CRETACEOUS - TERTIARY BOUNDARY EVENTS

SYMPOSIUM 18 - 24 SEPTEMBER 1979

I. THE MAASTRICHTIAN AND DANIAN OF DENMARK

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TOVE BIRKELUND & RICHARD G. BROMLEY

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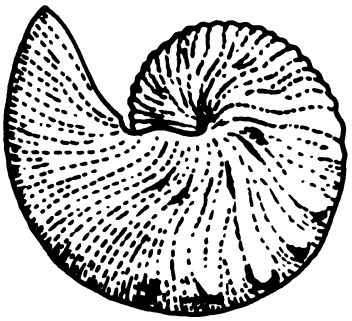


THE LAST MAASTRICHTIAN AMMONITES

Tove Birkelund

Institute of Historical Geology
and Palaeontology
Øster Voldgade 10, DK-1350 Copenhagen K

The continuous decline in number of Cretaceous ammonites from Early Cretaceous time to their final extinction at the Maastrichtian/Danian boundary is well documented by e.g. Wiedmann (1969). This reduction in number of genera can also be demonstrated within the Maastrichtian, about 34 genera being known from Lower Maastrichtian, but only about half that number from the Upper Maastrichtian.

New collecting in Maastrichtian chalk of Denmark has extended our knowledge of the stratigraphic distribution of the last ammonites of the Boreal province. Representatives of seven ammonite genera have been found in the topmost layer of the Upper Maastrichtian, confirming the sudden disappearance of the very last ammonites. The occurrence of large numbers of juvenile ammonites at the top (not to be confused with dwarfs) is ascribed to changing ecological conditions caused by the regression of the sea.

NOTES ON THE AMMONITE SPECIES AND THEIR STRATIGRAPHIC OCCURRENCE (Fig. 1).

The new material supplements Ravn's (1902) description of Upper Cretaceous ammonites from Denmark. Stratigraphically the material has the draw-back that most of the specimens have not been collected directly in connection with bulk sampling because of their sparse occurrence. Generally, therefore, they have only been referred to the one or two brachiopod zones represented at the locality in question. Some of the stratigraphic data are supplemented with data on ammonites from Germany, especially Hemmoor. Zone numbers used below refer to brachiopod zones as defined by Surlyk (1972).

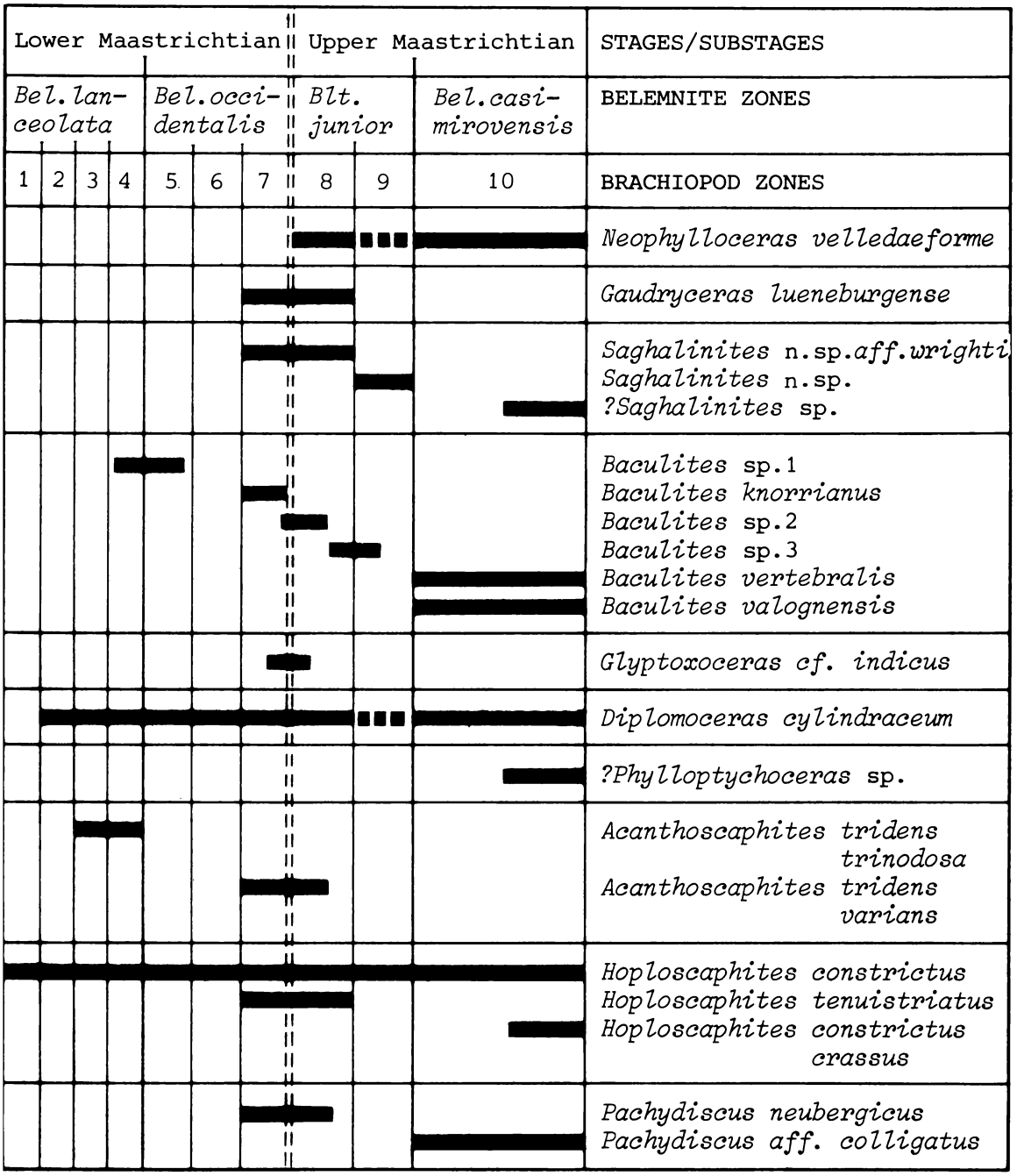


Fig. 1. Stratigraphic distribution of ammonites in the Maastrichtian white chalk of Denmark

Neophylloceras velledaeforme (Schlüter, 1876)

Very rare. One specimen from Fjerritslev described by Ravn (1902, p. 248, pl. 3, fig. 12). Now also known from Aalborg (zone 7-8), Dania (zone 10) and the topmost chalk at Stevns Klint in hardground facies.

Gaudryceras lueneburgense (Schlüter, 1872)

Very rare. Two specimens from Frejlev and Nørholm, respectively, mentioned by Ravn (1902, p. 252). Now also known from Hillerslev (zone 8) and Rørdal (zone 7-8). In Hemmoor it occurs in zone 8.

Saghalinites n.sp. aff. *wrighti* Birkelund, 1965

Specimens from Frejlev and Nørre Uttrup described by Schlüter (1876, p. 161, pl. 42, Figs 6-7) and Ravn (1902, p. 257, Pl. 3, Fig. 11) as *Ammonites* n.sp.? are closely related to *Saghalinites wrighti* Birkelund, 1965, from West Greenland. New material has been collected at Hillerslev, Rørdal and 'Danmark'. Zone 7-8. Also found at Hemmoor.

Saghalinites n.sp.

Rare. Occurs at Flødal (*Ammonites* n.sp.? in Ravn, 1902, p. 257), Hov and Bjerre. A specimen from Kunrade referred to *Gaudryceras* cf. *kayei* Forbes by Grossouvre (1908, p. 34, pl. 10, Fig. 5) may belong to this species. It differs from *Saghalinites* n.sp. aff. *wrighti* in having well developed constrictions and a wider umbilicus. Zones 9-10.

Baculites

The baculites are poorly preserved. The material is difficult to compare to other European *Baculites* because type material is poor and stratigraphic levels uncertain. Nevertheless, the collecting in the chalk shows that the ranges of the species are short, like those of the Western Interior of North America as described by Cobban (e.g. in Obradovich & Cobban, 1975). Thus *Baculites knorrianus* Desmarest, 1817, is restricted to zone 7-?8 (Rørdal) and *Baculites vertebralis* Lamarck, 1801, and *B. valognensis* Boehm, 1891, are only found in zone 10 (Dania, Stevns Klint). These species are often cited from other levels, but this is probably due to misidentification. A number of other *Baculites* species occur at other levels in the Danish chalk, but preservation is generally too poor for satisfactory description.

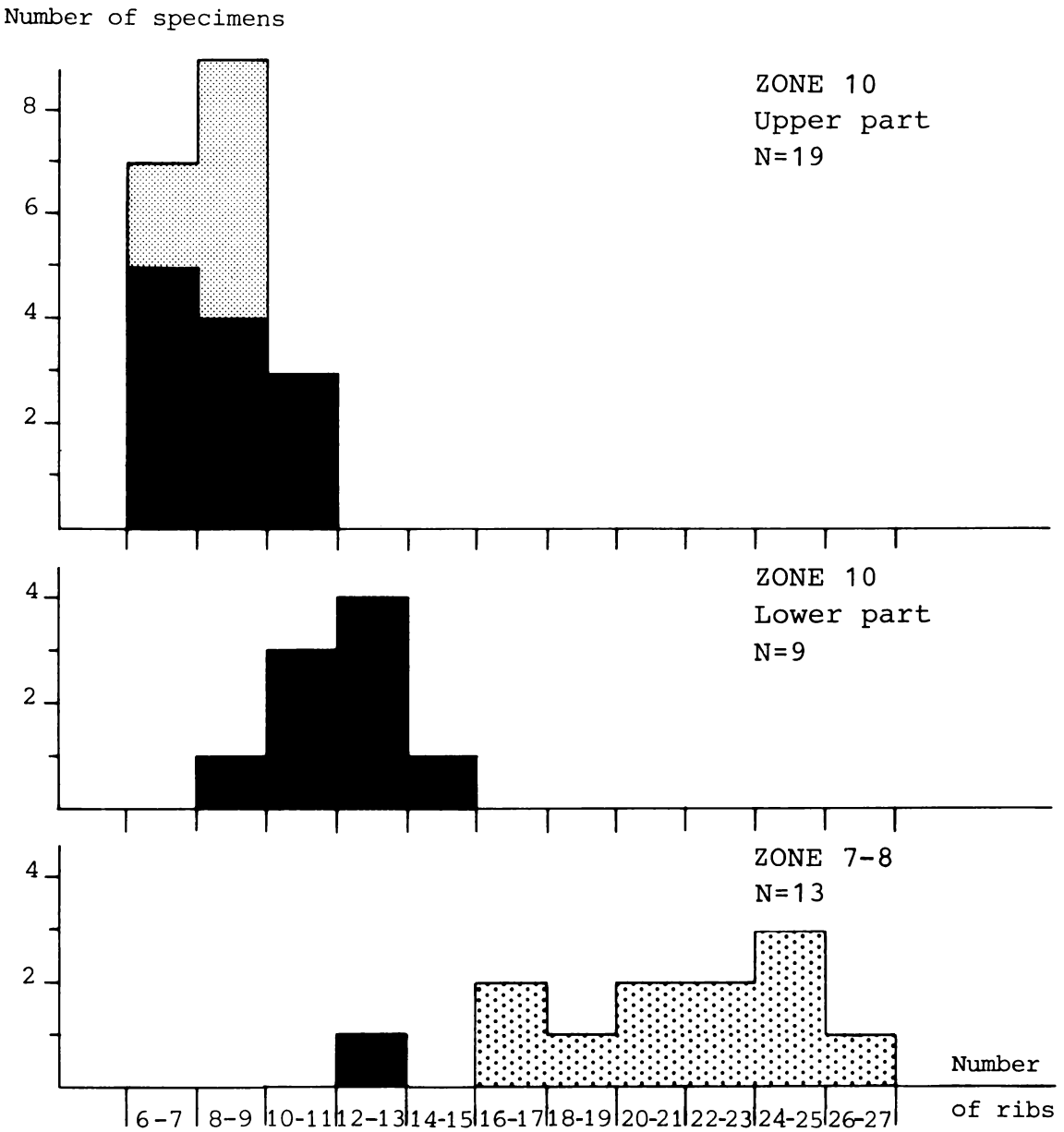


Fig. 2. Variation in number of ribs on the body chamber of mature macroconchs of *Hoploscaphites constrictus* ■, *H. constrictus crassus* ▒ and *H. tenuistriatus* ⁘. Number of ribs on 1 cm of the youngest part of the venter indicated.

Glyptoxoceras cf. *indicus* (Forbes, 1846)

One specimen has been found at Hillerslev (zone 7-8).

Diplomoceras cylindraceum (Defrance, 1816)

Fairly common. Described by Ravn (1902, p. 249). Has been found throughout most of the Maastrichtian and seems to occur to the top (Zones 2-8, 10).

Acanthoscaphites

Two subspecies have been found, both of limited stratigraphic extent: *Acanthoscaphites tridens trinodosa* (Kner, 1848) occurs in zones 3-4 of Møns Klint. The species is rare. *Acanthoscaphites tridens varians* (Lopuski, 1911) is rather common in Rørdal and Hillerslev in zones 7-8. It is also known from the same level in Hemmoor (e.g. Schmid, 1965).

The genus *Acanthoscaphites* is strictly European, most occurrences having been recorded from Poland and USSR.

Hoploscaphites

Hoploscaphites constrictus (Sowerby, 1817) is the classical guide fossil for the Maastrichtian and is distributed throughout the stage, but is rare in the lower part (see Schulz, 1978).

Although several hundred specimens have been collected, only a few characters can be systematically measured because of poor preservation.

Characters showing a definite stratigraphic variation are ribbing and distribution of nodes on the body chamber and youngest part of the phragmocone. Thus, the number of ribs on the youngest part of body chamber of macroconchs seems to decrease towards the top of Upper Maastrichtian (Fig. 2). A subspecies, *Hoploscaphites constrictus crassus* (Łopuski, 1911) may be separated on the basis of a more inflated shape and the development of strong nodes all the way from the phragmocone to the aperture. It occurs only at the top of zone 10.

Hoploscaphites tenuistriatus (Kner, 1848) occurs in zone 7-8 and has been found at the same level in Hemmoor. It differs from *H. constrictus* by finer ribbing on the body chamber and by having the nodes weakly developed or entirely lacking.

Pachydiscus

Two species have been found. *Pachydiscus neubergicus* (v. Hauer, 1858) is rare and occurs in zones 7-8. This species has been used in standard schemes as index for the Lower Maastrichtian; its occurrence just around the Lower/Upper Maastrichtian boundary renders this use problematical. *Pachydiscus* aff. *colligatus* (v. Binkhorst, 1861) is common in Zone 10 (especially in Dania), but has also been found in the top hardground of Stevns Klint. The species is well known from the Kunrade limestone of the Maastricht area, and has also been found in the Maastricht Tufkrijt, although generally replaced by *Sphenodiscus* spp. in this facies.

AMMONITES IN THE TOPMOST CHALK (HARDGROUND FACIES) OF THE MAASTRICHTIAN OF STEVNS KLINT

The topmost Maastrichtian chalk of Stevns Klint, where locally lithified by a hardground, contains many mature *Hoploscaphites* and *Baculites* of normal size and rare mature specimens of other genera. Together with these there are abundant juvenile specimens of scaphites and baculites, and juvenile *Saghalinites* sp., *?Phylloptychoceras* sp. and *Pachydiscus* sp. have also been collected. The following species are now known from this hardground:

Neophylloceras velledaeforme
Saghalinites sp.
Hoploscaphites constrictus constrictus
Hoploscaphites constrictus crassus
Baculites valognensis
Baculites vertebralis
Diplomoceras sp.
?Phylloptychoceras sp.
Pachydiscus aff. *colligatus*

Some juvenile ammonites from the hardground are shown in Fig. 3. Ammonitellas (i.e. the protoconch and first whorl terminating at the nepionic constriction) occur in profusion. Most of these ammonitellas are believed to belong to *Hoploscaphites* and *Baculites* because determinable later juvenile stages of these two genera are fairly common (Fig. 3A-C). The profuse occurrence of ammonitellas and absence of even younger stages seems to support the interpretation of the ammonitellas as embryos (Drushits & Khiami, 1970; Birkelund & Hansen, 1974). The change in growth at this constriction in *Baculites* from coiled to straight (Fig. 3G-H, also shown by Smith, 1901) adds further support.

The common occurrence of juveniles in this hardground is remarkable, as juveniles seem to be absent in other parts of the white chalk. In

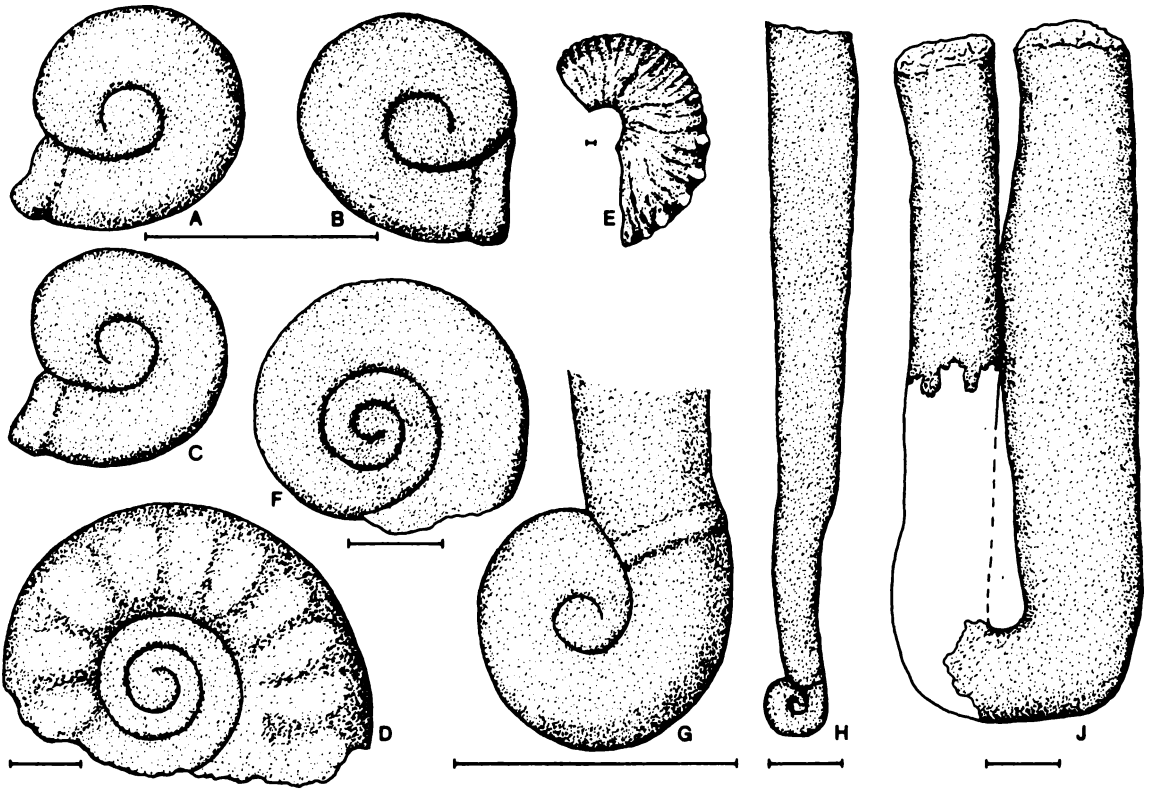
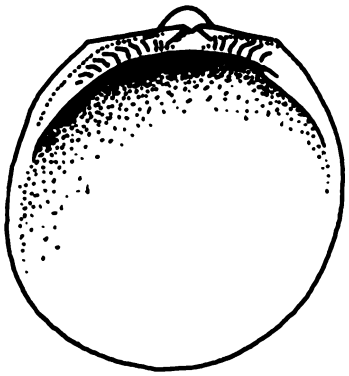


Fig. 3. Juvenile ammonites from the topmost chalk (hardground facies) of the Maastrichtian of Stevns Klint. Scales indicate 1 mm.
A-C: ammonitellas of *Baculites* or *Hoploscaphites* spp.;
D-E: juvenile stages of *Hoploscaphites constrictus*;
F: *?Saghalinites* sp.; G-H: *Baculites* sp.; J: *?Phylloptychoceras* sp.

clastic facies in North America and West Greenland juvenile scaphites become common in the Maastrichtian concurrently with the regression in these areas (Fox Hills, Waage, 1968; West Greenland, Birkelund, 1965), and it is tempting to consider a similar connection with the regression towards the top of the Maastrichtian at Stevns Klint.

In conclusion it is important to stress that there is no evidence to suggest that the ammonites were affected by poor living conditions to cause dwarfing or stunting (as supposed by Wiedmann, 1969, for a late Maastrichtian fauna of Zumaya, Spain); on the contrary, they seem to have lived perfectly well to the end.

In the Cerithium limestone above the Fish clay one or two fragments of baculites have been found. These specimens are considered to be reworked from the Maastrichtian as are some of the micro- and nannofossils.



BIVALVES FROM THE LATEST MAASTRICHTIAN OF STEVNS KLINT AND THEIR STRATIGRAPHIC AFFINITIES

Claus Heinberg

Institute of Historical Geology
and Palaeontology
Øster Voldgade 10, DK-1350 Copenhagen K

The topmost Upper Maastrichtian bryozoan chalk of Stevns Klint, Sjælland, is among the youngest Mesozoic strata yielding abundant macrofossils. Locally, this chalk has been cemented by early Danian hardground processes (Heinberg, 1976, Bromley, this volume; Surlyk, this volume).

In addition to calcitic skeletons, which are normally preserved in the chalk, the hardground limestone contains void moulds after originally aragonitic skeletons (Bromley, this volume) that are normally not preserved in the chalk. The presence of this aragonitic faunal element imparts a considerable importance to this bed for comparison of Cretaceous and Tertiary faunas (discussion by Russel, 1976). This importance has been accentuated by recent studies, which have revealed 14 aragonitic bivalve genera hitherto only known from the Cenozoic (Heinberg, 1976, 1979 and in prep.).

The stratigraphic range of genera present in the hardground is shown diagrammatically in Fig. 1. Three major types of time-range can be distinguished: (1) genera ranging from Upper Cretaceous (some appearing as late as the Upper Maastrichtian) to Recent, (2) genera ranging from Mesozoic (or earlier) to Cenozoic, (3) genera exclusively known from pre-Cenozoic deposits.

Genera originating in the Upper Cretaceous and continuing into the Cenozoic (group 1) are of special interest. The majority of these genera originated at the very top of the Maastrichtian (in the sediment beneath the hardground) within a community of extreme diversity and habitat diversification. It is noteworthy that it is among these highly specialized animals that we find the bulk of bivalve genera crossing the boundary.

Long-ranging Mesozoic-Cenozoic genera (group 2) are of limited

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