These estimates were based on geological concepts, and were not supported by *in-situ* measurements. It was assumed that the Coal Measures continued beyond the known mining zone with similar characteristics under a progressively thicker overburden. Exploration carried out during the last decade has revealed that there may be a considerable variation in coal content depending on the stratigraphic horizon and the subsidence regime of the different structural blocks.

A more detailed reserve assessment has been applied to the Eisden-North and Neeroeteren-Rotem coalfields and resulted in demonstrated recoverable reserves of 250 million tonnes, or 5 Mio T/km^2. This figure is well comparable both to the mined-out amounts in the collieries and to the mean values established solely from boreholes.

For all recent boreholes the number of potentially exploitable coal seams, their thickness range and tonnage have been noted. These figures then can be related to stratigraphic position and to location within structural blocks.

The most striking results were:

- The limited variability in mean coal seam thickness averaging 123 cm of pure coal, varying only between 118 cm and 128 cm in each major block, with a maximal thickness of 299 cm. This constant behaviour is the legacy of the original depositional environment at the transition of upper delta plain to lower alluvial plain. There is no clear relationship between thickness of individual coal seams and overall coal content.
- The great variability in recoverable reserves, depending on the number of thick seams. The tonnage difference between the richest and the poorest block attains a factor 7. This is mostly due to the great lateral variability in coal content within some stratigraphic sequences, especially in the upper Westphalian.

  This variation is best explained in terms of different subsidence regimes on the various structural blocks coupled with variations in sediment supply at the onset of the Variscan deformation phase.
- Total recoverable coal reserves in the prospected area amount to 835 Mio T representing 3.340 Mio T of coal in place in thick seams.

Additional reserves are present in the collieries, both closed or working and in the seismically explored northfield where no borehole control exists. Inferred resources are furthermore present in the northern Campine-Coal reserves in the Campine thus are largely sufficient to ensure further uşe as a source of energy.

BIOCLAST ASSEMBLAGES IN THE CRETACEOUS OF WEST FLANDERS, BELGIUM.

P.J. (Sjeuf) FELDER[1]

(3 figures)

ABSTRACT.- The Belgian Geological Survey put at my disposal samples recovered from the boreholes Nieuwkerke (80 samples), Wervik (58 samples), Rekkem (49 samples), Bellegem (5 samples), Rollegem (18 samples) and Bossuit (12 samples) all located in the province of West Flanders, Belgium. The thickness of the Cretaceous in the boreholes decreases from 80 m at Nieuwkerke to about 10 m at Bossuit, about 40 km to the east of Nieuwkerke.

The samples were washed and sieved. Subsequently the bioclasts of the 1-2.4 mm fraction have been analysed. This method has been applied successfully in the Belgian Campine, in the province of Liège and in Dutch Limburg (Felder *et al.*, 1985, Felder & Bless, 1989).

The most complete section was found in the Nieuwkerke borehole (fig.1) in which white chalk with some flints occurs between 89 and 169 m. On the basis of bioclast assemblages this section can be subdivided into three ecozones:

Ecozone 3 (89-114 m), with large numbers of bioclasts and high percentages of Mollusca.
Ecozone 2 (114-132 m), with fewer bioclasts, but higher percentages of Echinoderms.
Ecozone 1 (132-169 m), with fewer bioclasts, but higher percentages of large Foraminifera.

These ecozones can also be recognised in Wervik (ecozone 3, 113-136 m; ecozone 2, 136-148 m; ecozone 1, 148-164 m) and Rekkem (ecozone 3, 110-130 m; ecozone 2, 130-134 m; ecozone 1, 134-146 m). The Bellegem, Rollegem and Bossuit boreholes with a decreased Cretaceous thickness only contain the ecozones 2 and 3 (fig. 2-3).

The ecozones 2 and 3 of Nieuwkerke also occur in the Diksmuide borehole, some 30 km to the north of Nieuwkerke (ecozone 3, 201-218.5 m; ecozone 2, 218.5-232 m). They have been dated Santonian-Coniacian by F. Robaszinsky (pers. comm.). Ecozone 1 has not yet been dated but may be attributed to the Turonian or Coniacian.

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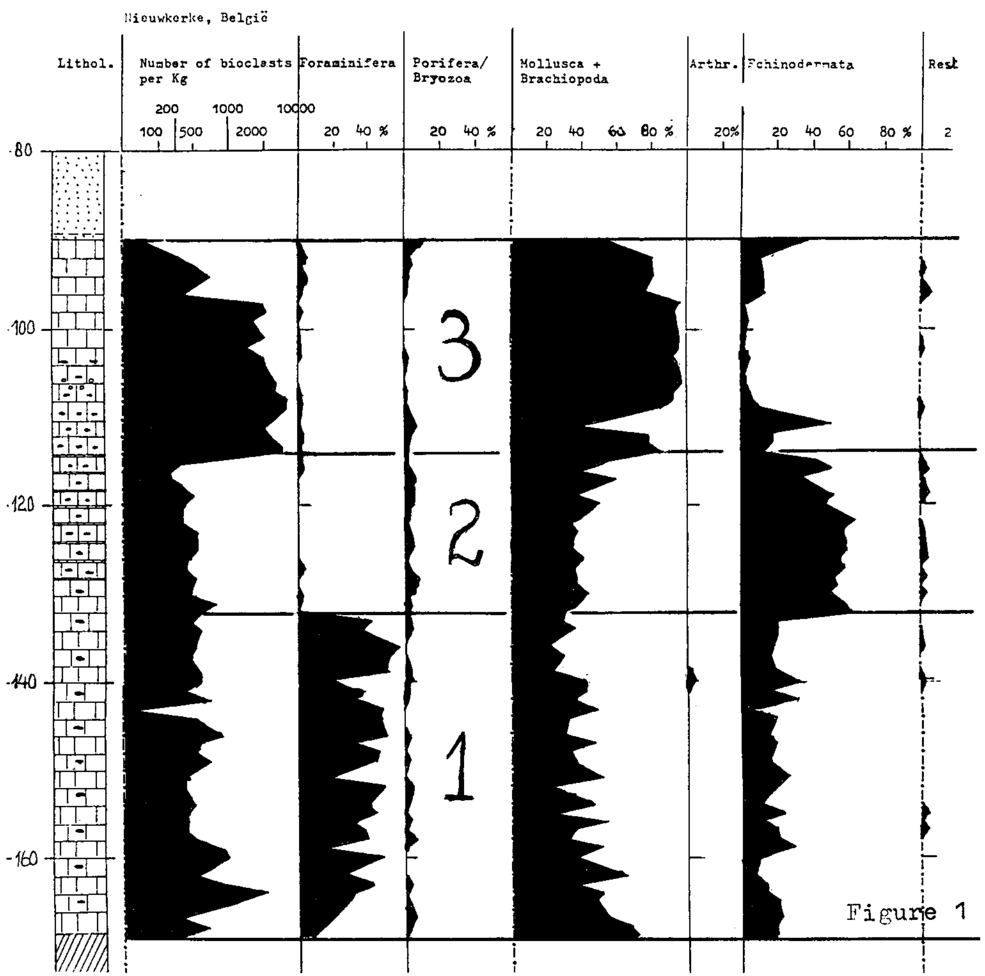

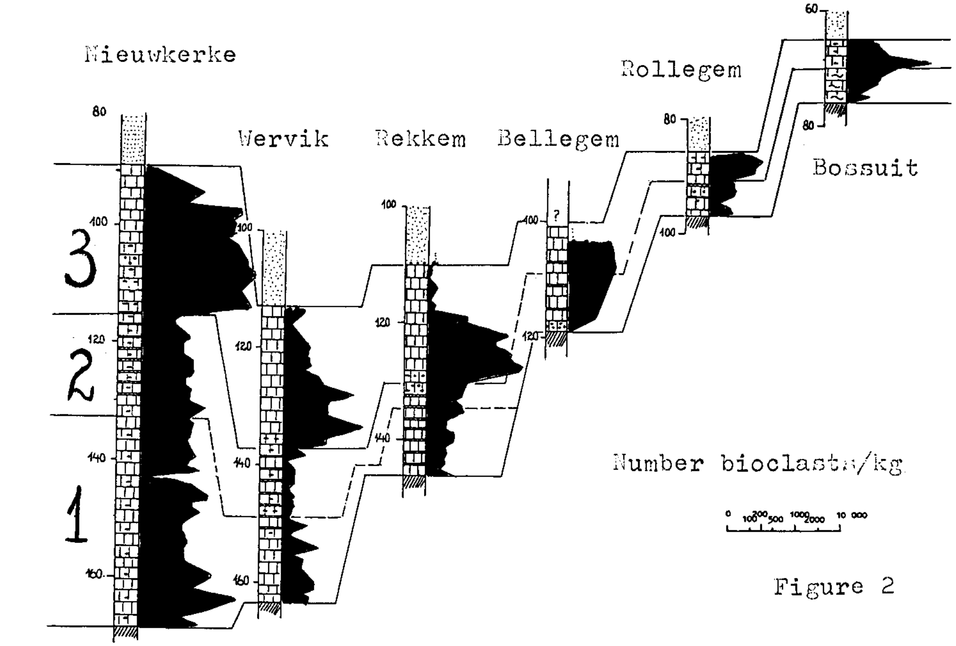

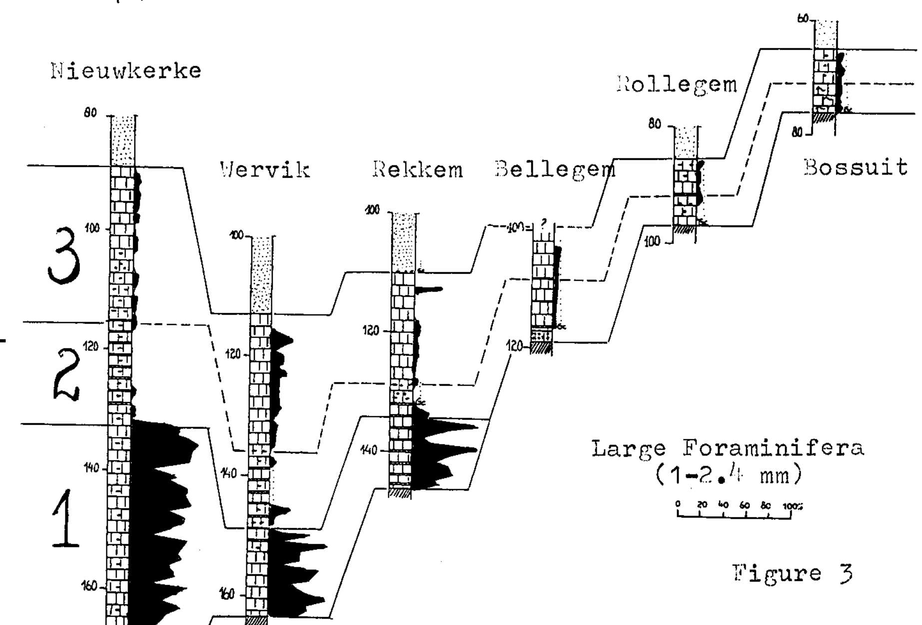

Figure 1.- Cretaceous bioclast assemblages of the Niewkerke borehole. 1-3 Ecozones.

Figure 2.- Correlation of Number-of-large bioclasts/kg profiles in the Cretaceous of West Flanders. 1-3 Ecozones.

Figure 3.- Correlation of percentage profiles of large foraminifera in the Cretaceous of West Flanders. 1-3 Ecozones.

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MATURITY INDICATORS IN THE WESTPHALIAN KEY-WELL KEMPERKOUL-1

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ABSTRACT.- Well Kemperkoul-1 (South Limburg, The Netherlands) was drilled during a coal-inventory programme that ran from 1982-1986. The borehole yielded an unusual amount of high quality data.

Carboniferous strata between 489 m and 1665 m depth were continuously cored. The age of this interval ranges from Early Westphalian B to Late Westphalian C.The Westphalian sediments are unonformably overlain by Cretaceous and younger sediments.

The Westphalian sediments show an alternation of terrestrial sand, clay and peat, occasionally interrupted by marine or brackish clay, together depicting a paralic facies.

Various depth-related rock-parameters have been analysed. Special attention has been given to the thermal maturity of the organic matter in shales and coals. The vitrinite reflectance values of the Westphalian coals from this well range from 0.65-1.25 %Rm. These values coincide with the oil generation window. Volatile matter (VM) decreases from 40% to 27%. The Thermal Alteration Index (TAI) increases from 3.5 to 5.5 over the total Westphalian depth interval. The moisture content decreases from 6% to 1% in this inverval Tmax increases from approximately 430°C to 470°C. There is a relatively small scatter in Tmax values of coals as compared to the shales.

The Hydrogen Index (HI) is generally very low, ranging between 100 and 300 in coals and between 50 and 180 in shales, which confirms the predominantly gasprone type III kerogen character of the coals and shales. The Production Index (PI) is extremely low in the coals, not exceeding 0.06 in coals, and up to 0.20 in shales. These values indicate that the residual petroleumpotential is very low indeed.

The parameters all show distinct interrelations, which allows the establishment of calibration functions. These are considered of importance for the Dutch hydrocarbon exploration activities, in particular because the maturity interval of Kemperkoul-1 (0.6-1.25 %Rm) largely covers the oil window. The relative depth dependence of the parameters and their interrelations are statistically quantified by minimum least-squares curve fitting. Third order polynomial regression equations generally yield satisfactory results.

The maturation history of the Westphalian strata is complex. At the end of the Carboniferous the area was deeply buried. The overburden of Westphalian C-D, Stephanian (?) and Permian (?) strata may have been more than 2000 m at Kemperkoul, but is nowadays completely removed. This overburden is either related to an northward areal extention of nappe-like structures from the Variscan mobile belt, or a molasse-like deposition of sediments in front of the Variscan Orogeny. No information is known about the local lithological characteristics of these eroded rocks. Eventual hydrocarbon plays are all removed during subsequent erosion. Extrapolation of the moisture content values to depth makes the occurrence of deep-seated hydrocarbon plays in the area extremely unlikely. There are indications that at or around the time of maximal overburden two major thermal events acted upon the Carboniferous strata of Kemperkoul-1. One distinct coalification pattern in the area is related to the Variscan orogeny during which the Ardennes were formed, somewhat to the south. Towards the north of South Limburg a local magmatic body in the neighbouring German area has influenced the maturity pattern as well. Both events may have taken place somewhere towards the end of the Carboniferous or at the beginning of the Permian. There are also indications that during the time interval between the two thermal events a compressional phase took place that resulted in the formation of a local anticlinal structure, *i.e.* the Visé-Puth anticline. The coalification trends seem

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