THE AGE OF BEDS IN THE LETTENKOHLE FACIES IN SOUTH-EAST FRANCE (A PALYNOLOGICAL APPROACH)

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SOMMAIRE. — Le contenu pollinique des dépôts de Lettenkohle près d'Ucel (Ardèche, France) ressemble à celui du Carnien typique des Alpes autrichiennes. *Camerosporites secatus*, espèce importante pour la stratigraphie du Trias supérieur du Bassin de la Mer du Nord est également présente. Une corrélation avec les dépôts de Lettenkohle près de Crussol (50 km au nord-est d'Ucel) n'est actuellement pas possible.

Introduction.

Along the eastern margin of the French Massif Central several isolated outcrops of Triassic sediments occur, one of these being situated by the road Ucel - Saint-Privat, near Ucel (Fig. 1). RICOUR (1962, p. 181-182) gave a description of the lithological succession in this section, together with a tentative chronostratigraphical interpretation (Fig. 2). In RICOUR's opinion the « argile noire » at the base of his « partie supérieure » could be placed in the Lettenkohle « Stage » of the French classification of Triassic rocks. This conclusion was based on two points : firstly the resemblance of this « argile noire » to Lettenkohle deposits in North-East France, and secondly the occurrence below the « argile noire » of the « formation anhydritique » which is considered to be characteristic of the French Muschelkalk.

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This paper deals with a palynological assemblage obtained from the « argile noire » at Ucel. Published information on Upper Triassic palynological assemblages from France is scarce (TAUGOURDEAU, 1963), but the assemblage found is comparable with assemblages from the Upper Triassic of Austria, Germany, Switzerland, and England. Furthermore several elements match the biozonation proposed by GEIGER and HOPPING (1968) for the Upper Triassic of the North Sea Basin.

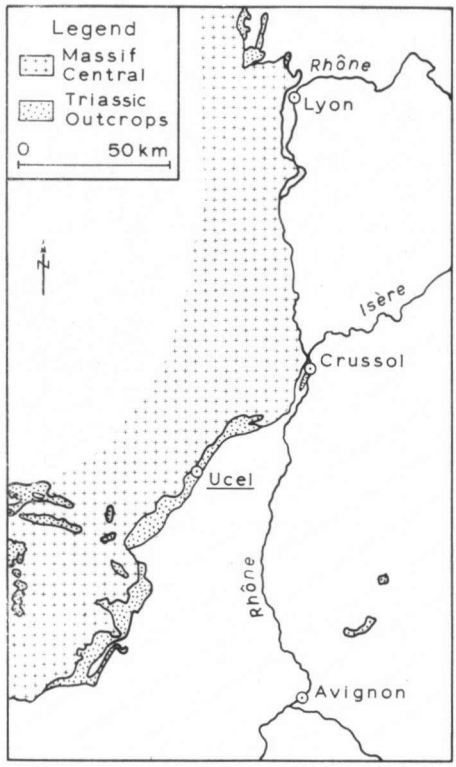


FIG. 1. — Location of Ucel and Crussol (geology after RICOUR, 1962).

The Lettenkohle.

The meaning of the term Lettenkohle is somewhat confused as currently it has both a lithological and a chronostratigraphical meaning.

Originally the name Lettenkohle(n) was introduced by J. VOIGT in 1800 to describe coal-bearing deposits in Thuringia. It was first

used in a stratigraphical sense as lowermost Keuper by VON SCHAUROTH in 1853 and since that time has had both lithological and stratigraphical connotations. When coal-bearing strata in this level in Germany are absent, the term Lettenkeuper is often used. In France Lettenkohle refers to a sequence of dolomites and lignitic sandy marls.

In a strictly stratigraphical sense the Lettenkohle comprises the lower part of the Upper Triassic (Keuper) in Germany, while in France it is affiliated to the upper part of the Middle Triassic (Muschelkalk). RICOUR (1962, p. 11) refers to this terminology problem as a « question d'accolade ».

The Ucel Palynological Assemblage.

The qualitative and quantitative date from the Ucel palynological assemblage are given in Fig. 3. These data are based on two samples, which showed no mutual differences. Preservation was relatively poor, as can be seen from the high precentage of « unclassified » material. About 10 % of the better preserved specimens could not be identified.

The specimens are mounted in permanent slides, prepared with glycerine. The slides are numbered UCE 1, UCE 2, etc., and are stored in the collection of the Division of Palaeobotany and Pollen Morphology, State University, Utrecht, The Netherlands.

The stratigraphically most important species are :

Ellipsovelatisporites plicatus KLAUS (Plate I, fig. 1).
Ovalipollis breviformis KRUTZSCH (Plate I, fig. 2).
Camerosporites secatus LESCHIK (Plate I, fig. 3).
Duplicisporites granulatus LESCHIK (Plate II, fig. 1).
Paracirculina maljawkinae KLAUS (Plate II, fig. 3).
Enzonalasporites explanatus (LESCHIK) nov. comb. (Plate II, fig. 4).
Enzonalasporites tenuis LESCHIK (Plate II, fig. 2).

Although it has been suggested (RICOUR, 1962) that the « argile noire » at Ucel may belong to the Lettenkohle « Stage », none of the spores found in the Lettenkohle of Germany by MÄDLER (1964) and SCHULZ (1966) occur in the Ucel assemblage. There is, however, good agreement with assemblages from the *Cardita, Halobia,* and Lunzener Shales in Austria (KLAUS, 1960 ; KAVARY, 1966), which represent the typical deposits of the Karnian Stage in the Alpine Triassic. This Karnian Stage, first proposed by VON MOJSISOVICS in 1869, is biostratigraphically defined by two ammonite zones, viz. the *Trachyceras aonoides* Zone and the *Tropites subbullatus* Zone (cf. KUEHN, 1962, p. 237-238).

Several of the Ucel spores were considered by KLAUS (1960) to be diagnostic Karnian fossils. These include the genera *Duplicisporites*, *Paracirculina*, and *Praecirculina*, further details of the forms common to both the Ucel assemblage and the Karnian assemblage described by KLAUS (1960) being given in Fig. 3, column A.

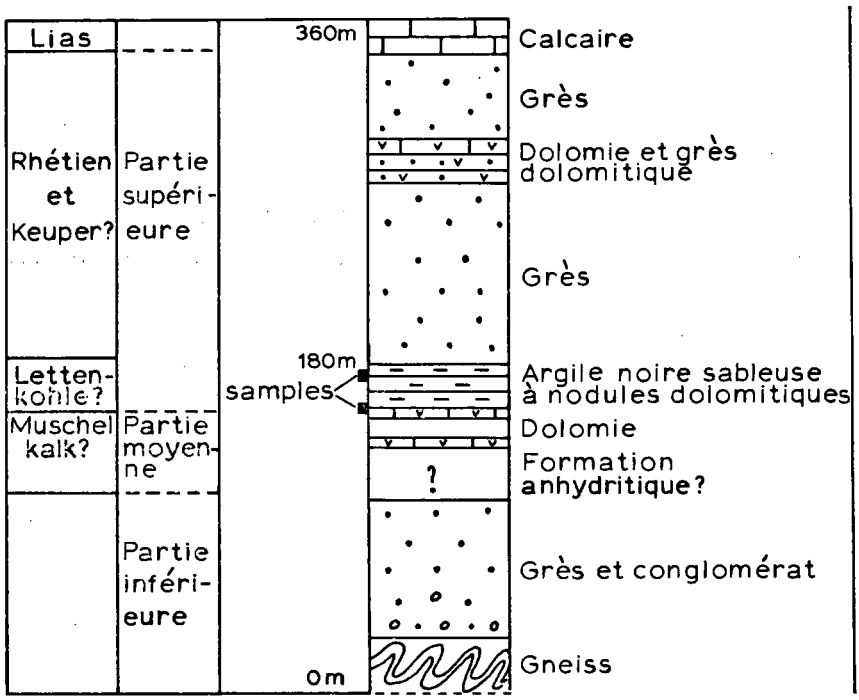
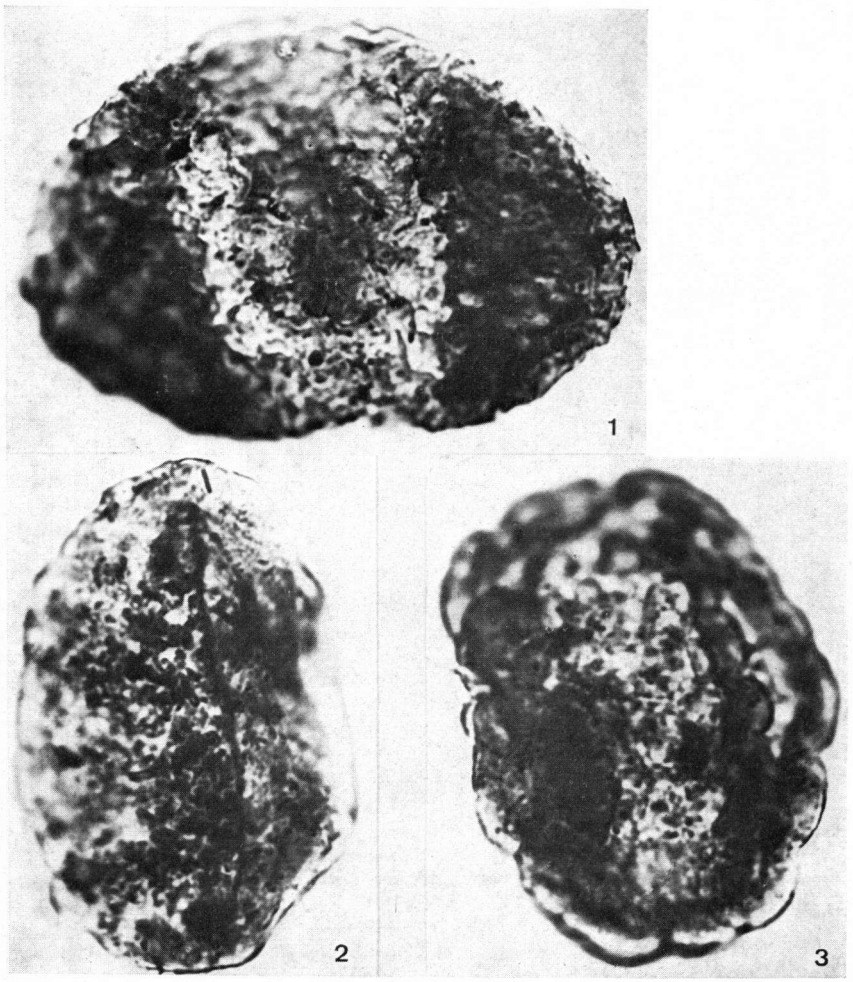


FIG. 2. — The Ucel stratigraphical section (after RICOUR, 1962).

The Ucel assemblage also shows affinities with an assemblage from the Schilfsandstein near Neuewelt, Basel, described by LESCHIK (1956), and the British « Upper Keuper » assemblage from the Arden Sandstone (CLARKE, 1965). The correlations are shown in Fig. 3, columns B and C, respectively. The Schilfsandstein is generally correlated with Karnian deposits in Austria (compare, e.g., GIGNOUX, 1950, p. 295 ; RICOUR, 1962, p. 22), while palynological evidence led WARRINGTON (1967) to correlate the Arden Sandstone with the German Schilfsandstein and hence also with the Karnian.

The palynological biozonation of the Triassic in the southern North Sea Basin by GEIGER and HOPPING (1968) both extends and confirms these correlations. Here the assemblage zone with *Ovali-*

pollis ovalis, Enzonalasporites vigens, Camerosporites secatus, and *Aratrisporites scabratus* marks the Karnian Stage. It should be noted, however, that the most important constituent of this zone, *Camerosporites secatus,* seems to be absent in the Alpine Upper Triassic, since it was not found by KLAUS (1960) or by KAVARY (1966). In contrast this species is relatively common in the Ucel samples, toge-



LEGEND OF PLATE I.

FIG. 1. — *Ellipsovelatisporites plicatus* KLAUS. Slide UCE 10. 60 µ.
FIG. 2. — *Ovalipollis breviformis* KRUTZSCH. Slide UCE 05. 45 µ.
FIG. 3. -- *Camerosporites secatus* LESCHIK. Slide UCE 40. 45 µ.

ther with forms closely related to the other three diagnostic elements noted by GEIGER and HOPPING (1968). Recently *Camerosporites secatus*, together with *Ovalipollis* and *Enzonalasporites* was found to be abundant in samples taken by H. VISSCHER and the author in the « Grès à roseau » (the French equivalent of the Schilfsandstein) in North-East France.

From the evidence so far available a Karnian age of the Ucel assemblage can be reasonably concluded.

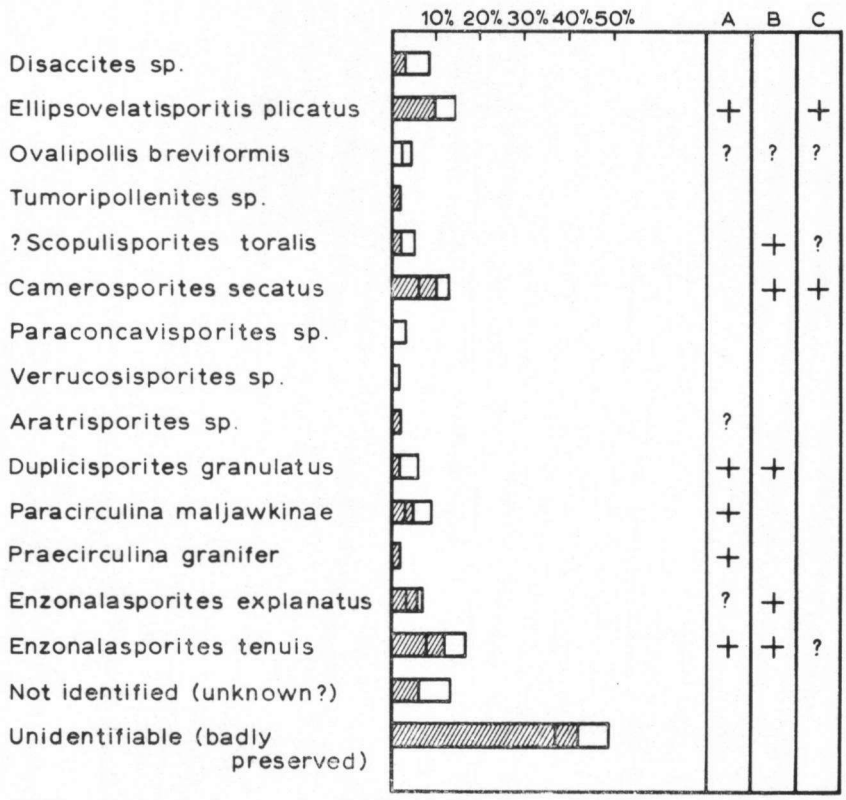
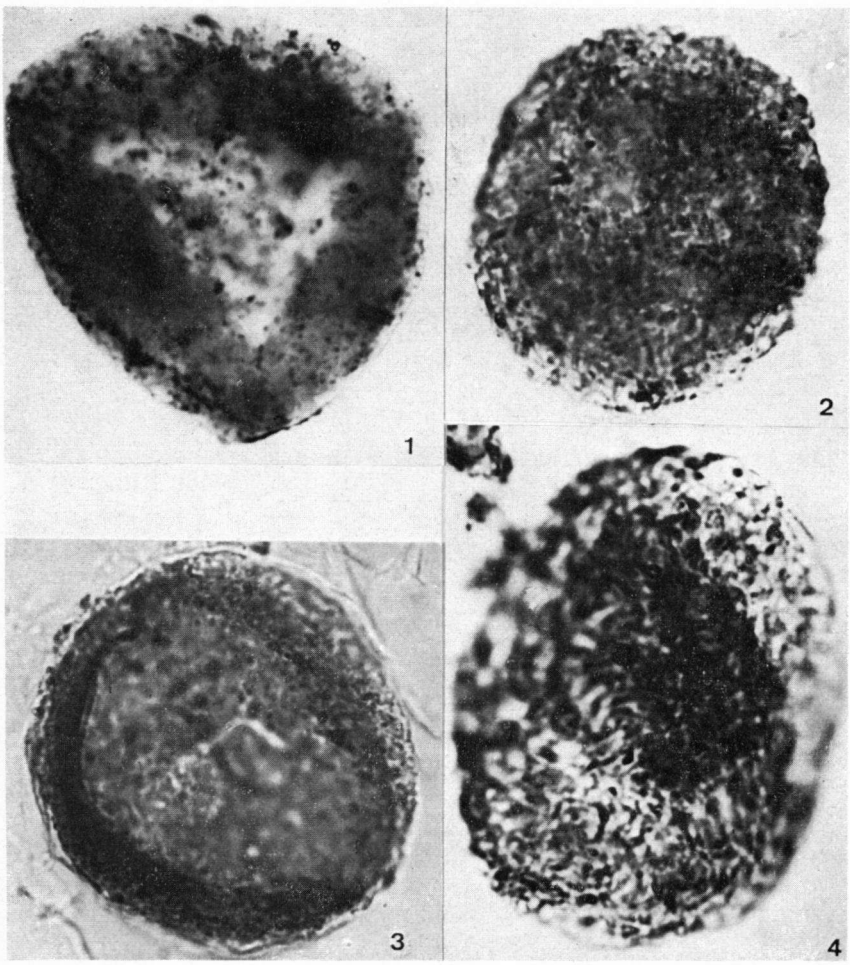


FIG. 3. — Percentages from the Ucel samples, based on three counts, each with a different quantity of pollen and spores. Shaded areas give percentages obtained with the highest sum (= 95). Columns A, B, and C show the species in common with those described by KLAUS (1960), LESCHIK (1956), and CLARKE (1965), respectively.

The Crussol Palynological Assemblage.

A rich palynologival assemblage obtained from « Lettenkohle » beds outcropping in the vicinity of Crussol (see Fig. 1) was studied by SISSINGH (1968). The samples studied were taken near the base

of level 4 as defined by RICOUR (1962, p. 174). The assemblage shows striking differences from that obtained from Ucel and at present it cannot be adequately compared with other known assemblages. The genera *Camerosporites, Enzonalasporites,* and *Duplicisporites* are absent, while distinctive forms of bisaccate pollen grains (e.g., *Triadispora,* well-known from the Lower Triassic of western Europe) are common.



LEGEND OF PLATE II.

FIG. 1. — *Duplicisporites granulatus* LESCHIK. Slide UCE 39. 32 μ.
FIG. 2. — *Enzonalasporites tenuis* LESCHIK. Slide UCE 66. 36 μ.
FIG. 3. — *Paracirculina maljawkinae* KLAUS. Slide UCE 25. 36 μ.
FIG. 4. — *Enzonalasporites explanatus* (LESCHIK) nov. comb. Slide UCE 17. 36 μ.

Although this assemblage is probably Late Triassic in age, it seems older than the one from Ucel. Further research is necessary to reveal the exact stratigraphical interrelation of the beds classified as Lettenkohle in South-East France. Palynology promises to be a valuable aid in this respect.

Reference List.

Disaccites sp.

Ellipsovelatisporites plicatus KLAUS, 1960, p. 571, fig. 64, 65; CLARKE, 1965, p. 303, plate 39, fig. 1, 2.

Ovalipollis breviformis KRUTZSCH, 1955, plate 1, fig. 7, 8 ; CLARKE, 1965, p. 367, plate 39, fig. 11, 12 ; probably identical : *Unatextisporites mohrensis* LESCHIK, 1956, p. 60, fig. 8 ; *Ovalipollis grebeae* KLAUS, 1960, p. 154, plate 35, fig. 52, 55.

? *Scopulisporites toralis* LESCHIK, 1956, p. 64, plate 10, fig. 1-3 ; = *Alisporites toralis* (LESCHIK) CLARKE, 1965, p. 308, plate 38, fig. 4-6.

Tumoripollenites sp. (*Tumoripollenites* BHARADWAJ, 1962).

Camerosporites secatus LESCHIK, 1956, p. 40, plate 5, fig. 11-13 ; CLARKE, 1965, p. 313, plate 36, fig. 10 (not fig. 11), plate 38, fig. 12, 13, textfig. 10.

Paraconcavisporites sp. (*Paraconcavisporites*, KLAUS, 1960).

Verrucosisporites sp. (*Verrucosisporites* IBRAHIM emend. SMITH *et al.*, 1964).

Duplicisporites granulatus LESCHIK, 1956, p. 23, plate 2, fig. 23 (? not fig. 21) ; KLAUS, 1960, p. 161, plate 25, fig. 53 (not fig. 52).

Paracirculina maljawkinae KLAUS, 1960, p. 163, plate 36, fig. 62, 63.

Praecirculina granifer (LESCHIK) KLAUS, 1960, p. 162, plate 36, fig. 61 ; = *Granulatisporites granifer* LESCHIK, 1956, p. 30, plate 3, fig. 23.

Aratrisporites sp. (*Aratrisporites* LESCHIK, 1956).

Enzonalasporites explanatus (LESCHIK) **nov. comb.** = *Zonalasporites explanatus* LESCHIK, 1956, p. 46, plate 6, fig. 9 (the species is here included in *Enzonalasporites* LESCHIK emend. SCHULZ, 1967, rather than in the ambiguous Late Carboniferous genus *Zonalasporites* IBRAHIM) ; probably identical : *Patinasporites iustus* KLAUS, 1960, p. 169, plate 37, fig. 68, 69.

Enzonalasporites tenuis LESCHIK, 1956, p. 44, plate 6, fig. 1 ; KLAUS, 1960, p. 168, plate 37, fig. 66 ; at present it is uncertain whether *Enzonalasporites tenuis* should be regarded as a synonym of *Enzonalasporites vigens* LESCHIK, 1956.

Summary.

The palynological assemblage from Lettenkohle deposits near Ucel (Ardèche, France) can be matched with those from Karnian deposits in the Austrian Alps. The occurrence of *Camerosporites secatus* suggests a correlation with the Middle Upper Triassic (Karnian) of the North Sea Basin. The Ucel assemblage shows striking differences to a palynological assemblage obtained from Lettenkohle deposits near Crussol (50 km North-East of Ucel).

Acknowledgements.

I am very grateful to H. VISSCHER, who initiated this study and gave much valuable criticism. Prof. F. P. JONKER, P. R. R. GARDINER, and P. van den KRUK read and criticised the manuscript. W. SISSINGH kindly allowed me to use some unpublished data from the Crussol assemblage.

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