FORAMINIFERA OF THE EOCENE OF BELGIUM

CHAPTER I

STRATIGRAPHIC REVIEW

INTRODUCTION

In 1833 LYELL subdivided the Tertiary period into four groups : Eocene, Miocene, Older Pliocene and Newer Pliocene. He based his subdivisions on the percentages of living species of molluscs of the various known fossil faunas of northwestern Europe. For these percentages he adopted the countings given by DESHAYES (1830). The percentage of the Eocene was mainly based on the rich faunas of the Paris basin.

Since LYELL's proposal, the Eocene suffered the separation of the Oligocene (BEYRICH, 1854) and of the Paleocene (SCHIMPER, 1874), but it still represents the central and main part of the Paleogene (NAUMANN, 1866) or Nummulitique (RENÉVIER, 1873; HAUG, 1911).

Paleogene strata appear at the surface in a large part of Belgium. They belong to a much larger area of former deposition which included southern England (London and Hampshire basins), northern France (Paris basin) and the southern Netherlands.

The relationship between this great anglo-franco-belgian basin and the depositional areas in the northern Netherlands, northern Germany, and Denmark is not quite clear. According to stratigraphic maps, published by PANNEKOEK (1956), the Belgian basin was separated from the Northern German-Danish basin by a SE-NW striking swell. During at least part of the Eocene there must have been some connection between the two basins.

Since LYELL's time the Eocene has been subdivided into a number of stages. These stages, such as those established by DUMONT, were originally merely names for rock-units. Later on a more or less vague time-stratigraphic meaning was added. Furthermore, each stage had to correspond with a cycle of sedimentation. It should comprise a transgression at the beginning of a marine phase, which after some time was followed by a recurrence of continental conditions. The next cycle again started with a marine transgression.

This subdivision based on cyclic sedimentation was developed in Belgium (RUTOT, 1883*a*; and others) and France, and later on was applied to the Tertiary strata of England (STAMP, 1920).

Two cycles were recognized in the Paleocene, four in the Eocene, and one in the Oligocene.

At the end of the nineteenth century it became a general rule to introduce a stage with every basal bed that corresponded to a (supposed) transgression. This certainly overemphasized the importance of local conditions in the shallow seas that covered these areas. As a consequence the stratigraphy of especially the Upper Eocene in the Franco-Belgian territory was burdened with a large number of stage-names.

We will try to clear up part of the involved confusion by making a sharp distinction between rock- and time-stratigraphic units, as was done by Batjes (1958) for the Oligocene.

The rock-stratigraphic units are named after the type-locality with the addition of general names, such as formation, member or bed(s), or otherwise of nouns that indicate the lithologic nature of the unit. The time-stratigraphic units will be given the ending -ian or -an, and in most cases they are derived from the name of a type-locality, as recommended by the International Geological Congress at Paris in 1900.

For the reader's orientation a short review will be given of the main Eocene stratigraphic units of northwestern Europe, and their correlation, as found in literature.

BELGIUM

The first important papers on the Eocene stratigraphy of Belgium are those by Dumont (1839, 1849, 1851, etc.) and d'Omalius d'Halloy (1842).

In 1839 Dumont subdivided the Belgian Tertiary in the following « systèmes » : Landenian, Bruxellian, Tongrian, Diestian, Campanian, and Hesbayan. In 1849 he further subdivided the Landenian into Landenian and Ypresian. Two years later he added three more units, thus subdividing the Belgian Eocene into : Heersian, Landenian, Ypresian, Paniselian, Bruxellian, Laekenian, and Tongrian.

This classification still forms the foundation of Belgian Paleogene stratigraphy, though more or less completed and modified by later authors, especially by Mourlon, Rutot and G. Vincent during the second half of the 19th century. They based the stratigraphic subdivision on cycles of sedimentation, and in relation with this principle added some more stage-names : Ledian (Mourlon and E. Vincent, 1887), Wemmelian (Rutot and G. Vincent, 1878) and Assian (Rutot, 1882*b*), which were intended as parts of the Laekenian and the Tongrian of Dumont.

The stratigraphic code, adopted for the geological maps of Belgium (1 : 40.000 and 1 : 160.000), was based for the greater part on this subdivision of the Eocene, with more additions by Rutot.

Research of the Belgian Eocene and correlation with the deposits in surrounding countries were especially continued by Leriche. His results were laid down in various publications from 1899 to 1951. He recognized the excessive subdivision into stages, and consequently he reduced the stratigraphic sequence to only four cycles of sedimentation during the Eocene, those of the Ypresian, Bruxellian (or Lutetian), Ledian and Bartonian. These correspond with the former Ypresian and part of the Paniselian, part of the Paniselian and the Bruxellian, the Laekenian and the Ledian, and the Wemmelian together with the Assian, respectively.

An extensive compilation of the more important data on the stratigraphy of the Belgian Eocene was published by Gulinck and Hacquaert in the « Prodrome d'une description géologique de la Belgique » (1954).

In 1958 Batjes suggested that the Lower Tongeren beds, usually referred to as Lower Tongrian (Oligocene), probably belong to the Bartonian.

Hardly anything is known of Belgian Eocene foraminifera. GULLENTOPS (1956) published some remarks on smaller foraminifera of the Sands of Lede in a description of a foraminiferal fauna from a sample of Oligocene Oude Biezen Sands from Borgloon. Only the nummulites received more attention (DE LA HARPE, 1881, 1882; VAN DEN BROECK, 1896), but a revision of this group might be welcome.

FRANCE

PARIS BASIN

The Paris basin is separated from the Belgian area of deposition by the western continuation of the Ardennes into the so-called Axis of Artois (see map 1).

The Tertiary series of the Paris basin (see figs. 1 and 2) begin with deposits said to be of Montian (DEWALQUE, 1868) and of Landenian age, both considered to belong to the Paleocene.

The Landenian is represented by marine as well as by continental sediments, often distinguished as Thanetian (PRESTWICH, 1850) and Sparnacian (DOLLFUS, 1880; named after Epernay), respectively. They are more or less successive parts of the Landenian.

General time scale	ENGLAND		FRANCE	BELGIUM	NETHERLANDS	GERMANY
	Hampshire Basin	London Basin	Paris Basin		Northern German- Danish - Basin	
Tongrian	Headon Beds		Marnes supragypseuses	Tongeren Beds		Latdorf
Bartonian	Upper / Middle / Lower Barton Beds		Gypse de Montmartre	Sands of Asse	Bartonian s.l.	Upper Eocene
				Clays of Asse		
			Marnes à Pholadomya ludensis	Sands of Wemmel		
Ledian	Upper Bracklesham Beds		Sables de Marines / Sables de Beauchamp; Calcaires de St. Ouen	Sands of Lede		
Lutetian	Lower	Bagshot Beds	Calcaire grossier	Sands of Brussels	Lutetian	Lower Eocene 4
				Panisel Beds		
Ypresian	London clay	London clay / Claygate Beds / Blackheath Beds	Sables de Cuise; Grès de Belleu	S. of Mons-en-Pévèle	Ypresian s.l.	Lower Eocene 3
			Argiles plastiques	Clays of Ieper		Lower Eocene 2 / Lower Eocene 1
Landenian	Reading Beds	Reading and Woolwich Beds		Sands of Landen- Erquelinnes	Paleocene	Paleocene

FIG. 1. — General classification of the Paleocene and Eocene stratigraphic units of northwestern Europe.

The marine part of these strata is mainly represented by the Sands of Bracheux, which occur only in the northern part of the basin. LERICHE (1912) distinguished three paleontological zones, but FARCHAD (1936) remarked that the species of *Cyprina* and *Pholadomya*, which had been used for that purpose, are not of time-stratigraphic value over a greater distance, since they are only indicators of more or less littoral environments.

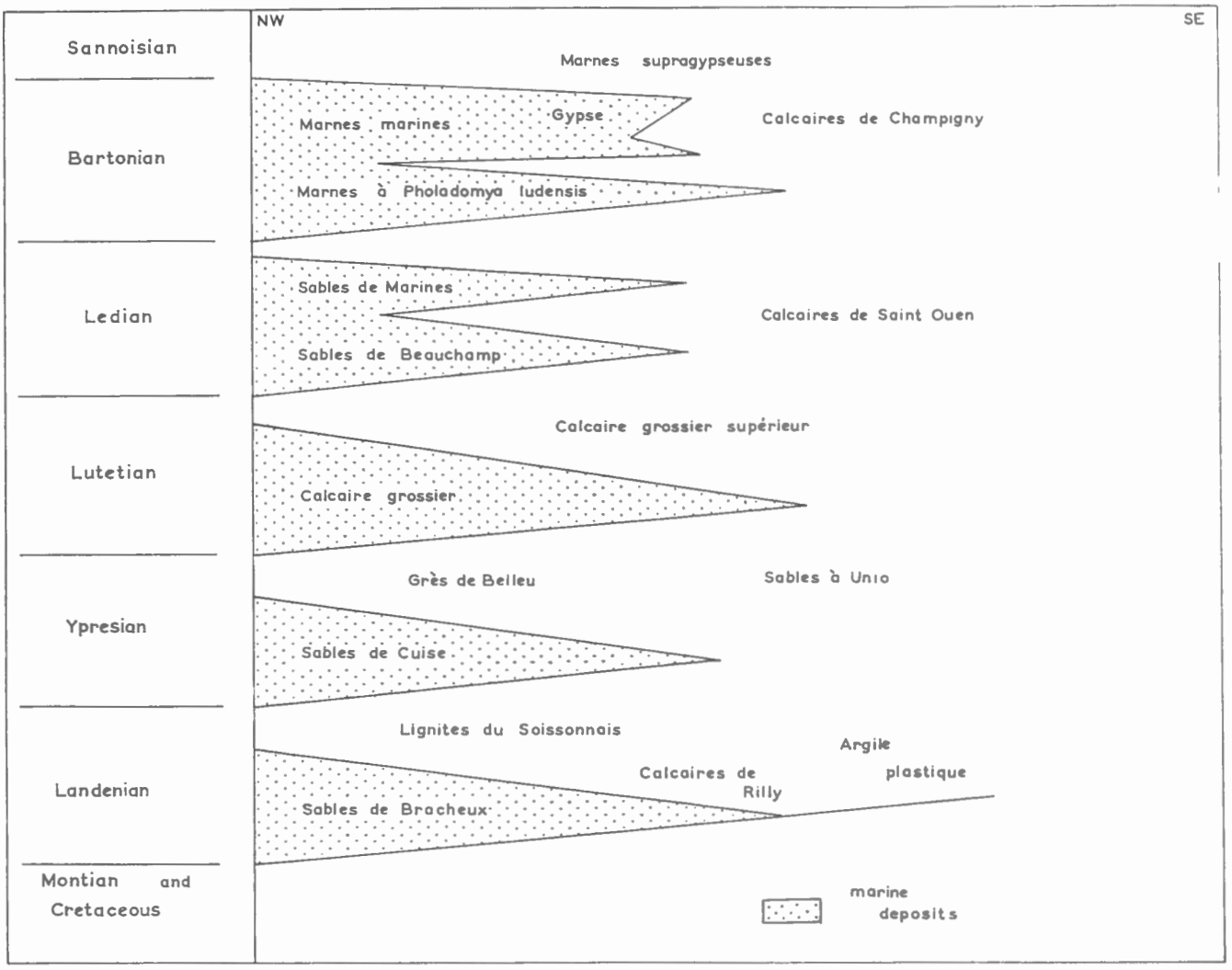

FIG. 2. — Paleocene and Eocene rock-units of the Paris basin (after LERICHE, 1912).

Along the borders of the area of these glauconitic Sands of Bracheux continental formations are to be found, the most important of which are the Limestones of Rilly with *Physa gigantea*, and the Conglomerate of Cernay with the oldest known mammalian fauna of the European Tertiary, but also with marine molluscs (TEILHARD DE CHARDIN, 1916-1921). Probably these deposits are lateral equivalents of the Sands of Bracheux, but they are often regarded as the lowermost part of the Sparnacian. This shows that the terms Thanetian and Sparnacian have often been used because of the facies of the sediments only. As time-stratigraphic units they had better to be neglected.

The « continental » part of the Landenian, often described as Sparnacian, includes various sediments, such as clays, lignites, limestones, and sands. Generally two groups of deposits are distinguished :

1. North and east of Paris, the mainly brackish sediments of the « Lignites du Soissonnais », consisting of clays, with lignites and some beds with marine to brackish molluscs : *Cyrena cuneiformis, Melania inquinata,* etc.

2. South of Paris, fully continental deposits, the « argile plastique », consisting of plastic clays with some irregular sandy intercalations.

There is some confusion as to whether these deposits belong to the cycle of sedimentation of the Landenian or to that of the Ypresian. In the last few years they have been regarded as continental variants of the Ypresian (FEUGUEUR, 1955).

In the northern part of the basin the overlying marine deposits, the Sands of Cuise, belong to the Ypresian cycle. These Sands of Cuise are often regarded as the type deposits of the Cuisian (DOLLFUS, 1880), but this Cuisian is no more than a synonym for the Ypresian.

The Sands of Cuise are characterized by *Nummulites planulatus.* At many places the base of the Sands is formed by a pebble bed, composed mainly of silex and fossil remains. These fossils, partly derived from the « Lignites du Soissonnais », are mixed up with those of the Sands of Cuise. This association is explained by the invasion of the Ypresian sea into the lagoons of the « Lignites du Soissonnais ».

The top part of the Sands of Cuise is formed by the Sands of Hérouval, in which a mixture is found of molluscs of the Sands of Cuise and of the « Calcaire grossier ».

Towards the end of Ypresian times continental conditions spread over the entire basin. One of the important members in the continental series, deposited after this marine period, is formed by the Sandstones of Belleu, with remains of *Lepidosteus* and of plants. Near Epernay, the « Sands with *Unio* », another member of these continental series, yielded mammalian remains of a fauna already related to that of the Lutetian (STEHLIN, 1941).

After the continental period of the Ypresian, another transgression brought back the sea into the Paris basin, this time with maximal extensions to the south beyond Paris. This transgression marks the beginning of the Lutetian (A. DE LAPPARENT, 1883; named after Lutetia = Paris), which corresponds to the formation referred to as the « Calcaire grossier ».

The marine part of the Lutetian deposits is mainly formed by soft limestones and/or calcareous sands. The basal coarse sand with quartz and glauconite as main components is called the « Glauconie grossière ».

In the sequence of the Lutetian LERICHE (1912) and ABRARD (1925) each distinguished four paleontological zones, sometimes with different names, but obviously with about the same meaning. They are from top to bottom :

4. Zone with *Cerithium giganteum* and *Orbitolites complanatus* (LERICHE)=
   Zone with *Orbitolites complanatus* (ABRARD);

3. Zone with *Ditrupa strangulata* (LERICHE)=
   Zone with *Echinolampas calvimontanus* and *Echinanthus issayvensis* (ABRARD);

2. Zone with *Nummulites laevigatus*;

1. Zone with *Maretia omaliusi* (LERICHE)=
   Zone with two nummulites : *Nummulites laevigatus* and *N. lamarcki* (ABRARD).

These zones form by far the best way for a subdivision. The listed fossils appear to have a greater horizontal distribution than the numerous lithologie variations.

Overlying these four zones the topmost beds of the Lutetian are indicated as the « Calcaire grossier supérieur ». They consist mainly of crags with *Cerithium*, locally with some intercalated lignite horizons.

On top of these brackish and continental beds the Sands of Beauchamp belong to the sedimentary cycle of the Ledian.

Many variations of the marine environment resulted in several strictly local deposits. The Sands of Auvers are often taken as type for the Auversian (Dollfus, 1880). They belong to the lower part of the Ledian series of the Paris basin. Higher sands, such as the Sands of Marines, have been thought to represent the Bartonian, but they form parts of the younger Ledian deposits.

Encircling the area of the marine sands, several lacustrine limestones are found, such as the Limestones of Saint Ouen with *Planorbis pseudoammonius* and *Limnaea longiscata*.

The Ledian cycle ended with a continued deposition of lacustrine limestones, which spread over the greater part of the Paris basin.

The following cycle, the one during the Bartonian, started with the deposition of the transgressive « Marls with *Pholadomya ludensis* ». These are marly sands, marls or limestones, with their main outcrops near Ludes, in the vicinity of Reims. On top of this followed the deposition of the famous Gypsum beds of Montmartre, alternating with brackish or marine marls with molluscs.

South of the line Paris-Reims occur the Limestones of Champigny with scarce freshwater molluscs (*Limnaea, Hydrobia, Nystia*, etc.).

In France this stage is often indicated as the Ludian (Munier-Chalmas and de Lapparent, 1893), an equivalent of the Bartonian.

The Oligocene is considered to begin with lagoonal deposits, the « Marnes supragypseuses », mostly supposed to be of Sannoisian (=Tongrian) age.

The important papers on smaller foraminifera by d'Orbigny (1826-1852) were partly based on material from the Eocene of the Paris basin, especially from Lutetian deposits. The same is true for earlier, but very important, notes of Lamarck and Defrance. Later on Terquem (1882) described foraminifera of the Lutetian deposits of Septeuil and Vaudancourt. The latter's collections, completed by material from several other localities of Lutetian deposits, were redescribed by Yolande le Calvez (1947-1952). She also described some foraminifera from the Sands of Hérouval.

Several papers and notes were published dealing with the nummulites of the Paris basin (Bruguière, 1792; Lamarck, 1804; Douvillé, 1919; Abrard, 1928; Schaub, 1951).

ENGLAND

In England the Paleogene strata are exposed in two areas, the London basin and the Hampshire basin.

LONDON BASIN

In the London basin (see fig. 3) the Tertiary system begins with the marine Thanet beds (Thanetian : Prestwich, 1850), typical in the Isle of Thanet. These Thanet beds are generally regarded as equivalents of the lower parts of the Landen beds of Belgium. They are poor in fossils, but they have yielded *Cyprina morrisi* and *Pholadomya koninckí*.

Overlying these sandy beds follow the marine Bottom beds (of the Woolwich series), marked by the appearance of *Cyprina scutellaria*. They have been correlated with the upper part of the marine Landen beds of Belgium, approximately our Sands of Grandglise, or at least the upper part of these.

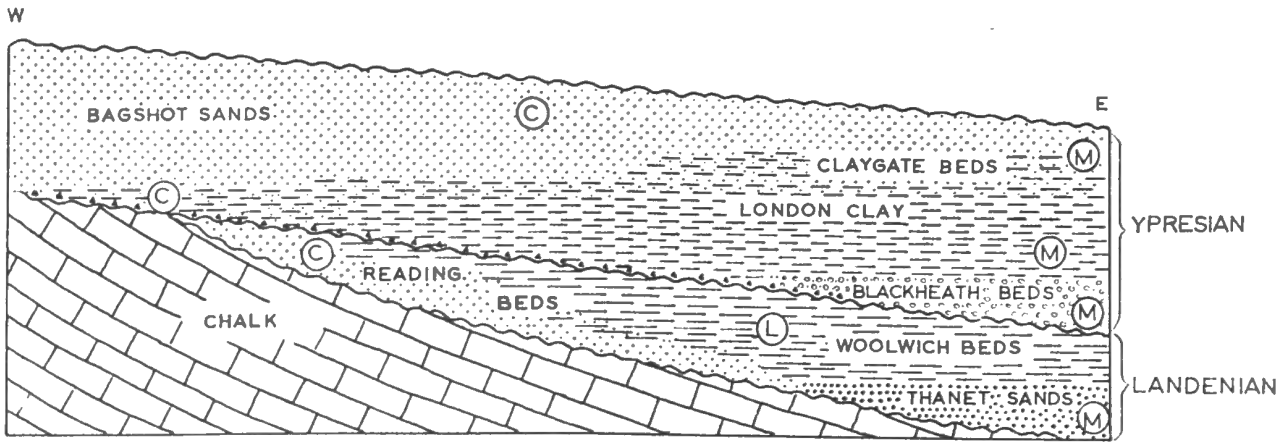

FIG. 3. — Generalized section through the Paleocene and Lower Eocene strata of the London basin (after WELLS, 1951). C : continental; L : lagoonal; M : marine.

The overlying Woolwich and Reading beds are lateral equivalents of different facies. The former are thought to be of estuarine or lagoonal origin; the second consist of freshwater deposits.

The Woolwich beds are found in the central area of the London basin. They contain a characteristic molluscan assemblage with *Cyrena cuneiformis, Melania inquinata* and *Potamides funatus*.

The area of the Reading beds forms a broad fringe along the western side of the Woolwich beds. They consist of current-bedded gravels and sands, and of clays and freshwater limestones.

This would be the end of the Landenian cycle.

The basal part of the overlying London Clay is formed by the Blackheath beds : pebble beds and sands with occasional pebbles. The fauna includes some brackish-water forms of the Woolwich beds and numerous marine species. In the western part of the London basin these beds are absent, and the London Clay directly overlies the Reading beds.

The London Clay is formed by a monotonous series of clays with layers of big septaria. Fossils are scarce. Subdivisions have not been made, except for one based on differences of the fauna :

Top beds,
Main mass,
Basement beds.

The fauna of the Basement beds suggests shallow water conditions; for the Main mass the water would have been deeper, and for the Top beds shallower conditions again recurred. Both the Bottom and the Top beds contain plant and animal remains, derived from the hinterland.

The Top beds pass upwards into the sandy Claygate beds, which, in the type area, consist of numerous alternations of sand and clay in thin layers. The Claygate beds are only known in the London area.

Upwards the London Clay or the Claygate beds pass into the Bagshot Sands, which, lithologically, closely resemble the Reading beds, again mainly consisting of current-bedded sands. Fossils are practically absent, only plant remains have been found.

In the London basin no Paleogene strata are present which are younger than the Bagshot Sands.

HAMPSHIRE BASIN

In the Hampshire basin the Landenian is represented by the Reading beds and the Woolwich beds; the latter are only present in the extreme eastern part of the basin.

The overlying London Clay, often having the local name of Bognor beds, is similar in character to that of the London basin. Lithological equivalents of the Blackheath and the Claygate beds are absent in the Hampshire basin. Westwards in this area the London Clay thins steadily, becoming more sandy and showing intercalated pebble beds.

Covering the London Clay, the Bagshot beds are found. They are marine deposits in the east, but have a fluviatile origin in the western part of the basin. In this fluviatile part pipeclay beds are found, which contain numerous leaves of plants, mainly of dicotyledonous angiosperms.

Overlying the Bagshot beds, the Bracklesham beds and the Barton beds represent the Lutetian, the Ledian and the Bartonian, as distinguished on the continent.

In the eastern part of the basin the Bracklesham beds consist of sandy clays with a rich fauna of marine molluscs and other fossils. The subdivision of these beds is based on species of *Nummulites*. The lower part contains *Nummulites laevigatus*, the upper part *N. variolarius*. The macrofauna of the Lower Bracklesham beds is said to differ more from the Upper Bracklesham assemblage than the latter does from the fauna of the Lower Barton beds. The Lower Bracklesham fauna contains, amongst others, *Turritella imbricataria, Venericardia planicosta*. The upper part with *Nummulites variolarius* is furthermore marked by the presence of *Cerithium giganteum*.

In western Hampshire, as well as at Alum Bay on the Isle of Wight, the entire series of the Bracklesham beds are formed by more or less continental sandy deposits. These beds are supposed to have been laid down on the seaward side of the deltas that extended from the west into the Lutetian and Ledian seas.

The lower limit of the overlying Barton beds in the type area has been defined by the appearance of *Nummulites orbignyi* (=*N. wemmelensis*). This species is confined to the lower part of the Barton beds. The threefold division of the Barton beds has been based on molluscan assemblages and on lithologic features.

The Lower Barton beds are green clays with sandy partings, and with a fauna of many species that range up from the Bracklesham beds, in addition to a number of new forms.

The Middle Barton beds are formed by the Barton Clay. The fauna consists for the greater part of molluscs, with but few characteristic species, however.

The Upper beds mainly consist of sands. The most fossiliferous horizon is the famous *Chama*-bed with abundant *Chama squamosa*. Towards the top the admixture of brackish-water fossils reflects the gradual shallowing and withdrawal of the Bartonian sea.

The topmost Barton beds and the lower strata of the overlying Headon beds form an almost continuous lithological unit. These beds and others, considered to belong to the Oligocene, are found only in the northern part of the Isle of Wight and in the adjacent parts of the mainland.

The Oligocene strata are represented by a thick series of freshwater and estuarine deposits, with occasional intercalated marine beds.

BURROWS and HOLLAND (1897) and HAYNES (1956, 1957, 1958) described some of the foraminifera from the Thanet beds of the London basin; BOWEN (1954, 1957) foraminiferal associations from the London Clay and the Barton beds. Smaller foraminifera from the Headon beds were described by BHATIA (1955), especially from Whitecliff Bay, Isle of Wight.

Nummulites have been described by WRIGLEY and DAVIS (1937), WRIGLEY (1934) and CURRY (1937).

THE NETHERLANDS

PANNEKOEK (1956) published many data concerning the stratigraphy of the subsurface Eocene of the Netherlands, illustrated by several isopach maps and some sections.

In the Netherlands the main masses of the Eocene sediments occur in two areas. One is in the southwest, forming the northern part of the Belgian basin, the other is in the northeast, forming the western continuation of the Northern German-Danish basin. These two basins are separated by a swell without Eocene deposits, roughly from Nijmegen to The Hague. This structure is not distinct in the distribution of the Paleocene sediments, but it is found to be clear in the Eocene rocks, again fading out in those of the Upper Oligocene. These changing paleogeographic conditions are probably connected with the tectonic movements in the southeastern Netherlands, which resulted in the so-called « Horst and Graben structure » of that region.

In the southern basin the stratigraphic sequence is best known from the boring Woensdrecht. Our detailed investigation of this boring shows the distinct connection of its sedimentary series with those of the Belgian area.

In the northern basin the Eocene has been subdivided into three parts, indicated as Lower Eocene (Ypresian s.l.), Middle Eocene (Lutetian), and Upper Eocene (Bartonian s.l.).

The lower part of the sediments of the Lower Eocene consists of clays with intercalated sands, sandstones and numerous thin layers of bentonite. It corresponds to the more extensive deposits of this type in Denmark and Northern Germany. This lower part is thought to be mainly of lagoonal origin, which is in accordance with the type of the foraminiferal association. The clayey upper part of the Lower Eocene is distinctly marine.

The Middle Eocene deposits mainly consist of marine, marly and clayey deposits.

The lower part of the Upper Eocene series comprises sands, marls and limestones. *Nummulites orbignyi* (=*N. wemmelensis*) occurs throughout. The upper part is formed by sandy clays, with indications for a deposition in a shallowing sea, as was concluded from the presence of organic matter and wood fragments (PANNEKOEK).

Sediments of the Lower Oligocene have not been recorded. If present, they are very indistinct.

TEN DAM (1944, 1945) studied the foraminifera of the Dutch Paleocene and Eocene. The faunae closely resemble those found in our Belgian material.

NORTHERN GERMANY

In Northern Germany the Eocene is again mainly known from borings.

Eocene deposits are found in a large area north of the line Münster-Hannover-Berlin. The subdivision of these beds is largely based on micropaleontological characteristics, which enabled the distinction of Lower Eocene 1, 2, 3 and 4, followed by Upper Eocene. BETTENSTAEDT (1949) emphasized the fact that the recognition of these units is for the greater part connected with differences of the facies of the sediments, but they show a remarkable horizontal continuity throughout the Northern German-Danish basin.

The correlation with the international stages is not quite clear. The lower three units and possibly part of the Lower Eocene 4 would correspond with the Ypresian. According to BETTENSTAEDT (1949) the Lutetian would be represented by the upper part of the Lower Eocene 4 and the lower part of the Upper Eocene. The top of the Upper Eocene would correspond to the Dutch Bartonian s.l. (e.g. the frequently adopted interpretation of the Bartonian, combining the Bartonian s.s. and the Ledian).

REUSS (1855, 1864) published some notes on foraminiferal assemblages of Eocene deposits of Germany. A general survey of the microfaunae of the German Tertiary was published by STAESCHE and HILTERMANN (1940) (with many illustrations of associations and of single specimens), and by HILTERMANN (1949). Also SCHUH (1952) published data on foraminifera, especially on those of the Upper Eocene; WICK (1946) on those of the Paleocene and Lower Eocene 1.

CHAPTER II

BELGIAN ROCK-UNITS

INTRODUCTION

In Belgian literature Paleocene and Eocene are often taken together as Eocene. In this paper the differentiation between Paleocene and Eocene is maintained, and the Eocene is considered to begin with the Ypresian, which in this northern region is characterized by the appearance of nummulites.

It has often been suggested that the area of sedimentation during Eocene time formed a single basin from Paris to the Netherlands, including the English basins. Isolated occurrences of deposits on the ridges in between the actual basins prove that during at least part of the Eocene, there must have been connections between the Paris and Belgian basins, as well as between the London and Hampshire basins. These deposits are partly of shallower water origin than their Belgian equivalents. This shows that the Axes of Artois and Weald, to-day mainly with outcrops of Paleozoic and Mesozoic rocks, must already have been an important geomorphologic feature during the Eocene.

In this paper the Axis of Artois is assumed to have formed the southern border of the Belgian basin. No distinct northern and eastern boundaries of the Eocene basin are known.

Towards the east certain Eocene deposits have been found as far as the line Namur-Leopoldsburg. Towards the north the area of sedimentation continued in the southern Netherlands. In our investigations the boring of Woensdrecht is the most northern occurrence of Eocene rocks.

In the northern part of the Belgian area the Eocene sediments are covered by younger rocks, in the southern part they crop out south of the line Sint-Niklaas-Mechelen-Leuven-Tienen.

Most of the data, on which this chapter is based, were gathered during the field work. Data from the literature and from the Archives of the Geological Survey of Belgium have been added.

STRATIGRAPHIC MAPS

Three geological maps (no. 3-5) illustrate the distribution of the rock-units. They have been based on the Geological Maps of Belgium, namely the maps 1 : 40.000 published between 1890 and 1910, the map 1 : 160.000 of 1920, and the recent map 1 : 500.000 of DE BÉTHUNE, published in the Atlas of Belgium of 1954.

Thirteen maps (no. 6-18) further demonstrate the distribution and some other features of the various rock-units. These maps have been based on the geological maps, combined with our own observations and with data from the literature and the Archives of the Geological Survey at Brussels.

The data of only a few borings have been published, the greater part had to be collected from the Archives. Most are from water borings, many of which were flush borings and therefore less reliable. They had to be used by lack of sufficient data from dry or cored borings. In the northern part of the discussed area the water borings were not deep enough to reach the Eocene deposits. From this region only some widely spaced deep borings, nearly always flush borings, furnished some data. These data, when indicated, are considered to be very unreliable.

The description of borings and exposures in the Archives of the Geological Survey are not uniform. They have been made by several authors on samples that had usually been collected by the foremen of the borings, which fact often caused uncertainty in the interpretation of the reports.

These remarks must be taken into account when consulting the maps. However, the isopach maps and the contour maps may be considered to show the general features of the units.

LIST OF ROCK-UNITS

Our subdivision of the Eocene deposits is shown in the next table. The underlying and the covering units are also indicated.

The succession in the list is not a time-stratigraphic one, only the most probable sequence of the discussed rock-units. Some of them have to be considered as lateral equivalents of one another (see Chapter V).

The notations between brackets are those of the geological map 1 : 160.000 or/and of the Stratigraphical Code adopted in 1932.

Rock-units introduced in this paper are : the Sands of Oostende, and the Sands of Vlierzele.

	....	Sands of Voort (V).
	Rupel formation (R)	Boom Clay (R2c). Nucula-clay (R1c). Sands of Berg (R1b).
Oligocene (see Batjes, 1958).	Upper Tongeren beds	Sands and marls of Oude-Biezen (Tg2c). Clays of Henis (Tg2n). Sands and marls of Boutersem (Tg2m). Sands of Kerkom (Tg2k).
	Tongeren formation (Tg).	
	Lower Tongeren beds	Horizon of Hoogbutsel (Tg1m). Sands of Neerrepen (Tg1d). Sands of Grimmertingen (Tg1c).
	Asse formation (Ba)	Sands of Asse (Asd ....) (As). Clays of Asse (Asc) ..... Sands of Wemmel (We).
Upper Eocene.	Lede formation (Le)	Sands of Lede (Le).
Middle Eocene.	Brussels formation (B)	Sands of Brussels (B).
	Upper Panisel beds	Sands of Aalter (P2).
	Panisel formation (P)	
	Lower Panisel beds	Sands of Vlierzele (P1d). Sandy Clays of Anderlecht (P1c). Clays of Roncq (P1m).
Lower Eocene.	Ieper formation (Y)	Clays of Roubaix ..... (Y1b). Sands of Mons-en-Pévèle ..... Morlanwelz member. Clays of Ieper (Y1a).
	Upper Landen beds	Sands of Oostende ..... Sands of Landen ..... (L2). Sands of Erquelinnes .....
Paleocene.	Landen formation (L).	
	Lower Landen beds	Sands of Grandglise (L1d). Clays of Louvil (L1c). Marls of Gelinden. Sands of Orp.

LANDEN FORMATION

named after Landen, in the Hesbaye

(Maps 3, 7 and 8)

The Landen formation overlies rocks of Paleozoic, Cretaceous, or Montian age; it is usually covered by the Clays of Ieper.

In the complicated series of rocks of different facies the Belgian geologists distinguish two greater units :

the Upper Landen beds, and
the Lower Landen beds.

The Upper Landen beds comprise sediments deposited in lagoonal to fluviatile environments. The Lower Landen beds are formed by deposits of marine origin; only their upper member will be dealt with.

SANDS OF GRANDGLISE (D'OMALIUS D'HALLOY, 1842; LERICHE, 1928)

named after Grandglise, in the western part of Hainaut

Exposures of the Grandglise Sands occur in part of the provinces Hainaut and Brabant, and in northern France. Furthermore these sands were encountered in borings in Flanders and the Kempen.

They usually cover the Louvil Clays, but in the southern part of Brabant and the eastern part of Hainaut they overlie rocks of Paleozoic or Cretaceous age.

The Sands of Grandglise mainly consist of fine-grained, glauconitic sands, often with clayey intercalations. In the upper part the bedding is irregular and often disturbed by tubulations (probably worm tubes), in the lower part bedding is more regular. In this lower part, near the transition into the Louvil Clays, the sands are rich in glauconite. The content of this mineral diminishes higher on, and locally the top beds are devoid of glauconite, and thus they may pass gradually into the Sands of Erquelinnes or of Landen.

Such a gradual passage occurs in the central part of the E-W directed depression of the Haine basin. Along the borders of this basin, as at Erquelinnes, the glauconitic Grandglise Sands have been ravinated before the deposition of the Upper Landen beds.

In the Hesbaye the transition zone shows distinct cross-bedding and intra-stratal crumpling features (GULINCK, 1948). At other places of this area the Sands of Grandglise have again been ravinated by the overlying Upper Landen beds.

Diminishing glauconite content and gradual passage into the Sands of Erquelinnes have been reported from many localities in northern France. In this area a distinction has been made between the « faciès flamand » and the « faciès cambrésien » of the Sands of Ostricourt (GOSSELET, 1883). The first is equivalent with our Grandglise Sands, the second, formed by non-glauconitic, cross-bedded sands with many worm tubes, is partly the equivalent of our Upper Landen beds.

The Grandglise Sands are mostly overlain by the Ieper Clays. Wherever Oostende Sands are present, they are intercalated between the Sands of Grandglise and the Clays of Ieper. Along the southern and eastern border of the area the Grandglise Sands are covered by the Sands of Erquelinnes or of Landen.

In the greater parts of Flanders and Brabant a rather constant thickness of about 12 m has been found. In the Hesbaye thicknesses (up to 20 m) are more variable because of the erosion before the deposition of the Upper Landen beds.

The Grandglise Sands are devoid of fossils, except for small numbers at some localities, such as Nalinnes, Erquelinnes and Kortrijk. In northern France fossiliferous deposits are less rare.

The most frequent species are *Cyprina scutellaria, Venericardia pectuncularis, Crassatella bellovacina, Ostrea bellovacina, O. inaspecta.* From Erquelinnes also reptiles and fishes have been reported. They partly are of freshwater origin.

Leriche (1903) subdivided the Lower Landen beds into three paleontological zones; the upper one of which (the zone with *Cyprina scutellaria*) is about equivalent with our lithologic unit of the Grandglise Sands. In Belgium the threefold division is of little practical value because of the scarcity of fossils.

SANDS OF ERQUELINNES AND SANDS OF LANDEN (d'Omalius d'Halloy, 1842; Rutot, 1881)

named after Erquelinnes, in eastern Hainaut; and after Landen, in the Hesbaye

(Maps 3, 7 and 8)

We did not separate the Sands of Erquelinnes and the Sands of Landen because a good differential diagnosis cannot be given.

Their outcrops are found in two distinct areas : the southern and eastern part of Hainaut, and the Hesbaye, respectively (map 3). In between these two regions some dispersed small occurrences of lignitic clays are known. Their equivalence with the Upper Landen beds is questionable, however.

In the western part of the areas these units overlie the Grandglise Sands. More eastwards the Sands of Grandglise are absent and the Sands of Erquelinnes-Landen cover the Louvil Clays or older rocks.

As has been described already the Grandglise Sands may gradually pass into the Sands of Erquelinnes-Landen. The lower part of the latter sands are of variable lithologic composition. They are mostly fine-grained sands, more or less lignitic, and often cross-bedded. Intercalations of clays, lignitic clays and marls may be of local importance, such as 5 m of lignitic clays at Havré.

In northern France equivalent deposits contain brackish-water fossils, often accumulated at certain levels.

At other places the base of the Sands of Erquelinnes and of Landen contains many pebbles, which underlie coarse, current-bedded sands, deposited in more or less distinct erosion channels. From northern France such channels were described of 100 to 200 m wide and 50 m deep, incised as deep as in rocks of Cretaceous age. At a few places such coarse sediments were found in channels, incised in fine-grained Upper Landen beds only.

Both in the Hesbaye and in Hainaut the higher deposits become more fine-grained and pass into sands with frequent intercalations of clays and marls. These sediments resemble those already described from places where the coarser base is absent.

The upper sands often contain enormous sandstones pieces, the « grès mamelonnés », of about 1 to 2 m thickness (Ledoux, 1911), with frequent plant remains (partly roots of water-plants, Rutot, 1887*b*).

The Sands of Erquelinnes and of Landen are well known for the mammalian faunae of Orsmaal and of Erquelinnes (TEILHARD DE CHARDIN, 1927) with, amongst others, *Phenacodus europaeus* and *Teilhardina belgica* at Orsmaal. From Erquelinnes *Coryphodon* cf. *eocaenus* (=*Coryphodon eocaenus* in DOLLO, 1909) and *Hyracotherium* sp. (=*Propachynolophus maldani* in RUTOT, 1881) should be mentioned.

LERICHE (1902) described the fish remains of the Sands of Erquelinnes and of Landen. Invertebrate fossils are very scarce, only *Unio* and *Helix* have been reported.

SANDS OF OOSTENDE (1)

named after Oostende, in western Flanders

(Map 8)

Because of the frequent fossils the Upper Landen beds in western Belgium differ so much from the Sands of Erquelinnes and of Landen that the new name, the Sands of Oostende, is proposed for them. They are furthermore distinct by the different areal distribution.

They consist of fine-grained, sometimes slightly glauconitic sands and lignitic clays, with several fossiliferous beds, such as limestones with numerous molluscs.

The Oostende Sands have been observed only in a number of borings. Their northern extension is unknown. In between the borings with Sands of Oostende others are present in which Ieper Clays directly overlie Grandglise Sands, so that the area of the Oostende Sands is probably not continuous.

At Oostende the Sands cover fossiliferous Clays of Louvil, but in other borings, especially near the borders of the area, they rest upon Grandglise Sands. Towards these borders the lithologic difference between Sands of Grandglise and Sands of Oostende is not very clear.

In the whole area the Sands of Oostende are overlain by the Ieper Clays.

At the type locality the unit appeared to consist of 26 m of sands and clays, often lignitic (GULINCK and HACQUAERT, 1954). This thickness of 26 m seems to be a maximum, other borings indicate 19,50 m (Gent) and 10 m (Beernem).

The most frequent fossil species are *Cyrena cuneiformis, C. forbesi, Ostrea bellovacina, Veretrix obliqua, Melania inquinata,* and *Otodus striatus* (LERICHE, 1899; GLIBERT in FEUGUEUR, 1955).

During the investigation of a number of samples of the Collections of the Geological Survey of Belgium, derived from the boring Oostende, no foraminifera were found. The samples yielded some *Cyprideis*, but no other ostracods.

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(1) Since completion of the manuscript Ir. GULINCK has kindly drawn my attention to the fact that the name « Assise d'Ostende » was already used as early as 1868 by DEWALQUE for a deposit that is characterized by *Corbicula fluminalis*. This deposit was regarded by TAVERNIER (1954, Prodrome d'une description géologique de la Belgique, p. 533) as belonging to the Riss-Würm interglacial.

Furthermore DUMONT (1839) has already used the name « Clay of Oostende ».

To avoid confusion we propose to alter the name of Sands of Oostende to Sands of Oostende-ter-Streep which name is derived from the old name (qth century) for Oostende.

IEPER FORMATION

(Maps 3, 8-12)

In the type area the Ieper formation is formed by the Clays of Ieper overlain by the Sands of Mons-en-Pévèle.

In northern France Gosselet (1874) distinguished the Clays of Orchies, the Clays of Roubaix and the Clays of Roncq. This clay series is often referred to as the Clays of Flanders (« Argiles de Flandres », Ortlieb and Chelloneix, 1874). The Clays of Orchies continue into our Clays of Ieper. The Clays of Roubaix are considered to be a lateral equivalent of the Sands of Mons-en-Pévèle. The Clays of Roncq belong to the Panisel formation. No distinct subdivision could be made in this French clay series by means of fossils (Leriche, 1928).

CLAYS OF IEPER (d'Omalius d'Halloy, 1842)

named after Ieper, in western Flanders

(Maps 3, 8, 9 and 10)

The base of the Ieper Clays consists of a layer of sand or sandy clay of some cm to three metres thickness. These basal sediments are absent in the greater part of Hainaut, Brabant and the eastern part of France du Nord.

If present these basal sands are usually coarse grained, especially near the contact with the underlying strata. Intercalated plastic clay beds have been found. The frequent occurrence of a basal gravel of small, mostly black silex pebbles has been reported. Associated with the silex, sandstone pieces, fragments of silicified wood, and occasional fish teeth (*Lamna elegans*) have been found (Halet, 1913). However, such pebbles or gravel may be entirely absent.

At a number of localities in France du Nord and Hainaut the transition from the Grandglise Sands into the Ieper Clays was observed to be gradual by the appearance of clayey intercalations in the upper part of the Grandglise Sands (Delvaux, 1884; Rutot, 1887; Dehée, 1927).

The bulk of the Ieper Clays consists of silty to plastic clays, mostly more or less blue to grey, fairly rich in pyrite, and with occasional small septaria. Furthermore muscovite, glauconite and gypsum are present.

The lower part of the clays often contains plant remains (Rutot, 1904; Y. le Calvez and Feugueur, 1955). The higher part may show very silty beds, with a thickness of up to 3 m. Occasionally these beds are indurated. From the topmost part again more plant remains have been reported.

In the Kempen the Ieper Clays are represented by sandy and plastic clays, with intercalated sands and clayey sands. From the boring Kwaadmechelen plant remains have again been reported. Further eastwards, at Beeringen, no distinction is possible between Clays of Ieper and Sands of Mons-en-Pévèle; at this place sands predominate in the Ieper formation.

The Ieper Clays are mostly covered by the Sands of Mons-en-Pévèle, in the southwestern area by the Clays of Roubaix.

The fauna is poor. Locally some fossiliferous beds are met with, mostly with preponderance of *Turritella solanderi, Pecten corneolus, Lingula tenuis* and *Xanthopsis leachi,* species that are also present in the Sands of Mons-en-Pévèle. In a boring at Marck, near Calais, Leriche (1909*b*, 1937*a*) found fossiliferous clays with *Pholadomya margaritacea* and a number of intercalated sandy beds with *Turritella hybrida, T. solanderi, T. carinifera* and *Nummulites planulatus.* This small fauna very much resembles that of the Sands of Mons-en-Pévèle.

Important monographical studies about the fossil fishes have been published by LERICHE (1905*a*, 1951) and CASIER (1946). PASTIELS (1948) described some of the microfossils, such as radiolarians, pollen, hystrichosphaerids.

SANDS OF MONS-EN-PÉVÈLE (ORTLIEB and CHELLONEIX, 1874)

named after Mons-en-Pévèle, in France du Nord

(Maps 3, 11 and 12)

Except for the area of the Roubaix Clays the Clays of Ieper are nearly everywhere covered by the Sands of Mons-en-Pévèle.

LERICHE (1909*b*) recorded occurrences of sandstone pieces with *Nummulites planulatus* from the region of Artois, which fact gives an idea of the former extension of the Sands in southern direction.

Often there is no distinct limit with the underlying Ieper Clays. Generally there is an intermediate zone of silty, micaceous clay, or of alternating silty and clayey beds. Only near Renaix did DELVAUX (1887) find a bed with gravel and worn remains of fossils in between the Ieper Clays and the Sands of Mons-en-Pévèle.

In typical occurrences the sands are fine-grained, micaceous and glauconitic. They are thin-bedded with occasional cross-bedding, but bedding planes are often entirely absent. In western Belgium they are more clayey and hardly separable from the Clays of Ieper or from the Clays of Roubaix. From the region of Torhout and Tielt RUTOT (1886) described the uppermost beds as coarser grained, thus forming a gradual transition into the coarse sediments of the Lower Panisel beds of this region.

At Mons-en-Pévèle a series of about 50 m of sands, sandy clays and clays has been described (PARENT, 1894; HÉRENT, 1895). About twelve nummulite beds are intercalated.

In Belgium, and also at Mons-en-Pévèle, these nummulite beds often consist of sandy, glauconitic limestones, with numerous nummulites (LEDOUX, 1911). At Maulde (DE) we found a thickness of about 15 cm for one of these limestones, CASIER (1946) reported thicknesses of 2 to 10 cm at Forest. In Belgium these nummulite beds are less numerous than at Mons-en-Pévèle. Only one to three of them are present; mostly they are not indurated. In western Belgium the deposits of many localities have been reported to be devoid of nummulites.

The topmost Sands of Mons-en-Pévèle pass gradually into the Clays of Roncq. Especially in Brabant clayey intercalations in the sands mark the passage.

Fossils are mainly known from the nummulite beds. The most frequent molluscs are *Turritella solanderi, Lucina squamula, Pecten corneolus, Ostrea submissa* and *O. multicostata*. *Ditrupa plana*, one of the most common fossils of the Sands of Mons-en-Pévèle, is locally concentrated in distinct beds. Coral fragments of *Turbinolia sulcata* also occur. Among the fish remains, described by LERICHE (1905*a*, 1951) and CASIER (1946), mention should be made of those of *Odontaspis macrota, Lamna lerichei, Myliobatis toliapicus*.

CLAYS OF ROUBAIX (Gosselet, 1874)

named after Roubaix, in northern France

(Maps 3, 11 and 12)

The Clays of Roubaix cover the Ieper Clays, and they are in turn overlain by the Clays of Roncq, or especially along the borders of their area by the higher Sands of Mons-en-Pévèle.

They should be distinguishable from the Ieper Clays by the less compact appearance and a higher silt content (Leriche, 1928). When shell fragments are present the distinction is somewhat easier, because of the usual absence of such fossil remains in the Ieper Clays. If such remains are absent the distinction is difficult or impossible.

From Moen a thickness of 14 m has been reported, but the overlying 26 m of fine-grained sands, sandy clays and clays show a gradual passage into the Sands of Mons-en-Pévèle (also observed in DH), which fact renders the recorded thickness to a more or less arbitrary value.

Paleontologically the Clays of Roubaix resemble the Sands of Mons-en-Pévèle. Locally many nummulites are present, sometimes concentrated in distinct beds, such as near Moen (Halet, 1913).

MORLANWELZ MEMBER (Mourlon, 1880)

named after Morlanwelz, in eastern Hainaut

In the eastern part of Hainaut the Ieper formation consists of a series of alternating fine-grained sands, sandy clays, and silty and plastic clays (Leriche, 1936; Schellinck, 1937). They are most distinct around Morlanwelz and Carnières.

In Belgian literature this unit is incorrectly referred to as the « Argilites de Morlanwelz », but real « argilites » (clayey sandstones with coarse glauconite grains, sponge spicules, and a clayey to clayey-siliceous matrix; Schellinck, 1937) form only a minor part of the alternating series.

Some confusion exists about the horizontal and vertical extent of this member. For instance, Legrand and Tavernier (1948) concluded its absence at Godarville, because of the absence of typical argilites. However, the section of the Ieper formation at this locality strongly reminds of those of the Morlanwelz region.

On the geological maps the distinction between Sands of Mons-en-Pévèle and Clays of Ieper is everywhere maintained. Evidently it was based on the correct supposition of a lower, more clayey and an upper, more sandy part of the series. However, in the area of the Morlanwelz member the boundary is arbitrary and the distinction of two units fairly artificial.

Especially from the sandstones a rich fauna has been collected with, amongst others, *Nummulites planulatus, Nucula fragilis, Leda corneta, Pecten corneolus, Voluta depressa, Turritella solanderi, T. hybrida,* and *Xanthopsis bispinosus.* Leriche (1905*a*, 1951) and Casier (1946) described the fish remains, Pastiels (1948) some of the microfossils.

In southwestern direction the described deposits of the Morlanwelz member pass into the local variant of the Sands of Péissant (Briart, 1882), which have a lesser clay content and a predominance of sands.

The Sands of Péissant, with a thickness of up to 40 m (Stevens, 1946), are medium to fine-grained, and slightly glauconitic. Thin intercalated clay beds are present. The basal part is said to be formed by lignitic clays with plant remains. The upper part contains sandstone pieces with many *Nucula fragilis.* It also contains pieces of wood, perforated by boring animals.

From Trélon, south of Péissant and near Avesnes, Leriche (1936) described the occurrence of the Sands of Trélon with about the same lithology as the Sands of Péissant, and with a fauna characteristic of the Ieper formation.

PANISEL FORMATION

named after the mont Panisel, near Mons

(Maps 4, 13 and 14)

DUMONT based his « Paniselien » on the « Psammites du mont Panisel » (D'OMALIUS D'HALLOY, 1842). Later research revealed the more complete series of the « Paniselian » in Flanders, those of the mont Panisel only being a far southeastern occurrence.

In Flanders the formation can be subdivised into four or five members.

CLAYS OF RONCQ (GOSSELET, 1883)

named after Roncq, in northern France

The Clays of Roncq form the basal part of the Panisel formation both in France du Nord and in Flanders. In the region of Torhout and Tielt, in the Kempen, and at the mont Panisel the Clays of Roncq are absent.

They overlie the Sands of Mons-en-Pévèle or the Roubaix Clays, usually with a gradual transition.

The Roncq Clays consist of plastic, grey clays, with local sandy intercalations, in which there are often clay pebbles. Most occurrences of clay pebbles are in western Flanders near the area of Torhout and Tielt. At some places shell fragments have been found, mostly as worn remains occurring in pockets (LERICHE, 1927). With the exception of these pockets, the clays are generally unfossiliferous.

Near the top the plastic clays become glauconitic and sandy, and gradually pass into the Sandy Clays of Anderlecht.

In the borings of Brabant and eastern Flanders thicknesses are remarkably constant, 4 to 8 m. In the central part of Flanders the thickness is more variable. In southern Flanders and in France du Nord up to 10 or 12 m have been found.

The Roncq Clays yielded, amongst others, *Turritella solanderi, Pinna margaritacea, Xanthopsis leachi, Lamna obliqua*, and *Nummulites planulatus*.

SANDY CLAYS OF ANDERLECHT (G. VINCENT, 1874)

named after Anderlecht, near Brussels

This unit covers a wider area than the Roncq Clays, including the Kempen, the region of Torhout and Tielt, and the mont Panisel.

Mostly there is a gradual passage from the Roncq Clays into the Sandy Clays of Anderlecht. In the region of Torhout and Tielt there is coarse, gravelly sand with lignite remains and a few sandstone fragments at the base (P1a of the Geological Map) (RUTOT, 1890*b*; HALET and LEJEUNE DE SCHIERVEL, 1905). Around this area the sand seems to fade out between the Roncq and Anderlecht members. Also in the Kempen there is a basal gravel, this time with fish remains, shell fragments and many, small *Nummulites planulatus*.

The greater part of the unit is formed by clayey sands and sandy clays, often in alternating layers of some centimetres thickness, and mostly with fairly regular bedding. The bedding planes have often been disturbed by organisms (GULINCK, 1952). Intercalations of plastic clay have been found, which lithologically resemble the Roncq Clays.

Sandstone pieces, mostly in discontinuous layers, form a characteristic feature of the Anderlecht member. Only in the lowermost part are they absent. The sandstone pieces, with thicknesses of up to 60 cm, have a variable degree of indurating. Generally, the pieces of the lower part are fossiliferous, higher up less fossil remains have been found, and the sandstones become quartzitic. They may be perforated by worm tubes.

In western Belgium the upper part of the Anderlecht member becomes very sandy and there is a more gradual transition into the Vlierzele Sands. The limit between these two units becomes artificial.

In the Kempen and in the boring Woensdrecht the Sandy Clays of Anderlecht are so sandy that they are inseparable from the Vlierzele Sands.

Because of the gradual passages thicknesses are unreliable. Near Vilvoorde 5 to 9 m are fairly certain.

The greater part of the fossils have been derived from the sandstone pieces, often as siliceous casts.

Very fossiliferous exposures are those of Teralfene (BG) and Scheutveld, near Anderlecht, with, amongst others, *Pinna margaritacea, Lucina squamula, Ostrea submissa, Nucula parisiensis, Leda striata, Rostellaria fissurella, Pleurotoma lajonkairei, Nummulites planulatus, Turbinolia sulcata,* some fish remains, pieces of silicified wood, and fructifications of *Nipadites*. The sandstone pieces are furthermore rich in diatoms, radiolarians and sponge spicules. *Nummulites planulatus* is also abundant at other localities, such as Grammont, Renaix, and Torhout.

SANDS OF VLIERZELE

named after Vlierzele, between Gent and Aalst

(Type locality : ZB)

The Vlierzele Sands occupy about the same area as the Anderlecht member. There is a gradual passage in between. They probably occur as far east as Oostham and Kwaadmechelen (Asselberghs, 1926).

The member mainly consists of fine-grained, glauconitic, and rather well-sorted sands. Often distinct cross-bedding is found, which is usually absent in the lower part and more distinct higher upwards, such as at Vlierzele (ZB) and Balegem (ZF). Locally many tubulations, probably worm tubes, have been found. There are intercalated beds of plastic clay, which may be of considerable thickness towards the top of the unit (1 to 2 m at Mechelen; 50 cm in the hills of Esschene and Hekelgem).

Associated with the fine-grained, glauconitic sands there occur coarser and less glauconitic sands, sometimes with lignite particles and silicified wood remains, the latter with perforations of boring animals. Some beds with clay pebbles have been reported as well.

Sandstone pieces are frequent, mostly flat pieces, but also with the shape of the « Grès fistuleux » of the Brussels Sands. All these pieces are quartzitic.

In the Kempen the Vlierzele member is partly overlain by the Sands of Brussels (maps 13 and 14). In Flanders, as well as in the boring Woensdrecht and in some hills of northern France, the Vlierzele Sands are covered by the Sands of Aalter, sometimes with the Sands of Aalterbrug in between.

Magar (1947) reported thicknesses of up to 10 or 20 m; others found 7 m at Gent and 5 m at Esschene.

Fossils are rare. Some ten species of plants have been recognized among the wood fragments (STOCKMANS and WILLIÈRE, 1943). Some localities with silicified fossils occur in the region of Torhout and Renaix. They contain, amongst others, *Nummulites planulatus*.

In the region of Gent and Brugge, the topmost beds of the Vlierzele Sands are known as the Sands of Aalterbrug (HACQUAERT and TAVERNIER, 1939; LERICHE, 1941). They are often referred to as « Panisélien ligniteux ».

At Aalterbrug these sands cover glauconitic Vlierzele Sands with perforated, silicified wood fragments. They are greenish to brownish, micaceous, fine-grained, glauconitic sands and clayey sands, with intercalations of clay lenses and of lignite beds. Further constituents are silicified, often perforated, wood fragments, flattened clay pebbles, and pieces of soft, lignitic sandstones. The whole series is strongly cross-bedded and is rich in tubulations, probably worm tubes.

From Gent these sands have been reported as lignitic sands of about 1,50 m thickness (STAINIER, 1930) overlying white sands, which pass downwards into glauconitic sands. At the top there is a gradual passage into the Aalter Sands.

At Woensdrecht the Aalter Sands directly overlie the Vlierzele Sands, without distinct Sands of Aalterbrug in between. However, the uppermost samples of the Vlierzele Sands of this boring contain some lignite fragments.

SANDS OF AALTER (LERICHE, 1937)

named after Aalter, between Brugge and Gent

(Map 4)

Outcrops of the Sands of Aalter are only known in the region of Aalter and Gent, and near Cassel. BAUDET (1941) reported a probable occurrence near Renaix. The occurrences of Gent and Aalter continue westward below younger deposits and are again cropping out on the bottom of the North Sea, off the Belgian coast. Along the coast, between Le-Coq-sur-Mer and Blankenberge, pieces of fossiliferous sandstone with *Venericardia planicosta* are quite common.

In the type region the transition into the Vlierzele Sands is formed by the intermediate Sands of Aalterbrug, which, however, are absent near Cassel (CAA) and inconspicuous in the Woensdrecht boring.

The Aalter Sands are glauconitic, slightly clayey sands. They are fossiliferous, except for their lower part. Mostly there are two very fossiliferous beds, that are locally indurated. The lower bed is rich in *Venericardia planicosta*, the upper one in *Turritella solanderi*. These two beds are separated by about one metre of fossiliferous, glauconitic sand, with many worn *Turritella* near the base.

In the boring Woensdrecht the Aalter Sands seem to be represented by sand rich in shell fragments (HALET, WATERSCHOOT VAN DER GRACHT and TESCH, 1913).

The contact with the Brussels Sands is only distinct in the hills near Cassel.

At Aalter thicknesses of about 8 m have been reported, at Cassel of 7 m.

The fossils are often more or less worn and somewhat decalcified. FEUGUEUR (1951) reported 106 species of molluscs, CASIER (1946) and LERICHE (1905*a*, 1951) a number of species of fishes. LERICHE's determination of *Nummulites lucasi* must be considered doubtful, since it was based on a few worn, unsectioned specimens (1937*b*).

BRUSSELS FORMATION

The Brussels formation contains only one unit, the Sands of Brussels.

SANDS OF BRUSSELS (d'Omalius d'Halloy, 1842)

named after Brussels

(Maps 4, 13 and 14)

Northwest of the Belgian capital, the Brussels Sands gradually thin out between the Panisel formation and the Lede formation. Along the valley of the Senne the western border of the area is a puzzling straight line, which seems to be connected, for at least the greater part, with a difference of topography, with higher hills east of the valley. Possible deposits west of this line have been removed by erosion. However, other explanations are equally possible, such as that of Simoens (1904) with more or less complicated movements along a fault in the Senne valley.

In Flanders the Brussels Sands are absent, with the exception of some occurrences in the hills of Cassel, and probably near Amougies (Baudet, 1941).

In part of Brabant the Brussels Sands overlie rocks of Paleozoic or Mesozoic age, at other places they cover the Landen or the Ieper formation. Near Vilvoorde and in the Kempen they overlie Lower Panisel beds, near Cassel and in the boring Woensdrecht Sands of Aalter.

When they are in contact with Paleozoic rocks the lower part mostly contains gravelly sands, often with cross-bedding, and sometimes with intercalated clay beds (Leriche, 1943*a*). Elsewhere pebbles are usually absent at the base. Near Brussels the base locally contains reworked elements of the Ieper formation. At Godarville a gravel bed was found with derived *Nummulites planulatus*.

Lithologically the Sands of Brussels are variable in features such as grainsize, lime content, glauconite, etc. On the basis of the grainsize Claeys (published by de Heinzelin, 1947) made a regional subdivision of the Sands (fig. 4).

Generally, two types of sands are distinguishable :

a) quartz sands, and

b) calcareous sands.

Their areas roughly coincide with those of Claeys's coarse, and medium to fine-grained sands, respectively.

a) In the areas of coarse sands around Wauthier-Braine the whole section is formed by rather coarse, non-calcareous sands with some cross-bedding. Towards the north these non-calcareous sands continue with a gradually decreasing grainsize and an increasing degree of sorting. Near Brussels they form only the lower part of the series.

The Brussels Sands around Mont-Saint-Guibert and Ottignies resemble the quartz sands of Wauthier-Braine and Brussels. Towards the north these coarse sands continue as the lower part of the series, as, for instance, near Hoegaarden and Jodoigne. In these quartz sands, which are often strongly cross-bedded, there are thin and lenticular intercalations of marls, which are more or less silicified. Denayer (1950) described them as « calcédonilithe ». The quartz sands of this region are rather glauconitic and, at some places, rich in tubulations. Still further north, in the borings of Diest, Aarschot and Westerloo, sands of about the same characters have been observed.

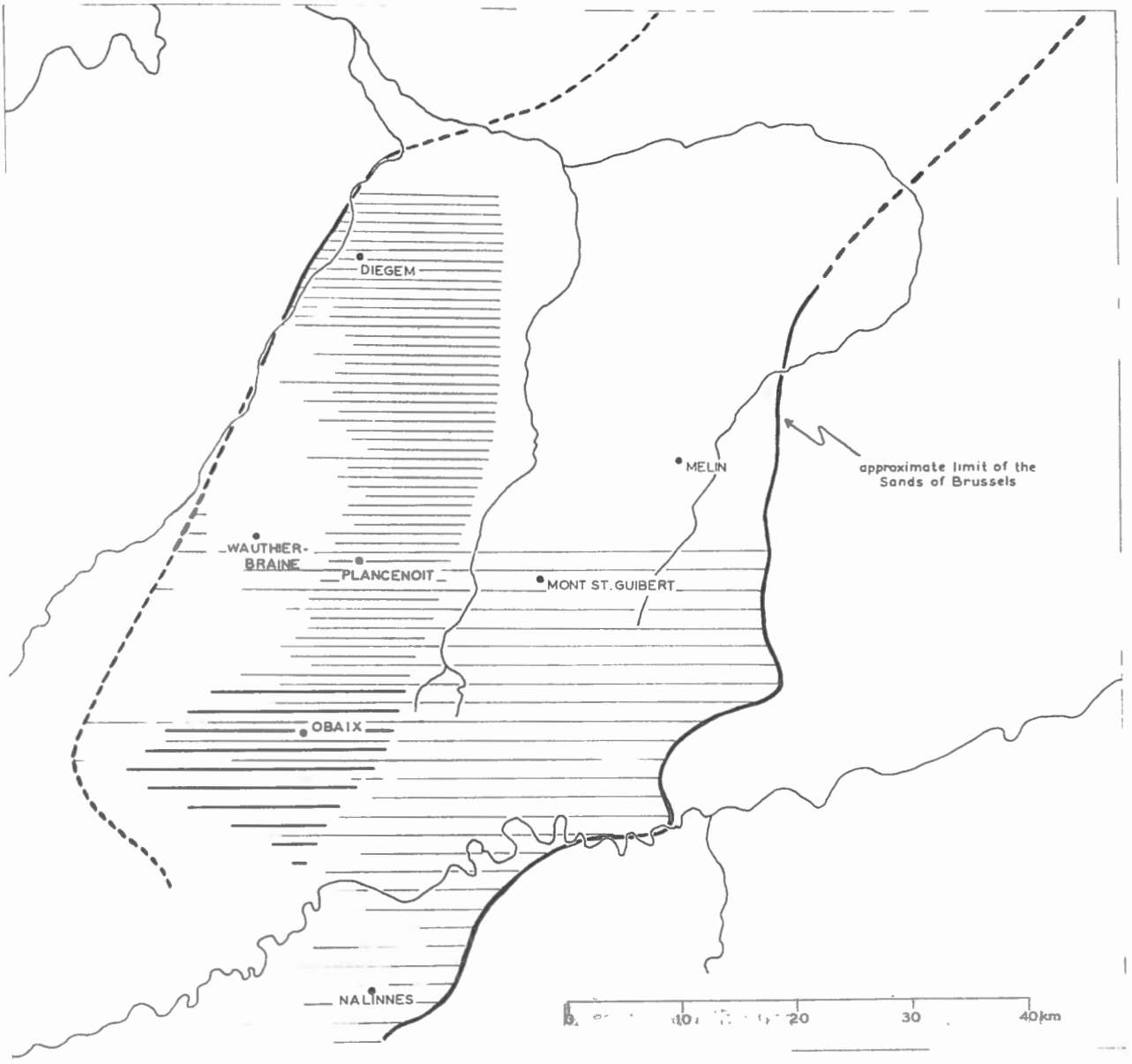


FIG. 1. — Grainsize distribution of the Sands of Brussels (after CLAEYS, 1947).

coarse-grained sands.

medium-grained sands.

fine-grained sands.

In the most eastern occurrences of Brabant, as at Grand-Rosières and Folx-les-Caves, the sands show rather frequent clayey intercalations, but they also contain pebbles in coarse sands.

In the lower sands of the region of Brussels frequent tubulations, probably worm tubes, have been found. They are especially numerous near the contact with the overlying calcareous sands (see fig. 5).

FIG. 5. — Sands of Brussels, rich in worm tubes, Sint-Job (BA).

A common feature of the quartz sands are the siliceous concretions of peculiar form, known under the name of « Grès fistuleux » and « Pierres de grottes ».

They consist of hollow tubes, often with an indurated core, and they were probably formed around worm tubes. The « Grès fistuleux » are the simple forms of a single tube, the « Pierres de grottes », the more complicated ones, consisting of an agglomeration of a number of these tubes. The concretions are often more or less concentrated in layers.

b) The second type of Brussels Sands is formed by calcareous, medium to fine-grained, fairly homogeneous sands, that form the upper part of the series near Brussels as well as near Melin. These sands often contain pieces of calcareous sandstone to sandy limestone, mostly in discontinuous layers, as, for instance, near Diegem. Locally the limestone is silicified.

From Gobertange have been described the « Grès de Gobertange » which are limestones in discontinuous to fairly continuous beds of 20 to 40 cm thickness. In the pieces thin beds of some mm to three cm are apparent. This bedding is more or less disturbed by biologic action, mostly that of annelids. The beds consist of very fine-grained, calcareous material, with intercalated seams of fine sand with glauconite. The calcareous matter consists of debris of foraminifera, sponge spicules, echinid spines, bryozoan and shell fragments (*Lucina volderiana* is often found as casts), and calcite (LEDOUX, 1911). In the region of Gobertange about eight to ten of these banks have been found, in a series of about 10 m of very calcareous sands.

The Brussels Sands of the region of Cassel consist of a basal part of glauconitic and fine-grained quartz sands, overlain by whitish, calcareous sands with intercalated sandy limestones with *Nummulites laevigatus*. A similiar succession was found in the boring Woensdrecht.

The Brussels Sands are mostly covered by the Lede Sands. Outside the area of the latter unit they are overlain by Lower Tongeren beds.

Fossils are usually scarce, but there are some rich outcrops, such as those of Nil-Saint-Vincent, Neder-Okkerzeel, Nalinnes. GLIBERT (1933) described the molluscs of a number of localities around Brussels, CANU and BASSLER (1929) the bryozoans, LERICHE (1905*a*, 1951) a number of fish species, and STOCKMANS (1936) some plant remains.

One of the frequent species is *Ostrea cymbula*. It is associated with many others, such as *Gladius baylei, Rhinoclavis unisulcatus, Rostellaria fissurella, Natica labellata, Athleta cithara, Cassidaria coronata, Nautilus labellata, Lucina volderiana, Cardium porulosum, Meretrix proxima, M. laevigata, Corbula gallica, Maretia omaliusi, Lenita patellaris*, and species of *Turbinolia, Sphenotrochus, Paracyathus*, and *Amphibelia*. Furthermore there are frequent bryozoan debris, a fish fauna with *Odontaspis macrota*, especially in the basal beds and the limestones, remains of turtles (*Emys camperi*), and plant fragments, such as drift-wood, fructifications of *Nipadites burtini*.

Nummulites laevigatus is scarce to absent in the lower part of the Sands of Brussels, but it is abundant in the upper part, as at Cassel and Woensdrecht. Most of the other occurrences are found along the eastern and southern borders of the area, but also at some other places.

LERICHE (1922*a*) used the nummulites for a subdivision of the Brussels Sands. He found a lower zone without nummulites and an upper one with *Nummulites laevigatus*. This subdivision was attacked by HALET (1939) as being too detailed for the scanty knowledge of the distribution of the nummulites. However, during our research we found the scheme of LERICHE to be generally correct.

LEDE FORMATION

The Lede formation consists of only one member, the Sands of Lede.

SANDS OF LEDE (MOURLON, 1873)

named after Lede, between Aalst and Gent

(Maps 5, 15 and 16)

The Lede Sands cover the Sands of Vlierzele or those of Aalter in the western and central parts of the area. They overlie the Sands of Brussels in the farther occurrences of eastern Brabant, the borings Turnhout and Woensdrecht, and the hills of Cassel.

The basal part is formed by coarse sands with well-rounded, mostly hyaline quartz grains of 1 to 3 mm diameter. Sometimes these basal sands are indurated. Locally they overlie a ravinated surface of the older sediments. At these places, such as Forest and Vlierzele, they contain many worn fish remains, shell fragments (e.g. *Terebratula, Ostrea cymbula*), nummulites (recorded as *Nummulites laevigatus*), associated with small silex pebbles and fragments of calcareous sandstone, the latter often perforated. Near Brussels also mammalian remains have been found in these basal sands, such as *Lophiotherium cervulum, Lophiodon*, and *Chasmotherium minimum*.

At several places a second pebble bed has been found, higher up in the sands. This one is rich in *Nummulites variolarius* and shell fragments. It is especially developed around Brussels, where the underlying part of the sands may be as thick as 4 m.

On such lower sands DUMONT (1851) based his Laekenian stage, named after Laeken, a northern municipality of Brussels. Further studies revealed the absence of the upper pebble bed and the consequent indistinctness of the Sands of Laeken at many localities. Furthermore no distinct paleontological characteristics could be found to distinguish them from the higher Sands of Lede.

The fine-grained sands on top of the basal gravel are mostly of remarkably uniform lithologic character. They are ill-sorted, and very rich in debris of fossils. Locally they con-

tain slightly clayey beds (Waterloo, Glabais, Gent). The variable glauconite content is especially high in the western part of Flanders, from which region LERICHE (1913) described the Sands of Strymees. In the latter sands fossils are rare, and the basis contains fragments of wood and pebbles of clay, derived from the Panisel beds.

At the type locality Lede, the sandpits only showed decalcified sands. In his first description MOURLON already remarked this feature for the vicinity of Lede. However, at that time, some sandpits with incomplete decalcification of the sands occurred as well. A sample, taken by MOURLON, from one of the calcareous patches in these sands, could be investigated. It is indicated as « Lede ».

Commonly there are three discontinuous layers of sandy limestone. They are rather continuous in the area between Aalst and Balegem. They have local names after the villages near which they were formerly quarried, such as Balegem, Bambrugge.

These limestones, with fairly high content of $CaCO_3$ (51 to 68 per cent), are formed by fine-grained quartz, foraminifera (especially nummulites), sponge spicules and calcite (LEDOUX, 1911). Also shell fragments and tubes of *Ditrupa* occur. Many casts and moulds give a vacuolar appearance.

Except for the limestone banks, indications of bedding are usually absent. However, near Renaix, an abandoned sandpit was found, where the Lede Sands are distinctly current-bedded, with a general dip towards the south.

In almost the whole area the Lede Sands are overlain by the Asse formation. Only in the extreme eastern occurrences of the Kempen and in the southern occurrences of Brabant are they covered by Lower Tongeren beds.

The composition of the rich fauna appeared variable from one locality to the other. As main components may be listed *Nummulites variolarius, Turbinolia sulcata, Turritella imbricataria, Solarium nysti, Rostellaria fissurella, Ostrea gryphina, Pecten corneus, Nautilus lamarcki, Echinolampas affinis, Terebratula kickxi, Ditrupa strangulata,* fish remains (often more or less worn), such as *Lamna vincenti* and *Odontaspis macrota,* many bryozoan debris, as for instance of *Lunulites latera.*

CANU and BASSLER (1929) described the bryozoans of the Lede Sands; LERICHE (1905*a*, 1951) a number of fish species.

ASSE FORMATION

(Maps 5, 17 and 18)

Formerly Belgian geologists distinguished two stages : the Wemmelian and the Assian. Later research, especially that of LERICHE, revealed that the deposits of these two units had better be taken together as the Asse formation.

Three members can be distinguished.

SANDS OF WEMMEL (G. VINCENT, 1871)

named after Wemmel, a village northwest of Brussels

(Maps 17 and 18)

The Sands of Wemmel usually cover the Sands of Lede, but in the northwestern part of the area they overlie the Sands of Vlierzele or those of Aalter.

In the borings Asse and Brussegem and at some other places the Wemmel Sands are separated from the Lede Sands by a thin gravelly bed, of up to 30 cm, with *Nummulites variolarius*. At other localities no layer with pebbles was found, as, for instance, at Mechelen (HALET, 1910) and Forest (LERICHE, 1943*b*).

On top of the sandy bed with pebbles a clayey zone of about 10 cm, rich in glauconite, has been observed.

In the vicinity of Wemmel the Sands form a homogeneous mass of fine-grained, calcareous sands, rich in fossils. Towards the top alternating sandy and clayey beds were found, which mark the transition to the Asse Clays. Locally there is some coarse sand near the supposed limit (RUTOT, 1887*a*).

Near Asse other types of Wemmel Sands have been found. They are fine to coarse-grained and there are interstratified gravel beds. The sands of this region may contain tubulations, probably worm tubes, and they are more or less cross-bedded. Clayey intercalations have also been described. Towards the north this irregular series passes into more regularly bedded, glauconitic, clayey sands.

South of Brussels the Wemmel Sands were found to be non-calcareous, sometimes slightly clayey, and with intercalations of coarser sands. Near Solbosch they form a complex of about 10 m, with cross-bedded parts and intercalated gravel beds, which were interpreted by LERICHE (1943*b*) as recurrences of the basal gravel.

In the borings of northern Belgium the Sands have mostly been described as glauconitic and clayey, with *Nummulites orbignyi*.

The Wemmel Sands are covered by the Clays of Asse, or, in the extreme eastern part of the area, near Leuven, by the Lower Tongeren beds. A gradual passage from the Wemmel Sands into the Asse Clays has been found; at other places these two members are separated by the « bande noire » (LYELL, 1853), a very glauconitic bed of dark green to black.

The Sands of Wemmel are very rich in fossils, especially molluscs (GLIBERT, 1936 and 1938) with predominance of pelecypods. As the main components of the fauna should be mentioned : *Pecten corneus, Nuculella nysti, Ostrea cubita, Astarte nysti, Cardita sulcata, Crassatella cossmanni, Scala spirata*, scaphopods, coral remains (*Eupsammia burtinana*), bryozoans, and fish remains. The latter were described by LERICHE (1905*a*, 1951). Many nummulites have been found : *Nummulites orbignyi* (=*N. wemmelensis*) and possibly *N. variolarius*.

Outside the Wemmel region the Sands are poor in fossils. Mainly nummulites and *Pecten corneus* have been found.

CLAYS OF ASSE (G. VINCENT and A. RUTOT, 1878)

named after Asse, between Brussels and Aalst

The Clays of Asse overlie the Sands of Wemmel, but between Eekloo and Antwerp an area without Wemmel Sands is present, in which the Asse Clays directly cover the Sands of Lede.

A continuous passing from the Wemmel Sands into the Clays of Asse is often observed, by means of gradually increasing clay and glauconite contents. At other places the change is more abrupt, and the base of the Clays is formed by the « bande noire ». Often the « bande noire » is a thin band of coarse glauconitic sand, with many fossils, such as *Pecten corneus*, *Nummulites orbignyi* and *Eupsamnia burtinana* (Wemmel, BW). Such a glauconitic layer may also be present when the Asse Clays overlie the Lede Sands.

Locally the « bande noire » may be present as a series of interfingering beds, as described by RUTOT (1882*b*) and LERICHE (1943) from the hills near Cassel and from Gent, at which locality this series may reach a thickness of about 1 m.

The Asse Clays are compact clays, that are partly sandy and glauconitic. In the type region and in Meetjesland, the region southeast of Brugge, the lower and upper parts are glauconitic, the middle part is devoid of this mineral and of lead-grey colour. This grey clay diminishes in thickness towards the south and the east, and near Brussels the entire mass of the clay is glauconitic.

At Cassel the Asse Clays consist of a lower part of glauconitic, sandy clays with fossils, and an upper part of grey, plastic clays without fossils.

The uppermost beds of the Clays become sandy and pass into clayey sands that form the base of the Sands of Asse.

The reported thicknesses of the Asse Clays, from borings, are highly variable, probably as a consequence of frequent incorporation of the clays of the lower part of the Asse Sands. HALET (1910) reported thicknesses of about 6 to 7 m at Mechelen. Northwest of Brussels thicknesses seem to vary between 3 and 10 m; at Cassel 13 to 16 m have been found.

Fossils are scarce in the Clays of Asse. Most of the described species have been derived from the lower glauconitic part, the fauna of which resembles that of the Sands of Wemmel. Dominant are *Pecten corneus* and *Nummulites orbignyi* (=*N. wemmelensis*).

SANDS OF ASSE (HENNEQUIN, 1880)

named after Asse, between Aalst and Brussels

In the northern and northwestern parts of Belgium the Asse Clays are overlain by the Sands of Asse, which, in turn, are covered by the basal beds of the Rupel formation.

Near Asse the Asse Clays become sandy near the top and pass into sands that are mostly ill-sorted and glauconitic. These sands, with a thickness of 9 m in our boring of Asse, become clayey again in the uppermost few metres and then pass into 1 to 2,50 m of plastic clay, which is often micaceous. VELGE (1896*a*) described this clay as the « argile gris supérieure d'Assche ». Upwards the clay is covered by more or less clayey, fine-grained sands that are again frequently micaceous.

Most facts of the Asse Sands are known from borings in northwestern Belgium, but it should be emphasized that the records of most of these borings are fairly unreliable, which may

account for the frequent absence of reports of the threefold subdivision. Although MEUGY reported sands in between glauconitic clays and grey, plastic clays, as early as 1852, the presence of the Asse Sands in the hills of Cassel has not been verified.

The Asse Sands are locally fossiliferous. HENNEQUIN (1880) already reported the presence of fossiliferous, limonitic sandstones from sands that overlie the Asse Clays near Asse, at the « Camp romain ». RUTOT (1882*b*) described their fauna as consisting of a number of Eocene species associated with some Oligocene forms. VINCENT (1897) reported limonitic sandstone pieces with *Nummulites orbignyi*. HALET (1910) found some beds with nummulites in clayey sands of several borings near Mechelen.

The contact of Asse Sands and Berg Sands, the basal member of the Rupel formation in western Belgium, is usually not sharp. Only at some places there are dispersed pebbles at the contact of both units.

These Berg Sands are composed of fairly fine-grained sands with silex fragments and some glauconite (BATJES, 1958). Locally they are fossiliferous with *Pycnodonta callifera* as a characteristic species. Their thickness in western Belgium amounts to about 20 m.

LOWER TONGEREN BEDS

Distinct Lower Tongeren beds occur only in the Leuven-Tongeren-Dutch Limburg area. There are two members and sometimes a basal gravel.

The Sands of Grimmertingen are fine-grained, micaceous, clayey sands with, amongst others, *Ostrea ventilabrum* and *Turritella crenulata*. West of Leuven this unit is said to be more clayey (MOURLON, 1912).

The Sands of Neerrepen are fine-grained, micaceous sands, with small quantities of glauconite. They cover the Grimmertingen Sands. From the region of Leuven this unit is reported as yellowish sands that cover the sandy clays of the Grimmertingen member.

For more details about the Tongeren beds the reader may be referred to BATJES' study of the Oligocene of Belgium (1958).

BATJES (1958) discussed the few records of Lower Tongeren beds in a number of borings west of the Hageland, for which the occurrence of *Ostrea ventilabrum* and of mica in the sediments would be indicative. The value of *Ostrea ventilabrum* as an index fossil is considered doubtful by BATJES as long as no comparative study has been made with related species, such as *Ostrea wemmelensis* from the Asse formation. Furthermore, micaceous sediments occur both in the Asse formation and in the Lower Tongeren beds. Consequently the presence of mica can not be used as an argument. BATJES concluded that the presence of Lower Tongeren beds is very doubtful in the area west of the Hageland.

CHAPTER III

LOCALITY DETAILS

All sediments descriptions are based on field observations or data from the Archives of the Geological Survey of Belgium. No detailed account is given of the petrographic features of the sediments.

The legend of the figured sections of both outcrops and borings is to be found in figure 16.

The stratigraphic symbols marked on the left of the lithologic columns are given in Chapter II (p. 16).

BELGIUM

(Map 19)

LIST OF LOCALITIES FOR EACH STRATIGRAPHIC UNIT

SANDS OF OOSTENDE

Boring Oostende.

CLAYS OF IEPER

CE	Carnières.	
CN	Godarville	samples CN 52-54.
CO	Godarville.	
DA	Havinnes	samples DA 311, 314.
DC	Saint-Maur.	
KG	Moen.	
KJ	Zwevegem.	
MME	Cuesmes	samples MME 27, 28.
MMF	Hyon	sample MMF 33.
NO	Tubize	samples NO 1170, 1173.
NT	Écaussines-Lalaing	samples NT 1181, 1182.
NX	Quenast	samples NX 89, 91, 92.
PD	Izegem.	
PJ	Ardoie.	
PPA	Poperinge.	
RA	Kortemark	samples RA 253, 254, 1071, 1072, 1079.
RD	Rumbeke	samples RD 1080, 1081.
YA	Ieper	sample YA 262.
YB	Zonnebeke.	
YC	Ledegem.	
YF	Voormezele.	
Boring Woensdrecht		samples W 476-597 m.

MORLANWELZ MEMBER

CD	Carnières.	
CF	Leval-Trahegnies.	
CI	Leval-Trahegnies	sample CI 41.
CL	Carnières.	

CLAYS OF ROUBAIX

KA	Luingne	samples KA 305, 306, 1092, 1093.
KE	Mouscron.	
KF	Moen	samples KF 1094-1096.
KG	Moen.	
KH	Knokke.	
LLA	Ploegsteert	sample LLA 1087.
YB	Zonnebeke.	

SANDS OF MONS-EN-PÉVÈLE

BD	Forest	sample BD 445.
CAG	Mons-en-Pévèle	samples CAG 1249, 1250, 1252.
CB	Manage.	
CO	Godarville	samples CO 58, 59, 60, 62, 1241.
DD	Mouscron.	
DE	Maulde	sample DE 1204.
DF	Mont-Saint-Aubert	samples DF 1205, 1206.
DG	Mont-Saint-Aubert.	
DH	Mont-Saint-Aubert	samples DH 1208-1212.
DL	Ellignies-lez-Frasnes	sample DL 1218.
DM	Saint-Sauveur.	
DN	Saint-Sauveur.	
KG	Moen.	
MMV	Hyon	samples MMV 79, 80, 1201.
NT	Ecaussines-Lalaing	sample NT 1183.
NV	Ecaussines-Lalaing.	
NX	Quenast	sample NX 95.
PJ	Ardoie.	
RC	Staden.	
XB	Frasnes-lez-Buissenal.	
XC	Frasnes-lez-Buissenal	sample XC 1226.
Boring Aalter-Sainte-Marie		samples Aalter-Sainte-Marie 21, 22, 24, 25.
Boring Brugge		sample Brugge 24.
Boring Gent		samples Gent; Gent 24912.
Boring Mechelen		samples Mechelen 105, 106.
Boring Vinderhoute		samples Vinderhoute 106, 107, 110, 111, 116, 117, 119.
Boring Woensdrecht		samples W 462-474 m.

CLAYS OF RONCQ

DH	Mont-Saint-Aubert	sample DH 1213.
GE	Ellezelles.	
PJ	Ardoie.	
RC	Staden	samples RC 1066-1068.
Boring Brugge.		
Boring Mechelen.		
Boring Vinderhoute		samples Vinderhoute 104, 105.
Boring Woensdrecht		sample W 459 m.

SANDY CLAYS OF ANDERLECHT

BG	Teralfene.	
DO	Saint-Sauveur.	
DP	Saint-Sauveur.	
DQ	Saint-Sauveur.	
GF	Ellezelles.	
GH	Geeraardsbergen.	
KD	Ansegem.	
KP	Ruien.	
MMT	Hyon.	
MMW	Hyon	samples MMW 84, 85.
PB	Eegem.	
PC	Eegem.	
PH	Pittem.	
RB	Hooglede.	
Boring Vinderhoute		sample Vinderhoute 102.

SANDY CLAYS OF ANDERLECHT + SANDS OF VLIERZELE

Boring Mechelen	sample Mechelen 84.
Boring Woensdrecht	samples W 386-442 m.

SANDS OF VLIERZELE

BRG	Beernem.	
CAA	Cassel.	
DK	Mont-Saint-Aubert.	
DR	Saint-Sauveur.	
GG	Ellezelles.	
GH	Geeraardsbergen.	
KB	Orroir.	
KC	Amougies.	
KD	Ansegem.	
KK	Tiegem.	
KL	Russeignis.	
MMT	Hyon.	
MMU	Hyon	sample MMU 78.
MMW ...	Hyon.	
PA	Bellem.	
PF	Loo-ten-Hulle.	
YD	Kemmel.	
ZB	Vlierzele.	
ZF	Balegem.	
ZH	Gijzenzele.	
ZJ	Munte.	
ZK	Gavere.	
Boring Asse		samples Asse 45, 46.
Boring Brugge.		
Boring Hoboken.		
Boring Vinderhoute		samples Vinderhoute 63, 65.

SANDS OF AALTER

BRA	Aalter.	
BRC	Aalter.	
CAA	Cassel	samples CAA 273-277, 279-281.
PG	Aalter.	
Boring Vinderhoute.		
Boring Woensdrecht		samples W 374-384 m.

SANDS OF BRUSSELS

BA	Sint-Job	samples BA 100-106.
BB	Woluwe-Saint-Lambert.	
BC	Diegem	samples BC 113-117.
BD	Forest	samples BD 388, 390-394, 1255.
BN	Hoeilaart.	
BO	Overijse.	
BP	Tourneppe	samples BP 1164-1167.
BQ	Forest	sample BQ 1168.
BR	Brussels	sample BR 1169.
CA	Heppignies.	
(?) CC	Carnières	sample CC 1197.
CM	La Hestre	sample CM 51.
CO	Godarville	samples CO 56, 64, 1241.
LAA	Bertem	sample LAA 1127.
LAB	Heverlee.	
LAE	Blanden	sample LAE 1130.
LAF	Pécrot.	
LAG	Archennes.	
LAH	Saint-Remy-Geest	sample LAH 1136.
LAJ	Saint-Remy-Geest	sample LAJ 1137.
LAK	Gobertange	sample LAK 1138.
LB	Korbeek-Loo	samples LB 124, 125.
LK	Hoegaarden	sample LK 163.
LR	Huldenberg	sample LR 1118.
LS	Huldenberg	sample LS 1119.
LT	Huldenberg.	
LW	Vossem	sample LW 1123.
LY	Bertem	sample LY 1125.
LZ	Bertem	sample LZ 1126.
NA	Esschenbeek.	
NB	Wauthier-Braine	samples NB 401, 403.
NC	Braine-l'Alleud	samples NC 405-407.
ND	Genappe	samples ND 410-412.
NG	Maransart.	
NH	Sart-Dame-Avelines	sample NH 1156.
NJ	Plancenoit	sample NJ 1158.
NK	Plancenoit	samples NK 1159, 1160.
NM	Braine-le-Château.	
NN	Tourneppe.	
NNA	Spy	samples NNA 1151, 1152.
NNB	Spy.	
NNC	Velaine.	
NP	Virginal-Samme.	
NQ	Hennuyères.	

NR	Henripont.	
NS	Henripont.	
THA	Nalinnes.	
THB	Nalinnes	samples THB 1189-1194.
THC	Jamioulx.	
WA	Lathuy	samples WA 164, 165, 166, 1139.
WB	Jodoigne	samples WB 169, 1141.
WD	Ottignies.	
WE	Chaumont-Gistoux.	
WF	Opprebais	sample WF 1134.
WG	Dongelberg	sample WG 1135.
WH	Folx-les-Caves.	
WJ	Grand-Rosière.	
WK	Perwez	sample WK 1145.
WL	Perwez.	
WM	Nil-Saint-Vincent.	
WN	Mont-Saint-Guibert.	
WO	Mont-Saint-Guibert	sample WO 1148.
WP	Mont-Saint-Guibert.	
WQ	Hévillers.	
WR	Tilly.	
Boring Woensdrecht		samples W 360,50-365 m.

SANDS OF LEDE

BD	Forest	samples BD 444, 1256-1258.
BE	Brussels	sample BE 446.
BJ	Esschene.	
BL	Asse	sample BL 1035.
BM	Asse	samples BM 1036, 1037.
GA	Roozebeke.	
GC	Erwetegem.	
GD	Erwetegem.	
KB	Orroir.	
KM	Kwaremont.	
KO	Kwaremont.	
LAC	Blanden	sample LAC 1128.
LV	Vossem	sample LV 1122.
LX	Leefdaal.	
MC	Meldert	sample MC 1040.
NE	Glabais.	
NL	Bois-Seigneur-Isaac.	
ZA	Gent	sample ZA 583.
ZB	Vlierzele	samples ZB 1021a, 1022.
ZC	Oordegem.	
ZD	Bambrugge	samples ZD 340, 342, 343, 1011-1017.
ZE	Lede.	
ZG	Balegem	sample ZG 1025.
Lede		sample Lede 2-V.
Boring Asse		samples Asse 37-44.
Boring Brussegem		samples Brussegem 28, 29, 33.
Boring Hoboken		samples Hoboken 16, 19.
Boring Lokeren		samples Lokeren 26, 27, 29.
Boring Mechelen		samples Mechelen 60, 62, 67, 70.
Boring Woensdrecht		samples W 347-355,75 m.

SANDS OF WEMMEL

BK	Asse.	
BS	Jette	samples BS 1259, 1260.
BT	Jette	sample BT 1266.
BV	Strombeek-Bever	samples BV 1269-1272.
Boring Asse		samples Asse 32-35.
Boring Brussegem		samples Brussegem 17-27.
Boring Heist-op-den-Berg		samples H 121,50-124,50 m, 125,50-129,50 m.
Boring Hoboken		samples Hoboken 13-15.
Boring Mechelen		samples Mechelen 54, 55.
Boring Wemmel		samples 10-12,50, 13, 14, 14,50, 15 m. 14-5, 5,50, 6, 6,50, 7, 9,50, 10, 10,50, 11 m. 16-6, 7, 9 m. 48-22, 23,50 m.
Boring Woensdrecht		samples W 346 m, 335 m.

CLAYS OF ASSE

BF	Jette.	
BK	Asse.	
BT	Jette.	
BW	Wemmel	sample BW 1273.
BRB	Oedelem	samples BRB 237, 238, 241, 247, 1054-1057.
GB	Grootenberge	sample GB 1109.
MB	Moorsel.	
YE	Kemmel.	
ZA	Gent	samples ZA 1242, 1243, 1244.
ZD	Bambrugge.	
ZE	Lede.	
Boring Asse		samples Asse 29, 30.
Boring Brussegem		samples Brussegem 15, 16.
Boring Hoboken		sample Hoboken 12.
Boring Lokeren		samples Lokeren 19, 20, 24.
Boring Mechelen		samples Mechelen 50, 51.
Boring Woensdrecht		samples W 331-324 m.

SANDS OF ASSE

Boring Asse	sample Asse 17.
Boring Hoboken.	
Boring Mechelen.	
Boring Woensdrecht.	

SHEET BRUSSELS

(Map 20)

BA Sint-Job, sandpit « Ficerp » (250 m N of the church-tower of Sint-Job). See fig. 6.

Visited August 1953.

Sands of Brussels.

Quaternary loess covered about 13 m of sand. The lower part of the section was formed by 5,50 m of medium to fine-grained sand of greyish-green to yellow colour. The sand contained glauconite, some muscovite and many shell fragments (mainly *Ostrea cymbula*). No layers were apparent, except for an

indistinct thin-bedded stratification, mostly cross-bedded, at some places. The upper part of this lower sand was rich in tubulations (probably wormtubes), which decreased in number downwards. At the top there was an indurated calcareous layer of variable thickness (max. 20 cm), rich in shell fragments and foraminifera.

Dispersed in the sand we found very hard concretions of the same material, rich in sponge spicules, cemented by SiO_2 (« Grès fistuleux » and « Pierres de grottes »).

Higher upwards the described sands gradually passed into more calcareous sand of yellowish-white colour, regularly stratified. In this part of the exposure, the upper 7,50 m under the Quaternary base, the sand was fine-grained, locally rich in shell fragments (mainly *Ostrea*), and it contained small, flat, more or less marly lenses (perhaps remains of slightly decalcified, more or less lenticular sandy limestones). Near the top the sand was coarser grained and slightly indurated.

The samples, **BA 100-106,** taken in the eastern part of the E-W striking wall, showed fairly rich foraminiferal faunae, increasing in abundance upwards. Associated were ostracodal remains, shell fragments, echinid debris, sponge spicules, bryozoan debris and some radiolarians. All the samples contained some muscovite (with green varieties) and glauconite (scarce in the upper samples).

BB Woluwe-Saint-Lambert, sandpit (1.250 m N and 250 m W of the church-tower of Woluwe-Saint-Lambert).

Visited August 1953.

Sands of Brussels.

Great excavation with about 14 m of decalcified sand, but locally with some very fragile shell remains (possibly mainly *Ostrea cymbula*). The sand was of whitish-yellow colour, and fine-grained. Sometimes stratification was visible by colour differences. There were irregular-shaped concretions of the same material, rich in sponge spicules and cemented by SiO_2 (partly « Grès fistuleux »). Towards the top the sands became coarser and greyish-brown (iron oxides), with a few scattered, small and flat clay lenses of some cm length.

The samples from the lowermost 5 m were taken at levels with shell fragments. They yielded also echinid remains and some ostracods. Muscovite was found, with increasing quantity higher upwards.

BC Diegem, sandpit (500 m W of the church-tower of Diegem); also point 88 (E) 207 of the archives of the Geological Survey. See fig. 6.

Visited August 1953.

Sands of Brussels.

Exposure of about 13 m height. Samples were taken in the southern part of the pit.

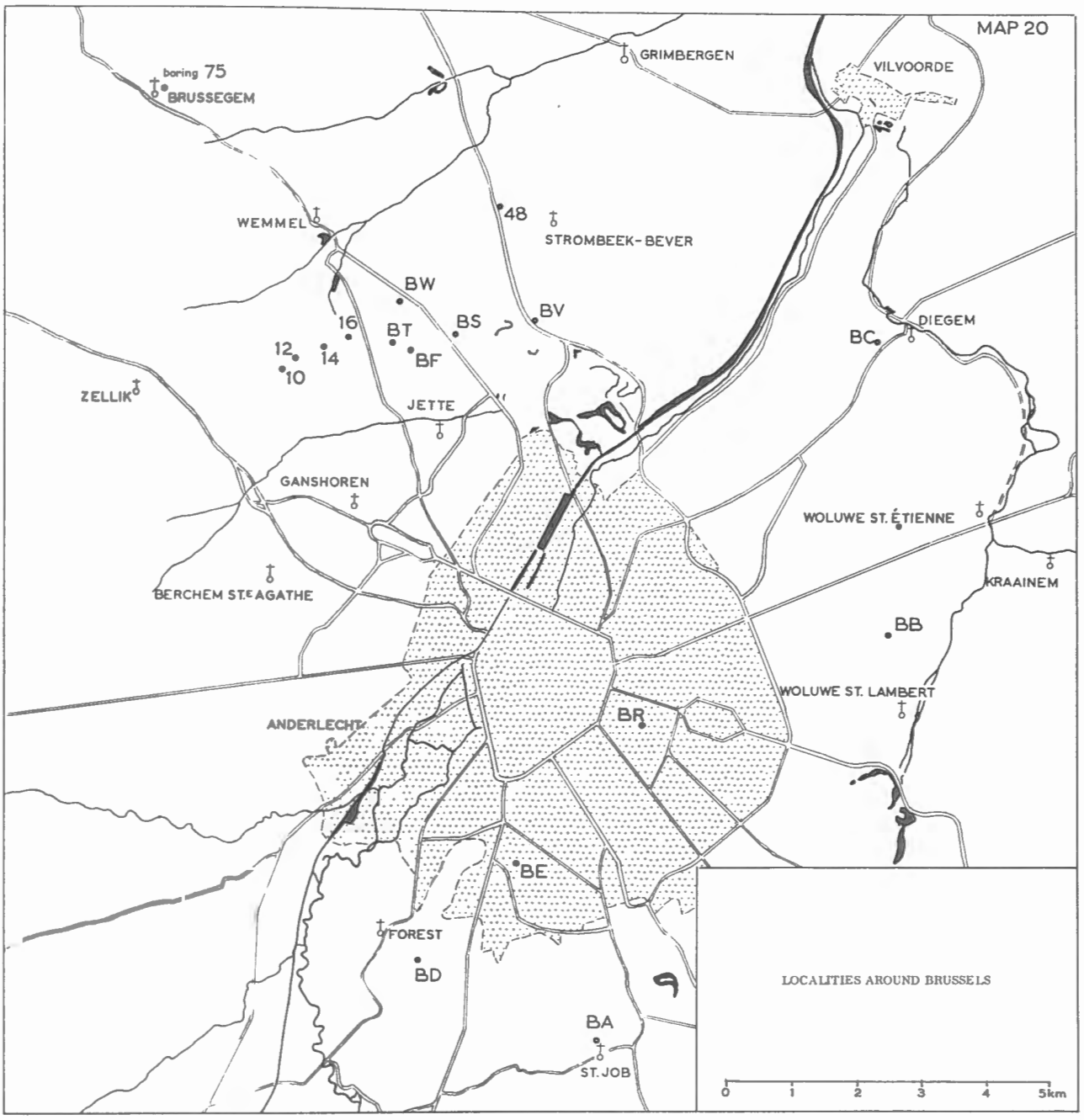
Under the Quaternary loess and the decalcified sands below followed a complex of about 8,50 m of very calcareous sands, whitish or yellowish, fine-grained, rich in organic remains. Interstratified occurred a number of discontinuous layers of sandy limestones, distances in between variable (5-130 cm). The pieces mostly had flat sides, but rounder ones were found as well (thickness 10-20 cm).

The uppermost part of the sand was distinctly decalcified. Decalcification sometimes showed a very irregular pattern (resembling organ pipes, etc.). This greenish layer, of variable thickness, was indistinctly overlain by Quaternary loess.

All samples (**BC 113-117**) are rich in foraminifera, associated with shell fragments, ostracods, echinid remains, fish remains, bryozoan debris, sponge spicules, radiolarians, etc. The wash residues showed no apparent variation of the grainsize of the sands.

BD Forest, exposures near the Stadium of the « Centre de Sports et de Santé »; also points 102 (W) 93 and 323 of the archives of the Geological Survey. See fig. 7.

Visited August 1953 and September 1955.



Literature :

M. MOURLON, 1905, Ann. Soc. Géol. Belg., vol. 32, mem., pp. 342-344; 1908, Bull. Soc. belge Géol., vol. 22, P.V., pp. 157-158; 1908, Ann. Soc. Géol. Belg., vol. 35, Bull., pp. 207-211.

A. LEDOUX, 1911, Ann. Soc. Géol. Belg., vol. 38, mem., pp. 171-172.

M. LERICHE, 1922, Congrès Géologique Internat., Livret-Guide Exc. A 4, Belgique, pp. 30-33.

M. CASIER, 1946, Mém. Musée R. Hist. Nat. Belg., no. 104, pp. 22-30.

Two points were studied and sampled :

a) Abandoned sandpit « Jules Eggerickx », at present Stadium of C. S. Forestoise;

b) Exposure in hollow roadside, corner Avenue du Domaine-Avenue Minerve.

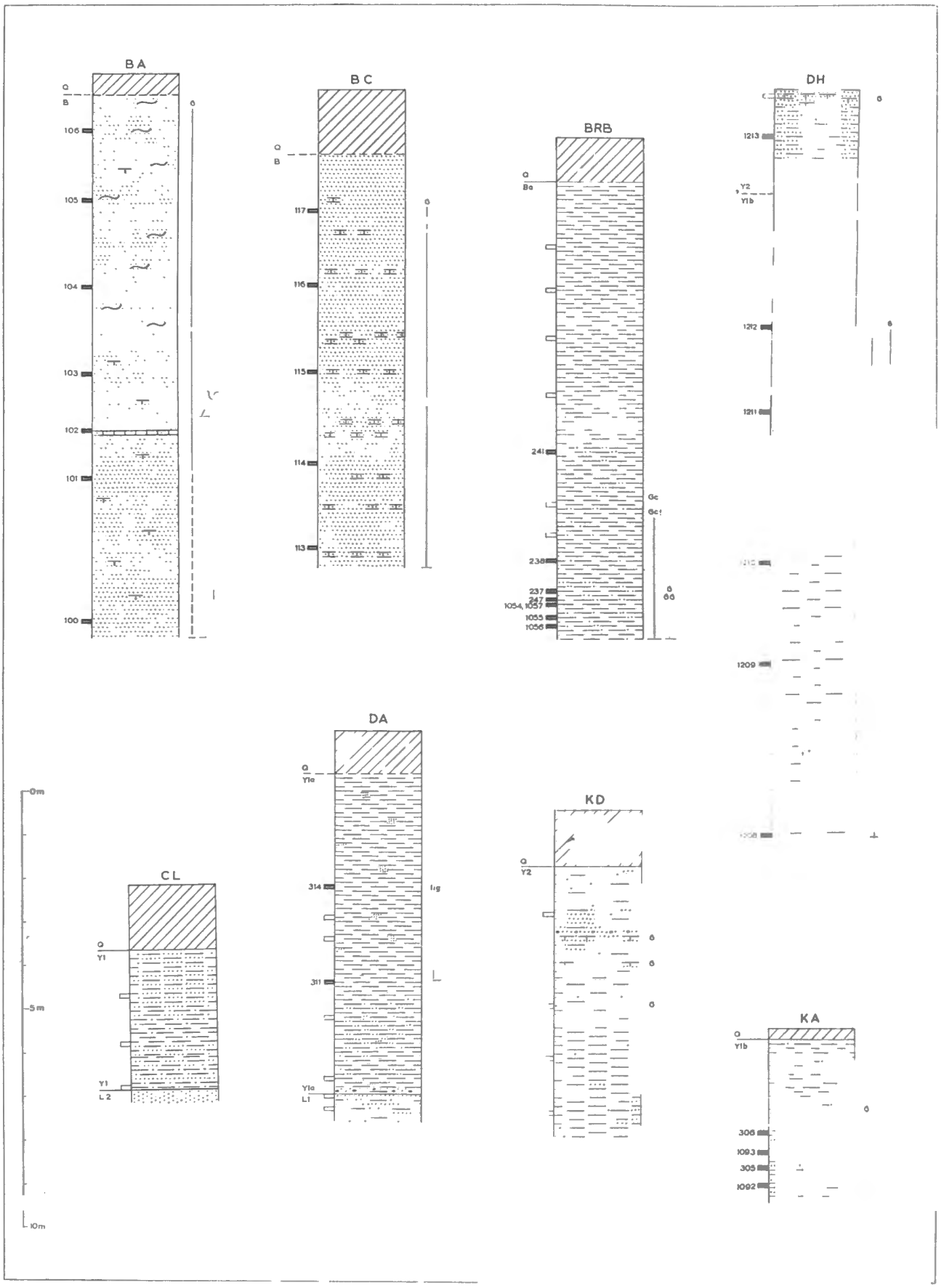


FIG. 6.

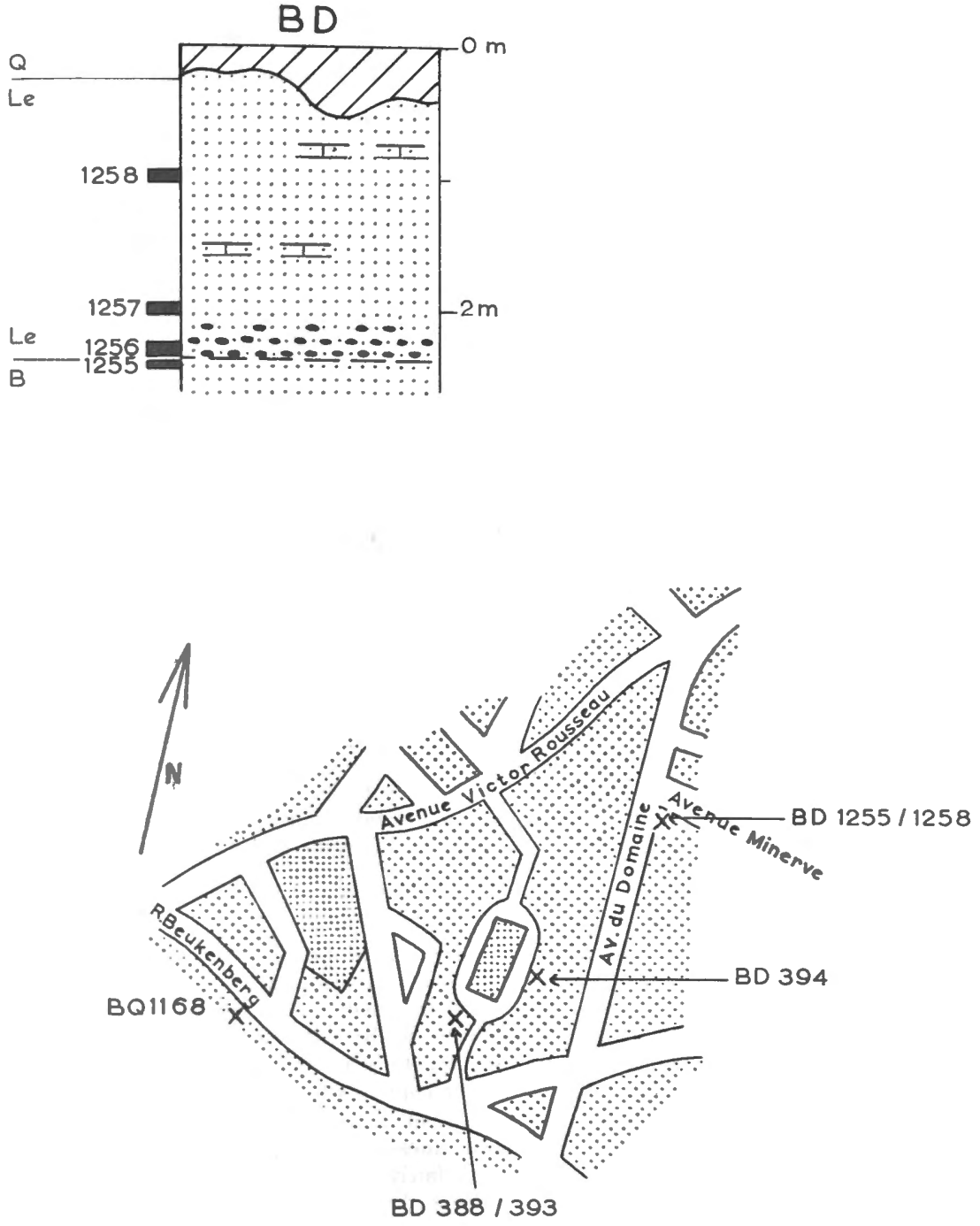


FIG. 7. — Location and section of the BD samples, Forest. (Scale 1 : about 7500.)

a) The exposed parts of the old wall of the pit did not allow a detailed stratigraphic survey. Exposed were Sands of Mons-en-Pévèle and Sands of Brussels.

Sands of Mons-en-Pévèle.

The base of the exposure was formed by fine-grained, clayey sands of green-grey colour, with calcareous remains, but without foraminifera.

In the collections of the Geological Institute of Utrecht we found a sample (**BD 445**) of the same stratigraphic level, labeled as a « weathered lime with *Nummulites planulatus* », but being an indurated fine-grained, glauconitic and calcareous sand with numerous nummulites. Microscopically it appeared rich in organic remains such as foraminifera, ostracods, shell fragments, tubes of *Ditrupa*, echinid spines, etc.

Sands of Brussels.

The Sands of Mons-en-Pévèle were overlain by Sands of Brussels, the lower part rich in quartz, and the upper part more calcareous. No contact between the Sands of Mons-en-Pévèle and the Sands of Brussels was visible.

The lower part of about 8 m thickness was formed by rather coarse, pale-yellow sands, which at the top became slightly calcareous, with shell fragments (amongst others, *Ostrea cymbula*), and at some places with very small, flat clay lenses of a few centimetres lenght. In the sand there were capricious concretions of the same material, cemented with SiO_2 (« Grès fistuleux » and « Pierres de grottes »).

In the upper part of the lower sands the samples **BD 388**, **390** and **394** were taken; **BD 394** about 4 m above the base, **390** about 1,50 m higher, and **388** near the transition to the calcareous sands. The wash residues contained shell fragments (*Ostrea cymbula*), echinid spines, bryozoan debris, ostracods, sponge spicules, fish remains, in addition to a fairly rich foraminiferal fauna.

The upper part of the Sands of Brussels consisted of whitish, calcareous sands, rather fine-grained, rich in organic remains, with some glauconite, muscovite and silex fragments. Locally the sand was somewhat marly. Interstratified in the sand there were discontinuous layers of flat pieces of calcareous sandstones to sandy limestones, with a maximal thickness of about 30 cm.

Samples **BD 391** (below), **392** and **393** at distances of 1 m; no record with regard to the top and the base of the calcareous sands. The wash residues yielded a rich foraminiferal fauna (among which are nummulites) and many organic debris.

b) At this place we found Sands of Lede overlying Sands of Brussels (see fig. 7). Close to the contact the Sands of Brussels were very calcareous, medium-grained and of yellowish colour. Sample **BD 1255**, taken directly below the contact, probably contained elements from the overlying material. The wash residues contained many organic remains and a rich microfauna with, amongst others, nummulites. Furthermore coarse, well rounded, hyaline quartz grains were found.

Sands of Lede.

In this small exposure the contact between the Sands of Brussels and the Sands of Lede was mostly obscure. The base of the Sands of Lede was formed by coarse, mostly indurated sand, with worn fossil remains (large, flat nummulites; shark-teeth; shell fragments, etc.), coarse, hyaline quartz grains, and more or less rounded sandstone fragments of some centimetres diameter. Higher up the sand, calcareous and with nummulites, became finer-grained, slightly glauconitic and with whitish pockets with small shell fragments in yellowish sand. The glauconite content increased towards the top (green-white colours directly below the Quaternary loess). Interstratified in the sand there were some discontinuous layers of flat, sandy limestone fragments of variable thickness.

The samples **BD 1256**, **1257** and **1258**, showed a fairly rich microfauna and many other organic remains, such as echinid spines, shell fragments, *Ditrupa*, bryozoan debris, ostracods, and others.

In the collections of the Geological Institute of Utrecht a sample (**BD 444**) was encountered from the same lithologic level, labeled as « sand with *Nummulites variolarius* », and derived from locality BD-a. In the wash residues a rich microfauna. About the same components were found as in those of samples BD 1256-1258.

BE Brussels, former exposure near the prison of Saint-Gilles.

Sands of Lede.

A sample (**BE 446**) in the collections of the Geological Institute of Utrecht was labeled as « base of the Ledian ».

It consisted of calcareous sand, rich in nummulites and shell fragments. The wash residues yielded a rich microfauna and many other organic remains.

BF Jette, small exposure in a foundation pit (1.300 m N and 450 m W of the church-tower of Jette).

Visited May 1954.

Clays of Asse (probably basal layers).

Exposure, at about +65 O.D. Oostende, with glauconitic clay covered by Quaternary loess. The clay was of green-grey colour and clearly showed the glauconite grains. In the wash residues of some samples we observed some shell fragments (*Pecten*), echinid spines, ostracodal fragments, fish remains, etc.

BG Teralfene, hollow roadside (600 m N and 850 m W of the church-tower of Teralfene); also point 87 (W) 213 of the archives of the Geological Survey.

Visited May 1954.

Literature :

G. VINCENT, 1889, Ann. Soc. Malac. Belg., vol. 24, Bull., pp. 156-162.

Sandy Clays of Anderlecht.

Small exposure, at about +37 O.D. Oostende, of about 1 m height, formed by Quaternary loess that covered clayey sand with an intercalated sandstone layer.

The sand was of brown-green colour, rather rich in glauconite, medium to fine-grained. The wash residues of a sample contained fragments of nummulites, ostracods, echinid spines and some indeterminable smaller foraminifera.

The sandstone was hard, medium to fine-grained, blue-grey, with casts of molluscs (mainly pelecypods), sometimes with silicified shell remains. Thickness variable (max. 60 cm). VINCENT recorded *Nummulites planulatus* from this sandstone.

BJ Esschene, abandoned sandpit (50 m N and 800 m W of the church-tower of Esschene); also point 87 W 148 of the archives of the Geological Survey.

Visited May 1954.

Possibly decalcified **Sands of Lede.**

Only small parts of the old wall were still visible. Sampled at about +60 O.D. Oostende.

Sample of fine-grained, yellow-green, slightly glauconitic and micaceous sand. Some more or less decalcified and undeterminable fragments of nummulites were found.

BK Asse, hollow roadside and abandoned claypit (50 m S and 1.350 m W of the church-tower of Asse): also point 87 (W) 66 of the archives of the Geological Survey.

Visited May 1954.

Sands of Wemmel (?) and **Clays of Asse.**

In the hollow roadside, directly E of the abandoned claypit, as well as in the wall of the pit glauconitic clay was exposed. In the pit it overlay sandy deposits.

The latter sands were medium to fine-grained, slightly glauconitic, of yellowish-brown to green colour. Exposed over 80 cm, at the top with interstratification of irregularly bedded sandy clay. Microscopically we found, amongst others, some tiny shell fragments (gastropods) and bone fragments (probably fish remains).

The stratigraphic position of the sands with regard to the base of the glauconitic clay could not be established.

The wall of the old pit was formed by about 13 m of clay with a variable degree of weathering, and consequently with variable colours (grey-green to brown-green). The clay contained variable quantities of glauconite, which decreased towards the top of the exposure. The mineral was sometimes concentrated in small spots of some millimetres diameter. Near the base the clay was fairly sandy, higher upwards the sand content decreased, but there were intercalated beds of very sandy clay to clayey sand.

Seven samples were taken. They show an increasing muscovite content towards the top of the exposure. Faunal elements were lacking.

BL Asse, hollow roadside (100 m S and 1.500 m W of the church-tower of Asse).

Visited May 1954.

Sands of Lede.

Some small exposures of sands, at about +50 O.D. Oostende. The sands were calcareous, pale green, fine-grained, rich in nummulites.

The wash residues of **BL 1035** contained many organic remains (such as a rich microfauna, shell fragments, echinid remains, *Ditrupa*, bryozoan debris), and some glauconite and muscovite.

BM Asse, hollow roadside (1.600 m W of the church-tower of Asse).

Visited May 1954.

Sands of Lede.

Small exposure, at +50 O.D. Oostende, with a height of 1,50 m.

Exposed we found fine-grained, calcareous sands, at some places slightly decalcified, at others more or less indurated.

At the base of the exposure sample **BM 1036** was taken from slightly decalcified sand with nummulites. The wash residues contained a rich microfauna and many organic remains as well as scarce glauconite and muscovite.

One meter higher sample **BM 1037** was taken from calcareous sand, again with many nummulites. In the wash residues some pyrite was found in addition to components identical to those of BM 1036.

BN Hoeilaart, abandoned sandpit (100 m S and 400 m W of the church-tower of Hoeilaart).

Visited June 1954.

Sands of Brussels.

About 6 m of sands covered by 0,50 m to 2 m of Quaternary loess. The bottom part of the wall was covered by sand from higher parts of the wall.

The base of the exposure was formed by horizontal, indistinctly bedded, coarse sand of yellowish colour, followed by obliquely bedded sands (dipping NW), with some tubulations (probably worms). In this part of the wall the bedding was visible by different contents of iron-oxides, and by small flat clayey particles of some mm length. On top of 35 cm of these current-bedded sands a more regulary bedded complex was found of about 80 cm thickness and formed by yellowish, medium-grained sand with intercalated irregular laminae of clayey composition.

Higher up the sand became fine-grained and contained irregularly shaped concretions of the same material, but richer in sponge spicules, cemented by SiO_2 (« Grès fistuleux » and « Pierres de grottes »). The bedding was irregular, but in general horizontal. Some cross-bedding was observed, with increasing importance towards the top of the exposure. Some clayey bands occurred near the top.

About 100 cm below the covering loess pockets with fine-grained gravel formed a discontinuous layer of about 10 cm thickness.

A sample at the base of the sands contained mainly quartz.

BO Overijse, sandpit « Van Billoen » near Zavelborre (150 m S and 2.300 m W of the church-tower of Overijse).

Visited June 1954.

Sands of Brussels.

Wall of about 20 m height with non-calcareous (possibly decalcified) sands. The steep wall did not allow for a detailed description of the succession, but in general the section resembled that of BN.

The basal part of the section was formed by pale-grey, medium-grained sands. Higher up the sands were coloured brownish by limonite. The sand was rich in « Grès fistuleux » and « Pierres de grottes », sometimes slightly calcareous.

A sample near the base of the pit yielded, amongst others, some ill-preserved fragments of bryozoa.

BP Tourneppe, hollow roadside at Bruineput (1.000-1.200 m N and 400 m W of the church-tower of Tourneppe).

Visited June 1954.

Sands of Brussels.

In an ascending road (Tourneppe - Bruineput) the sides showed calcareous sands over a total stratigraphic height of about 15 m (+75 to +90 O.D. Oostende).

Exposed were medium to fine-grained sands of whitish colours, with green-coloured, less calcareous parts in between. In the highest parts of the section calcareous patches occurred in rusty brown, decalcified sands. The sands were at some places more or less indurated.

Four samples were taken (**BP 1164** and **1165** at about +75, **BP 1166** at +81 and **BP 1167** at +88 O.D. Oostende). The wash residues of all these samples contained many organic remains, such as fairly rich microfaunae, echinid spines, shell fragments and some bryozoan debris.

BQ Forest, excavation at the Rue Beukenberg (small pit near newly-built houses). See fig. 7.

Visited June 1954.

Sands of Brussels.

A poor exposure, of about 1 m height, of very calcareous, white sands, irregularly bedded, medium-grained, covered by less calcareous, fine-grained, green-grey sands.

Sample **BQ 1168**, from the base of the exposure, yielded wash residues with a rich microfauna and many organic remains, especially shell fragments and echinid remains.

BR Brussels, station-junction of Leopoldswijk, tunnel-construction under the Rue Belliard; also point 88 (W) 637 of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

Exposure at the eastern side of the works, at about +56 O.D. Oostende.

Exposed we found greenish, slightly calcareous sands. Some 2 m below the level of the street there were intercalated fine-grained, yellowish-white, occasionally indurated sands, rich in quartz and with some shell fragments.

Sample **BR 1169** was taken from these intercalated sands. The wash residues yielded some foraminifera, ostracods and other organic remains, such as echinid spines, bryozoan debris and sponge spicules. Some muscovite was present.

BS Jette, hollow roadside of the Rue du Marathon near the Stadium of Heizel (about 100 m S of the Stadium).

Visited September 1954.

Sands of Wemmel.

Exposure, of about 0,50 m height, of yellowish-green, fossiliferous and medium-grained sands, rich in shell fragments (amongst others, *Pecten corneus*, *Ostrea*), nummulites, *Ditrupa*-tubes, bryozoan debris and coral remains.

Two samples, **BS 1259** and **1260**, yielded wash residues with rich microfaunae and many other organic remains [amongst others, fish remains (otolithes), radiolarians, echinid spines].

BT Jette, excavation for the construction of a drainage system (1.450 m N and 700 m W of the church-tower of Jette).

Visited July 1956.

Sands of Wemmel and **Clays of Asse.**

A sample, **BT 1266**, from heaps of sand from a ditch dug out in fossiliferous sands, fine-grained and yellowish-green. The wash residues contained a small microfauna in association with other organic remains as shell fragments, bryozoan debris, echinid spines, *Ditrupa*.

Another sample from grey-green glauconitic clay, with some rare shell fragments contained no foraminifera.

BV Strombeek-Bever, excavation for tunnel-construction at the Meyselaan near Heizel, at « De dikke Linde »; also point 88 (W) 1402 of the archives of the Geological Survey.

Visited September 1956.

Sands of Wemmel.

Excavation, of about 7 m height, with homogeneous, green to yellow, medium-grained sands. The sands were fossiliferous in the lower part and passed higher up into a brownish-green, decalcified, slightly clayey sand.

The sands of the lower part were very rich in shell fragments (amongst others, *Pecten corneus*, *Ostrea wemmelensis*, *Nuculella nysti*, *Nemocardium*, *Aloides*, *Tellina rostralina*, *Nucula lunulata*, *Cardita*, *Turritella*, *Solarium*), nummulites and other foraminifera. The fossils were concentrated in indistinct layers or lenses of 20 to 30 cm thickness. Also glauconite, muscovite and, sometimes, some pyrite were found.

Four samples (**BV 1269-1272**) were taken from the fossiliferous lower sands :

BV 1269, about 7 m under streetlevel; **BV 1270** about 4 m higher; **BV 1271** about 4,50 m below streetlevel and **BV 1272** from material, rich in shell fragments, washed together by the rain.

The wash residues of all these samples yielded fairly rich microfaunae associated with many other organic debris, such as shell fragments, bryozoan debris, echinid spines, etc.

BW Wemmel, excavation near the crossing of the Avenue Limburg Stirum and the Chaussée Romaine.

Visited October 1956 by Dr. D.A.J. Batjes.

Clays of Asse.

During the construction of a new road W of the mentioned crossing, Clays of Asse were found exposed with very glauconite-rich basal layers, rich in nummulites.

Sample **BW 1273** [=sample 29362 of the Paleontological Department of the Geological Survey of the Netherlands (Haarlem)], taken from these basal beds, yielded wash residues with much glauconite and a rich microfauna associated with other organic remains.

SHEET BRUGGE

BRA Aalter, railwaycut at the station (1.000 m N and 100 m W of the church-tower of Aalter); also point 39 (W) 157 of the archives of the Geological Survey.

Visited September 1953.

Literature :

E. DELVAUX, 1886, Ann. Soc. Malac. Belg., vol. 21, pp. 275-276.

Sands of Aalter.

Along the northern side of the cut, at about +15 O.D. Oostende, large, slightly decalcified patches with many shells were present in completely decalcified, slightly glauconitic sands.

The exposure was of some 50 m length and of about 1,50 m height.

Some samples were taken from one of the mentioned patches, which was 60 cm broad, 80 cm high, and covered by 70 cm of decalcified sand and Quaternary coverings. The wash residues contained many shell fragments (amongst others, *Venericardia planicosta*, *Turritella solanderi*) in addition to bryozoan debris, bone fragments (probably fish remains), etc.

BRB Oedelem, claypit of the « N. V. Steenbakkerijen van Oedelem » (400 m E of the church-tower of Oedelem); also point 38 (E) 42 of the archives of the Geological Survey. See fig. 6.

Visited September 1953 and May 1954.

Clays of Asse.

The base of the section was formed by very glauconitic, silty clay (glauconite often as rather coarse grains). The clay was slightly micaceous and contained some pyrite, and some coarse, hyaline, well-rounded quartz grains. In connection with a slight diminishing of the glauconite contents the colour of the clay changed from blue-green at the base to blue-grey towards the top of this glauconitic part of the section. The basal part was rich in shell fragments (amongst others, *Pecten corneus*); upwards the number of which decreased to a complete absence in the highest part of the glauconitic clay.

Above this glauconitic clay a sharp decrease of the glauconite content marked the beginning of plastic clay, in the lower part of which some silty beds were still present. Near the base some glauconite occurred, but higher on this mineral was absent. Much pyrite and some gypsum were found.

About 4,50 m to 5 m below the grass (in the north-eastern part of the pit) a distinct, rusty-brown band was visible. Above it the clay was oxidized, and of yellowish-brown colours. From some non-oxidized patches the two uppermost samples were taken. In the upper one some muscovite was found.

The top of the section was formed by 0,50-1 m of Quaternary sand with cryoturbation phenomena and some gravel at the base.

All samples were taken in the eastern part of the pit; **BRB 237**, **238**, **241**, **247** and **1054** in the north-eastern corner, **BRB 1055-1057** in the south-eastern part.

The samples **BRB 237**, **238**, **247**, **1054-1057**, from the lower, glauconitic part of the wall, yielded wash residues with rich microfaunae (with nummulites in samples **247**, **1054-1057**), associated with bryozoan debris, shell fragments, fish remains (as otolithes and bone fragments), radiolarians, echinid spines, calcareous worms, sponge spicules, etc.

A sample, **BRB 241**, from one of the silty bands in the plastic clay, was found to contain a small microfauna.

BRC Aalter, hollow roadside (800 m N and 550 m E of the church-tower of Aalter).

Visited May 1954.

Sands of Aalter.

A poor exposure, at about +16 O.D. Oostende, near the bridge that crosses the railroad of Gent to Brugge, east of the station of Aalter.

The exposed sands were of yellowish-green colour, medium-grained, with some glauconite, slightly clayey and rich in shell fragments (many *Turritella*) that were often worn and showed traces of the holes of boring animals.

The wash residues of a sample yielded, amongst others, some bryozoan remains and muscovite.

BRG Beernem, small sandpit (3.400 m S and 1.600 m W of the church-tower of Beernem).

Visited May 1954.

Sands of Vlierzele.

A wall with about 70 cm of ferruginous sands with an intercalated discontinuous sandstone layer (up to 10 cm), formed by thin (maximally 1 cm) laminae that were also more or less discontinuous.

The sand was of brownish-green colour with many rusty-brown horizontal stripes; with small, flat clay-lenses. At the base of the exposure some cross-bedding was apparent.

The sands were covered by 60 cm of Quaternary loess with a silex-rich base.

SHEET CHARLEROI

CA Heppignies, sandpit of the « Société de Mont-Saint-Guibert » (1.300 m S and 400 m W of the church-tower of Heppignies); also point 142 (E) 146 of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

Quaternary loess covered some 6 to 7 m of Sands of Brussels.

The sand was mostly yellowish-brown, and it contained a number of dispersed sandstone concretions (partly «Grès fistuleux»). The sand was rather coarse and with black grains, probably of Mn-oxide. Some dispersed rusty brown bands occurred.

CB Manage, abandoned sandpit north of « Les Mourettes » (900 m S and 1.100 m E of the church-tower of Manage); also point 141 (E) 208 of the archives of the Geological Survey.

Visited July 1954.

Probably **Sands of Mons-en-Pévèle.**

A poor exposure of fine-grained, yellowish-green sand, slightly glauconitic and with some nummulites.

The wash residues of a sample yielded, amongst others, shell fragments, a few nummulites (but there was no microfauna) and muscovite.

F. HALET (1920, archives of the Geol. Survey) recorded *Nummulites planulatus* from this locality.

CC Carnières, outcrop in the western side of a railroadcut (1.500 m S and 1.300 m E of the church-tower of Carnières); also point 152 (E) 107 of the archives of the Geological Survey.

Visited July 1954.

Probably **Morlanwelz member** contaminated with **Sands of Brussels.**

Again a poor exposure of contaminated, grey-green, silty clay or clayey silt.

Sample **CC 1197** contained, amongst others, organic remains, such as sponge spicules, echinid spines, shell fragments and a small microfauna.

The archives of the Geol. Survey recorded overlying fossiliferous Sands of Brussels, with silex gravel at the base. Perhaps our sample was contaminated with material from this overlying fossiliferous sand.

CD Carnières, exposure in railroadcut (900 m S and 400 m E of the church-tower of Carnières).

Visited July 1954.

Probably **Morlanwelz member.**

We took a sample of pale grey, silty clay. The wash residues contained rare glauconite and muscovite, in association with some organic remains as sponge spicules, echinid spines and ill-preserved foraminifera (indeterminable; partly nummulites).

CE Carnières, exposure in the northern side of the hollow road near the « Tranchée de Beauregard » (1.200 m E and 100 m N of the church-tower of Carnières); also point 152 (E) 265 of the archives of the Geological Survey.

Visited July 1954.

Possibly **Clays of Ieper.**

A sample from indurated, brown-green clay with some glauconite, muscovite, sponge spicules, lignite fragments, etc.

CF Leval-Trahegnies, exposure in northern side of a hollow road (700 m S and 300 m E of the church-tower of Leval-Trahegnies); also points 152 (E) 21 and 254 of the archives of the Geological Survey.

Visited July 1954.

Sands of Mons-en-Pévèle or Clays of Ieper (of the facies of the **Morlanwelz member**).

A poor exposure, at about +155 O.D. Oostende, of grey-green, slightly silty clay with flat, indurated parts of the same material («argilite»), which may be somewhat more sandy.

The wash residues of a sample contained, amongst others, glauconite, rare muscovite, some sponge spicules and lignite.

CI Leval-Trahegnies, excavation in a road (800 m S and 450 m E of the church-tower of Leval-Trahegnies); also point 152 (E) 20 of the archives of the Geological Survey.

Visited May 1953.

Probably Sands of Mons-en-Pévèle (of the facies of the **Morlanwelz member**).

An exposure, at about +165 O.D. Oostende, of yellowish-brown sandy clay, with some green, probably unweathered, patches.

Sample **CI 41**, taken from such a green patch, was slightly glauconitic and micaceous. The wash residues contained some foraminifera, in addition to sponge spicules, etc.

CL Carnières, sandpit « Dufonteny Frères » at « Saint-Eloy » (75 m N and 850 m W of the church-tower of Carnières); also point 152 (E) 283 of the archives of the Geological Survey. See fig. 6.

Visited May 1953.

Clays of Ieper (of the facies of the **Morlanwelz member**).

At the base of the section Sands of Grandglise were found, which were overlain by Sands of Erquelinnes. The latter were whitish coloured, at some places with rusty-brown spots. Some thin clayey beds were intercalated. No bedding planes were visible, except for the uppermost part, where they were distinctly horizontal.

The contact with the overlying Clays of Ieper was sharp and horizontal.

The basal part of the clays was formed by distinctly bedded, brown-green clay with thin sandy layers in betwee.n The clay was slightly glauconitic. The wash residues of a sample from this basal part contained some indeterminable fragments of foraminifera.

Higher upward the intercalated, sandy beds thickened and the clay was getting somewhat more sandy and glauconitic (the glauconite was more or less transformed in limonite).

This complex was covered by greenish, plastic clay which again passed into a sandy clay, more or less micaceous, and locally indurated, probably by siliceous cement («argilite»).

Covered by 1,50 m of Quaternary loess.

CM La Hestre, abandoned sandpit (750 m N and 150 m W of the church-tower of La Hestre).

Visited May 1953.

Sands of Brussels.

Small exposure (about 150 cm high) of green, medium-grained sand.

The wash-residues of a sample, **CM 51**, contained, amongst others, some foraminifera (partly indeterminable and incrustated with calcite).

CN+CO Godarville, canal-cut (see fig. 8 and 13).

Literature :

R. LEGRAND and R. TAVERNIER, 1948, Bull. Soc. belge Géol., vol. 57, pp. 249-276.

Between Godarville and Seneffe an elongated hill forms the watershed between the hydrographic basins of the Scheldt and the Meuse. Formerly the Canal of Brussels to Charleroi passed this hill through two tunnels. Nowadays this part of the canal is modernized and excavated.

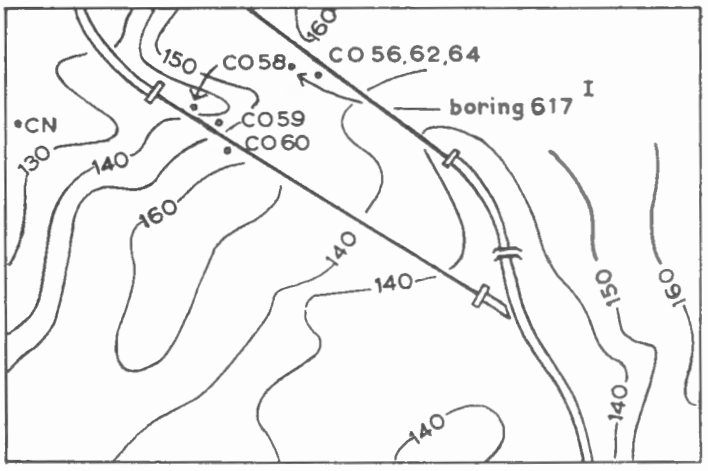


FIG. 8. — Location of the CN and CO samples, Godarville.
Scale : 1 : 40.000.

During our visit (May 1953) nearly complete series of Clays of Ieper, Sands of Mons-en-Pévèle and Sands of Brussels were exposed. However, it appeared impossible to sample a continuous stratigraphic section only remote parts of the canal sides being exposed, and often more or less covered by debris.

A number of reports of borings for the Geological Survey made during the first exploration (archives of the Geol. Survey) enabled us to make a fairly exact correlation between our own survey and the bore data.

One representative boring (no. 617-I) is figured with the supposed position of our samples.

CN Godarville, canal-cut east of the bridge near Long-Sart (1.250 m N and 900 m W of the church-tower of Godarville); also point 141 (E) 289 of the archives of the Geological Survey. See fig. 13.

Visited May 1953.

Clays of Ieper.

Some samples were taken in the walls of a new part of the canal.

Just above the camp-shot of the wall, at about +118 O.D. Oostende, a dark-grey, sandy clay was exposed. Higher up this clay was darker, locally even black; and 4 m above the camp-shot the clay passed rather abruptly into a slightly sandy, brownish clay. The contact was variable in position, and marked the boundary between two clay-complexes with a different degree of weathering. Above the contact the clay was indistinctly bedded.

Sample **CN 52**, taken at the height of the camp-shot, was rich in pyrite (possibly pyritised lignite). In the wash residues it contained some foraminifera, sponge spicules, muscovite, glauconite, etc.

Sample **CN 53**, directly below the contact with the brownish clay, contained less pyrite and more glauconite. Some foraminifera and radiolarians were encountered.

Sample **CN 54** contained some foraminifera (more or less covered by secondary $CACO_3$) and some bone fragments (probably fish remains). This sample is in the basal part of the brownish clay.

A sample taken somewhat higher contained the same components as the three others, but no foraminifera.

CO Godarville, construction of the canal-parts above the tunnels under the « Bois de Bomerée »; also points 141 (E) 292,299 of the archives of the Geological Survey. See fig. 13.

Visited May 1953.

Clays of Ieper and **Sands of Mons-en-Pévèle.**

On top of the clayey beds of the CN-series followed a complex of alternating clayey sands and sandy clays, with a thickness of about 10 m. Grey colours dominated; the sands were fine-grained.

The series continued with a sandy complex, clayey at the base, but with decreasing clay content towards the top. The base was formed by dark greenish, fine-grained, glauconitic, sandy clay with intercalated grey clay lenses of small dimensions (some centimetres). Higher up the colour became grey-green, and bedding was distinct. The sand was medium to fine-grained.

The samples (**CO 58** from the clayey base; **CO 59** near the transition to overlying sands) were rich in organic remains (foraminifera, such as fragments of nummulites; shell remains; bryozoan debris; sponge spicules; echinid spines; fish remains).

Above the level of CO 59 about 8,50 m of quartz sand was found. On top of this sand there were again clayey layers in the sand.

Sample **CO 60** was taken at the base of this clay and sand complex from a very clayey, fine-grained, brownish-green sand.

The complex, with a thickness of about 8 m, ended near the top with some layers of grey sandy clay, rich in foraminifera.

From one of these layers sample **CO 62** was taken; in the wash residues ostracodal fragments, sponge spicules, echinid spines, radiolarians, etc.

Sands of Brussels.

Sands of Brussels were found overlying the described complex of mainly sandy clays.

At the base well rounded pebbles (quartz, sandstone) were interbedded in coarse, greenish sands with shell fragments. Upwards rather coarse, greenish-brown sand was found, with shell fragments and nummulites. In this sand, about 2,50 m above the base, occurred some dispersed lenses of gravel, sometimes with bone fragments.

Sample **CO 56** was taken from the basal part with pebbles. The wash residues contained some foraminifera, shell fragments, sponge spicules, echinid spines, etc.

Sample **CO 64**, about 2 m above the base, yielded wash residues with many shell fragments (mainly *Ostrea*) and nummulites, a rather rich microfauna and bryozoan debris.

During a visit to the same constructional works in May 1954 Prof. dr. G. H. R. von KOENIGSWALD took two samples:

Sample **CO 1240** from fossiliferous Sands of Brussels. The wash residues yielded many shell fragments (*Ostrea*, *Solarium*, etc.), rich microfauna, echinid spines, bryozoan debris, sponge spicules, radiolarians, etc.

Sample **CO 1241** from a fossiliferous sandy clay from the Sands of Mons-en-Pévèle, possibly at the level of CO 62. Wash residues with a rich microfauna in addition to shell fragments, bryozoan debris, fish remains, radiolarians, echinid spines, sponge spicules, etc. Also nummulites were found.

SHEET TOURNAI

DA Havinnes, claypit of the « Nouvelles Tuileries de Havinnes, S. A. » (2.250 m E of the church-tower of Havinnes); also point 125 (W) 484 of the archives of the Geological Survey. See fig. 6.

Visited September 1953.

Literature :

J. BAUDET, 1939, Bull. Soc. belge Géol., vol. 49, pp. 307-308.

Sands of Grandglise and **Clays of Ieper.**

The base of the section was formed by more or less glauconitic, grey, clayey sand, pyritiferous (pyrite derived from the Clays of Ieper). Less glauconite was found in the upper part of the Sands of Grandglise.

The wash residues of some samples yielded, amongst others, sponge spicules and bone fragments (probably fish remains).

The base of the overlying clay contained dispersed, irregular pyritiferous concretions of black colour with a yellowish exterior; as well as some small, well rounded silex fragments of black colour. The silty clay furthermore contained sand of variable grain-size, and patches and discontinuous layers of plastic clay. This basal layer was about 30 cm thick.

Upwards the clay remained silty, with small sand-spots or strings. The samples yielded no microfauna; some bone fragments (probably fish remains) were found.

Some 2,50 m above the base the clay became lignitic. Some of the lignite occurred in bands with narrow, yellow, pyritiferous zones alongside them. At this level the clay was plastic with occasional small sand-patches; also gypsum was found.

Sample **DA 311** was taken at the base of this non-silty clay. The wash residues contained some foraminifera. .

Sample **DA 314** appeared to contain gypsum, pyrite, some foraminifera, etc.

On approaching this level the clay appeared to be oxidized and of brown-yellow colour.

DC Saint-Maur, claypit of the « Briqueterie de Wissempierre » (300 m S and 300 m W of the church-tower of St. Maur, municipality Ere); also point 124 (E) 402 of the archives of the Geological Survey.

Visited September 1953.

Clays of Ieper.

About 5,50 m of slightly silty, grey clay with scarce shell fragments. Five m below the surface there was a 10 cm bed of claystone.

The wash residues of the samples contained lignite, glauconite, muscovite, but no foraminifera.

DD Mouscron, railroadcut (2.000 m S and 900 m W of the church-tower of Mouscron); also point 119 (W) 112 of the archives of the Geological Survey.

Visited May 1954.

Perhaps **Sands of Mons-en-Pévèle.**

A poor exposure of clayey, rather coarse-grained, brownish-yellow to green sand.
Contaminated samples without microfauna.

DE Maulde, hollow roadside in the « Bois des Houpes » (750 m N and 1.100 m W of the church-tower of Maulde); also point 125 (E) 120 of the archives of the Geological Survey.

Visited July 1954.

Sands of Mons-en-Pévèle.

The entrance of an old fox-hole showed a whitish-green bank of about 15 cm, with many nummulites and shell fragments (*Ostrea*), in grey-green, fine-grained, more or less glauconitic sand.

Sample **DE 1204**, from this band, yielded wash residues with a rich microfauna with many nummulites, also many shell fragments, echinid spines, bone fragments, sponge spicules and radiolarians.

DF Mont-Saint-Aubert, hollow roadside (350 m S and 400 m E of the church-tower of Mont-Saint-Aubert); also point 112 (W) 17 of the archives of the Geological Survey.

Visited July 1954.

Literature :

M. MOURLON, 1885, Ann. Soc. Géol. Belg., vol. 19, pp. 148-149.

Sands of Mons-en-Pévèle.

A small exposure, at about +90 O.D. Oostende, 1,50 m high.

The lower part of the exposure was formed by grey-green, very fine-grained micaceous sands, slightly glauconitic. Upwards the sands became brownish-green and clayey, up to a silty clay.

Sample **DF 1205**, taken from the basal part, yielded some foraminifera, sponge spicules and bone fragments.

Sample **DF 1206**, 1,30 m higher, from the brownish-green, clayey sand, contained some scarce foraminifera.

DG Mont-Saint-Aubert, hollow roadside (150 m S and 1.350 m E of the church-tower of Mont-Saint-Aubert); also point 112 (W) 155 of the archives of the Geological Survey.

Visited July 1954.

Possibly a clayey part of the **Sands of Mons-en-Pévèle.**

A poor exposure of green-grey, micaceous and silty clay, weathered and loamy.
The wash residues of a sample showed limonite, glauconite, muscovite, but no microfauna.

DH Mont-Saint-Aubert, hollow roadside (about 550 m N and 500 m E of the church-tower of Mont-Saint-Aubert); also points 112 (W) 71 and 111 (E) 528,529 of the archives of the Geological Survey. See fig. 6.

Visited July 1954.

The lower part of the exposure evidently belonged to the **Sands of Mons-en-Pévèle.** The boundary with the **Clays of Roncq** must be somewhere in the covered part of the section.

In the western side of the road, on the northern slope of the mont Saint-Aubert, clayey sands were exposed in the lower part of the exposure. These sands were fine-grained, brownish, and perhaps more or less contaminated with overlying Quaternary loess.

In the lowest part of the section no nummulites were observed, but higher up they were locally abundant, usually concentrated in small lenses and thin layers.

Upwards the clay content decreased; mostly the clay was restricted to thin bands. The colour changed to green-grey. These more or less micaceous sands were, in general, richer in nummulites than the underlying sediments. Also shell fragments occurred in this higher part.

Above these sands a part of the section was covered by Quaternary loess, after which followed greenish-brown sandy clay with some glauconite. In the upper part a lens (of about 10 cm thickness and 70 cm length) of indurated sandy clay, rich in fossil casts (mainly *Turritella solanderi*).

In the lower part of the section the samples **DH 1208-1210** were taken, all with a rather rich microfauna together with shell fragments (rare in 1208, increasing amount higher up), *Ditrupa*-fragments (possibly *D. plana*), remains of calcareous algae, echinid spines, bone fragments, sponge spicules and radiolarians.

The samples **DH 1211** and **1212** from the overlying sands yielded wash residues with rich microfaunae (with nummulites), associated with shell fragments, echinid spines, *Ditrupa*-fragments, etc. Furthermore sandstone fragments and rather much glauconite.

DH 1213 from the uppermost part contained a small microfauna and some echinid remains, etc.

A sample of the sandy claystone contained some foraminifera but too incrustated with calcite for a specific determination.

DK Mont-Saint-Aubert, hollow roadside (50 m N and 150 m W of the church-tower of Mont-Saint-Aubert); also points 111 (E) 523 and 543 of the archives of the Geological Survey.

Visited July 1954.

Possibly **Sands of Vlierzele.**

A poor exposure of yellowish-green sands, fine-grained, with glauconite and muscovite, and with flattened, siliceous sandstone pieces with the same lithological features.

The samples, without microfauna, contained some sponge spicules and radiolarians.

DL Ellignies-lez-Frasnes, hollow roadside (400 m N and 150 m E of the church-tower of Ellignies-lez-Frasnes); also point 112 (E) 150 of the archives of the Geological Survey.

Visited July 1954.

Sands of Mons-en-Pévèle.

The sides of the road yielded some scattered sandstone pieces with nummulites; at some places these were probably in situ and surrounded by clayey, yellowish-brown sand, which was fine-grained, calcareous and mostly weathered. Unweathered, greyish-green colours dominated.

Sample **DL 1218** contained a small microfauna in addition to many nummulites, some shell fragments, *Ditrupa*-tubes (possibly *D. plana*), echinid spines, sponge spicules, bone fragments and radiolarians.

DM Saint-Sauveur, hollow roadside (1.850 m S and 800 m W of the church-tower of Saint-Sauveur).

Visited July 1954.

Probably **Sands of Mons-en-Pévèle** (either clayey intercalation in the sands, or clayey equivalent of the sand, thus resembling the Clays of Roubaix).

A poor exposure of silty, greyish-green clay, with some glauconite.

The wash residues of a sample were without foraminifera.

DN Saint-Sauveur, hollow roadside (1.900 m S and 700 m W of the church-tower of Saint-Sauveur); also point 112 (E) 188 of the archives of the Geological Survey.

Visited July 1954.

Possibly **Sands of Mons-en-Pévèle.**

A poor exposure of fine-grained, greyish-green sand, slightly glauconitic and micaceous.

The wash residues of a taken sample contained some echinid spines and sponge spicules.

DO Saint-Sauveur, hollow roadside (1.900 m S and 600 m W of the church-tower of Saint-Sauveur); also point 112 (E) 226 of the archives of the Geological Survey.

Visited July 1954.

Possibly **Sandy Clays of Anderlecht.**

Small exposure of pale grey-green clay with some small sandstone pieces with fossil casts [DELVAUX, 1881, (archives of the Geol. Survey) reported *Nucula*]. The clay was slightly sandy and the wash residues of a sample contained some silex fragments and sponge spicules, but no foraminifera.

DP Saint-Sauveur, hollow roadside (2.050 m S and 350 m W of the church-tower of Saint-Sauveur); also point 112 (E) 227 of the archives of the Geological Survey.

Visited July 1954.

Perhaps **Sandy Clays of Anderlecht.**

A poor exposure of clayey sand with interbedded sandstone. Both were of grey-green colour, fine-grained, with quartz and glauconite.

The wash residues of a sample contained coarse silex fragments, lignite, etc.

DQ Saint-Sauveur, small excavation (1.150 m S and 450 m E of the church-tower of Saint-Sauveur); also point 112 (E) 246 of the archives of the Geological Survey.

Visited July 1954.

Sandy Clays of Anderlecht.

Exposure of silty, green-grey clay with intercalated sandstones of greyish-brown colour, with fossil casts (reported as *Nucula parisiensis* in the archives of the Geol. Survey).

The wash residues of a sample, with glauconite and much limonite, contained no foraminifera.

DR Saint-Sauveur, hollow roadside (1.350 m S and 600 m E of the church-tower of Saint-Sauveur); also point 112 (E) 248 of the archives of the Geological Survey.

Visited July 1954.

Sands of Vlierzele.

Sample of greenish-grey, clayey, glauconitic sand, with clayey patches and intercalated flat sandstone pieces with fossil casts.

Wash residues with sponge spicules, muscovite, silex fragments, etc.

SHEET GEERAARDSBERGEN

GA Roozebeeke, small excavation (300 m N and 700 m W of the church-tower of Roozebeeke); also point 85 (W) 540 of the archives of the Geological Survey.

Visited May 1954.

Probably **Sands of Lede.**

A poor exposure, at the bifurcation of the roads from Munkzwalm to Roozebeke and to Elst, with yellowish-brown, slightly clayey sand, that was fine-grained, with glauconite.

The sample contained no microfauna. Bone fragments, muscovite and much limonite were present.

GB Grootenberge, hollow roadside (50 m S and 1.350 m E of the church-tower of Grootenberge); also points 85 (W) 282 and 283 of the archives of the Geological Survey.

Visited May 1954.

Clays of Asse.

Exposure, at about +90 O.D. Oostende, of pale greyish-green, slightly silty clay. Present as unweathered patches in brownish, silty clay.

Sample **GB 1109** yielded wash residues with some foraminifera and ostracods.

GC Erwetegem, sandpit (1.100 m S of the church-tower of Erwetegem); also point 84 (E) 427 of the archives of the Geological Survey.

Visited June 1954.

Possibly decalcified **Sands of Lede.**

Under about 1 m of Quaternary loess, with an irregular base, some 3 m of sand were exposed. The sand was fine-grained and slightly clayey in the upper 2 m.

A sample from the basal part contained some shell fragments associated with limonite, pyrite and muscovite.

GD Erwetegem, sandpit (1.300 m S of the church-tower of Erwetegem); also point 85 (E) 426 of the archives of the Geological Survey.

Visited June 1954.

Probably **Sands of Lede.**

About 1 to 1,50 m was exposed. The sand was medium to fine-grained, green, with mica and glauconite, also some dispersed silex pebbles and clay lumps.

A sample yielded silex fragments, muscovite,pyrite, etc.

GE Ellezelles, railroadcut of the station (1.300 m N and 100 m W of the church-tower of Ellezelles); also point 99 (W) 7 of the archives of the Geological Survey.

Visited July 1954.

Clays of Roncq.

Exposure of greyish-brown to yellow, brittle clay with whitish, sandy spots (of some millimetres diameter), mainly consisting of hyaline quartz grains.

A sample contained some indeterminable foraminifera in addition to calcareous fragments, pyrite, etc.

GF Ellezelles, hollow roadside (1.250 m N and 850 m E of the church-tower of Ellezelles); also point 99 (W) 221 of the archives of the Geological Survey.

Visited July 1954.

Probably **Sandy Clays of Anderlecht.**

A poor exposure of yellowish-grey, sandy clay, with irregular, brownish bands, rich in limonite. A sample gave wash residues with some sponge spicules, etc.

GG Ellezelles, railroadcut (1.300 m N and 200 m E of the church-tower of Ellezelles); also point 99 (W) 37 of the archives of the Geological Survey.

Visited July 1954.

Possibly **Sands of Vlierzele.**

Alongside the railway some scattered sandstone pieces were found, mostly with a whitish and weathered surface, but unweathered of grey-green colour. Locally there were some ill-preserved fossil casts.

Some poor exposures of sand were found as well.

A sample yielded some sponge spicules, muscovite, glauconite, etc.

Possibly, pale-brown glauconitic clay was present under the sand.

GH Geeraardsbergen, abandoned sandpit (150 m N and 700 m E of the church-tower of Geeraardsbergen); also point 100 (W) 10 of the archives of the Geological Survey.

Visited July 1954.

Possibly **Sandy Clays of Anderlecht** and **Sands of Vlierzele.**

The ancient wall of the pit was almost completely overgrown and covered by debris. Some small exposures were found, such as:

3,50 m below the top: yellowish-grey, sandy and glauconitic clay with irregular brownish bands, rich in limonite;

1,10 m below the top: grey-green, glauconitic, medium-grained sand, equally rich in limonite.

Samples, taken from both exposures, yielded no foraminifera; the highest exposure yielded some sponge spicules and muscovite.

SHEET KORTRIJK

KA Luingne, claypit of the « Briqueteries Modernes » (950 m E of the church-tower of Luingne); also point 97 (W) 201 of the archives of the Geological Survey. See fig. 6.

Visited September 1953 and May 1954.

Clays of Roubaix.

Wall of silty, brownish-grey, with more intense brown colours upwards (more oxidized). The lower part contained some shell fragments and other calcareous remains; upwards quantities decreased.

Four foraminiferous samples (**KA 1092, 305, 1093, 306**). The wash residues yielded shell fragments, remains of calcareous algae, ostracods, echinid spines, sponge spicules, fish remains, radiolarians, bryozoan debris, muscovite and glauconite.

All the samples, except for KA 306, contained some nummulites.

KB Orroir, sandpit (1.250 m N and 500 m E of the church-tower of Orroir); also points 98 (W) 24 and 772 of the archives of the Geological Survey.

Visited September 1953.

Sands of Vlierzele and possibly **Sands of Lede.**

A wall of about 4 m, with at the base medium-grained sands. These sands were micaceous and rather glauconitic (with the glauconite concentrated in thin laminae). Current-bedding frequently occurred.

Some 50 cm above the base of the pit, the sand contained thin clay seams over another 50 cm. This clay was of pale-green colour, and more or less silty. The beds were of variable thickness and sometimes discontinuous.

Upwards again medium-grained, micaceous, greenish-yellow sand was found, which showed a distinct bedding by alternating layers of different glauconite contents.

The whole complex was strongly disturbed.

About 4 m above the bottom of the pit, fine-grained, green-grey, glauconitic sand was found, possibly representing the Sands of Lede.

The whole wall showed many bands rich in limonite, sometimes indurated.

KC Amougies, sandpit (1.400 m N and 200 m E of the church-tower of Amougies); also points 98 (W) 55 and 59 of the archives of the Geological Survey.

Visited September 1953.

Possibly **Sands of Vlierzele.**

About 5 m of sand covered by Quaternary loess.

The base of the section was formed by clayey sand of brownish-yellow colour, slightly micaceous, and with some glauconite (often more or less weathered).

Upwards the clay content decreased. From about 2 m from the base of the section onwards pure sand was encountered. The grain size was fine; the colour brownish-grey with white spots.

The uppermost sands were yellowish-white, fine-grained and with many irregular rusty-brown bands and spots. The latter were rather numerous in the entire section; locally they were indurated.

Several samples, but no foraminifera.

KD Ansegem, claypit of the « Briqueterie du Borreberg » (150 m N and 50 m E of the church-tower of Ansegem); also point 84 (W) 1355 of the archives of the Geological Survey. See fig. 6.

Visited September 1953.

Sandy Clays of Anderlecht passing into **Sands of Vlierzele.**

At the base of the pit sandy, glauconitic and micaceous clay was found, of greyish-green colour with some rusty-brown spots, and rusty-brown to yellow, more sandy patches. Upwards the rusty-brown patches slightly increased in number, and also the glauconite contents of the clay increased. At about 1,50 m to 2 m above the base the colour gradually changed in olive-green, and 2,50 m from the base shell remains (mainly fossil casts) and pyrite were found.

Still higher the sandy clay passed into clayey sand, in which two whitish sandstone beds, of variable thickness (3-6 cm) were met with. They contained some fossil casts. Sometimes some gravel overlay the sandstone.

The uppermost sand was less clayey, thin-bedded and rather micaceous.

The samples contained no foraminifera.

Already GULINCK (1951, archives of the Geol. Survey) reported some indications of disturbed bedding planes, perhaps due to worm action. He found silicified wood remains at the levels of the sandstone beds.

KE Mouscron, claypit of the « Briqueterie Du Croisé » (500 m N and 650 m W of the church-tower of Mouscron).

Visited May 1954.

Clays of Roubaix.

The lower part of the 2,70 m wall showed brownish-grey, silty clay with shell fragments. Some 2 m from the top the clay got more brown and weathered.

Two samples were taken from the lower, unweathered clay. Both were rich in remains of calcareous algae, furthermore some fragments of nummulites, and shell debris. The fragments of nummulites were the only foraminiferal remains.

KF Moen, claypit of the « Briqueterie De Meester » (300 m S and 300 m W of the church-tower of Moen).

Visited May 1954.

Clays of Roubaix.

Some 8 m of silty clay to clayey sand, at the base dark-grey, higher upward paler. About 5,50 m from the top the clay became brown and oxidized. The clay was micaceous and of variable silt content.

Three samples were taken; all three had a rather small microfauna.

Sample **KF 1094**, taken at the base of the pit, from very silty clay, with bryozoan debris, shell fragments, sponge spicules, pyritised lignite particles, etc.

Sample **KF 1095**, about 7,20 m below the top, was taken from a silty clay with about the same components as 1094, but with less organic debris, though some fragments of nummulites.

Sample **KF 1096**, 6 m from the top, from very silty, pale-grey clay. The wash residues contained foraminifera (amongst others, some nummulites), some ostracods (*Cytherella* sp.), shell fragments, fish remains, echinid spines, sponge spicules, pyritised lignite, etc.

KG Moen, claypit of the « Briqueterie Moderne » (2.750 m N and 850 m W of the church-tower of Moen).

Visited May 1954.

Clays of Ieper with a gradual transition into **Sands of Mons-en-Pévèle** or **Clays of Roubaix.**

The lower part of the section was described from the southern part of the pit; the top from the northern part.

The basal part of the pit was formed by plastic clay; about 12 m below the grass. The clay was grey-green, pyritiferous, gypsiferous and slightly micaceous. Some small septaria (about 10 cm diameter) were found.

The wash residues of a sample from the base of the section yielded some shell fragments and bone remains.

Upwards the clay showed a very gradual increasing silt content. A sample from this silty clay (4,30 m above the previous one), yielded shell fragments and fish remains.

From 6 m below the top onwards the clay became more and more brownish (oxidation). The wash residues of a sample from this level yielded some sponge spicules, bone fragments, muscovite and scarce glauconite.

In the brownish clay a further increase of the silt content was found. At 4 m from the top it had changed into very clayey and very fine-grained sand.

These upper sands were sampled in the northern part of the pit, where they occurred unweathered. The wash residues were rich in glauconite and limonite, also muscovite, sponge spicules, radiolarians, etc., were found.

Whether these very clayey sands belong to the Sands of Mons-en-Pévèle or to the Clays of Roubaix is more or less uncertain.

KH Knokke, abandoned sandpit (1.600 m S and 1.750 m E of the church-tower of Zwevegem).

Visited May 1954.

Probably **Clays of Roubaix.**

The two uppermost metres of the old wall were still exposed. They showed very silty, laminated clay, with some current-bedding.

Two samples were taken; one at the base, and the other 1 m below the surface. The lower one showed fragments of *Lingula tenuis* and some fossil casts. The wash residues of both samples yielded shell fragments, bone remains, etc.

KJ Zwevegem, claypit of the « Briqueterie Ernest Dumoulin » (400 m N and 100 m W of the church-tower of Zwevegem).

Visited May 1954.

Clays of Ieper.

A wall of 3,30 m high, with the upper 1,50 m formed by Quaternary loess, and oxidized, weathered, brown, silty clay.

The lower part was formed by yellowish-grey to green clay, more or less silty near the contact with the weathered clay and a decreasing silt content lower down.

Two samples, one near the base of the exposure (3,10 m below the top), the other under the contact with the oxidized clay (1,70 m from the top) yielded wash residues with some glauconite and muscovite, etc.

KK Tiegem, sandpit (700 m N and 1.400 m W of the church-tower of Tiegem).

Visited May 1954.

Sands of Vlierzele.

Exposure of about 6 m, the lower 5,50 m formed by more or less glauconitic sands, covered by 0,50 m of Quaternary loess.

At the base of the section we observed medium-grained, brownish-yellow sand, with glauconite and muscovite. The quartz grains of this sand were mainly angular.

No bedding was visible in the lower part, upwards it was more apparent by laminations caused by variable glauconite content and by intercalated thin clayey beds.

Upwards the sand became coarser and greener (less limonite), also pyrite was found. In these upper 3,80 m the sands were distinctly cross-bedded (faintly at the base, more distinctly so higher up), with the dominant direction of the bedding planes towards the NE to E.

None of the taken samples yielded a microfauna.

KL Russeignies, sandpit (1.550 m N and 500 m E of the church-tower of Russeignies).

Visited July 1954.

Probably **Sands of Vlierzele.**

Under 30 cm of Quaternary loess with some scattered pebbles (mainly silex) at the base, 4,70 m of sand were exposed, with an intercalated clay lens of maximally 90 cm thickness.

The base of the exposure was formed by fine-grained, yellowish-brown to green sand, with mica and glauconite. Higher up it showed some clay lumps scattered at random. The upper part of this lower sand contained many rusty-brown bands.

At the top of the sand (1,70 m to 2,50 m from the base) there was a layer of pale-grey to green clay. This clay had an oblique base, with in the southern part of the pit the base 80 cm lower than it was in the northern part, with a distance between both points of about 50 m. The clay contained some greener, sandy parts and many brown, limonitic spots and irregular bands.

Overlying the clay (thickness of 10-90 cm) again sand was found. In the sand dispersed, discontinuous limonitic, brown claybeds of some cm thickness occurred. At its base this sand began with 15 cm of clayey sand of green-brown colour. Upwards it contained more glauconite, and less clay.

Probably we were dealing with the Sands of Vlierzele, which in this region contains clayey lenses at the transition towards the underlying, locally more sandy, Sandy Clays of Anderlecht.

KM Kwaremont, abandoned sandpit (1.150 m S and 950 m E of the church-tower of Kwaremont).

Visited July 1954.

Probably **Sands of Lede.**

The top of this old sandpit was formed by 30 cm of Quaternary loess, that covered 3,50 m of sand with many current-bedding features and some intercalated claybeds.

The current-bedding in the sand always had a southern direction with a maximal dip of 24°. The layers with the current-bedded laminae were rather variable in thickness, up to 55 cm.

The sands were often more or less salmon-coloured, with the bedding mostly visible by colour variations caused by variations of the glauconite or limonite contents. Perhaps there was also less conspicuous variation in the grainsize of the various layers.

Flat, clayey particles of some mm length occurred dispersed in the sand. Furthermore three claybeds, mostly brown, with a maximal thickness of 5 cm were horizontally intercalated. The lower 25 cm, and the upper 50 cm of sand were without current-bedding.

Some samples yielded wash residues with rather angular quartz grains in addition to muscovite, limonite, glauconite, sponge spicules, etc.

KO Kwaremont, hollow roadside (650 m S and 200 m E of the church-tower of Kwaremont); also point 98(E) 36 of the archives of the Geological Survey.

Visited July 1954.

Literature :

M. LERICHE, 1940, Bull. Soc. belge Géol., vol. 50, pp. 214-216.

Perhaps **Sands of Lede.**

A poor exposure, at the base with some 10 cm of green, sandy clay, locally enriched in lime (whitish parts of the clay). On top 3 m of salmon to green sand with current-bedding was found. This sand was fine-grained, with much limonite and glauconite.

A sample, from the basal clay, yielded sponge spicules, muscovite, etc., but no foraminifera.

KP Ruien, hollow roadside (1.250 m S and 150 m E of the church-tower of Ruien); also point 98 (W) 162 of the archives of the Geological Survey.

Visited July 1954.

Possibly belonging to the upper part of the **Sandy Clays of Anderlecht**, close to the transition into the Sands of Vlierzele.

In the roadside was exposed dark-green clayey sand, rich in glauconite. Downwards it passed into a sandy clay.

SHEET LEUVEN

LAA Bertem, hollow roadside (1.700 m N and 2.350 m E of the church-tower of Bertem); also point 89 (E) 28 of the archives of the Geological Survey.

Visited June 1954.

Probably **Sands of Brussels** or Sands of Lede (the poor fauna indicated either the Sands of Brussels or those of Lede).

A poor exposure, at about +47 O.D. Oostende, of more or less calcareous, fine-grained sands.

Sample **LAA 1127** was taken from a calcareous part in whitish, glauconitic sand, with some shell fragments (mainly *Ostrea*). The wash residues contained a poor microfauna and many organic remains, such as calcareous algal fragments and bryozoan debris.

LAB Heverlee, abandoned sandpit (250 m S and 1.300 m E of the church-tower of Heverlee).

Visited June 1954.

Sands of Brussels.

In the northern part of this old pit a section was exposed of some 2,50 m high, of strongly current-bedded sands. The sand was rather coarse-grained, glauconitic, and of greenish to brownish-green colour. It contained sometimes sandstone pieces of flat or capricious form, which were of grey-whitish colour.

The current-bedded sands were in layers of about 20 cm thickness, alternating with more or less horizontally bedded sands of about 10 cm. The overall inclination was towards the NE.

No samples were taken.

LAC Blanden, hollow roadside (1.350 m N of the church-tower of Blanden).

Visited June 1954.

Sands of Lede.

Poor exposure, at about +53 O.D. Oostende, of fine-grained, grey-white, calcareous sands with some soft, very sandy limestone pieces.

Sample **LAC 1128** yielded wash residues with a rich microfauna and many other organic remains (shell fragments, echinid spines, bryozoan debris, sponge spicules). The foraminifera were strongly incrustated with secondary $CaCO_3$.

LAE Blanden, hollow roadside (200 m S and 300 m W of the church-tower of Blanden); also point 89 (E) 69 of the archives of the Geological Survey.

Visited June 1954.

Probably **Sands of Brussels** or Sands of Lede.

A poor exposure, at about +65 O.D. Oostende, with fine-grained, calcareous, grey-white sands with some tiny shell fragments.

Sample **LAE 1130**, taken from this sand, yielded a fairly rich microfauna in addition to shell fragments, bryozoan debris, echinid spines, sponge spicules, etc.

LAF Pécrot, abandoned sandpit (600 m N and 150 m E of the church-tower of Pécrot, municipality of Bossut-Gottechain); also point 103 (W) 120 of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

In the old sandpit there was a section of about 3,70 m of sands covered by about 80 cm of Quaternary loess.

The lowermost 2,30 m were formed by medium to fine-grained, brownish-yellow to green sands, more or less glauconitic, with sandstone concretions of capricious or flattened forms. These pieces were calcareous, occasionally they contained shell fragments. The bedding was indistinct. Interstratified there were five sandstone beds, more or less discontinuous. The basal ones were more or less calcareous, with shell fragments, and with some string-like marly parts.

The higher part, of about 1,40 m, showed irregular cross-bedding. Two fragmented and brittle sandstone layers occurred in the sand. Also a rusty-brown clayey bed of 15 - 20 cm was intercalated, at about 60 to 100 cm from the base of this part of the section. These upper sands were distinctly brown, with decreasing intensity of the colour lower down. There were concentrations in 2 to 5 cm rusty-brown bands.

LAG Archennes, sandpit (300 m N and 300 m W of the church-tower of Archennes); also point 103 (E) 74 of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

A wall of about 6 m of grey-green sand, with much current-bedding, in which the dip was towards the NNE. Intercalated there were more horizontally bedded parts; some more or less horizontal, discontinuous sandstone layers, and some rusty-brown bands.

A sample from the base of the current-bedded sands (western wall) was taken in medium to coarse-grained sands, with silex fragments, scarce glauconite, muscovite, etc.

LAH Saint-Remy-Geest, old store of the so-called « Grès de Gobertange » (700 m N and 300 m W of the church-tower of St. Remy-Geest); also point 104 (W) 12 of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

Some limestone pieces in this old store had a soft, weathered outer part. A sample was taken by scraping off some of the stones. The limestone itself was sandy, yellowish-white exteriorly and grey-white inside, and contained some casts of *Lucina volderiana*, and a number of dispersed glauconite grains.

The wash residues of sample **LAH 1136** contained a rather rich microfauna (among which some nummulites; covered by secondary $CaCO_3$), associated with echinid remains, bryozoan debris, sponge spicules, etc.

LAJ Saint-Remy-Geest, shallow ditch along road (650 m N and 400 m W of the church-tower of Saint-Remy-Geest); also point 104 (W) 12 of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

Quaternary loess (50 cm) covered brittle sandy limestone of 20 cm, that overlay softer sandy limestone. The latter (sample **LAJ 1137**) was yellowish-white, with rare glauconite, and possibly mixed with some of the overlying loess.

The wash residues contained some foraminifera, shell remains, bryozoan debris and echinid spines, etc.

LAK Gobertange, old store of the so-called « Grès de Gobertange » (900 m S and 650 m W of the church-tower of Saint-Remy-Geest); also point 104 (W) 127 of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

Sample **LAK 1138** consisted of some pieces of soft, weathered, sandy, yellowish-white limestone. It contained some casts of *Lucina volderiana*.

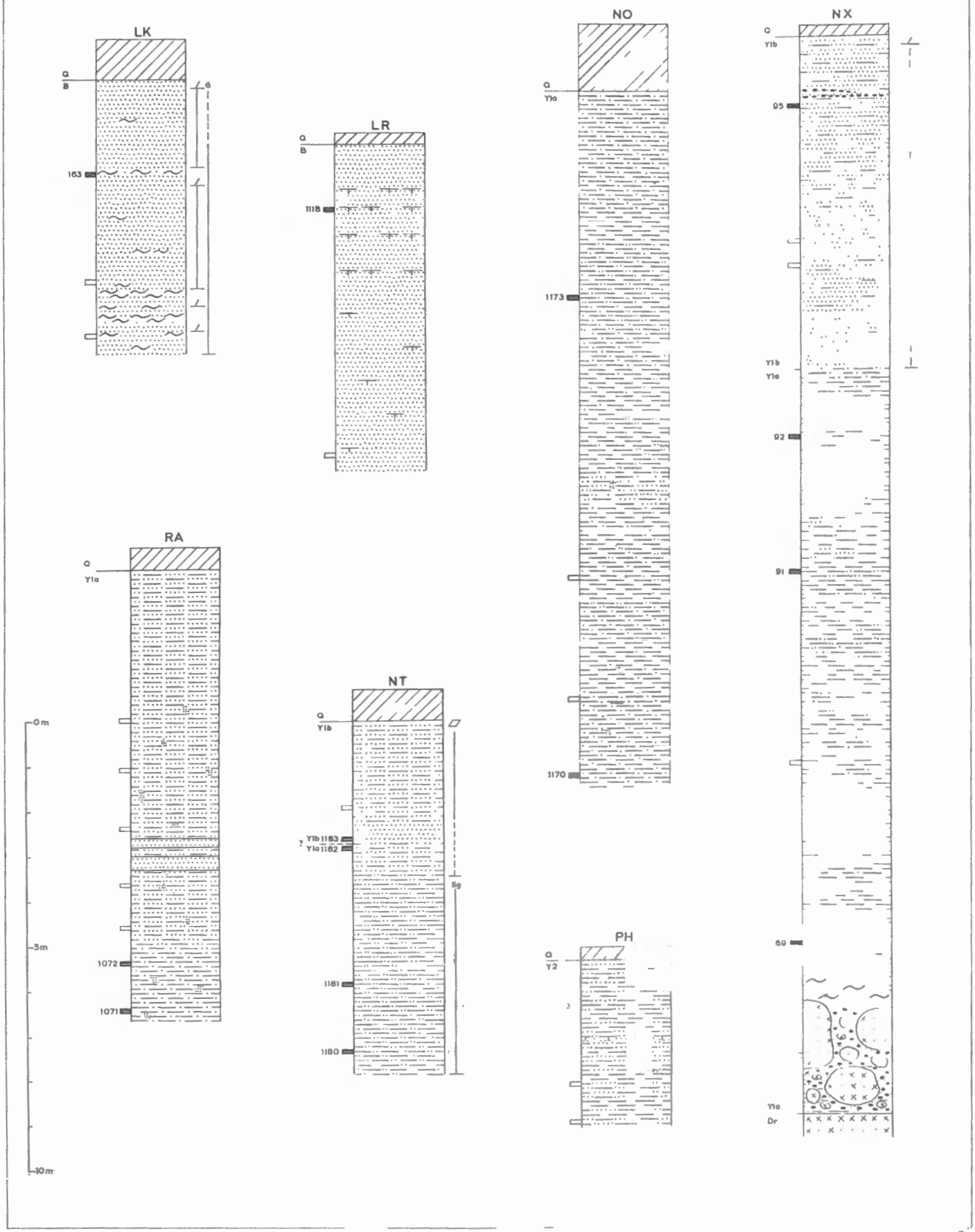
The wash residues contained a fairly rich microfauna, associated with many other organic remains.

LB Korbeek-Loo, hollow roadside (250 m S and 2.050 m W of the church-tower of Korbeek-Loo).

Visited August 1953.

Sands of Brussels.

Along the southern side of the road, at about +40 to +50 O.D. Oostende, some small and mostly poor exposures of calcareous sands were found, with intercalated discontinuous sandy limestone beds.


LK
Q
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1173
1170
NX
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92
91
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5m
10m
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1071
NT
Q
Ylb
Ylb 1183
Ylc 1182
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1180
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FIG. 9.

The limestones were of greyish-white colour and rich in shell fragments. Mostly they contained thin marly intercalations (of some millimetres thickness and some millimetres length).

From one of the exposures samples **LB 124** and **LB 125** were taken, at a mutual distance of 3,50 m and with LB 125 about 80 cm below the base of the Quaternary loess. Both samples consisted of rather fine-grained, calcareous, pale green-grey sands, more or less glauconitic and micaceous. The wash residues yielded many shell fragments (such as *Ostrea* and gastropods), echinid spines, bryozoan debris, sponge spicules, bone fragments (probably fish remains), some foraminifera and ostracods.

LK Hoegaarden, sandpit behind the brewery « Hoegardia » (600 m N and 50 m W of the church-tower of Hoegaarden). See fig. 9.

Visited August 1953.

Literature :

M. LERICHE, 1922, Congrès Géol. Internat., Belgique, Livret-Guide, Exc. A 4, pp. 21,22.

Sands of Brussels.

The lower part (1,25 m) of the section was formed of alternating, medium to coarse-grained, glauconitic sands and marly beds. The sands were mostly more or less calcareous, with some shell fragments, and distinct cross-bedding (the bedding was partly apparent from thin marly lenses). Between these sandlayers more marly sands were intercalated. They were mostly yellowish, with interstratified non-marly, very thin sandy layers, which increased in number and thickness towards the top of these marly sands.

A sample near the base of the complex, from a marly glauconitic sand, yielded many coarse elements in the wash residues, such as well-rounded quartz grains, glauconite, silex fragments, sandstone-pieces, and some shell fragments.

On top followed some 4,50 m of glauconitic, sometimes marly, cross-bedded sands, with some interstratified marly lenses (of some centimetres thickness and some decimetres length). There were also more continuous, horizontal, sandy marls and marly limestones.

A sample from the base of these cross-bedded sands was taken from a marly, glauconitic sand with shell and coral fragments. The wash residues contained many coarse elements.

About 2,50 m above the base of this sand sample **LK 163** was derived from an interstratified yellowish-white marly bed of about 10 cm thickness. The wash residues yielded a rich microfauna, associated with remains of calcareous algae, sponge spicules, radiolarians, echinid spines, bryozoan debris, some shell fragments, and also coarse, well-rounded quartz grains.

LR Huldenberg, sandpit 1.100 m S and 1.700 m W of the church-tower of Huldenberg). See fig. 9.

Visited June 1954.

Sands of Brussels.

The lower part of the section was formed by medium-grained, yellowish-green sand with some scarce shell fragments. The latter were concentrated in small, whitish patches of 3 to 5 cm diameter. Many sandstone concretions of capricious form («Pierres de grottes» and «Grès fistuleux») and occasionally marly patches occurred dispersed in the sand.

The higher part consisted of more or less glauconitic, brownish-green sands with a number of discontinuous sandstone beds of variable thickness (max. 15 cm). No calcareous remains were found in this sand, but in the sandstones some calcareous places did occur.

Some samples of dispersed sandstone pieces from the lower part of the section appeared to be rich in sponge spicules. Some foraminifera occurred, but the specimens were too ill-preserved for specific determination.

Sample **LR 1118**, taken from some calcareous spots in one of the sandstone beds, yielded some foraminifera (mostly siliceous casts) and ostracods, also some shell fragments, bryozoan debris and many sponge spicules.

LS Huldenberg, hollow roadside (1.250 m S and 1.600 m W of the church-tower of Huldenberg); also point 103 (W) 25 of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

A poor exposure of calcareous sand in between two sandy limestone banks of 5 to 10 cm thickness.

Sample **LS 1119** was taken from grey-white, slightly micaceous, fine-grained sand with sponge spicules. The wash residues delivered a fairly rich microfauna and many other organic remains, such as echinid spines, fish remains, bryozoan debris, radiolarians.

LT Huldenberg, abandoned sandpit (800 m S and 350 m E of the church-tower of Huldenberg); also point 103 (W) 19 of the archives of the Geological Survey.

Visited June 1954.

Probably **Sands of Brussels.**

A sample could be taken from rather coarse, rusty-brown to yellow sands with more or less altered glauconite and coarse silex fragments.

LV Vossem, hollow roadside (300 m S and 850 m E of the church-tower of Vossem); also point 89 (W) 26 of the archives of the Geological Survey.

Visited June 1954.

Probably **Sands of Lede.**

A poor exposure, in the western side of the road, at about +76 O.D. Oostende, showed fine-grained calcareous sand with some glauconite.

Sample **LV 1122** yielded a rather rich microfauna, shell fragments, bryozoan debris, sponge spicules and radiolarians.

LW Vossem, small sandpit (700 m E of the church-tower of Vossem).

Visited June 1954.

Sands of Brussels.

The wall of about 2,50 m was formed by about 50 cm of Quaternary loess over 2 m of medium-grained sands.

The sands were yellowish in the upper part with some calcareous spots of pale-grey colour. Downwards the latter increased in number and size. About 1,30 m below the loess, the sands appeared to be entirely calcareous. Throughout there were dispersed sandstone concretions of capricious form.

Sample **LW 1123**, taken at 2,30 m below the grass, yielded wash residues with a small microfauna as well as other organic remains, such as shell fragments, echinid spines, bryozoan debris, sponge spicules, radiolarians, etc.

LX Leefdaal, hollow roadside (200 m S and 1.200 m W of the church-tower of Leefdaal); also point 89 (W) 86 of the archives of the Geological Survey.

Visited June 1954.

Sands of Lede (MOURLON, 1890, archives of the Geol. Survey).

In both sides of this hollow road fine-grained, yellow-brown quartz sands were exposed.

A sample from the southern side of the road, at about +86 O.D. Oostende, yielded wash residues rich in limonite and muscovite.

LY Bertem, abandoned sandpit (150 m N and 650 m E of the church-tower of Bertem).

Visited June 1954.

Sands of Brussels.

Under a covering of 1 m of Quaternary loess, the lower 50 cm with much gravel, 1,75 m of sands were exposed.

The sand was medium-grained, glauconitic and green-grey, with some rusty-brown bands. Some whitish calcareous patches occurred.

From such a spot sample **LY 1125** was taken, about 25 cm below the base of the Quaternary. The wash residues yielded a small microfauna (the foraminifera were strongly incrustated by $CaCO_3$; frequent siliceous casts), some shell fragments, echinid spines, sponge spicules, etc.

LZ Bertem, hollow roadside (2.000 m E of the church-tower of Bertem); also points 89 (E) 27 and 27*a* of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

A poor exposure, at about +40 O.D. Oostende, of calcareous sands with capricious sandstone concretions («Pierres de grottes»).

Sample **LZ 1126** was from yellowish-white, medium-grained, calcareous sand with some shell fragments. The wash residues contained a rather rich microfauna and other organic debris.

SHEET PLOEGSTEERT

LLA Ploegsteert, claypit of the « Briqueterie La Lys » (950 m S and 3.050 m E of the church-tower of Ploegsteert); also point 110.12 of the archives of the Geological Survey.

Visited May 1954.

Clays of Roubaix.

About 3 m below the grass very silty clay of dark-grey colour was exposed, with some muscovite and shell fragments. Upwards the clay was less silty and of greener colour.

Sample **LLA 1087**, 3,20 m below the grass, yielded a rather rich microfauna, associated with shell fragments, nummulites, sponge spicules, radiolarians, etc.

SHEET MECHELEN

MB Moorsel, hollow roadside (1.100 m N and 150 m E of the church-tower of Moorsel).

Visited May 1954.

Clays of Asse.

Newly-constructed road with fresh sides.

Exposed was greenish, plastic clay with rusty-brown sand patches of some millimetres diameter, mainly quartz.

The wash residues of the sample yielded some glauconite, radiolarians, etc.

MC Meldert, abandoned sandpit (50 m S and 600 m E of the church-tower of Meldert).

Visited May 1954.

Sands of Lede.

The old wall was strongly overgrown and covered by debris. A small pit had to be dug for a fresh exposure.

Exposed was sandy limestone, of about 40 cm thickness, covered by Quaternary loess. The limestone bank was more or less discontinuously developed and overlay yellowish-white, fine-grained, calcareous sand, with nummulites and shell fragments, such as *Ostrea*, *Pecten*.

Sample **MC 1040**, of the sand, yielded a rather rich microfauna in addition to many other organic remains, such as bryozoan debris, echinid remains, *Ditrupa*, fish remains, sponge spicules, radiolarians, etc.

SHEET MONS

MME Cuesmes, abandoned sandpit on the western side of the Mont Eribus (900 m E of the church-tower of Cuesmes); also point 151 (W) 28 of the archives of the Geological Survey.

Visited May 1953.

Literature :

A. RUTOT, 1903, Bull. Soc. belge Géol., vol. 17, mem., pp. 431-434.

Clays of Ieper.

In the northern part of the old pit, east of the railroad Mons-Ciply, some poor exposures of sandy clay were found. Two foraminiferous samples were taken in a small exposure of 1,50 m high, about 5 m above the bottom of the pit.

The base of the exposure was formed by sandy clay, higher up there was a gradual transition into clayey sand interstratified with some plastic clay seams of 2 to 5 mm thickness.

Sample **MME 27**, of green-grey clay with some patches of yellow-brown sand, contained some foraminifera. About 5 m above the bottom of the pit.

Sample **MME 28** was taken from green-grey, clayey, glauconitic sand, with some tubulations, of about 2 mm diameter, filled with greyish-white sand. The sand was fairly rich in limonite and contained some ill-preserved foraminifera and some bone fragments (probably fish remains). 1,50 m above MME 27.

MMF Hyon, sandpit « Malengrez » on the southern side of the Mont Eribus (1.500 m W and 1.100 m S of the church-tower of Hyon).

Visited May 1953.

Literature :

A. RUTOT, 1903, Bull. Soc. belge Géol., vol. 17, mem., pp. 431-434.

Sands of Grandglise and **Clays of Ieper.**

Under Quaternary loess some 2,50 m of clays were exposed, covering about 7 m of sands.

The lowermost part of the sand was formed by grey-green, glauconitic, slightly clayey, fine-grained sand, with some tubulations (probably of annelids) filled with grey-white sand.

Upwards a decrease of the clay and glauconite was found, the colour became paler, and there was a gradual change into medium-grained sands. Also the number of tubulations increased. About 4 m below the contact with the overlying clay there was a layer of rusty-brown patches.

The contact of sand and clay was sharp, regular and horizontal. Directly above it brownish, weathered sandy clay was met with, containing some small spots of yellowish-brown sand. Higher upward the clay remained sandy, but it showed unweathered grey-green patches and spots of whitish sand, up to 5 mm diameter.

A sample, some centimetres above the contact, contained no microfauna, but it yielded many silex fragments.

Sample **MMF 33**, 1,80 m from the contact of sand and clay, contained some foraminifera.

MMT Hyon, hollow roadside (300 m N and 1.350 m E of the church-tower of Hyon); also point 151 (E) 231 of the archives of the Geological Survey.

Visited May 1953.

Probably the passage from **Sandy Clays of Anderlecht** into the **Sands of Vlierzele.**

Poor exposure, at about +85 O.D. Oostende, of greenish, slightly micaceous and glauconitic, clayey sand with sandstone pieces. The latter were hard and blue, weathered ones had a yellowish-white colour.

A sample near the level of the sandstone, 75 cm below the Quaternary coverings, yielded sponge spicules.

MMU Hyon, hollow roadside (400 m N and 750 m E of the church-tower of Hyon); also points 151 (E) 38 and 381 of the archives of the Geological Survey.

Visited May 1953 and July 1954.

Literature :

A. RUTOT, 1903, Bull. Soc. belge Géol., vol. 17, mem., pp. 461-462.
A. LEDOUX, 1911, Ann. Soc. Géol. Belg., vol. 38, mem., p. 163.

Sands of Vlierzele.

In the northern side of this road on the hill of the «Bois de la Haut» there was an exposure of grey-green sand with many irregular rusty-brown spots and stripes. The medium-grained sand was more or less clayey, with decreasing clay contents upwards.

A sandstone bed of about 20 cm thickness was found intercalated. It was of bluish-grey colour, and fairly rich in glauconite.

Sample **MMU 78** was taken just above the sandstone, about 3 m below the grass. The wash residues contained some ill-preserved foraminifera, radiolarians, etc.

Another sample, from about the same stratigraphic level, at some 60 m southward of the previous one, composed of weathered sandstone pieces, yielded only some bone fragments (probably fish remains) and sponge spicules.

MMV Hyon, hollow roadside (400 m S and 700 m E of the church-tower of Hyon); also points 151 (E) 37 and 382 of the archives of the Geological Survey.

Visited May 1953 and July 1954.

Literature :

A. RUTOT, 1903, Bull. Soc. belge Géol., vol. 17, mem., pp. 461-462.

Sands of Mons-en-Pévèle.

In the western side of this hollow road, in the southern part of the hill of the «Bois de la Haut», there was an exposure of about 1,50 m with fine-grained, grey-green sand. The basal sands were very clayey and contained many nummulites. The nummulites were often concentrated in pockets or small layers. Upwards the clay content decreased and less nummulites were found, the colour becoming yellowish-green.

From these sands the following samples were taken : **MMV 79**, of very clayey, greenish, fine-grained sand, with a rich microfauna with many nummulites, associated with fish remains, echinid spines, radiolarians, etc.

Sample **MMV 1201** from the same level as MMV 79; the wash residues also with a rich microfauna and many organic remains.

Sample **MMV 80** was taken from clayey sand with less nummulites, about 1 m above MMV 79. The wash residues contained a rich microfauna and the same other components as the previous two samples.

MMW Hyon, hollow roadside (500 m N and 650 m E of the church-tower of Hyon); also point 151 (E) 39 of the archives of the Geological Survey.

Visited May 1953.

Literature :

A. RUTOT, 1903, Bull. Soc. belge Géol., vol. 17, mem., p. 462.
A. LEDOUX, 1911, Ann. Soc. Géol. Belg., vol. 38, mem., p. 162.

Sandy Clays of Anderlecht passing into **Sands of Vlierzele.**

In the southern side of this hollow road, in the western part of the hill of the «Bois de la Haut», some samples were taken from sandy clays passing into clayey sands.

Sample **MMW 84** was taken at about +55 O. D. Oostende. It consisted of sandy, green-grey clay with rusty-brown spots and stripes, and contained sandstone pieces and shell fragments. The wash residues yielded some foraminifera, bryozoan debris, echinid spines, sponge spicules, etc.

Upwards this clay passed into clayey, glauconitic sand of greyish-green colour. Sandstone pieces with fossilcasts and shell fragments (as *Pinna margaritacea*) were visible as an indistinct layer of about 7 cm thickness.

Sample **MMW 85**, 1,30 m above MMW 84, contained some foraminifera, sponge spicules, echinid spines, etc.

Upwards the clay content decreased further and the grain-size of the sand became coarser.

At about +60 O.D. Oostende, we found slightly clayey sand with sandstone beds of a thickness of about 7 cm, again with fossilcasts and shell fragments.

SHEET NIVELLES

NA Esschenbeek, sandpits « Denayer » and « Louis Marcelis » (800 m S of the church-tower of Esschenbeek).

Visited September 1953.

Sands of Brussels.

The lower 8 m of this section were sampled in the sandpit « Denayer », the upper 9 m in that of «L. Marcelis».

The base of the section was formed by brownish-green, fine-grained, clayey sand, rich in limonite. A sample, from this level, contained some foraminifera, associated with some calcareous remains, etc.

This sand continued over about 2 m and was covered by fine-grained, sandy gravel, mainly consisting of silex.

Higher on the grainsize of the sand became coarser. It contained some sandstone pieces of capricious form.

Still higher upwards clay particles of some mm length were found. About 5,50 m above the mentioned sample began a series of alternating yellow, medium-grained sands and brown-yellow, fine-grained sands, which showed distinct current-bedding. The yellow sand contained some small clay lenses and irregular sandstone pieces.

This type of sands continued upwards, but with a more regular bedding.

About 8,50 m above the base of the pit a clayey band was observed, which again was covered by medium to coarse-grained sands with many sandstone concretions. The wash residues of some samples were very rich in hyaline, mostly angular quartz grains.

Higher on many limonite bands were found in this upper sandy complex of about 9 m with a fairly regular bedding. Towards the top of the section the colour became paler to whitish.

NB Wauthier-Braine, sandpit (250 m N and 1.900 m E of the church-tower of Wauthier-Braine); also point 116 (W) 132 of the archives of the Geological Survey.

Visited September 1953.

Sands of Brussels.

An excavation at the bottom of the pit yielded an additional section of some 3 m. At the bottom of this excavation we observed slightly clayey sand, brownish-green with some whitish, calcareous patches and larger, brownish spots.

Sample **NB 401** of this level yielded some foraminifera, sponge spicules, echinid spines, glauconite, muscovite, etc.

In the next metre upward the whitish spots gradually disappeared, also the brownish spots grew absent. The clay content slightly decreased.

The wash residues of sample **NB 403**, 2,40 m above NB 401, contained some foraminifera and ostracods, associated with other organic remains, such as shell fragments, sponge spicules, etc.

The upper part of the wall, of about 13 m, was formed by yellowish sands, mainly quartz with some glauconite.

NC Braine-l'Alleud, abandoned sandpit « Flamant » (500 m S and 250 m E of the church-tower of Braine-l'Alleud); also point 116 (W) 213 of the archives of the Geological Survey. See fig. 10.

Visited September 1953.

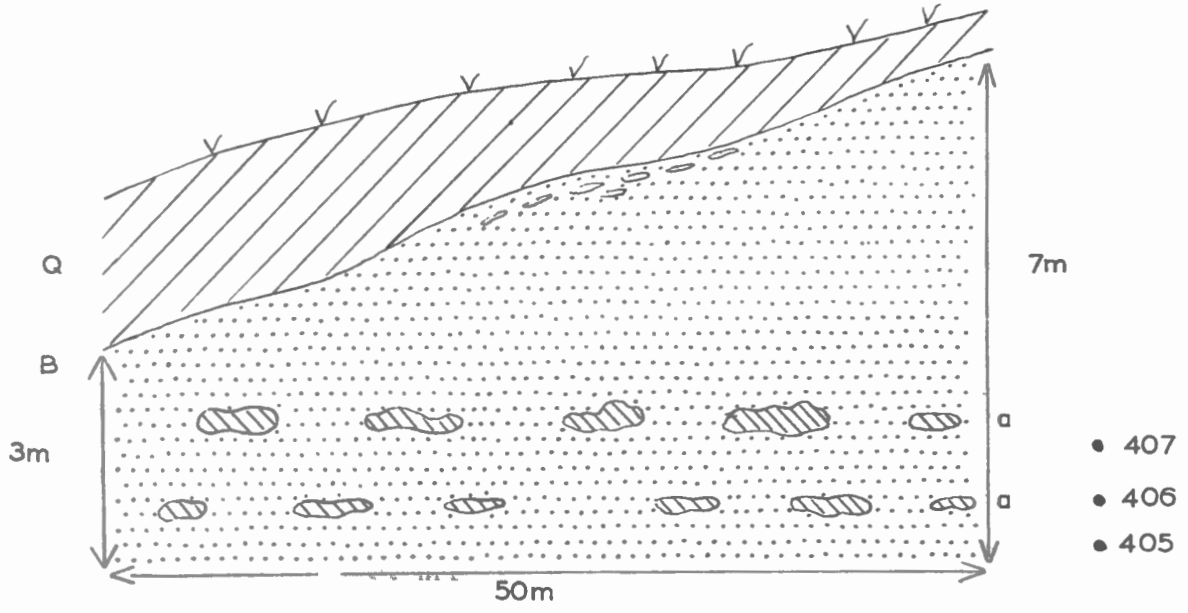

FIG. 10. — Schematic section of NC, Braine-l'Alleud
(after the archives of the Geological Survey of Belgium).

Sands of Brussels.

The more or less covered walls of the pit did not allow for an accurate section. For this reason the section in the archives of the Geological Survey (VERDIN) is figured with the supposed position of the foraminiferous samples (fig. 10).

The base of the section was formed by grey-green, fine-grained, calcareous sand with some glauconite. Upwards two discontinuous sandy limestone banks (a in the fig. 10) were found, each with a

maximal thickness of 20 cm, and composed of the same material as the sand, but more calcareous. On top of the upper one the sand appeared decalcified, green, fine-grained, with some glauconite and muscovite.

The samples **NC 405**, **406** and **407** contained rich microfaunae, shell fragments (mainly *Ostrea*), echinid remains, bone fragments, many sponge spicules, bryozoan debris, radiolarians. The foraminifera of NC 406, of the level of the lower limestone, were strongly covered by secondary $CaCO_3$.

ND Genappe, hollow roadsides (650 m N and 50 m W of the church-tower of Genappe).

Visited September 1953.

Sands of Brussels.

There were two exposures along the road Charleroi-Brussels. In the southern one calcareous sands were exposed over about 3 m height; in the northern one the same sand was found, but here it appeared decalcified.

The calcareous sand was of pale-yellowish colour and fine-grained, with some more or less rusty-brown bands. In the sand also some pieces of limestone, possibly in a discontinuous layer. Also some «Grès fistuleux» were present.

Two samples (**ND 410** at the base of the exposure, **ND 411** about 2,80 m higher) appeared rich in incrustated foraminifera, associated with echinid remains, radiolarians, ostracods, sponge spicules, bryozoan debris, shell fragments, fish remains, some debris of calcareous algae, etc.

Sample **ND 412** was taken from the greyish-green, fine-grained, decalcified sands which contained more or less calcareous spots. The wash residues yielded some foraminifera and other organic remains.

NE Glabais, hollow roadside (800 m N and 500 m W of the church-tower of Glabais); also point 129 (E) 6 of the archives of the Geological Survey.

Visited September 1953.

Literature :

M. MOURLON, 1891, Bull. Acad. r. Sc. Belg., ser. 3, vol. 22, no. 8, p. 107; no. 11, pp. 387-390; 1895, Ann. Soc. r. Malac. Belg., vol. 30, mem., p. 25.

G. VINCENT and J. COUTURIAUX, 1891, Bull. Acad. r. Sc. Belg., ser. 3, vol. 22, no. 12, pp. 521-528.

Sands of Lede.

A poor exposure of more or less clayey, greenish-brown, medium-grained sand with much limonite and some fossil casts (MOURLON found typical fossils of the Sands of Lede among the casts).

NG Maransart, sandpit (1.050 m N and 150 m E of the church-tower of Maransart); also point 116 (W) 127 of the archives of the Geological Survey.

Visited September 1953.

Sands of Brussels.

In this large sandpit we found a lower part of about 3 m of medium to coarse-grained sands, and a higher part of 7 m of finer grained, whitish to yellow sands. Many of the beds, especially the lower ones, showed current-bedding. « Grès fistuleux » with some fragments of *Ostrea cymbula* occurred throughout the section.

The higher sands were sometimes more or less clayey, and contained some small clay-lenses of some centimetres diameter.

NH Sart-Dame-Avelines, hollow roadside (300 m N and 900 m W of the church-tower of Sart-Dame-Avelines).

Visited July 1954.

Sands of Brussels.

A small exposure of about 1,20 m high, with fine-grained sands, more or less rich in limonite. Intercalated there were some clayey beds of about 5 cm. About 30 cm from the base we observed a layer of 20 cm of dispersed sandstone pieces of capricious form, rich in sponge spicules.

Sample **NH 1156**, taken about 50 cm from the base of the exposure, contained some foraminifera, echinid spines, sponge spicules, etc.

NJ Plancenoit, abandoned sandpit (250 m S and 800 m E of the church-tower of Plancenoit); also point 116 (E) 132 of the archives of the Geological Survey.

Visited July 1954.

Sands of Brussels.

Only some poor exposures remained. Exposed was fine-grained, calcareous, whitish sand with some pieces of slightly sandy limestone, and contaminated with overlying loess.

Sample **NJ 1158** contained a rich microfauna associated with many other organic remains, such as echinid remains, shell fragments, bryozoan debris, sponge spicules, remains of calcareous algae, radiolarians, etc.

NK Plancenoit, hollow roadside (350 m S and 800 m E of the church-tower of Plancenoit).

Visited July 1954.

Sands of Brussels.

Some poor exposures were found of whitish, calcareous, fine-grained sands with small pieces of sandy limestone.

Two samples were taken, **NK 1159** and **NK 1160**, with a vertical distance of 2 m. Lithologically they were identical with that of the nearby exposure of NJ.

The wash residues of both samples contained fairly rich microfaunae, associated with many other organic remains, with about the same components as NJ 1158.

NL Bois-Seigneur-Isaac, hollow roadside (300 m S and 550 m E of the church-tower of Bois-Seigneur-Isaac; also point 129 (W) 16 of the archives of the Geological Survey.

Visited July 1954.

Sands of Lede.

Exposure of fine-grained, brownish-yellow sands which were slightly glauconitic and contained limonite, sometimes concentrated in rusty-brown bands.

The sample contained some brown sandstone fragments, coarse quartz grains, radiolarians, etc.

NM Braine-le-Château, hollow roadsiide (650 m S and 550 m E of the church-tower of Braine-le-Château).

Visited July 1954.

Sands of Brussels.

A poor exposure of rusty-brown, medium-grained sands with some hard and cavernous sandstone pieces of capricious form.

The sample contained mainly angular quartz grains and sponge spicules.

NN Tourneppe, hollow roadside (1.350 m W of the church-tower of Tourneppe).

Visited July 1954.

Possibly **Sands of Brussels.**

Another poor exposure of rusty-brown, fine-grained sands with some sandstone pieces.
The wash residues of the taken sample yielded, amongst others, sponge spicules.

NO Tubize, claypit of the « Tuileries et Briqueteries du Brabant » (400 m S and 150 m E of the church-tower of Tubize); also point 115 (E) 5 of the archives of the Geological Survey. See fig. 9.

Clays of Ieper.

Claypit with a section of about 16,75 m, the upper 1,50 m of which were formed by Quaternary loess with gravel in the lower 1,20 m.

Near the base of the section slightly silty clay was found, of olive-green colour, and with small strings of fine-grained quartz sand. This clay was found over 3,70 m, upwards greyer of colour, and with occasional rusty-brown bands.

The series continued with 1,80 m of grey silty clay with irregular, rusty-brown seams and spots, which usually showed a rusty-brown wall.

Upwards some 70 cm of silty clay with discontinuous, brownish and more silty beds occurred. At the base of this clay some beds (max. 10 cm) of fine-grained quartz sand were present.

The overlying 70 cm of very silty clay with thin sandstrings, gradually passed into 2,20 m of greyish-brown, less silty clay, with sand strings and some discontinuous clay seams (up to 10 cm).

Higher upwards 1 m of slightly silty clay was found, overlain by 2 m of silty clay (**NO 1173**), which gradually passed into 70 cm of dark-grey, plastic clay.

The clay series ended with 2,60 m of silty clay, rich in limonite.

Sample **NO 1170**, from the basal clays, contained some foraminifera (partly fragmentary nummulites) in addition to shell fragments, muscovite, etc.

Another sample of this clay contained no microfauna, except for some fragments of nummulites.

Sample **NO 1173** yielded some foraminifera, also muscovite, etc.

NP Virginal-Samme, sandpit (500 m S and 1.000 m W of the church-tower of Virginal-Samme).

Visited July 1954.

Sands of Brussels.

Some 20 m of coarse-grained, rusty-brown to yellowish sand were exposed. Sandstone pieces, mostly of capricious form, occurred either dispersed in the sand or in discontinuous layers.

In the lower part of the section much cross-bedding was found; upwards the bedding became more regular, and the sand finer grained.

A sample taken near the base of the section was almost completely formed by hyaline quartz grains.

NQ Hennuyères, sandpit (1.100 m S and 1.250 m E of the church-tower of Hennuyères); also point 128 (W) 207 of the archives of the Geological Survey.

Visited July 1954.

Literature :

M. LERICHE, 1924, Bull. Soc. belge Géol., vol. 34, p. 49.

Sands of Brussels.

The pit had a wall of 19 m of coarse to medium-grained sands of yellowish to brownish colours, with much limonite in the higher parts.

«Grès fistuleux» occurred throughout, a discontinuous bed of «Pierres de grottes» was found about 5 to 7 m above the base. Cross-bedding of the sand was only faintly present.

The sand was covered by about 1 m of Quaternary loess.

NR Henripont, sandpit of the « Sablonnière Marouset » (1.300 m N and 500 m W of the church-tower of Henripont); also point 128 (W) 209 of the archives of the Geological Survey.

Visited July 1954.

Literature :

M. LERICHE, 1924, Bull. Soc. belge Géol., vol. 34, p. 50;
R. LEGRAND, 1945, ibid., vol. 54, pp. 91-103.

Sands of Brussels.

A wall of about 24 m; the upper 5 m were formed by Quaternary loess. The samples were taken in the southeastern part of the pit.

The lowermost part consisted of coarse-grained, pale rusty-brown sands with dispersed sandstone pieces (mostly «Grès fistuleux»). Discontinuous sandstone banks were found, formed by capricious, cavernous pieces. About 5 m above the bottom there were 2,50 m with indistinct current-bedding. On top coarse to medium-grained sands with discontinuous sandstone beds reappeared. In this part of the wall brown bands made their appearance, becoming more numerous and generally thicker upwards. Locally these bands were salmon coloured. These bands contained concretions of limonite that were often hollow and had thin, hard walls.

The upper 3 m of the sand were rich in limonite and of distinctly brownish colours, and again with concretions of limonite.

NS Henripont, abandoned sandpit (400 m E and 50 m N of the church-tower of Henripont); also point 128 (W) 232 of the archives of the Geological Survey.

Visited July 1954.

Sands of Brussels.

A wall of about 5 m, the upper 30 cm of which were formed by Quaternary loess.

The lower sands were of variable grain-size (mostly medium-grained) and with discontinuous sandstone levels, which consisted of flat pieces of maximally 30 cm length and some centimetres thickness. In the sand there were dispersed sandstone pieces of irregular form.

Altogether 5 sandstone levels were found at intervals of 60 to 80 cm, the first one near the base of the section.

The upper sands were medium to fine-grained, with green and salmon colours, and brownish, more or less irregular, bands.

Samples were taken from the first, third and fifth sandstone level. The foraminifera of these samples were mostly silicified and too ill-preserved for specific determination. Furthermore the wash residues contained echinid spines, sponge spicules, shell fragments, ostracods, bryozoan debris, etc.

NT Ecaussines-Lalaing, claypit (350 m N and 200 m E of the church-tower of Ecaussines-Lalaing); also point 128 (E) 18 of the archives of the Geological Survey. See fig. 9.

Visited July 1954.

Probably the passage of **Clays of Ieper** into **Sands of Mons-en-Pévèle.**

The base of the section was formed by dark grey, slightly silty clay, with increasing small quantities of lignite spots towards the top of the clay.

A sharp boundary marked the beginning of silty to very silty, yellowish-brown clay, with muscovite and glauconite. This sandy clay passed gradually into fine-grained, dark yellowish-green sand, with again glauconite and mica. This in turn was overlain by grey, silty clay; the lower part of which showed some tiny, rusty-brown spots. Upwards the limonite was more abundant and the colour was rusty-brownish to grey.

Samples **NT 1180** and **NT 1181** contained foraminifera, shell fragments, fish remains, muscovite, etc.
Sample **NT 1182** yielded the same components, and also sponge spicules.
Sample **NT 1183** contained foraminifera, shell fragments, much limonite, etc.

NV Ecaussines-Lalaing, quarry (1.400 m S and 400 m E of the church-tower of Ecaussines-Lalaing); also point 128 (W) 197 of the archives of the Geological Survey.

Visited July 1954.

Sands of Mons-en-Pévèle.

On top of the quarried Carboniferous limestone some sandy deposits were found. The sand was fine-grained and slightly clayey.

NX Quenast, quarry (about 950 m S and 250 m E of the church-tower of Quenast); also points 115 (W) 110 and 111 of the archives of the Geological Survey. See fig. 9.

Visited September 1953.

Clays of Ieper and **Sands of Mons-en-Pévèle.**

The greyish microdiorite (**Dr** in the section) was covered by its weathering products, which were green with yellowish spots, and of rather variable grain-size.

The base of the overlying clay was formed by a very coarse conglomerate of diorite boulders of 50 cm and more, in sandy and clayey materials of dark brownish to grey.

A sample yielded wash residues with coarse quartz grains, fish remains, diorite fragments, etc.

On top of the conglomerate thin-bedded, red to yellow, marly clay was found, followed by plastic, grey clay with some small sand patches. Upwards the silt content increased, and rusty-brown spots occurred at the level of NX 91. From the latter level upwards a rather sudden transition occurred into more sandy clay, followed again by pale clay. NX 92 was taken from slightly silty clay of green-grey colour.

Three samples (**NX 89**, **91** and **92**) contained foraminifera. The wash residues of NX 89 were rich in fish remains (bone fragments, teeth, etc.), in addition to diorite fragments, shell remains, echinid spines, etc. Fish remains were also found in the wash residues of NX 91.

Over the clay a sandy series was found, clayey at the base, with upwards diminishing clay content. At some places the sand showed cross-bedding. The grain-size was variable, but usually medium to fine-grained. From about 3 m above the base the sand was fine-grained, more or less clayey, and pyritiferous. The clay content gradually increased, and cross-bedding of thin laminae was present.

At some places lenses of gravel were very numerous, some 40 of them were counted in the southern part of the pit. In our section such a lens, mainly silex in coarse sand,figures above the level of NX 95.

Upwards the sand became again fine-grained and clayey.

Only one sample, **NX 95**, contained some foraminifera, in association with glauconite, muscovite, etc.

SHEET NAMUR

NNA Spy, abandoned sandpit (850 m N and 1.000 m E of the church--tower of Spy).

Visited June 1954.

Sands of Brussels.

Only parts of the original section of the wall were exposed.

Near the bottom of the southern part of the pit an exposure of 80 cm of calcareous sand was found, interstratified with three sandy limestone banks of 8 to 20 cm. White colours dominated, except for some rusty-brown seams of about 2 cm.

Sample **NNA 1151** from this exposure yielded a rich microfauna (with nummulites), associated with shell fragments, echinid remains, bryozoan debris, sponge spicules, etc.

Higher upward decalcified sands were found, with at the base white calcareous sands with some green spots. In the decalcified sands occurred some discontinuous, whitish sandstone beds, with a thickness of 3 to 15 cm.

The northern part of the pit (distance about 7,50 m from the southern exposure) showed about the same type of sands as the first described exposure.

Sample **NNA 1152** was taken from these calcareous, fine-grained sands. The wash residues had about the same components as those of NNA 1151.

NNB Spy, abandoned sandpit (1.050 m S and 600 m E of the church-tower of Spy); also point 143 (E) 192 of the archives of the Geological Survey).

Visited June 1954.

Literature :

X. STAINIER, 1911, Ann. Soc. Géol. Belg., vol. 38, Bull., pp. 318-324.

Sands of Erquelinnes and **Sands of Brussels.**

The basal part of the section was formed by some 3 m of white sands, which STAINIER assigned to the Landenian, probably Sands of Erquelinnes.

The top of the sand was marked by a black zone with dispersed gravel at the base. The black grains (probably Mn-oxide) were concentrated in thin bands over about 40 cm.

Upwards 1 m of sand was found, with interstratified flat sandstone pieces of about 5 cm thickness, and rich in sponge spicules.

Quaternary loess (1 m) was forming the top, following another metre of rusty-brown sands.

NNC Velaine, old quarry (700 m N and 1.450 m E of the church-tower of Velaine); also point 143 (W) 191 of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

Flat, greyish-white, medium-grained sandstone blocks of some metres diameter and about 30 cm thickness were formerly extracted from this quarry (« Grès de Fayat »). No fresh exposure was available.

From a heap of sand, without doubt coming from this sandpit, a sample was taken.

SHEET TIELT

PA Bellem, hollow roadside (2.150 m S and 100 m W of the church-tower of Bellem).

Visited September 1953.

Possibly **Sands of Vlierzele.**

Under the Quaternary coverings was exposed a medium-grained, yellow-white sand, which contained some sponge spicules.

PB + PC Eegem, sand and claypit of the « Steen- en Buizenbakkerij Gebr. Ampe » (600 m S and 2.100 m W of the church-tower of Eegem); also point 53 (W) 60 of the archives of the Geological Survey.

Visited September 1953.

Sandy Clays of Anderlecht.

PB The sandpit of these brick-works showed more or less medium-grained, green-brown sands in a wall of about 5 m, the upper metre formed by Quaternary loess.

The sand was more or less glauconitic and slightly micaceous. Wash residues yielded, amongst others, some fish remains and sponge spicules.

Two metres below the grass a 30 cm layer of sandstone of yellow to white colour, and rich in fossil casts.

PC At about the same topographical level a claypit was found, some 300 m to the west, with an exposure of about 5 m.

Visible was a sandy, brownish-green clay, rich in coarse glauconite grains. Half the way the section, a discontinuous sandstone layer of about 30 cm thickness was present, containing nummulites and fossil casts. Mostly the sandstone was weathered and of brownish-yellow colour; the unweathered interior was grey-brown, with coarse, green glauconite spots, muscovite and shell fragments (mostly pelecypods).

The stratigraphic relation between these two points was somewhat obscure. Either they were lateral facies of the same stratigraphic unit; or the clay was slightly below the level of the sand. Perhaps both exposures belonged to the passage beds of the Sandy Clays of Anderlecht into the Sands of Vlierzele.

PD Izegem, claypit of the « Briqueterie Van de Putte » (350 m S and 500 m W of the church-tower of Izegem); also point 68 (W) 489 of the archives of the Geological Survey.

Visited September 1953.

Clays of Ieper.

In the lower part of the exposed 7 m wall occurred blue grey, slightly silty clay with glauconite, muscovite and some fish remains in the wash residues.

Upwards the silt content of the clay increased and the colour became paler. Small brown, sandy spots with fine-grained sandy material were frequent. ,

Beneath the grass from about 3 m onwards the clay was weathered and oxidized to a rusty-brown clay.

PF Loo-ten-Hulle, sandpit (450 m S and 300 m E of the church-tower of Loo-ten-Hulle).

Visited May 1954.

Literature :

R. TAVERNIER, 1936, Natuurw. Tijdschr., Gent, jrg. 18, nr. 1, pp. 6-8.

Sands of Vlierzele.

Under 30 cm of Quaternary loess 2,70 m of sand were exposed.

In the lower part this glauconitic sand was rather coarse-grained; higher up the grain-size diminished.

Small, slightly calcareous tubulations (2 to 20 mm diameter) occurred, only the largest ones being hollow. Rare in the lower part, these tubes increased in number upwards, to just 1 m below the top of the section. Here a rather sharp boundary was found; below the sand was slightly indurated and full of tubulations. Above, the darker, grey-green sand contained very scarce tubulations.

The wash residues of the samples were rich in glauconite, with some calcareous remains, etc.

PG Aalter, railroadcut and sandpit (650 m N and 750 m E of the church-tower of Aalter); also point 64 (W) 8 of the archives of the Geological Survey.

Visited May 1954.

Sands of Aalter.

The main exposure of the Sands of Aalter was found along the southern side of the railroad, close to the small bridge that crosses the railroad east of the station of Aalter.

The base of this 1,50 m exposure was in slightly clayey, glauconitic, green sand, with many *Venericardia planicosta* and other shell remains, of mainly pelecypods. Furthermore it contained some bryozoan debris associated with glauconite and muscovite.

Upwards this sand with shell remains mainly contained *Turritella solanderi.* The fossils were worn and often perforated by boring animals. The samples from this level yielded scarce remains of the coral *Turbinolia* in addition to bryozoan debris, fish remains, etc.

Close to this exposure a small sandpit showed sands rich in *Venericardia planicosta*. The shells were mostly more or less decalcified. The sand was clayey and glauconitic, with decreasing glauconite content towards the top of this 1 m exposure.

PH Pittem, claypit of the « Steenbakkerij Claerhout » (150 m S and 1.850 m E of the church-tower of Pittem); also point 68 (E) 164 of the archives of the Geological Survey. See fig. 9.

Visited May 1954.

Sandy Clays of Anderlecht.

Quaternary loess (30 cm) covered about 3,60 m of sandy clay.

The base of the clayey series was formed by sandy to very silty, greyish-green clay with sand patches (some millimetres to 1 cm diameter), and dark brown spots. The rather fine-grained sand of the spots contained some glauconite and muscovite.

Upwards the same type of clay was found alternating with plastic claybeds of 6 to 20 cm. The latter clay was mostly brownish-green to grey, with rusty-brown spots. The thickness of the individual layers appeared rather variable.

Approaching the level of the upper sample the sand contents appeared slightly to increase; the wash residues of a sample contained some glauconite, muscovite, sponge spicules and radiolarians.

The sandy clay was again overlain by plastic clay of 5 cm thickness, followed by sandy clay with some flat sandstone pieces, of some decimetres diameter.

Alternating sandy and plastic clays continued higher up with again a discontinuous, intercalated sandstone layer. The layer was formed by flat, rounded pieces with a grey interior and shell fragments.

PJ Ardoie, claypit of the « Briqueterie Van de Vijvere » (200 m N and 2.700 m E of the church-tower of Ardoie); also point 68 (W) 58 of the archives of the Geological Survey.

Visited May 1954.

Possibly transitional beds from the **Clays of Ieper** into the **Sands of Mons-en-Pévèle**, and followed by the **Clays of Roncq.** In fact we may have to do with a sandy intercalation in the higher part of the Clays of Ieper.

About 3 m of clay with an interstratified sandlayer were exposed under a covering of Quaternary loess.

The lowermost 20 cm showed plastic, grey clay. Then followed 110 cm of silty to very silty, dark greyish-blue clay. The lower clays ended with 35 cm of alternating silty and plastic clay of dark greyish-blue colour.

The intercalated sandlayer of 60 cm was formed by greenish-yellow, fine-grained sand, with glauconite and muscovite. The contact with the overlying clays was somewhat irregular.

This overlying, green-grey clay, was slightly silty. A sample, close to its base, yielded glauconite, muscovite, etc.

SHEET PROVEN

PPA Poperinge, claypit of the « Mekanieke Steenbakkerij Sadi Schaballie » (850 m S and 700 m W of the church-tower of Poperinge); also point 80.72 of the archives of the Geological Survey.

Visited September 1953.

Probably **Clays of Ieper** with a sandy intercalation (with gravel). Possibly this gravel marks the base of the Clays of Roubaix, though in the Clays of Ieper sandy lenses have been entered in the legend of the geological map of this region.

The basal part of the section was formed by plastic clay (4,60 m), with in the upper 80 cm a slight silt content. The colour was in general dark bluish-grey, with occasional rusty-brown. The samples of this part of the section contained fish remains, shell fragments, etc.

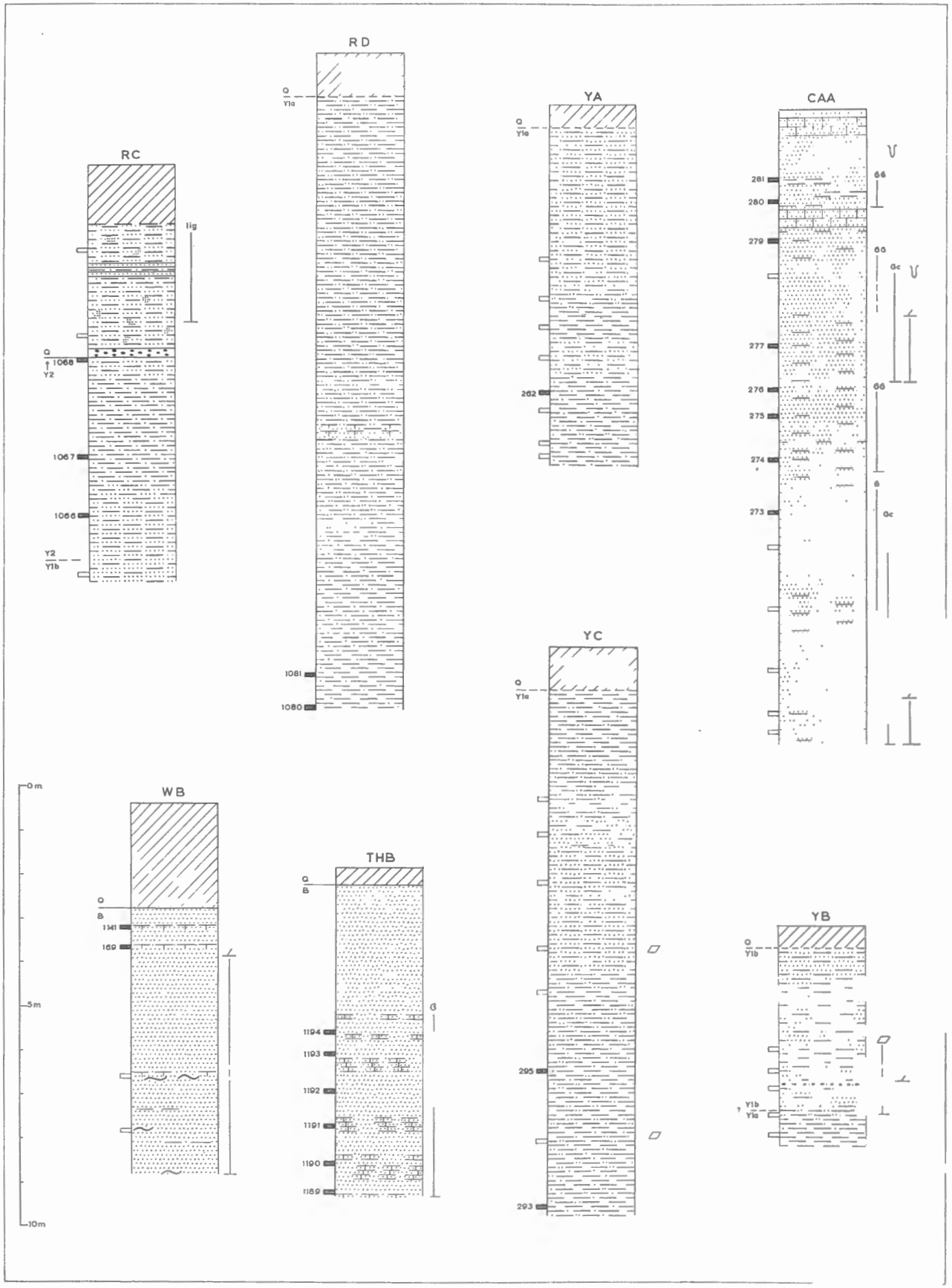
RD
Q
Y1a
1081
1080
RC
lig
Q
1068
Y2
1067
1066
Y2
Y1b
YA
Q
Y1a
262
CAA
V
281
66
280
279
66
Gc
V
277
276
66
275
274
273
Gc
YC
Q
Y1a
295
293
WB
0m
5m
10m
Q
B
1141
169
THB
Q
B
G
1194
1193
1192
1191
1190
1189
YB
Q
Y1b
Y1b
Y1a

FIG. 11.

Upwards occurred a rusty-brown layer of 10 cm of clayey sand, with some gravel (mainly silex). With an irregular contact followed 4,40 m of green, glauconitic, very silty clay, with green-brown bands of 5 to 10 cm.

Higher upward this clay became more oxidized and rusty-brown, with some sandy patches.

The series was covered by 50 cm of Quaternary loess.

SHEET ROESELARE

RA Kortemark, claypit of the « Steenbakkerij Gebr. Desimpel » (1.150 m S of the church-tower of Kortemark); also point 52 (W) 150 of the archives of the Geological Survey. See fig. 9.

Visited September 1953 and May 1954.

Clays of Ieper.

The drawing corresponds to the eastern part of the pit.

The base was formed by calcareous, slightly silty, dark blue-grey clay, with small patches rich in silt or fine-grained sand and perhaps some lignite.

The samples showed tiny shell fragments, a fairly rich foraminiferal fauna (with some nummulites), echinid spines, fish remains, ostracods, glauconite and muscovite. From the eastern wall the samples **RA 1071** and **RA 1072** appeared to be foraminiferous; also some foraminiferous samples from the western wall were investigated, namely **RA 253** (on the same level as the sample above RA 1072), **RA 254** and **RA 1079** (somewhat above the level of RA 1072).

This calcareous clay continued over 2 m from the base of the pit. Upwards the clay became paler and richer in silt. Some yellow-grey layers were intercalated, chiefly composed of fine-grained, silty sand, with some rare, small shell fragments. These layers, with a thickness of 30 to 40 cm were discontinuous, sometimes indurated, forming grey-blue sandstone.

The higher clays were greenish-grey, more or less rich in silt, with the upper 3,50 m formed by weathered, brownish-grey clay and Quaternary coverings.

RB Hooglede, claypit of the « Briqueterie Lamsens » (400 m N and 1.350 m W of the church-tower of Hooglede); also point 67 (E) 61 of the archives of the Geological Survey.

Visited September 1953.

Sandy Clays of Anderlecht.

The base of the wall (3,50 to 4 m) was formed by grey, plastic clay.

Overlying it 1,50 m of grey-green, sandy clay were found, which were very sandy at the base, and contained fossil casts, abundant at the base, diminishing in number upwards.

Higher up followed another 60 cm of grey-green clay, again sandy in the lower part, and less sandy upwards, but with less numerous fossil casts.

This clayey complex was followed by glauconitic, grey-green sand with many dark-brown fossil casts at the base. Clayey, partly lenticular, intercalations of some centimetres got more numerous in upward direction, merging into a clayey sand, at about 70 cm above the base.

After 30 cm of this clayey sand there was a rather abrupt change into slightly sandy clay, mixed with the loamy Quaternary coverings.

RC Staden, claypit of the « Steenbakkerij Debeil-Bonte » (1.300 m S and 1.100 m W of the church-tower of Staden); also point 67 (W) 207 of the archives of the Geological Survey. See fig. 11.

Visited May 1954.

Sands of Mons-en-Pévèle and **Clays of Roncq.**

The base of this claypit was formed by green-grey, fine-grained, clayey sand, with glauconite, muscovite and some sponge spicules. Lower down pure sand was reported to be present. Upwards this clayey

sand gradually passed into green-grey silty clay, which showed towards the top a continuous decrease of the silt contents, except for the last 50 cm (below the gravel bed) in which it again increased. The clay was slightly glauconitic and contained some muscovite.

The samples, **RC 1066**, **1067** and **1068**, showed rather poor microfaunae with some nummulites (RC 1068). Furthermore, shell fragments, echinid spines, fish remains, sponge spicules, radiolarians, etc.

A gravel bed of 10 to 20 cm, mainly composed of well-rounded quartz and silex, was found overlying this clay. These pebbles underlay greyish-brown, more or less silty clay.

According to C. CAMERMAN, (1951, archives of the Geol. Survey, unpublished) the gravel bed and the overlying deposits are of Quaternary age.

RD Rumbeke, claypit of the « Steenbakkerij Van de Putte » (600 m S and 2.600 m W of the church-tower of Rumbeke); also point 67 (E) 143 of the archives of the Geological Survey. See fig. 11.

Visited May 1954.

Clays of Ieper.

Under a covering of about 1 m of Quaternary loess about 14 m of more or less silty clay were exposed.

In the lower 6,50 m an exposure of slightly silty, grey-blue, gypsiferous clay. In the wash residues of **RD 1080** and **RD 1081** some foraminifera were found, also some shell fragments and fish remains.

In the upper part of this lower clay the silt content gradually increased. About 6,50 m above the base of the section a discontinuous layer of clayey sand was observed, 20 to 30 cm thickness, mostly indurated. The sand was very fine-grained and of green-grey colour.

Upwards again silty clay was noticed, with the upper 3 m weathered to a greyish-brown clay.

SHEET THUIN

THA Nalinnes, abandoned sandpit (400 m N and 300 m E of the church-tower of Nalinnes); also point 164 (E) 18 of the archives of the Geological Survey.

Visited July 1954.

Sands of Grandglise and **Sands of Brussels.**

The lowermost 20 cm of the partly covered wall were formed by rusty-brown to yellow, medium-grained sand, with glauconite and silex fragments. Upwards we found 10 cm of clayey, dark yellowish-brown sand.

On top followed 20 cm of gravel of mainly silex pebbles, coarse quartz grains, sandstone pieces and much glauconite.

Overlying this gravelly sand rested 1,75 m of rusty-brown to yellowish sand, in which BAYET (1884, archives of the Geol. Survey) observed some tubulations, probably of annelids.

The covering consisted of 70 cm of Quaternary loess.

THB Nalinnes, abandoned sandpit (100 m S and 650 m E of the church-tower of Nalinnes); also point 164 (E) 20 of the archives of the Geological Survey. See fig. 11.

Visited July and August 1954.

Literature :

A. BRIART, 1888, Ann. Soc. Géol. Belg., vol. 15, mem., p. 35; 1890, ibid. vol. 17, mem., p. 259.
J. GOSSELET, 1892, Ann. Soc. Géol. Nord, vol. 19, p. 39.

Sands of Brussels.

Only the upper part of the former wall of the « Sablonnière des Monts » was still visible.

The basal part of our section was formed by very calcareous sand with intercalations of more or less discontinuous, sandy limestone banks, with, in general, a horizontal interval of 30 to 35 cm between the limestone pieces.

The sands were yellowish coloured, but upwards the colour changed into pale whitish-green, corresponding to the increasing glauconite content. Locally there were some rusty-brown spots. The sands were fine-grained and rich in organic remains, such as shell fragments (*Ostrea gigantea*, *Pecten subornatus*, and many others), echinid remains (*Crenaster*), bryozoan debris, fish remains, nummulites (probably *Nummulites laevigatus*), etc.

The limestones were commonly of yellowish-white colour, and also rich in organic remains. Great differences with the surrounding sand could not be found, except for the greater lime content of the limestone. Thicknesses of the pieces are rather variable (8 and 35 cm).

The samples, **THB 1189-1194**, all possessed rich microfaunae in addition to many organic remains of the above mentioned groups and sponge spicules, fragments of calcareous algae, etc.

Overlying these calcareous sands followed 2,95 m of decalcified sand of rusty-brown to green colour and with increasing limonite contents in upward direction. This complex of decalcified sands was thin in the northern part of the pit, and increased in thickness towards the south.

THC Jamioulx, sandpit (300 m S and 1.500 m E of the church-tower of Jamioulx); also point 164 (E) 812 of the archives of the Geological Survey.

Visited July 1954.

Sands of Brussels.

The basal part of the section consisted of brownish-yellow to white, fine-grained, micaceous sands, with some (?) lignitic bands of some mm thickness. Some 60 cm from the base of the pit, a band of 10 cm thickness contained grey-white patches. These patches were rich in sponge spicules, and probably were the remains of a discontinuous sandstone layer.

A sample from one of these pockets yielded some ill-preserved foraminifera (siliceous casts), in addition to shell fragments, echinid spines, bryozoan debris, etc.

From this level onwards 4 m of rusty-brown sand were found covered by 1 m of Quaternary loess.

SHEET WAVRE

WA Lathuy, quarry of « Grès de Gobertange » (950 m N and 1.000 m E of the church-tower of Lathuy).

Visited August 1953 and June 1954.

Sands of Brussels.

A small mine for the extraction of sandy limestone («Grès de Gobertange»). The limestones were found, at about 17 m below the surface level, in two layers with an interval of about 70 cm. Their thickness was variable, the basal one 15 to 20 cm, and the upper one 20 to 25 cm. Unweathered the limestone was hard and whitish, slightly sandy and with occasional cavities filled with soft, calcareous material. Locally they contained many casts of *Lucina volderiana*.

Samples **WA 164**, **165** and **166** were taken during our first visit. The mine was closed at the time and only extracted pieces could be studied.

Sample **WA 1139** was taken in between the limestone levels, 30 cm above the lower limestone, from very calcareous, fine-grained, yellowish-white sand.

The wash residues of all samples showed rich microfaunae in addition to many other organic remains, such as shell fragments, echinid remains, bryozoan debris, sponge spicules, rests of calcareous worms, radiolarians, etc.

WB Jodoigne, sandpit of the « Briqueterie Lebegge » (50 m N and 850 m W of the church-tower of Jodoigne); also point 118 (W) 124 of the archives of the Geological Survey. See fig. 11.

Visited August 1953 and June 1954.

Sands of Brussels.

The basal part of the wall was formed by glauconitic, rather coarse-grained, yellow-green sands, with current-bedding, and occasional small clay-lenses and whitish marly patches. About 1 to 2 m were visible.

Upwards rather coarse-grained, glauconitic, brownish-green sand was met with, with a discontinuous sandstone level of about 6 cm thickness, of pale-grey colour, and locally more or less marly.

On top of this sandstone level 2,75 m of current-bedded sand was found, with dips towards the NE. The grain-size varied between medium and fine-grained. The bedding was visible by the concentrations of glauconite in thin layers, with diminishing quantities higher up. The thicknesses of the individual beds varied between 3 and 20 cm.

Overlying this sand 20 cm of calcareous sandstone were observed, in plates of about 2 m diameter, white with rusty-brown layers and spots. In between this bed and a higher one glauconitic coarse-grained sands were intercalated. The upper sandstone was about 10 cm thick, discontinuous and coarse-grained, with an irregular surface.

Upwards again coarse-grained, glauconitic, rusty-brown sands.

Only the two upper samples were foraminiferous. From both lower ones the residues yielded angular quartz grains, shell fragments, bryozoan debris, echinid spines, coarse silex fragments, and some nummulites.

Samples **WB 169** and **WB 1141** contained a small microfauna, associated with other organic remains.

WD Ottignies, abandoned sandpit (600 m S and 700 m W of the church-tower of Ottignies).

Visited August 1953.

Sands of Brussels.

On Palaeozoic rocks (quartzites and shales of the Revinian, according to the Geological Map) sands were found with gravel at the base. This gravel was rather fine-grained, of well-rounded quartz grains and Palaeozoic elements, bedded in rather glauconitic sand.

Higher up glauconitic quartz sand was noticed, mostly of green-grey colour, containing some capricious sandstone pieces, and some clay lenses of small diameter.

WE Chaumont-Gistoux, sandpit (850 m N and 650 m W of the church-tower of Chaumont-Gistoux); also point 117 (E) 89 of the Geological Survey.

Visited June 1954.

Sands of Brussels.

The wall had a length of about 250 m, about E-W directed, over a total height of sand of 25 to 30 m.

The sand showed some current-bedding and many capricious sandstone pieces, both dispersed and in discontinuous layers. The limonite contents increased towards the top.

WF Opprebais, abandoned quarry (400 m N and 750 m E of the church-tower of Opprebais); also point 118 (W) 231 of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

The coverings of the Palaeozoic quartzites, formerly exploited in this quarry, were formed by sands and Quaternary loess. Only some small exposures of the sand could be found.

These showed brownish-green, medium-grained, quartz sand, with some more or less desintergrated sandstone pieces of whitish colour.

Sample **WF 1134** from one of the sandstone pieces yielded some foraminifera (mainly siliceous casts) and many sponge spicules, echinid remains, ostracods, bryozoan debris, etc.

WG Dongelberg, quarry (800 m S and 50 m W of the church-tower of Dongelberg); also point 118 (W) 39 of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

The exploited Palaeozoic quartzites were covered by sands, at the base coarse-grained, glauconitic and dark-green, with coarse hyaline, well-rounded quartz grains and bryozoan debris, higher onward whitish and with current-bedding.

Sample **WG 1135**, just above the contact with the quartzites, yielded a small microfauna, bryozoan debris, shell fragments, sponge spicules, echinid spines, etc.

WH Folx-les-Caves, sandpit (200 m S and 100 m E of the church-tower of Folx-les-Caves); also point 118 (E) 55 of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

About 4 m of quartz sands were found covered by 70 cm of Quaternary loess.

The basal 2 m were yellowish-white, showed current-bedding with southern dips, irregular, fistulose sandstone pieces, and some rusty brown bands and spots.

Upwards a 10 to 15 cm of discontinuous, weathered, yellowish-white sandstone bed, with some glauconite, was followed by 2 cm of greenish-brown silty clay and 4 cm of coarse-grained rusty brown sands with much limonite.

The overlying yellowish-white sands with rusty-brown bands showed towards the top a gradual increase of the limonite content.

WJ Grand-Rosière, sandpit 800 m S and 600 m E of the church-tower of Grand-Rosière); also point 131 (W 131 of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

Under 1 to 2 m of Quaternary loess ill-storted gravelly sand was visible over a height of about 8 m.

About 2 m below the surface a rather fine-grained gravel of 20 cm was present. Especially the gravel contained many silex fragments.

The grain-size of the sands was mostly coarse, but finer grained, mostly darker beds were found as well. Also lateral variation of grain-size was found. The sands were more or less greenish-grey, with some rusty-brown bands and spots.

WK Perwez, sandpit (50 m N and 2.350 m E of the church-tower of Perwez); also points 131 (W) 112 and 113 of the archives of the Geological Survey.

Visited June 1954.

Sands of Brussels.

The lower part of the 3,60 m high wall was formed by 1,10 m of green-grey sands, with brownish colours and irregular limonitic bands towards the top. Some small black spots (? Mn-oxide) increased in number and size in the same direction. The sand was fine-grained, glauconitic and with dispersed sandstone pieces.