Conjugated kinks were only observed at Nouzonville, where the external foliation dips more steeply (70°S).

The kink bands'geometric characteristics can be used to estimate the orientation of the related principal stress axis. The direction of the intermediate stress axis $\sigma2$ should be parallel to the kink axis, (subhorizontal E-W). The direction of uniaxial compression $\sigma1$ should be inclined from 10 to 45° more than the dip of the external foliation for the single kink set, and from 0 to 10° more than the dip for the conjugate kink set at Nouzonville. Accepting a uniform stress field over the whole region, this gives mean orientations of N 135°E/70°S for the $\sigma1$ axis, N 258°E/10°W for $\sigma2$ and N 352°E/18°N for $\sigma3$.

In this southern part of the Ardenne, the major Variscan deformation is characterized by E-W folding and boudinage, by southward dipping axial-plane cleavage and a southward plunging mineral extension lineation, contained in the cleavage planes. The intermediate Y-axis of finite deformation is assumed parallel to the E-W boudinage axis, the X-axis (maximum extension) should correspond to the southward-plunging mineral extension lineation (70-25°S) and Z-axis (maximum shortening) is approximated by the pole of the axial-plane cleavage (20-65°N). The formation of late Variscan E-W kink bands should then correspond to a marked change in the deformation regime during Variscan compressional tectonics in this part of the Ardenne. Altough it is not possible to compare principal stress axes and finite deformation axes, it is suggested that the intermediate finite deformation axis keeps his E-W orientation, while the principal plane of finite shortening probably rotated at high angle to the pre-existing cleavage planes.

THE HARD COAL RESERVES OF THE CAMPINE MINING BASIN

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ABSTRACT.- Coal production in Belgium is now restricted to the concealed Campine coalfield in the northeastern part of Belgium.

Exploration for coal was carried out with governement support simultaneously by the mining company «Kempense Steenkolenmijnen» (K.S.) and by the Belgian Geological Survey.

Surface coal exploration by means of seismics and boreholes and carried out in the interval 1979-1988 has brought a wealth of new information on the northern extension of the mining basin. Fifty three boreholes have cored the Westphalian to depths till 1600 m. Seven reflection seismic surveys resulted in ±700 km of profile-lines covering an area of 400 km². Borehole coverage is sufficient in two-thirds of this area (265 km²) with an average of one borehole per 5 km².

These boreholes are unevenly distributed. They were most numerous in areas close to coal mines, assessed for short term reserves evaluation (1 borehole per 2 km²). The borehole density gradually decreases northward and falls below one borehole per 20 km² of seismic exploration zone. Recent prospection campaigns covered only 30 % of the productive Coal Measures Subcrop in the Campine basin.

Coal occurs in hundreds of seams with varying thickness and extension. Only a small number of these seams are exploitable. Mineable reserves can be calculated according to delimiting criteria based on ECE recommendations, applicable to the Campine coalfield. Limiting factors can be specified:

- minimum seam thickness 90 cm
- maximum dirt content 50 weight %
- maximum depth -1200 m
- recovery factor 25 % composed of a factor of 50 % for exploitation losses, and another 50 % for coal seam irregularities.

Coal quality is not considered as a limiting factor since most critical properties do not differ much from the mean values such as 1.15 % sulphur or 3 % ash content and 33500 KJ gross calorific value. (average volatile matter content between 22 and 36 %). Differences in coal rank depend on stratigraphic position and on thermal history of the structural blocks.

The amount of coal present in the underground of the Campine basin is impressive. Previous mostly unpublished estimates of technically recoverable coal in place range from 5000 to 7000 million tonnes of inferred reserves in the Campine coal basin north of the mining district.

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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 use as a source of energy.

BIOCLAST ASSEMBLAGES IN THE CRETACEOUS OF WEST FLANDERS, BELGIUM.

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(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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