. Pervinquière (1907, p. 399) had already noted this similarity, suggesting that *xetra* was no more than an inflated *cephalotus*. *N. telingaeformis* (Solger) (1904, p. 108, pl. 3, figs. 2–4, text-figs. 9–17) and the varieties *elegans*, *palmata*, and *discrepans* Solger, all distinguished on sutural details, are juveniles within the range of variation seen in Touraine populations of *N. cephalotus*. Solger's figured adult (1904, pl. 3, fig. 2) shows typical features of the present species, having lost all ornament and developed a constricted aperture, although rather small (110 mm) compared with our individuals. The specimen figured by Reyment (1955, p. 66, pl. 11, fig. 4*a–b*) has an oval whorl section with markedly rursiradiate ribs, and does not belong here.

N. crassus Solger (1904, p. 119, pl. 3, fig. 5, text-figs. 18–19), including var. *asymmetrica* Solger, has a depressed whorl section when compared to other Cameroon specimens, but is no more depressed than the paralectotype of *N. cephalotus* figured here as Pl. 84, figs. 1–3; we would therefore also regard it as a synonym.

N. gibbosula von Koenen (1897, p. 9, pl. 1, fig. 5), to which Reyment's (1955, pl. 11, fig. 4*a–b*) *N. telingaeformis* should be referred is a *Hoplitoides*. *N. perovalis* von Koenen (1897, p. 10, pl. 1, fig. 3; pl. 2, fig. 6) is inseparable from *N. telingaeformis* and is also apparently based on small adult *N. cephalotus*. *N. gourguechoni* Pervinquière (1907, p. 400, pl. 27, figs. 8*a–b*, 9*a–b*, text-figs. 155–156), based on two or three specimens from Mrhila and Draa el Miaad, Tunisia, was separated from *N. cephalotus* on the basis of the more intricately and deeply incised lobes and saddles, which resembled those of *N. perovalis* (von Koenen), of which Reyment (1955, p. 67) regarded it a synonym. It is very similar to *N. cephalotus* (with which it occurs in North Africa), and there seems little doubt that it too is a synonym; indeed slender Touraine specimens (text-fig. 2C–D) have equally slender and incised sutures.

Although we would regard all of the species discussed above as synonyms of *N. cephalotus*, adult features are developed at quite different sizes in different areas. Touraine examples are adult between 180 and 220 mm, Israeli specimens at 190 to 240 mm, Moroccan specimens at 220 mm, and the Indian *N. telinga* at 270 mm. In contrast, the adult lectotype of *N. xetra* is only 135 mm diameter, the adult *N. telingaeformis* 110 mm diameter, and a Malagassy example figured by Collignon (1965, pl. 401, fig. 1685) is only 100 mm diameter with a complete constricted peristome. This may simply be intraspecific variation or geographic variation, or perhaps even dimorphism; the available data is inadequate to decide which.

N. xetriformis Pervinquière (1907, p. 398, pl. 27, figs. 5*a–b*, 6*a–b*, 7*a–b*) is a distinct species, described fully below. It differs from *N. cephalotus* in its much smaller adult size, in retaining ribs throughout development, and in having fewer ribs per whorl.

N. subxetriformis Collignon (1965, p. 54, pl. 349, fig. 1682) from the Late Turonian of Madagascar, has a sharp (subcarinate) venter, and is smooth. The suture line is said to be closer to that of *Thomasites* than *Neoptychites*. Collignon's var. *masiaposensis* (op. cit., p. 69, pl. 408, fig. 1969) is very depressed with a tiny umbilicus. Both of these are, to us, of uncertain systematic position.

N. hottingeri Collignon (1966, p. 44, pl. 25, figs. 1–1*b*) from the Turonian of

Tarfaya, Morocco, has a tabulate venter and is quite distinct from *N. cephalotus*, recalling rather the genus *Spathites* Kummel and Decker, 1954 as does *Vascoceras pioti* (Peron and Fourtau) as figured by Freund and Raab (1969, pl. 4, figs. 1–9), both of which we have suggested as possible *Betiokyites*. The four species of *Neoptychites* described by Leanza (1967) are difficult to place with any certainty, being largely based on juveniles. *N. transatlanticus* Leanza (1967, p. 201, pl. 1, figs. 7–8; pl. 3, figs. 7–8; pl. 4, figs. 5–6) has a flattened venter and is better compared with *Betiokyites*, especially the young of *V. pioti* (Peron and Fourtau), mentioned above. *N. andinus* (Leanza) (1967, p. 203, pl. 5, figs. 3–4, text-fig. 1) is based on 40 mm diameter flat-ventered juveniles only, and is specifically indeterminate; until adults are known it is best treated as only a possible *N.* (*Betiokyites*). Both *N. sohli* (Leanza) (1967, p. 204, pl. 7, figs. 4–6) and *N. difficilis* (Leanza) (1967, p. 205, pl. 5, figs. 5–6) are based on juveniles and are *nomina dubia*. It should also be noted that *Lewesiceras ubatense* Leanza (e.g. 1967, pl. 1, figs. 5–6) may in part be juvenile *Neoptychites*.

Occurrence. N. cephalotus is known from the early Turonian of France from Touraine south to Provence, northern Spain, Morocco, Algeria, Tunisia, Syria, Israel, Cameroon, Madagascar, southern India, and the Western Interior of the United States.

Neoptychites xetriformis Pervinquière, 1907

Plate 84, figs. 1–2; Plate 5, figs. 1–3

1903*b* *Neoptychites* cf. *N. xetra* (Stoliczka), Pervinquière, p. 101.
1907 *Neoptychites xetriformis* Pervinquière, p. 389, pl. 27, figs. 5–7; text-figs. 153–154.
?1920 *Neoptychites* aff. *xetriformis* Pervinquière; Böse, p. 223, pl. 18, figs. 9, 11; text-fig. 7.
1920 *Neoptychites* aff. *N. xetriformis* Pervinquière; Taubenhaus, p. 45, pl. 5, fig. 1.
1925 *Neoptychites xetriformis* Pervinquière; Diener, p. 103.
?1931 *Neoptychites* sp. aff. *N. gourguechoni* Pervinquière; Adkins, p. 57, pl. 2, figs. 18, 20.
1931 *Neoptychites xetriformis* Pervinquière; Basse, p. 35, pl. 12, fig. 1.
?1954 *Neoptychites* cf. *N. xetriformis* Pervinquière; Kummel and Decker, p. 315, pl. 32, fig. 3; text-figs. 5–6.
1963 *Neoptychites xetriformis* Pervinquière; Powell, p. 1229, pl. 171, figs. 2–4; text-fig. 5*b*.
1969 *Neoptychites xetriformis* Pervinquière; Freund and Raab, p. 48.
1972 *Neoptychites xetriformis* Pervinquière; Cobban and Scott, p. 89, pl. 30, figs. 2–6; text-fig. 48.

Types. Pervinquière based this species on several juvenile and adult specimens. The original of his pl. 27, figs. 5*a–b*, from the Lower Turonian of Draa el Miaad, Tunisia, is the holotype.

Material. In addition to the types in the collections of the Sorbonne, we have studied specimens from Texas and northern Mexico described by Adkins (1931), Kummel and Decker (1954), and Powell (1963), that from Colorado noted by Cobban and Scott (1972), and two specimens from Touraine; one in the collections of the Muséum d'Histoire Naturelle, Angers, from the St. Cyr-en-Bourg Fossil Bed, Saumoussay (Maine-et-Loire), the other in the G. Lecointre Collection, housed in the Château de Grand Pressigny.

Dimensions.

	D	*Wb*	*Wh*	*Wb*:*Wh*	*U*
AM 52	98·0(100)	32(33)	—(—)	—	—(—)
at	85·0(100)	40·0(47)	47·5(56)	—	(9)
Holotype	112·0(100)	640(57)	680(61)	0·94	10·0(9)

Description. Small (adult at 100–110 mm), very involute, with a small, deep umbilicus, the wall rounded and undercut on moulds. Whorl section a compressed oval, with swollen inner flanks, flattened convergent outer flanks and a broadly rounded venter on the phragmocone. Body chambers show a strong inflation

of the inner flank on the early part, but towards the aperture scaphitoid coiling is accompanied by a sharp contraction of whorl height and width to a more compressed section and constricted opening to the shell. Ornament consists of low, broad prorsiradiate straight ribs, which persist to maturity.

Suture lines poorly visible in French specimens, but resembling those of the holotype, with a plump E/L, large, deep, bifid L/U_2, U_2 only slightly smaller than E and a broad little incised lobe adjacent to U_2.

Discussion. N. xetriformis is a distinctive species, differing from *N. cephalotus* in its many forms in the small adult size, and retention of broad low ribs to maturity. This species generally accompanies the larger and, when adult, smooth *N. cephalotus*; it is tempting to regard it as the microconch of that species. Its relative scarcity in the Touraine fauna (two specimens, as opposed to several dozen *N. cephalotus*) indicates this to be unlikely, although positive proof is lacking.

Occurrence. N. xetriformis is restricted to the early Turonian, with records from Touraine, France, northern Spain, Tunisia, Morocco, Cameroon, Israel, Madagascar, northern Mexico, Texas, and Colorado.

DISCUSSION

Revision of the ammonite faunas of the type Turonian reveals four species of Vascoceratidae: *Vascoceras* sp. juv. (rare—1 specimen only), *Fagesia rudra* (Stoliczka) (rare—1 specimen only seen), *N. xetriformis* Pervinquière (rare—2 specimens only seen) and *N. cephalotus* (Courtiller)—common (6·6% of the ammonite fauna of the St. Cyr-en-Bourg Fossil Bed according to Amedro and Badillet (1978)).

Our own observations indicate these species to be confined to a horizon low in the Tuffeau, called the St. Cyr-en-Bourg Fossil Bed by Hancock *et al.* (1977), where they occur associated with *Spathites* (*Jeanrogericeras*) *reveliereanum* (Courtiller), *Kamerunoceras turoniense* (d'Orbigny), *Lewesiceras peramplum* (Mantell), *Collignoniceras woollgari* (Mantell), *C. carolinum* (d'Orbigny), *C. papale* (d'Orbigny), '*C*' (gen. nov.) *fleuriausianum* (d'Orbigny) (= '*Mammites*' *vielbanci* (d'Orbigny) of authors), and *Romaniceras kallesi* Zázvorka (= *Romaniceras hispanicum* Wiedmann).

In Spain, these vascoceratids are recorded from Wiedmann's (1959, 1964) Zones VI–VII, high in his Lower Turonian, together with a number of other non-collignoniceratid elements of the St. Cyr-en-Bourg Fossil Bed, although forms such as *S.* (*Jeanrogericeras*) *reveliereanum* and *Kamerunoceras turoniense* range as low as his Zone III. In Israel they range through Zones 5–7 of Freund and Raab (1969) at the top of these authors' Lower Turonian, and in Nigeria (Reyment 1955; Barber 1959) *Neoptychites* also occupies a relatively elevated position. In North America, *N. cephalotus* and *N. xetriformis* are recorded from a much lower horizon, the lowest *Watinoceras coloradoense* Zone of the Turonian, below that of *Mammites nodosoides* (Schlüter). In northern Mexico (Powell 1963) and west Texas (Adkins 1931), *N. xetriformis* is recorded from the *Spathites puercoensis* Zone associated with early *C. woollgari* (= *Selwynoceras mexicanum* auctorum). All these records save that from the Western Interior of the United States are consistent, and confirm that the fauna of the St. Cyr-en-Bourg Fossil Bed represents a horizon some way up in the Turonian, as is known from its position well above beds with rare *Mammites* of the *nodosoides* (Schlüter) group.

That so many zones are recognized below this level in Tethyan vascoceratid

dominated sequences accords with the emerging view (summarized by Kennedy and Hancock 1977) that the lowest 'Turonian' vascoceratid zones are equivalent in part or whole to the Boreal Upper Cenomanian.

There remains, however, the apparently anomalous appearance of *Neoptychites* in the Western Interior of the United States. The best dated records here are in the Hinkle Ranch Section, Colorado, described by Cobban and Scott (1972), where *N.* cf. *cephalotus* occurs in the same bed as *W. coloradoense* (Henderson) and *Vascoceras* (*Greenhornoceras*) *birchybyi* Cobban and Scott. The inner whorls of *Neoptychites* closely resemble those of *Paravascoceras* Furon, 1935 (see Schöbel 1975 for illustrations) from which it presumably evolved through an increase in size and degree of involution. *Paravascoceras* first appears in the very high Cenomanian or low Turonian in Israel and north Africa, but in the U.S. first appears in the *Pseudaspidoceras flexuosum* Zone of the southern Quitman Mountains in Calvert Canyon, west Texas (OUM Collections), where it co-exists with a *Neoptychites* sp. juv. which are approximately contemporaneous with the Colorado occurrences of *Neoptychites*. Either the genus appears much earlier in the New World than the Old, or again, we face the problem of the position of the Cenomanian/Turonian boundary in Boreal as opposed to Tethyan terms.

Acknowledgements. We thank Drs. J. M. Hancock and M. R. Cooper for their assistance in both field and laboratory, and are grateful to Dr. J. Sornay, Dr. M. K. Howarth, Mr. D. Phillips, Dr. C. Duerden, and Dr. W. A. Cobban for allowing us to study specimens in their care. The financial support of NERC and of Wolfson College, Oxford, is gratefully acknowledged, as is the assistance of the staff of the Geological Collections, University Museum, Oxford.

REFERENCES

ADKINS, W. S. 1931. Some Upper Cretaceous Ammonites in western Texas. *Bull. Univ. Tex. econ. Geol. Tech.* **3101,** 35–72, pls. 2–5.

AMEDRO, F. and BADILLET, G. 1978. Répartition des ammonites dans quelques coupes du Turonien des environs de Saumur (Maine-et-Loire). *C.R. hebd. Séanc. Acad. Sci. Paris*, **286D,** 323–325.

BARBER, W. M. 1957. Lower Turonian ammonites from north-eastern Nigeria. *Bull. geol. Surv. Nigeria*, **26,** 67 pp., 34 pls.

BASSE, E. 1931. Monographie paléontologique du Crétacé de la Province de Maintirano, Madagascar. *Mém. géol. Serv. Min. Madagascar*, 86 pp., 13 pls.

—— 1940. Les céphalopodes crétacés des massifs côtiers syriens. Pt. 2. *Haut Commiss. Répub. Franç. Syrie-Liban*, **2,** 165–230, pls. 8–11.

BERTHOU, P. Y. 1973. Le Cénomanien de l'Estrémadure Portugaise. *Mems. Servs. geol. Portugal*, N.S. **23,** 169 pp., 67 pls. + map.

—— and LAUVERJAT, J. 1974*a*. La limite Cénomanien-Turonien dans la séries à Vascoceratidés de l'embochure du Rio Mondego (Beira littoral, Portugal). *C.r. hébd. Séanc. Acad. Sci., Paris*, **D278,** 1463–1466.

—— —— 1974*b*. La limite Cénomanien-Turonien. Essai de corrélation entre la série Portugaise à *Vascoceras* et les séries de l'Europe du sud-ouest et de l'Afrique du Nord. Ibid. **278,** 2605–2608.

—— —— 1975*a*. Le Cénomano-Turonien à Vascoceratidés dans sa région type (embochure du Rio Mondego, Beira littoral, Portugal). *Newsl. Stratigr.* **4,** 96–118.

—— —— 1975*b*. La limite Cénomanien-Turonien dans les principaux facies du bassin occidental Portugais. *C.r. hébd. Séanc. Acad. Sci., Paris*, **D282,** 2143–2146.

BESAIRIE, H. 1930. Recherches géologiques à Madagascar. Première suit. La géologie du Nord-Ouest. *Mém. Ac. Malagache*, **21,** 9–259, pls. 1–24.

BÖSE, E. 1920. On a new ammonite fauna of the Lower Turonian of Mexico. *Bull. Univ. Tex. econ. Geol. Tech.* **1856,** 173–252, pls. 12–20.

CHOFFAT, P. 1898. Les Ammoneés du Bellasien, des couches à *Neolobites vibrayeanus*, du Turonien et du Sénonien. Part 2 of: Recueil d'études paléontologiques sur la faune crétacique du Portugal. *Trav. geol. Portugal*, 41–86, pls. 3–22.

COBBAN, W. A. and SCOTT, G. R. 1972. Stratigraphy and ammonite fauna of the Graneros Shale and Greenhorn Limestone near Pueblo, Colorado. *Prof. Pap. U.S. geol. Surv.* **645,** 108 pp., 39 pls.

COLLIGNON, M. 1965. *Atlas des fossiles caractéristiques de Madagascar (Ammonites)—XII, Turonien*, iv+82 pp., pls. 376–413. Service Geologique, Tananarive.

—— 1966. Les céphalopodes crétacés du bassin côtier de Tarfaya. *Notes Mém. Serv. Mines géol. Maroc*, **175,** 148 pp., 35 pls.

COQUAND, H. 1859. Synopsis des animaux et des végétaux fossiles observés dans la Formation crétacé du sud-ouest de la France. *Bull. Soc. géol. Fr.* (2), **16,** 945–1023.

COURTILLER, M. A. 1860. Description de trois nouvelles espèces d'ammonites du terrain crétacé des environs du Saumur. *Mém. Soc. imp. Agr. Sci. Arts, Angers*, **3,** 246–252, 3 pls.

—— 1867. Les ammonites du Tuffeau. *Ann. Soc. Lin. de Maine-et-Loire, Angers*, **9,** 8 pp., 8 pls.

DIENER, C. 1925. *Fossilium catalogus, 1, Animalia; 29, Ammonoidea neocretacea*, 244 pp. Junk, Berlin.

ECK, O. 1909. Bemerkungen über drei neue Ammoniten aus der oberen ëgyptischen Kreide. *S. B. Ges. Naturf. Fr. Berl.* **3,** 179–191.

FARAUD, M. 1934. Le Ligérien de la colline de Bernon, près de Tresques (Gard). *Bull. Soc. Sci. Nat. Vaucluse*, **1,** 11 pp.

FREUND, R. and RAAB, M. 1969. Lower Turonian ammonites from Israel. *Spec. Pap. Palaeont.* **4,** 83 pp., 10 pls.

GROSSOUVRE, A. DE 1896. Sur le genre *Neoptychites*. *Bull. Soc. géol. Fr.* (3) **24,** 86.

HANCOCK, J. M., KENNEDY, W. J. and WRIGHT, C. W. 1977. Towards a correlation of the Turonian sequences of Japan with those of north-west Europe. *Spec. Papers. Palaeont. Soc. Japan*, **21,** 151–168.

JUIGNET, P. 1977. Ammonite faunas from the Cenomanian around Le Mans (Sarthe, France). Ibid. 143–150.

KARRENBERG, H. 1935. Ammoniten fauna aus der nordspanischen Oberkreide. *Palaeontographica*, **82-A,** 125–161, pls. 30–33.

KENNEDY, W. J. and HANCOCK, J. M. 1977. Towards a correlation of the Cenomanian sequences of Japan with those of north-west Europe. *Spec. Papers. Palaeont. Soc. Japan*, **21,** 127–141.

KOENEN, A. VON. 1897–1898. Ueber Fossilen der unteren Kreide am Ufer des Mungo in Kamerun. *Abh. könig. Ges. Wiss. Göttingen, N.R.* **1,** 1–48, 4 pls.

KOSSMAT, F. 1895–1898. Untersuchungen über die südindische Kreideformation. *Beitr. Paläont. Geol. Öst. Ung.* **9** (1895): 97–203 (1–107), pls. 15–25 (1–11); **11** (1897): 1–46 (108–153), pls. 1–8 (12–19); **12** (1898): 89–152 (154–217), pls. 14–19 (20–25).

KULLMAN, J. and WIEDMANN, J. 1970. Significance of sutures in phylogeny of Ammonoidea. *Paleont. Contr. Univ. Kansas*, **47,** 1–32.

KUMMEL, B. and DECKER, J. M. 1954. Lower Turonian ammonites from Texas and Mexico. *J. Paleont.* **28,** 310–319, pls. 30–33.

LEANZA, A. F. 1967. Algunos ammonites nuevos o poco conocidos del Turoniano de Colombia y Venezuela. *Acta Geol. Lilloana*, **9,** 189–213, 7 pls.

MANTELL, G. A. 1822. *The fossils of the South Downs, or illustrations of the geology of Sussex*, 320 pp., 42 pls. London.

MATSUMOTO, T. 1973. Vascoceratid ammonites from the Turonian of Hokkaido. *Trans. Proc. palaeont. Soc. Japan* N.S. **89,** 27–41, pl. 8.

NEUMAYR, M. 1875. Die Ammoniten der Kreide und die systematik der Ammonitiden. *Z. dt. geol. Ges.* **27,** 854–892.

ORBIGNY, A. D'. 1850. *Prodrome de paléontologie stratigraphique universelle*, **2,** 427 pp. Masson, Paris.

PERON, A. 1889–1895. Description des mollusques fossiles des terrains Crétacés de la région des Hauts Plateaux de la Tunisie recueillis en 1885 et 1886 par M. Phillipe Thomas. *Exploration scientifique de la Tunisie*, 405 pp., 35 pls. Masson, Paris.

PERVINQUIÈRE, L. 1903*a*. *Ammonites cephalotus* Courtiller, 1860. *Pal. Univers. fiche*, 5.

—— 1903*b*. *Étude géologique de la Tunisie centrale*. Paris.

—— 1907. *Études de paléontologie tunisienne*. 1, Céphalopodes des terrains secondaires; système crétacique. *Mém. Carte géol. Tunisie*, 48 pp., 27 pls.

POWELL, J. D. 1963. Turonian (Cretaceous) ammonites from north-eastern Chihuahua, Mexico. *J. Paleont.* **37,** 1217–1232; pls. 166–171.

REYMENT, R. A. 1955. The Cretaceous ammonoidea of southern Nigeria and the southern Cameroons. *Bull. geol. Surv. Nigeria*, **25,** 112 pp., 25 pls.

RIEDEL, L. 1932. Die Oberkreide von Mungofluss in Kamerun and ihre Fauna. *Beit. Geol. Erforsch. dtsch. SchGeb.* **16,** 154 pp., 33 pls.

ROMAN, F. 1912. Coup d'oeil sur les zones de Céphalopodes du Turonien du Vaucluse et du Gard. In *Comptes Rendu de l'Association Française pour l'avancement des Sciences, Congrès de Nîmes*, **1912,** *Géologie et Mineralogie*, 1–15, pls. 1–3.

SCHÖBEL, J. 1975. Ammoniten der Familie Vascoceratidae aus dem Unterturon des Damergou-Gebietes, Republique du Niger. *Spec. Publ. palaeont. Inst. Uppsala*, **3,** 136 pp., 6 pls.

SHARPE, D. 1855. Description of the fossil remains of Mollusca found in the Chalk of England. 1, Cephalopoda. *Palaeontogr. Soc.* (*Monogr.*), 27–36, pls. 11–16.

SOLGER, F. 1904. Die Fossilien der Mungokreide in Kamerun und ihre geologische Bedeutung, mit besonderer Berücksichtigung der Ammoniten *In* ESCH, E., SOLGER, F., OPPENHEIM, M. and JÄKEL, O. *Beiträge zur Geologie von Kamerun.* 85–243, 3 pls. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.

SPATH, L. F. 1925. On Upper Albian Ammonites from Portuguese East Africa. With an Appendix on Upper Cretaceous ammonites from Maputoland. *Ann. Tvl. Mus.* **11,** 179–200, pls. 28–37.

STOLICZKA, F. 1863–1866. The fossil cephalopoda of the Cretaceous rocks of southern India. *Mem. geol. Surv. India Palaeont. indica*, (3) **1,** 41–56, pls. 26–31 (1863); **2–5,** 57–106, pls. 32–54 (1864); **6–9,** 107–154, pls. 55–80 (1865); **10–13,** 155–216, pls. 81–94 (1866).

TAUBENHAUS, H. 1920. Die Ammoneen der Kreideformation Palästinas und Syriens. *Z. dt. Palastver.* **43,** 58 pp., 9 pls.

WEDEKIND, R. 1916. Über Lobus, Suturallobus und Inzision. *Centbl. Miner. Geol. Pälaont.* **1916,** 185–195.

WIEDMANN, J. 1959. Le Crétacé Supérieur de l'Espagne et du Portugal et ses céphalopodes. *C.R. Congrès des Sociétés Savantes-Dijon 1959: Colloque sur le Crétacé supérieur français*, 709–764, 8 pls.

—— 1964. Le Crétacé Supérieur de l'Espagne et du Portugal et ses céphalopodes. *Estudios geol. Inst. Invest. geol. Lucas Mallada* **1964,** 107–148, 39 figs.

W. J. KENNEDY

C. W. WRIGHT

Geological Collections
University Museum
Oxford OX1 3PW U.K.
and
Wolfson College
Oxford

Typescript received 9 July 1978
Revised typescript received 6 November 1978