876. NUMMULITES AND ASSILINA FROM TANSEN AREA,
PALPA DISTRICT, THE NEPAL LESSER HIMALAYAS*

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Abstract. Middle Eocene (Lutetian) Nummulites beaumonti d’Archiac and Haime and Assilina papillata Nuttall are described from the Bhainskati Formation (Kirthar Series), Tansen Group in the Tansen area, Palpa district, the Nepal Lesser Himalayas. This is the first description of both species from Nepal. The specimens include only the megalospheric form and their internal morphology is discussed. Two species are useful in establishing a local and interregional correlation of marine Eocene strata. The paleoecology of the Nepal nummulitid bed is briefly described.

Key words. Nummulites, Assilina, Eocene, Nepal, Himalaya

Introduction

Much information concerning the geology and paleontology of the Nepal Lesser Himalayas has been accumulated in the last nineteen years (Hagen, 1969; Frank and Fuchs, 1970; Hashimoto et al., 1973; Sharma, 1977; Sakai, 1982, 1983, 1985; Kimura et al., 1985). Recently, the junior author, one of Japan Overseas Cooperation Volunteers has undertaken the geological survey around the Tansen-Palpa region, the Nepal Lesser Himalayas from 1980 to 1983. In the course of the survey, he could collect shaly limestone materials from the Bhainskati Formation (Kirthar Series), Tansen Group, and submitted them to the senior author for a paleontological study. The present paper contains an account of Nummulites beaumonti d’Archiac and Haime and Assilina papillata Nuttall with a general discussion on species described from the middle Kirthar (Lutetian) of Kutch, northwestern India and the Middle Kirthar (Lutetian) of the Karachi district, Pakistan, respectively.

The hypotypes of Nummulites and Assilina and slides described herein have been deposited in the collections of Department of Geology, Faculty of Education, Saitama University. The specimens collected from the same locality are deposited in the Geological Museum of Department of Geology, Trichandra Campus, Tribhuvan University.

Fossil locality and notes on the geology

Nummulites beaumonti d’Archiac and Haime and Assilina papillata Nuttall are found from a new locality in the western part of Tansen, in a Nummulites-bearing shaly
limestone bed whose exposure extends from the upper stream of the Badahare-Amile River to Taltung in the Tansen area, located midway between Pokhara and Butwal. The estimated position of this locality lies at Lat. 27° 50′N, Long. 83° 20′E. (Figure 1).

The Tansen area is situated in the Nepal Lesser Himalayas, which is bounded by the Main Boundary Thrust from the sub-Himalayan Siwalik belt comprising Neogene post-orogenic sediments in the south, and it is physiographically divided into the Mahabharat Range and the Midland Range. Those structurally complex, unfossiliferous and poor outcrop conditions of the Lesser Himalayas have hitherto impeded progress of geological studies.

The Lesser Himalayan rocks in the Tansen area are grouped into two major stratigraphic units, the Tansen Group and the Kali Gandaki Supergroup, by the junior author (1982, 1983, 1985). The Tansen Group consists of the Gondwana and post-Gondwana rocks of clastic sediments ranging in age from late Carboniferous to Tertiary. This group is separated from the underlying Kali Gandaki Supergroup ranging in age from late Precambrian to early Paleozoic by a distinct unconformity. The Tansen Group is subdivided into the Lower Gondwana Sisne Formation (1020 m thick), Upper Gondwana Taltung Formation (250 m), Amile Formation (230 to 300 m), Bhainskati Formation (160 to 200 m) and Dumri Formation (100 to 725 m) in ascending order, based mainly on paleontological and lithostratigraphic evidence (Figure 2). The Nummulites-bearing shaly limestone bed treated in the present study is included in the Bhainskati Formation, which is especially unique and important formation in the Lesser Himalaya because of the presence of fossiliferous beds yielding Nummulites beaumontii d'Arciqac and Haime, Assilina papillata Nuttall, Asteracanthus sp., land mammals, Teleostei, Chelonia and Trionychidae (Sakai, 1983). Furthermore, the Bhainskati Formation is sandwiched between the Cretaceous to probable Palaeocene Amile Formation consisting of thick massive quartzose sandstones and the Oligocene to possible early Miocene Dumri Formation comprising a series of fluvial sandstones intercalated with shale.
Paleoecology of the nummulitic shaly limestone or limy shale bands of the Bhainskati Formation of the studied area

As seen in the stratigraphic succession of the studied area (Figure 2), the Bhainskati Formation overlies the Amile conformably and is composed of a black shale which intercalates both molluscan fossil beds and nummulitic shaly limestone or limy shale bands in the lower part. In the upper part, the Bhainskati consists of a red-purplish and green mottled shale, molluscan fossil beds and oolitic hematite, and is conformably overlain by the thick fluvial sandstones of the Dumri Formation. In the lower part of the Bhainskati, the interbedded limestone or limy shale bands indicate shallow warm marine conditions with the precipitation of carbonate rocks. This interpretation is conformable to a paleolatitude estimate of 10°± 6° S for the uppermost part of the Bhainskati Formation, based on the paleomagnetic study (Yoshida and Sakai, 1984).

In the Surkhet valley of western Nepal, 200 km further west of the Tansen area treated in this paper, Tewari and Gupta (1976) described a larger foraminiferal assemblage from a limestone of the Subathu Formation, including Assilina cf. granulosa (d’Archiac), A. leymeriei (d’Archiac and Haime), A. granulosa var. chumbiensis Gill, A. subdaviesi Gill, Nummulites cf. mamilla (Fichtel and Moll), N. atacicus Leymerie and N. djokjokartae (Martin).

In this paper, the nummulitic limestone of the Subathu Formation, which is correlated with the Laki Formation of Pakistan (Nuttall, 1925), is interpreted to be indicative of shallow marine conditions where abundantly available carbonates led to the formation of nummulitic and other larger foraminiferal limestones. Although the Bhainskati Formation cannot directly be correlated with the Subathu Formation on the basis of the larger foraminiferal fauna. Nummulitic beds of both formations are similar in lithologic character and the paleoecological condition is referred to be shallow marine for both of them.

**Description of species**

**Family Nummulitidae de Blainville, 1825**

**Genus Nummulites** Lamarck, 1801

*Nummulites beaumonti* d’Archiac and Haime

Figures 5-1—14
876. Nummulites and Assilina from Nepal

1853 Nummulites beaumonti d’Archiac and Haime, p. 133, pl. 8, figs. 1a–e, 2–3.
1926 Nummulites beaumonti, Nuttall, p. 130–131, pl. 1, figs. 4–5.
1940 Nummulites beaumonti, Davies, p. 206–209, pl. 9, figs. 1–9.
1959 Nummulites beaumonti, Nagappa, p. 180, pl. 8, figs. 15–17; pl. 9, figs. 1–2.
1965 Nummulites beaumonti, Sen Gupta, p. 91–93, pl. 15, figs. 1–2, 5; pl. 16, figs. 3, 7, 9–10; pl. 17, figs. 1, 5–7, 12.
1972 Nummulites beaumonti, Blondeau, p. 149, pl. 24, figs. 11–14.

Description: —The test is small, thickly lenticular to biconvex, regularly sloping and sometimes depressive in the umbo. The sutures are visible as faint lines of radiating septal filaments near the surface. The spherical to subspherical protoconch is followed by a reniform deutoconch of second chamber, and both chambers are followed by closely coiled whorls. The septa are straight, or slightly curved, usually near the distal end. The spiral wall is thick. The axial plugs are composed of radiating columns of shell materials. The measurements are given as follows:

| Diameter (mm), 2.3–3.3; thickness (mm), 1.6–2.2; form ratio, 1: 1.4–1: 2.0 |
|------------------|----------------|---------|---------|---------|
|                   | 1              | 2       | 3       | 4       | 5       | 6       | 7       | 7 1/2  |
| Number of whorls, 7 1/2–8 |
| Number of chambers in whorls (one specimen shown on Figure 5–13) |
| Whorls | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 7 1/2 |
| Chambers | 13 | 25 | 34 | 38 | 41 | 44 | 42 | 36 |
| Rate of growth of whorls (4 specimens measures, μ) |
| Whorls | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| mean | 247.5 | 365.5 | 494.3 | 630.8 | 797.3 | 960 | 1149.3 |
| Thickness of spiral lamellae (4 specimens measured, μ) |
| Whorls | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| mean | 29.5 | 33.5 | 41.5 | 43.5 | 46.7 | 45.3 | 48 | — |

Stratigraphic horizon: — A 5 to 10 cm thick shaly limestone bed bearing Nummulites beaumonti and Assilina papillata, lying about 50 m above the base of the Bhan- skati Formation (Kirthar Series), Tansen Group.

Geological age: — Middle Kirthar, Middle Eocene (Lutetian).

Remarks: — As seen in the equatorial and axial sections of this form from the Tansen area, its small protoconch, a tight coiling of spiral wall, rhombic style of chamber form, and regularly straight and radial septa are the same as those in Nummulites beaumonti d’Archiac and Haime from Egypt, Lybia, and the type area of the Lower Tertiary rocks of the Pakistan-Indian region (d’Archiac and Haime, 1853; Nuttall, 1926; Davies, 1940; Nagappa, 1959; Sen Gupta, 1965 and others). Although isolating the Tansen specimens from the matrix for the examination of their surface markings was difficult, oblique and tangential sections of this form show radiating and regularly curved septal filaments, and nonpapilulate surface. These features have already been observed in figures of Nummulites beaumonti d’Archiac and Haime by some of the authors stated above.
Figure 3. Spira-diagram of Nummulites beaumonti d'Archiac and Haime from (1) slide 18, (2) slide 14, (3) slide 2 (including a specimen of Figure 5-13), (4) slide 2 of the Nummulites bed of the Bhainskati Formation, Nepal and (5) one based on the average of 5 specimens from the Lutetian of Kutch, India (Sen Gupta, 1965, fig. 1), respectively.

Figure 4. Spira-diagram of Assilina papillata Nuttall from (1) slide 6 of the Nummulites bed of the Bhainskati Formation, Nepal and (2) slide C31455/3 and (3) slide C31455/2, both from the Middle Kirthar (Lutetian) of Karachi District, Pakistan (Schaub, 1981, pl. 97, figs. 3-4), respectively.

As shown in Figure 3, the spira-diagram of *Nummulites beaumonti* from the *Nummulites* bed of the Tansen area shows that ontogenetic growth curves of coiled whorls of specimens are more tightly than those of *Nummulites beaumonti* d'Archiac and Haime from the Middle Eocene (Lutetian) of Kutch, western India (Sen Gupta, 1965). Sen Gupta (op. cit., p. 92) has once considered that *Nummulites beaumonti* d'Archiac and Haime may be a species showing much variation not only in external shape and size, but also in internal structure. Thus, difference between ontogenetic growth curves from Tansen specimens and Kutch ones shown in Figure 3 can be considered as a species variation of *Nummulites beaumonti*.

De la Harpe (1883, p. 166) once indicated that there is a shade of difference among the three species, *Nummulites beaumonti* d'Archiac and Haime, *N. discornus* (Schlotheim) and *N. striatus* Bruguère, on the view point of a tight coiling of spiral wall, chamber form and septa. This problem will be discussed near future.

Sen Gupta (1965) considered *Nummulites pengaronensis* Verbeek, *N. stamineus* Nuttall and *N. kelatensis* (Carter) to be a synonym of *N. beaumonti* d'Archiac and Haime. After all, Sen Gupta identified *Nummulites stamineus* Nuttall as a synonym of *N. beaumonti* d'Archiac and Haime, because he considered that the figures of *N. beaumonti* published by Davies (1940, pl. 9) are closely related to those of *N. stamineus*. Meanwhile, Smout (1954) considered *Nummulites stamineus* from Qatar as a synonym of *N. discornus* (Schlotheim), and he retained *N. beaumonti* as a valid species. Sen Gupta (1965) considered that although there is some confusion about the identity of *Nummulites kelatensis* of Carter (1861), *N. kelatensis* is closely connected with *N. beaumonti*. The present authors consider that the forms from Timor described as *Nummulites kelatensis* Carter by Henrichi (1934, p. 30–32) are definitely *N. beaumonti*, based on the increasing whorl, regular spacing of the septa and polar plug.

Sen Gupta (1965, p. 93) described that another synonym of *Nummulites beaumonti* d'Archiac and Haime is *N. pengaronensis* Verbeek. He mentioned as the typical features of *Nummulites beaumonti* are a tight coiling of spiral wall, which is almost uniformly thick, and small embryonic chambers. He also noted that these features are clearly recognized in the figures of *N. pengaronensis* by Cole (1957).

Doornink (1932) reported in detail the original descriptions of *Nummulites pengaronensis* from Borneo by Verbeek (1871) and *N. nanggoelani* from Java by Verbeek (1891), in addition to Vlerk's description and illustration of *N. pengaronensis* (1929, p. 20–21, figs. 12, 35a–b). He concluded that *Nummulites pengaronensis* is the megalospheric form and *N. nanggoelani* is the microospheric of the former. Doornink has the same opinion as Douville (1912) on this matter. Cole (1957) identified both megalospheric and microospheric specimens from the Eniwetok Atoll under the name *Camerina pengaronensis* (Verbeek), and Hashimoto et al. (1979) and Hashimoto and Matsumaru (1981) reported *Nummulites* cf. *pengaronensis* from Philippines, respectively. However, nobody except Sen Gupta identified *Nummulites pengaronensis* as a synonym of *N. beaumonti*.

**Genus Assilina d'Orbigny, 1839**

Recently, Hottinger (1977) included the genus *Assilina* in the *Operculina* d'Orbigny, 1826, based on the similarity of structures of stolons and canal systems in the wall of test. Schaub (1981) regarded the *Assilina* to be the subgenus of *Operculina*, being accepted with Hottinger's opinion. The authors do not have any data about the wall structures of *Assilina* specimens from Nepal, but regard as the *Assilina* having the peculiar characters of evolute form and straight septa, following a classification of Blondeau (1972).
Assilina papillata Nuttall

Figures 5-15—16

1926 *Assilina papillata* Nuttall, p. 144, pl. 6, figs. 5–7b.
1926 *Assilina subpapillata* Nuttall, p. 145, pl. 6, figs. 2–3a.
1940 *Assilina papillata*, Davies, p. 214, pl. 11, figs. 1, 3, 6, 8, 10–12b.
1959 *Assilina papillata*, Nagappa, p. 178, pl. 5, fig. 2.
1981 *Assilina papillata*, Schaub, p. 205–206, pl. 96, figs. 26–39; pl. 97, figs. 1–6, 8–12.

**Description**: —The diameter of the specimens would be more than 5 mm from the incomplete portions of the available sections in measurement. The thickness of the specimens through the centre of test is from 0.9 to 1.1 mm. The opening of the spire shows evolute form. The test is composed of approximately 5 volutions, with 7 chambers in the first whorl and 22 chambers in the 4th whorl. The chambers are higher than broad. The chamber walls are evenly and regularly straight, and are radial with a sharp curvature at distal ends. Transverse sections show the marginal cord with well developed pillar structures at the whorl junction. The chambers in transverse sections much higher than broad and typically tapering in shape.

**Stratigraphic horizon**: —The same bed as *Nummulites beamonti* d’Archiac and Haime.

**Geological age**: —Middle Kirthar, Middle Eocene (Lutetian)

**Remarks**: —Although uncertainty of specific identification may exist in dealing with material of this type, these specimens are referred to *Assilina papillata* Nuttall on the basis of descriptions and illustrations given by other workers stated above. There are agreements in the peculiar curve of the spira-diagrams between only one investigated specimen from Nepal and those of *Assilina papillata* from the Middle Kirthar in Gandbo Hill, northwest Karachi, Pakistan (Schaub, 1981), as shown in Figure 3. Therefore, the present form is identified with *Assilina papillata* Nuttall.

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**References**


