

# BOLETIM N.º 8

DOS

SERVIÇOS DE GEOLOGIA E MINAS DE ANGOLA



## ÍNDICE

N.º de  
página

### ESTUDOS :

G. HENRIQUE DA SILVA

*LAMELIBRANQUIOS DO CRETACICO DA REGIAO CARUNJAMBA-  
-SALINAS-S. NICOLAU (ANGOLA) ... .. 5*

W. I. STANTON, L. J. G. SCHERMERHORN,  
and H. R. KORPERSHOEK

*THE WEST CONGO SYSTEM ... .. 69*

W. I. STANTON

*THE GEOLOGY OF DEGREE SHEET <sup>Sul B-33</sup>  
J-P (MAQUELA DO  
ZOMBO-DAMBA) ... .. 79*

### INFORMAÇÕES :

*DOCUMENTAÇÃO ENTRADA NA SECÇÃO DE INFORMAÇÃO E  
DOCUMENTAÇÃO, DURANTE o 2.º SEMESTRE DE 1963 ... .. 137*

- 4 OCT 1964

# The West Congo System

BY

W. I. STANTON, Ph.D., F.G.S., L. J. G. SCHERMERHORN, Math. Phys. Dr., F.G.S.,  
and H. R. KORPERSHOEK, Math. Phys. Drs.

*Geologists of the Empresa do Cobre de Angola*

## RESUMO

A nomenclatura confusa da sucessão estratigráfica no Geossinclinal do Congo Ocidental é aqui revista e simplificada. As camadas geossinclinais ficam agrupadas num único Sistema do Congo Ocidental, de idade Precâmbrico Superior, assentando discordantemente num Complexo de Base mais antigo. As expressões «Sistema Maiombe», referindo-se às rochas metamórficas que formam parte da série inferior do Sistema do Congo Ocidental, e «Orogenia Maiombe», o que não se pode provar que tenha causado uma discordância de ordem orogénica, deveriam ser abolidas.

## ABSTRACT

The confused nomenclature of the stratigraphic succession in the West Congo Geosyncline is reviewed and simplified. The geosynclinal beds are best grouped into a single West Congo System, of Late Precambrian age, unconformably overlying an older Basement Complex. The terms «Mayumbe System», referring to metamorphic rocks forming part of the lowermost series of the West Congo System, and «Mayumbe Orogeny», which cannot be shown to have caused an unconformity of orogenic rank, should be abolished.

---

## INTRODUCTION

This paper reviews the confused stratigraphic nomenclature in use in the West Congo Geosyncline and simplifies it on the basis of recent work in Northwest Angola, where the detailed stratigraphy of some 70,000 square kilometres of country, mostly in West Congo strata, is now well known. The mapping was carried out by the authors, geologists of the Empresa do Cobre de Angola, during investigation of this company's mining concession and subsequently during geological surveying for the Government of Portugal. We are indebted to the Empresa do Cobre de Angola for permission to publish this paper.

## THE WEST CONGO GEOSYNCLINE

This geosyncline, of Late Precambrian age, is a trough at least 1200 km. long and up to 350 km. wide stretching from Gaboon through the Congo Republics far into Angola (Fig. 1). Its geology was first studied in the Belgian Congo (now Congo Federal Republic), and the names of most of the formations in Angola and French Equatorial Africa (now Congo Republic and Gaboon) are those given by the Belgian geologists.

The geosynclinal sediments, up to 14,000 m. thick (Fig. 2), lie between two major unconformities corresponding to orogenies. They show a lateral persistence of lithology which in many formations is remarkable and indicates uniform conditions of deposition during long periods in the evolution of the basin. Some of the limestone horizons in particular persist unchanged for more than 1000 km., and many of the terrigenous formations show only minor facies variations when followed for hundreds of kilometres along the strike.

Nevertheless geologists are not agreed on a standard subdivision of the geosynclinal succession. Classifications involving two, three or more systems are currently in use, having been set up independently in different parts of the geosyncline, in some cases ignoring older well-established nomenclature. They are summarized in the accompanying table <sup>(1)</sup>.

The comparatively good agreement between Angola and the ex-Belgian Congo is due to the adoption in the former of the succession first established in the latter. The confused situation in the ex-French Equatorial Africa, with subdivisions changing from map sheet to map sheet and from author to author, is difficult to understand as it is clear from the several descriptions that the formations defined in the Belgian Congo are equally recognizable there.

The Belgian Congo systems were originally thought to be separated by important unconformities and to be of widely different ages. However, the recent work in Angola (Stanton, Korpershoek and Schermerhorn 1962, Schermerhorn and Stanton 1963a, Stanton 1963, Korpershoek 1964) has shown beyond doubt that sedimentation continued without orogenic interruptions throughout the formation of the geosyncline. The sediments fall naturally into four series, each of which represents a sedimentary cycle (Schermerhorn 1961). Together they form the West Congo megacycle which began with deposition on a planed surface of Basement Complex rocks and ended with the West Congo Orogeny about 615 million years ago (Cahen *et al.* 1963). Although the sedimentary

---

<sup>(1)</sup> In a map of part of the Sansikwa massif (Carte Géologique du Congo Belge, planchette S.6/14, S.W.4; 1/50,000; 1958) the Mouyonzi Subseries was called «Etage de la Petite Bembezi», and the Haut Shiloango was subdivided into Sh1 to Sh8.

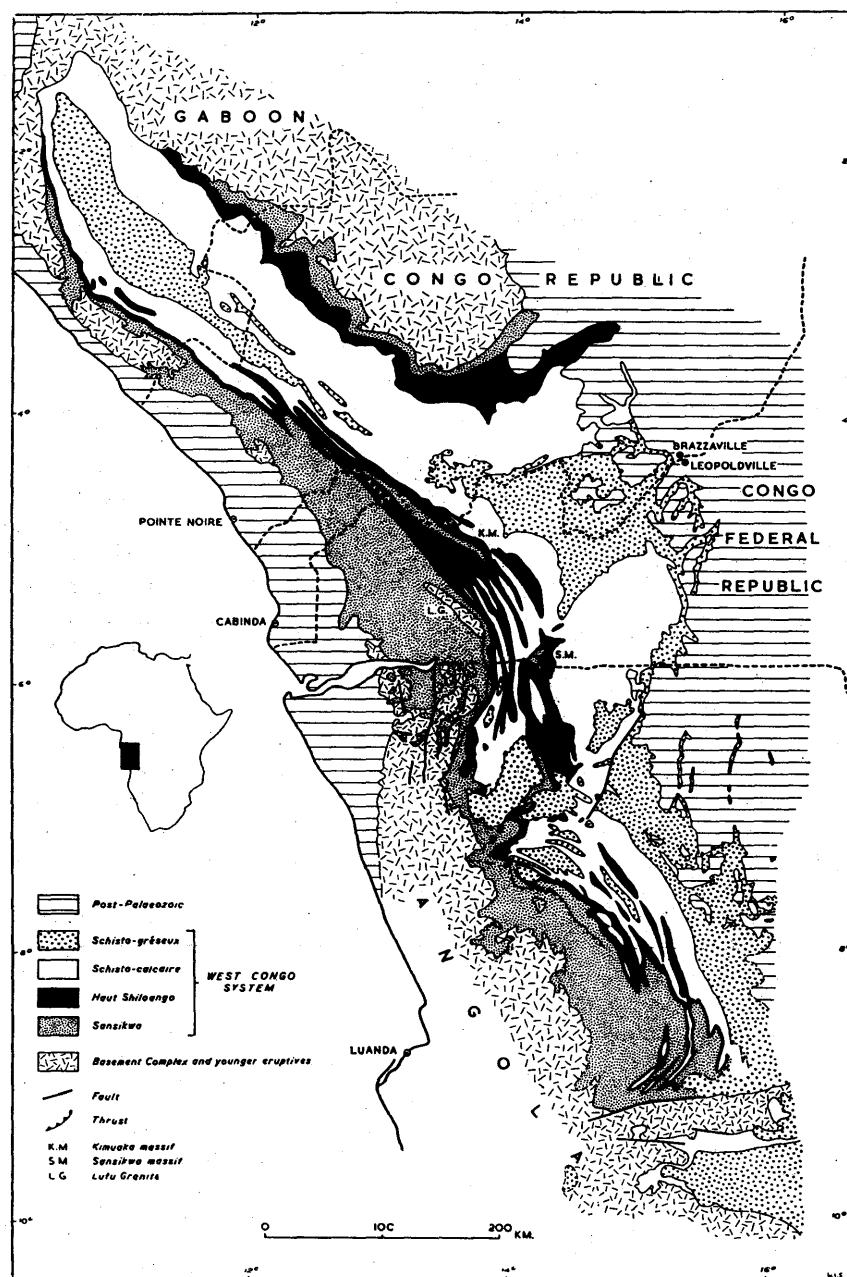


Fig. 1 — Geological map of the West Congo Geosyncline. Compiled from Gérard (1958), Dévigne (1959), Nicolini (1959), Cahen (1954), Korpershoek (1964), Sshermernhorn and Stanton (1963a), Stanton (1963), Stanton, Korpershoek and Schermernhorn (1962), and unpublished work by the authors and by Longyear Company.

column reaches the considerable thickness of 14 km., the lack of significant breaks other than the epeirogenic phases separating the cycles strongly suggests that it is all Late Precambrian (Precambrian IV).

#### EXPLANATION OF THE ANGOLAN MODIFICATIONS OF THE ORIGINAL BELGIAN CONGO SUCCESSION

##### 1. THE INTRODUCTION OF THE TERM «WEST CONGO SYSTEM» TO REFER TO THE COMPLETE GEOSYNCLINAL SUCCESSION.

The Belgian geologists (see Cahen 1954) applied the term «system» to the Schisto-gréseux, Schisto-calcaire, Haut Shiloango and Sansikwa (see table) in the supposition that the unconformities separating them were of major importance. The French, for the most part, downgraded the first three «systems» to series which together formed the «Système du Congo Occidental» but retained systematic status for the beds equivalent to the Sansikwa; Nicolini however retained the four «systems» but altered some of their limits and changed their names.

In 1959 the present authors established that in Angola the only major (orogenic) unconformities were those below the Sansikwa and above the Schisto-gréseux, and used the term «West Congo System» (see Schermerhorn 1961, p. 47) for the whole geosynclinal succession between the two unconformities, as a major rock-stratigraphic unit. Cahen (1963) nevertheless introduced another name, «West-Congolian», for the Schisto-gréseux, Schisto-calcaire and Haut Shiloango plus the Sansikwa as defined in the Belgian Congo which, as shown in the next section, is incomplete.

Of the nomenclatures listed above, only the «West Congo System» represents a natural grouping of beds enclosed between two well-established orogenic unconformities, conforming to the concept of a geological system as applicable in the Precambrian.

##### 2. THE REDEFINITION OF THE SANSIKWA SERIES.

The «Sansikwa System» as defined by Lepersonne (1951) in the Sansikwa massif of the Bas-Congo (the western part of the Belgian Congo; Fig. 1) consisted of up to about 1300 m. of quartzites, cherts, shales and phyllites, with a thin basal conglomerate, underlying the Tillite inférieure du Bas-Congo and resting unconformably on slightly metamorphic sericitic schists («Mayumbe»). The Sansikwa-«Mayumbe» unconformity is also seen at the Kimuaka massif (Fig. 1), more to the north (Antun 1961), but in the main belt of «Mayumbe» rocks farther west the contact appears to be conformable (Cahen 1954).

No equivalent unconformity exists in Angola, where rocks lithologically similar to Lepersonne's Sansikwa underlie the Lower Tilloid

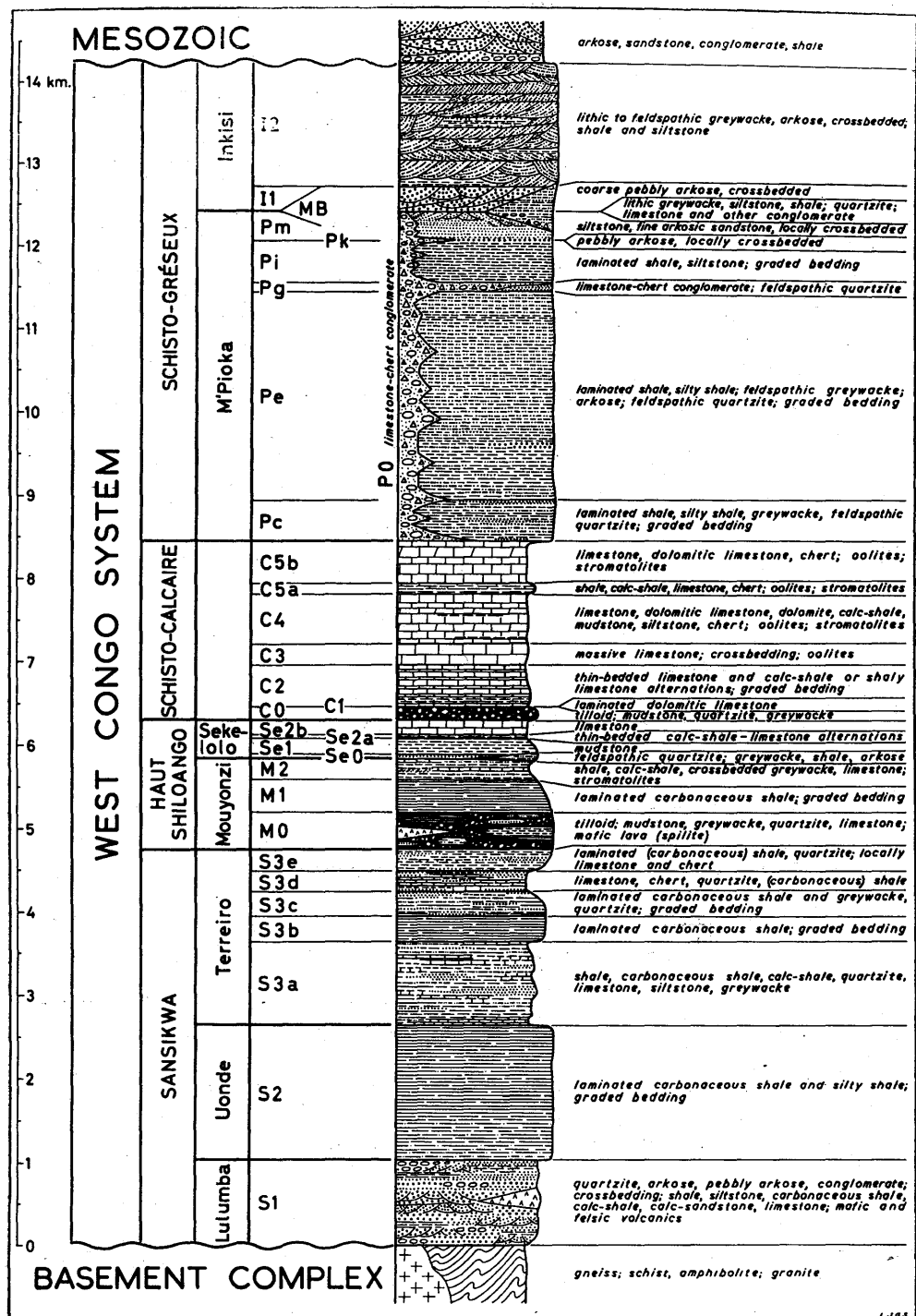


Fig. 2 — Generalized stratigraphic succession in the West Congo System in Northwest Angola

Formation and form the top of a well-exposed contormable succession several kilometres thick resting with great unconformity on the Basement Complex (Fig. 2). Lepersonne's Sansikwa probably represents the upper two-thirds of the Terreiro Subseries (Upper Sansikwa, S3) of Angola.

It is not rational to introduce a new sub-Sansikwa series in Angola below the beds corresponding to Lepersonne's Sansikwa, as this would create an artificial break in the middle of an important and widespread sedimentary cycle. The best solution is to regard the Angolan Sansikwa as the complete succession, and the apparent unconformity in the Sansikwa and Kimuaka massifs as an intraformational break of limited extent, the «Mayumbe System» being in fact the Lower and Middle Sansikwa as described below. Otherwise, the thick Lower and Middle Sansikwa sequences of Angola would have to suddenly die out crossing the frontier into the ex-Belgian Congo.

### 3. THE INCLUSION OF THE «MAYUMBE SYSTEM» IN THE SANSIKWA SERIES.

#### a) *The geological evidence:*

In the ex-Belgian Congo the Sansikwa strata as defined by Lepersonne were thought to rest with great unconformity (due to the «Mayumbe Orogeny») on the «Mayumbe System», characteristically composed of schists, metamorphic mafic and rhyolitic lavas, metaquartzites and meta-arkoses. Although no unconformity was seen along the contact of the Mayumbe belt in the west with the adjoining Sansikwa, both showing parallel fold trends, Cahen (1954) considered the existence of the Mayumbe Orogeny well proved because of the abovementioned «important angular discordance» in the Sansikwa massif and the occurrence of supposed pre-Sansikwa granites (Cahen in 1954 considered in effect all Bas-Congo granites to be of Mayumbe age, without giving any geological arguments).

Geologists working in French Equatorial Africa followed Cahen in using the term «Mayombe System» and assuming the existence of a Mayombe Orogeny, but they could not find any unconformities. Instead, they found that strikes in all formations followed the north-northwesterly West Congo trend for several hundred kilometres (except for northeasterly strikes in the oldest rocks, equivalent to the Basement Complex of Angola). Dévigne (1959) stated that the unconformity between the «Mayombe» and «Bamba» (Lepersonne's Sansikwa) systems is not well marked, even lacking a break in metamorphic grade.

In 1954 Cahen believed that the Mayumbe and West Congo orogenies had parallel (north-northwesterly) trends, but in 1963 he changed his mind, ascribing a roughly northeasterly trend to the Mayumbe Orogeny and admitting that most of the metamorphism and granites in Bas-Congo date from the much stronger West Congo Orogeny. Cahen's current view is that owing to refolding in the West

Congo Orogeny the Mayumbe rocks mostly exhibit strikes parallel to those of the West Congo strata, so that the unconformity between West Congo and Mayumbe beds is now only recognizable east of the main fold belt, in the Sansikwa and Kimuaka massifs. However, it seems most unlikely that an extremely strong angular unconformity, with the older folds striking at right angles to the younger ones, can be completely effaced by simple folding and thrusting.

The geological evidence for a Mayumbe Orogeny in Bas-Congo and the ex-French Equatorial Africa thus rests on the shaky foundation of the supposed unconformity in the Sansikwa and Kimuaka massifs. Nowhere else has an unconformity of appropriate magnitude been found.

In Angola, in a large tectonically uncomplicated region about 250 km south of the ex-Belgian Congo (Schermerhorn and Stanton 1963a), the complete Sansikwa succession is seen to rest with great unconformity on the Basement Complex (previously folded, metamorphosed, intruded by granites and planed by erosion). There is no intervening «Mayumbe». The Sansikwa succession can be traced northwards to the Congo frontier (Korpershoek 1964), the only significant change being the appearance of a thick level of metamorphic mafic and rhyolitic volcanics among the metaquartzites and meta-arkoses of Lower Sansikwa. When the frontier is reached *the Lower and Middle Sansikwa strata are found to be the prolongation of the «Mayumbe System» of the ex-Belgian Congo.*

b) *The absolute age determinations :*

Cahen *et al.* (1963) quote radioactive age determinations on zircons extracted from the Lufu granite in Bas-Congo (Fig. 1) and a quartz diorite in the Congo Republic (Brazzaville), both thought to date from the Mayumbe Orogeny. The ages vary from 1200 to 1500 million years. On the other hand, biotite from the Lufu granite gave an age of c. 475 m.y. (Cahen 1961). Sheared granites in the same tectonic setting and of exactly the same type as the Lufu granite occur in Angola not far south of the Congo frontier (Korpershoek 1964) and are syntectonic West Congo granites, being intrusive into the Upper Sansikwa. Locally they contain inclusions of various older rocks, and the zircons may therefore have been inherited from assimilated material. (Cahen rejects this possibility on the ground of their widespread occurrence in various types of rocks).

Microcline from augengneiss near Boma in the west of the Bas-Congo (in the continuation of the Basement Complex of Northwest Angola) gave a mean age of c. 1420 m.y., although feldspar and biotite from the same rock yielded younger ages (510 m.y. for the mica), owing to recrystallization in the West Congo Orogeny metamorphism. The 1200-1500 m.y. age may perhaps date a plutonic phase in the Basement Complex.

We consider that the geological evidence and age determinations from Bas-Congo and farther north are ambiguous, unlike the geological evidence from Angola. We therefore conclude that the «Mayumbe System» is the same as the Lower and Middle Sansikwa <sup>(1)</sup>, and that the terms «Mayumbe System» and «Mayumbe Orogeny» should be abolished.

4. *THE INCLUSION OF THE LOWER AND UPPER TILLOID FORMATIONS IN THE HAUT SHILOANGO AND THE SCHISTO-CALCAIRE.*

The tilloid formations were deposited from mudflows triggered by strong epeirogenic movements at the start of new sedimentary cycles (Schermerhorn and Stanton 1963b), of which they form the basal conglomerates. Each tilloid formation rests with disconformity or slight unconformity upon the underlying strata, and is followed conformably by genetically related sediments. There is locally a transition from M0 up into M1. The tilloid formations are therefore included in the Haut Shiloango and Schisto-calcaire series.

5. *THE DIFFERENT M'PIOKA SUCCESSION IN ANGOLA.*

The M'Pioka series as originally defined in the Belgian Congo rested unconformably on an eroded surface of Schisto-calcaire. The unconformity persists across the frontier into Angola but soon dies out southwards (Schermerhorn and Stanton 1960, Schermerhorn 1961, Stanton, Korpershoek and Schermerhorn 1962), to be replaced by a conformable, gradational junction. In Angola this is more widespread than the unconformity and where it is present the sedimentary column is much thicker (Fig. 2) than in Bas-Congo. A large part of the Angolan M'Pioka was deposited during the time interval represented by the unconformity in Bas-Congo, hence the Angolan succession differs from, and is more complete than, the original.

6. *THE ABOLITION OF THE «M'FIDI SERIES».*

The «M'Fidi Series» was separated from the M'Pioka Series by Brandes (1949) because it underlay P0, the supposed basal conglomerate of the M'Pioka. It has been shown elsewhere (Schermerhorn and Stanton 1960) that P0 is not a true basal conglomerate but a

---

<sup>(1)</sup> Except for basal «Mayumbe», mostly composed of northeast striking gneisses, which is apparently Basement Complex (see table).

# Stratigraphic successions in use in the West Congo Geosyncline

| NORTHWEST ANGOLA   |                              |                                          | Bas-Congo region of<br>CONGO FEDERAL REPUBLIC<br>(ex-Belgian Congo) |                                 |                                 |                                 | CONGO REPUBLIC<br>(ex-French Equatorial Africa) |                          |                    |                      |                             |                                      | GABOON<br>(ex-French Equatorial Africa) |                                         |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
|--------------------|------------------------------|------------------------------------------|---------------------------------------------------------------------|---------------------------------|---------------------------------|---------------------------------|-------------------------------------------------|--------------------------|--------------------|----------------------|-----------------------------|--------------------------------------|-----------------------------------------|-----------------------------------------|-------------------------------------|---------------------------------------------|------------------|-------------------------|---------------------------------------------|---------------------------|-------------------|----------------------|---------------------|--------------------------------------|----------------------|-----------------------------------------|
|                    |                              |                                          | Cahen 1954                                                          |                                 | Cahen 1963                      |                                 | Cosson 1955                                     |                          |                    | Gérard 1958          |                             | Nicolini 1959                        |                                         | Dévigne 1959                            |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
| WEST CONGO SYSTEM  | Schisto-gréseux Series       | Inkisi Subseries                         | GROUPE DU CONGO OCCIDENTAL                                          | Système schisto-gréseux         | Série de l'Inkisi               | OUEST-CONGOLIEN                 | Inkisi                                          | Séries schisto-gréseuses | Série de l'Inkisi  |                      | Système de l'Inkisi         |                                      | Série schisto-gréseuse supérieure       |                                         |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
|                    |                              | M'Bridge Formation                       |                                                                     |                                 | Série de la MPIoka              |                                 |                                                 |                          | Mpioka             | Série de la M'Pioka  | Série de la M'Pioka         |                                      | Série schisto-gréseuse inférieure       |                                         |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
|                    |                              | M'Pioka Subseries                        |                                                                     |                                 | Série de la MFidi               |                                 |                                                 |                          |                    |                      |                             |                                      |                                         |                                         |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
|                    | Schisto-calcaire Series      | C5                                       |                                                                     | Système schisto-calcaire        | Étage du Bangu                  |                                 | Schisto-calcaire                                | Série schisto-calcaire   | SC <sub>III</sub>  | SC <sub>II</sub>     | Système du Congo Occidental | Série schisto-calcaire               | Système du Niari                        | Série schisto-calcaire                  | SC <sub>IV</sub> Série de la Biboua | SC <sub>III</sub> ou SC <sub>5</sub>        | SC <sub>IV</sub> |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
|                    |                              | C4                                       |                                                                     |                                 | Étage de la Lukunga             |                                 |                                                 |                          |                    |                      |                             |                                      |                                         |                                         |                                     |                                             |                  | Étage du Kwilu          | SC <sub>II</sub> ou SC <sub>4</sub>         |                           |                   |                      |                     |                                      |                      |                                         |
|                    |                              | C3                                       |                                                                     |                                 | Tillite supérieure du Bas-Congo |                                 |                                                 |                          |                    |                      |                             |                                      |                                         |                                         |                                     |                                             |                  |                         |                                             | Système du Haut Shiloango | Étage de Sekelolo | Couches de NSékélolo | Couches de Diambala | Séries de la Louila et de la Bouenza | Système du Kouilou   | Série de la Louila et l'Étage Bouenzien |
|                    |                              | C2                                       |                                                                     |                                 |                                 |                                 |                                                 |                          |                    |                      |                             |                                      |                                         |                                         |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
|                    |                              | C1                                       |                                                                     |                                 |                                 |                                 |                                                 |                          |                    |                      |                             |                                      |                                         |                                         |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
|                    | C0 (Upper Tilloid Formation) |                                          |                                                                     |                                 |                                 |                                 |                                                 |                          |                    |                      |                             |                                      |                                         |                                         |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
|                    | Haut Shiloango Series        | Sekelolo Subseries                       |                                                                     | Se2<br>Se1<br>Se0               | Système du Haut Shiloango       |                                 | Étage de Sekelolo                               | Haut-Shiloango-Louila    | Série de la Louila | Couches de NSékélolo | Couches de Diambala         | Séries de la Louila et de la Bouenza | Système du Kouilou                      | Série de la Louila et l'Étage Bouenzien |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
| Mouyonzi Subseries |                              | M2<br>M1<br>M0 (Lower Tilloid Formation) | Étage de Mouyonzi                                                   |                                 |                                 |                                 |                                                 |                          |                    |                      |                             |                                      |                                         |                                         |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
| Sansikwa Series    |                              | Terreiro Subseries                       |                                                                     | Tillite inférieure du Bas-Congo |                                 | Tillite inférieure du Bas-Congo | Sansikwa                                        |                          |                    |                      |                             |                                      |                                         |                                         | Système des Monts Bamba             | Série de la Tillite inférieure du Bas-Congo |                  | Système des Monts Bamba | Série de la Tillite inférieure du Bas-Congo |                           | Système du Bamba  | Série de la Mossouva |                     | Système du Mayombe                   | Série de la Mossouva |                                         |
|                    | Assise supérieure            |                                          | Série de la Mossouva                                                |                                 | Série de M'Vouti                |                                 |                                                 | Série de la Mossouva     |                    | Série de la Banza    |                             |                                      |                                         |                                         |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
|                    | Assise inférieure            |                                          | Série de Mvouti                                                     |                                 | Série de M'Vouti                |                                 |                                                 | Série de M'Vouti         |                    |                      |                             |                                      |                                         |                                         |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
| BASEMENT COMPLEX   |                              |                                          | GROUPE DES MONTES DE CRISTAL                                        | Système du Mayombe              | Série de la Duizi               | MAYUMBIEN                       | Système du Mayombe                              | Série de la Loukoula     |                    | Système du Mayombe   | Série de la Loukoula        |                                      | Système du Mayombe                      | Série de la Loukoula                    |                                     | Système du Premayombe                       | Série de Sounda  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
|                    |                              |                                          |                                                                     |                                 | Série de Tshela                 |                                 |                                                 | Série de la Bikossi      |                    |                      | Série de la Bikossi         |                                      |                                         | Série de la Douigni                     |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
|                    |                              |                                          |                                                                     |                                 | Série de Palabala et de Matadi  |                                 |                                                 | Couches de Matadi        | Série de la Loémé  |                      | Série de la Loémé           |                                      |                                         | Série des Monts Kouboula                |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |
|                    |                              |                                          |                                                                     |                                 | Couches de Palabala             |                                 |                                                 |                          |                    |                      |                             |                                      |                                         | Série de la Doussa                      |                                     |                                             |                  |                         |                                             |                           |                   |                      |                     |                                      |                      |                                         |

diachronous facies repeated at several levels in M'Pioka (cf. Fig. 2) and that M'Fidi in fact forms part of M'Pioka. The same is true of the Biboua Series defined by Nicolini (1959) in French Equatorial Africa.

#### 7. THE INTRODUCTION OF THE M'BRIDGE FORMATION.

The M'Bridge Formation is a rock unit of local importance in Angola, thought to be of upper M'Pioka to Inkisi age. Owing to lack of exposures in the critical areas it cannot as yet be assigned to either the M'Pioka or the Inkisi Subseries or divided between them. Until this can be done it must remain as a separate formation.

### CONCLUSION

We believe that the stratigraphic succession now in use in Angola, resulting from more detailed mapping than elsewhere in the West Congo Geosyncline and based on the «West Congo System» as a single geosynclinal unit, is the most accurate, natural and convenient one yet devised.

### REFERENCES

- ANTUN, P. (1961) — *Observations préliminaires sur le massif cristallophyllien de Kimuaka (Bas-Congo)*. «Ann. Soc. géol. Belg.», 84, 229-240.
- BRANDES, M. C. (1949) — *La Série de la M'Fidi. Subdivision inférieure nouvelle du Système Schisto-gréseux*. «Bull. Soc. belge Géol.», 58, 436-442.
- CAHEN, L. (1954) — *Géologie du Congo belge*. Vaillant-Carmanne, Liège.
- (1961) — *Review of geochronological knowledge in Middle and Northern Africa*. «Ann. New York Acad. Sci.», 91, 535-567.
- (1963) — *Tectoniques superposées au Bas-Congo*. «Ann. Soc. géol. Belg.», 86, B 213-B 228.
- , DELHAL, J., LEDENT, D., et REINHARZ, M. (1963) — *L'âge des migmatites de Boma et de l'orogénèse ouest-congolienne. Indications préliminaires sur l'âge des formations mayumbiennes et antérieures*. «Ann. Soc. géol. Belg.», 86, B 229-B 269.
- COSSON, J. (1955) — *Notice explicative sur les feuilles Pointe-Noire et Brazzaville. Carte géologique de reconnaissance au 1/500.000*. «Gouvernement Générale de l'A. E. F.».

- DÉVIGNE, J. P. (1959) — *Le Précambrien du Gabon Occidental en Afrique Équatoriale Française et régions limitrophes*. «Bull. Inst. équat. Rech. géol. min.», 11, 1-315.
- GÉRARD, G. (1958) — *Carte Géologique de l'Afrique Équatoriale Française au 1/2.000.000*. «Notice explicative», Direction des Mines et de la Géologie, A. E. F.
- KORPERSHOEK, H. R. (1964) — *The geology of Degree Sheet Sul B-33/H-N (Noqui-Tomboco)*. «Bol. Serv. Geol. Min. Angola, No. 9 (in the press).
- LEPERSONNE, J. (1951) — *Données nouvelles sur la stratigraphie des terrains anciens du Bas-Congo*. «Bull. Soc. belge Géol.», 60, 169-189.
- NICOLINI, P. (1959) — *Le synclinal de la Nyanga (zone de la boucle du Niari)*. «Bull. Direction Mines Géol. A. E. F.», 10, 1-178.
- SCHERMERHORN, L. J. G. (1961) — *Sedimentary cycles in the West Congo Geosyncline of Northwest Angola*. «Bol. Serv. Geol. Min. Angola», N.º 3, 47-62.
- et STANTON, W. I. (1960) — *La limite Schisto-calcaire — Schisto-gréseux en Angola, en A. E. F. et au Congo*. «Ann. Soc. géol. Belg.», 84, 91-101.
- and ——— (1963a) — *The geology of Degree Sheet Sul B-33/U (Bembe)*, «Bol. Serv. Geol. Min. Angola», N.º 7, 5-101.
- and ——— (1963b) — *Tiloids in the West Congo geosyncline*. «Quart. J. geol. Soc. Lond.», 119, 201-241.
- STANTON, W. I. (1963) — *The geology of Degree Sheet Sul B-33/J-P (Maquela-Damba)*. «Bol. Serv. Geol. Min. Angola», n.º 8, 79-136.
- , KORPERSHOEK, H. R., and SCHERMERHORN, L. J. G. (1962) — *The Geology of Degree Sheet Sul B-33/I-O (São Salvador)* «Bol. Serv. Geol. Min. Angola», N.º 6, 15-86.