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NEW DATA ON THE COASTAL SEDIMENTARY FORMATIONS IN FRENCH GUIANA

OFFICE DE LA RECHERCHE SCIENTIFIQUE
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ORSTOM

NEW DATA ON THE COASTAL SEDIMENTARY FORMATIONS IN FRENCH GUIANA

M. BOYE and H. CRUYS

ABSTRACT

These papers deal with (1) a study of the Quaternary and the problem of the age of the White Sands (Zanderij, Série détritique de base): (2) the discussion of sedimentation in the Tertiary between the Paleocene and the Zanderij.

In the introduction the sedimentological study is described as consisting of the granulometric analysis of several clays. A micropaleontological study was made of the shaly limestone beds recovered from boreholes of the coastal plain. The stratigraphy and age of the sediments is discussed.

The Quaternary and White Sands are described with an up-to-date statement on the stratigrahy of the recent Quaternary and in particular a definition of the "Série des Savanes" which is equivalent to the Coropina deposits of Surinam. Different categories of bi-coloured clays and the difficulties of their classification are discussed. New data are given on the sedimentological characters of the White Sand Formation which lead to the conclusion that there have been several periods of deposition from the Plio-Pleistocene up to the period corresponding with Riss-Wurm interglacial.

The clay and sand, and shaly limestone formations of the Tertiary (pre-Zanderij) are also described. A study of some deep boreholes, by proving the existence of a shaly limestone formation dated as Paleocene shows a series of sediments sometimes rhythmic, sometimes cyclic with a preponderance of sand in the neighbourhood of the large estuaries and a preponderance of clays in the calmer zones. The palaeontogical and lithological studies of the shaly calcareous series, which is very fossiliferous and constitutes the lowest stratigraphical unit of the coastal sedimentary deposits, has shown the existence of a microfauna of Foraminifers characterizing the Paleocene of marine epicontinental facies.

1. The Quaternary and the Problem of Detritic White Sands

M. BOYE[1]

INTRODUCTION

The present note deals with recent sediments of the northern border of the French Guiana Shield, especially the coastal belt between Cayenne and the Maroni River.

Sedimentological studies, comprising several combined statistic methods, have been applied to the dry coastal savannas, the littoral muddy swamps and the sediments from some deep bore-holes, carried out by the Bureau Minier Guyanais in the Maroni-Mana triangle. The results have led to a satisfactory stratigraphy and chronology of Holocene and Pleistocene sediments. For instance, we may give a better definition of the Coropina Series which were named Coswine Series by Boris Choubert. We can also bring new arguments in the important problem of the significance of continental detritic sands which might be correlated to the White Sand Series of British Guiana or the Zanderij Series of Surinam.

I.—GEOMORPHOLOGY OF THE COASTAL BELT OF RECENT SEDIMENTS

The dry savannas, between Cayenne and Organabo to the North West, form a 1 to 10 Km wide belt of sandy silts which stretches parallel to the shore-line on a distance of 150 Km (Fig. 1).

These savannas are bounded to the North by a belt of 500 m to 5 Km wide sublittoral swamps and mangroves associated with several sandy ridges, more or less parallel to the present shore-line. The southern border coincides with the northern limit of the rain forest. It corresponds also with a festooned scarp 5 to 10 m in elevation above the savannas. So we can distinguish three main geomorphological units:

(1) The first one lies from zero to 5 or 6 m. above sea-level. It corresponds to a mainly muddy sedimentation controlled by the present base-level and by the somewhat higher sea-level, probably the maximum of the Demerara or Flandrain transgression. The landscape of mangroves and shallow swamps, associated with sandy bars parallel to the shore looks exactly like the Younger Coastal Plain in Suriname and British Guiana, but its extent is far more narrow than in the two other Guianas.

(2) The second level coincides with the dry savannas. Southwards, it rises gently

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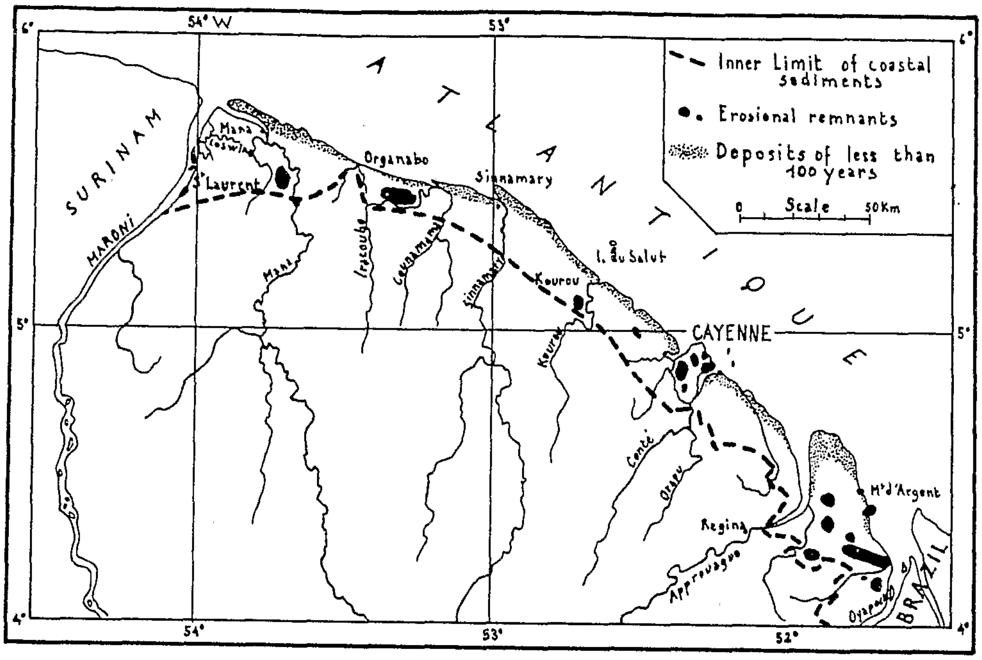


Fig. 1 SEDIMENTARY COASTAL PLAINS in FRENCH GUIANA—Location sketch (after B. Choubert).

from 6 or 8 m to 10 or 12 m high. It corresponds to a sheet of several kinds of marine sands with two or three ridges, also parallel to the present shore-line. This sheet is gullied by a preflandrian water system, partly filled up by younger clays, so that a so-called "rias" morphology occurs on the northern limit of the dry savannas.

However the trend of the relief is mainly southeast to northwest with a very gentle hilly region to the north of the older sand ridge with a wide flat to the south, where the streams are meandering in a general SE-NW direction before meeting the main rivers.

This landscape does not really look like the Older Coastal Plain in Suriname because the Coropina clays are scarcely found except on the inner zones of the largest estuaries. It disappears to the west of the Organabo uplift of the basement and it is replaced by a plateau of white sands from 10 to 20 m high.

The typical Coropina landscape exists only in the Maroni estuary, from Saint-Laurent to Mana River, as a triangle-shaped area, with strongly eroded clayey and sandy deposits. Not all these sediments are marine, but rather deposited into lagoons under the mangrove conditions or in a definite deltaic environment with a constant competition between fluvial supplies and marine actions, controlled by transgression older than the Demerara. In a good accordance with the recent conclusions of Dr. Th. van der Hammen, we can date this rising sea level from the Riss-Wurm interglacial. In other words we may give the name "Eemian" to this transgression after several Dutch authors working in Suriname.

(3) The third level is a plateau rising gently from 15 to 20 m above sea-level to 25 or 30 m further inland. The scarp above the savannas has been cut sometimes in the last hills of the lateritized Preeambrian basement, sometimes in several kinds of arenaceous detritals mainly of fluviatile origin; but these coarse sands often represent eluvial or colluvial residues of the crystalline basement washed out by heavy rainfalls and just spread into the nearby foreland. In present times such minor washing out occasionally occurs, spreading older sands on the southern part of the savannas.

Higher levels exist at 35 m above sea-level as fluvial terraces along the main rivers; at 40 or 45 m, in the Saut-Sabbat area immediately east of the Mana River; at 60 to 80 m, on the plateaus south of Saint-Jean du Maroni. For instance, at Laussat Creek (East of Saut-Sabbat) occur layers of quite rounded pebbles which might be smoothed by wave action but we must be careful in the interpretation because there is not any more evidence of a sea shore at this level, as we are to show presently by the shape of the cumulative curves of grain sizes.

II.—STRATIGRAPHY OF HOLOCENE AND PLEISTOCENE SEDIMENTS

Q. 4 *Most recent sediments*

They comprise essentially marine muds deposited as shoals on the strands or floculated under mangrove conditions. From these muds, sands must be segregated and erected as littoral bars. The sandy bars are frequently multicrested; it does not mean that there are several individual bars but this morphology might be in connection with a periodical phenomenon of erosion and accumulation alternating each eleven years in relation with the sun spots activity, as B. Choubert and I have recently published in a short note on that subject.

On the banks of the estuaries occurs a *slikke* (mud) consisting in thin coatings of sea clays mixed with fluvial muds.

Most of the authors think that the main part of these sediments is coming from the Amazon, drifted along the coasts by the Guiana Sea Current. We think so, too, but the clay load of the other rivers from the Guiana Shield is not to be neglected.

Q. 3 *Demerara Formation*

The sediments of Demerara Formation mainly consist in blueish plastic marine clays, composed with illite and kaolinite, the latter slightly predominating, according to X-ray analysis (Lafond 1953-54, Cruys 1959). These clays always contain more or less quartz sand, from 5 to 25%. In certain layers, which occur somewhat rhythmically throughout the Demerara beds, the clays are replaced by very fine grained silts, less than 37 microns. Such silts look much like clay but in reality it is a powder of quartz, as revealed on chemical diagrams. (Fig. 2).

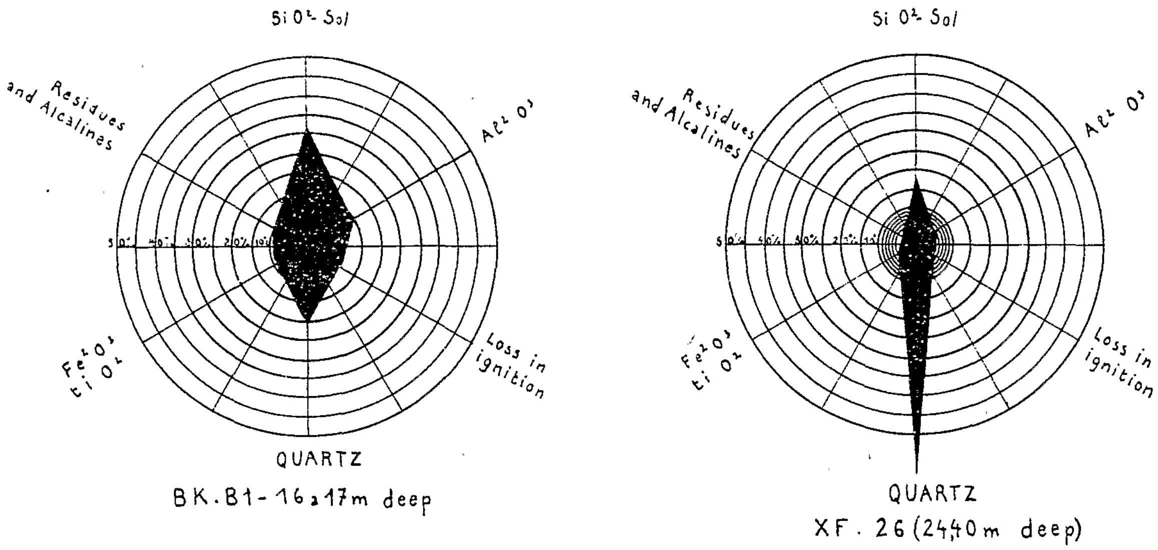


Fig. 2 HEXAGONAL DIAGRAMS OF CHEMICAL ANALYSIS
—to the left : typical Demerara clay, from swamps N.E. of Mana.
—to the right: very fine grained quartz silt, intercalated in a clay series (borehole at Felix Beach, N.E. of Mana)

Demerara clays and silts may have a maximum thickness of 10 to 15 m. Owing to the existence of vegetal remnants we may assume that they were predominantly deposited in coastal lagoons rather than in the open sea.

On the landside of the mangrove belt, the Demerara sediments form badly compacted soils with often a cover of peat from 1 to 2 m thick. The same clays and silts have filled up ancient rias existing in the pre-flandrian age.

There are very few fossils of still existing molluscs species. Nevertheless the Flandrian age is certain because of the 5 to 6 m transgression which has been identified all over the world in connection with the melting of the last Wurmian Ice-Caps.

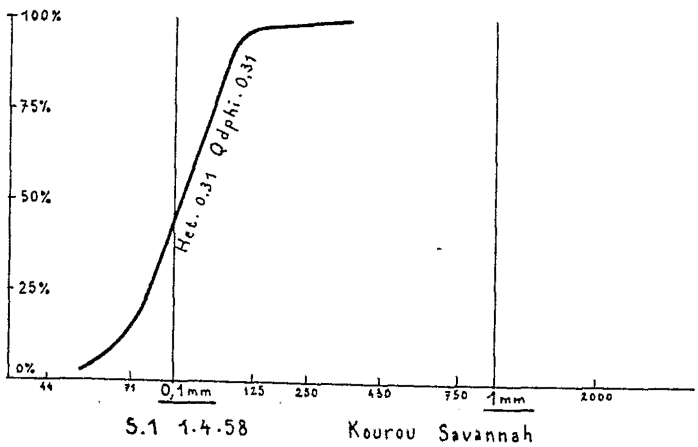
Practically, all the Holocene sediments in French Guiana are of the same kinds and lie one on the other without any significant change in the type of sedimentation.

Q. 2 *Coropina-Coswine Series*

In the dry savannas of French Guiana, older series are mainly represented by three types of marine sands whose sedimentological features are quite different from all other sands in the country.

1. *Grey-White Sands*: Generally very fine (from 53 to 300 microns in medium size) and hardly worn by mechanical actions, these sands have been deposited at the end of transportation in a shallow sea (10 m deep as a maximum). This is indicated by the logarithmic shaped cumulative curves of the grain sizes. The slope of the curves is quite steep, characterizing very well sorted sediments (Fig. 3). They form a regular level representing the upper part of the sedimentation, to be correlated to the Lelydorp landscape in Surinam. The mean thickness is about 1 to 2 metres. The poorest grasslands grow on them because they are often podzolized.

2. *Yellow-brown Sandy Loams*: This is a curious type of ferralitic soil, rich in ferruginous concretions sometimes lateritized, with predominant quartz grains and numerous mica flakes. In the topography they form low dome-shaped outcrops or ridges. Their cumulative curves show a good sorting at the small sizes, which looks marine, but on the



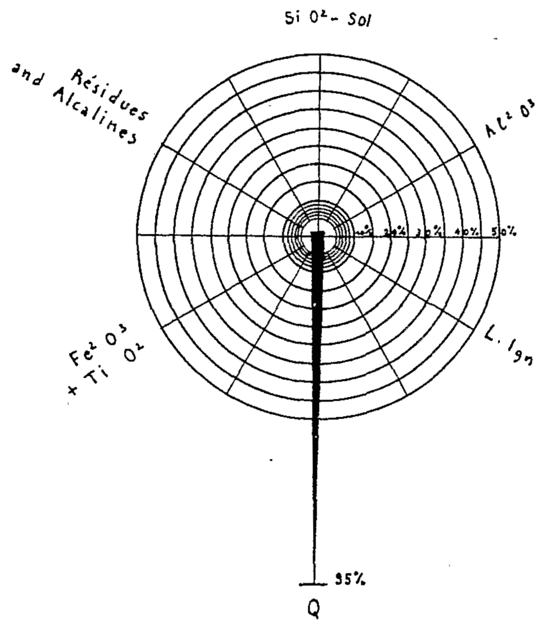


Fig. 3 SAVANNAS SANDS SERIES — Greywhite sand sample from the Eemian horizon, West of Kourou: grain sizes distribution and chemical analysis.
Note the logarithmic facies of the cumulative curve.

whole the shape of the curve is mostly hyperbolic (terminology according to Riviere's method of *"indice de facies"* for cumulative curves). This seems to indicate an eluvial material partly reworked by wave action. This interpretation is confirmed by chemical diagrams showing a certain amount of argillaceous minerals or silicates. (Fig. 4).

These soils are covered by woods or by the best developed grasslands.

3. *Yellow Sands*: These sands are derived from the previous soils by drifting along a shore; they are arranged in beaches around the hills or erected in two or three ridges which seem to be sandy bars linking several dome-shaped hills which may have been for-

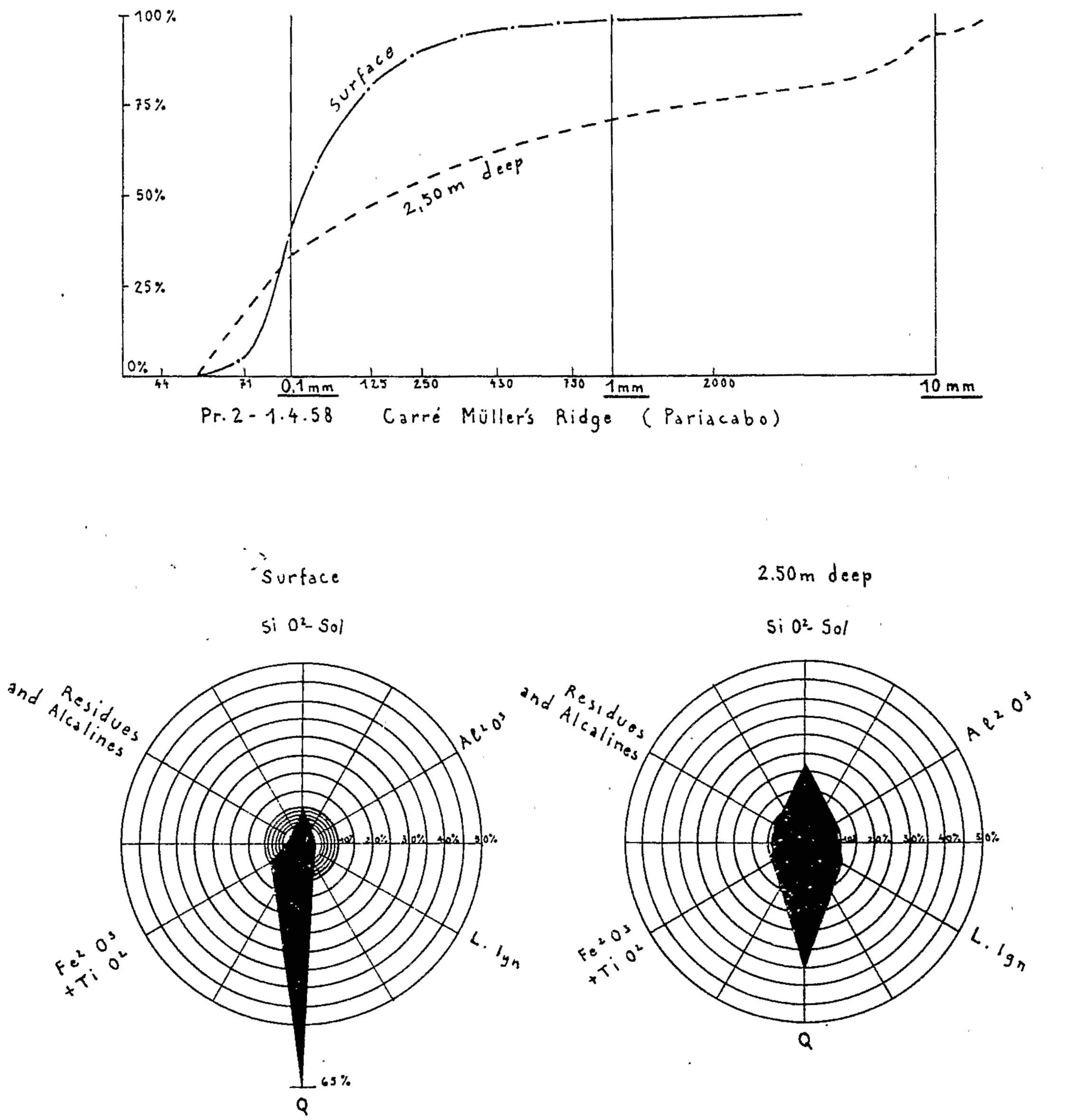
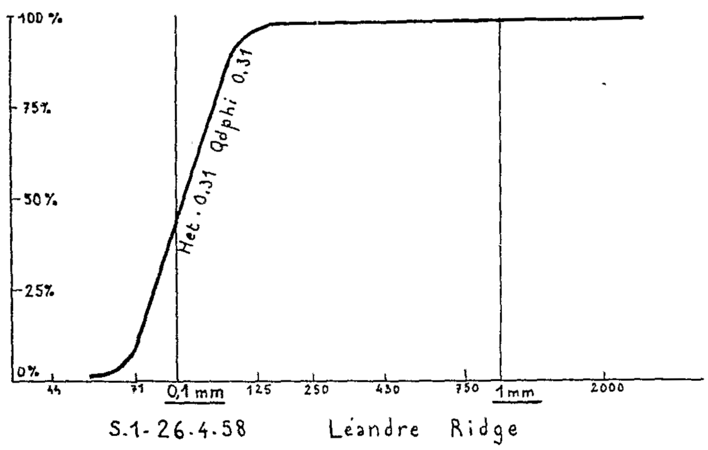


Fig. 4 SAVANNAS SANDS SERIES—Yellow-brown sandy loam samples from a ridge, West of Kourou.
—surface : type of soil reworked by the sea and slightly lateritised. Note the partly logarithmic and hyperbolic facies of the cumulative curve.
—at 2.5 m deep : the weathered bedrock, probably a granite.

merly islands. They are better sorted than the yellow-brown soils so that they give cumulative curves which are identical with those of the grey-white sands. However they are still a little bit loamy, as the chemical diagrams do show. (Fig. 5).

clays are intercalated. Not, or only slightly, worn by mechanical action, they show several signs of chemical weathering such as pock-marks looking like very small cupules with smoothed edges, on quartz grains and also on staurolites.



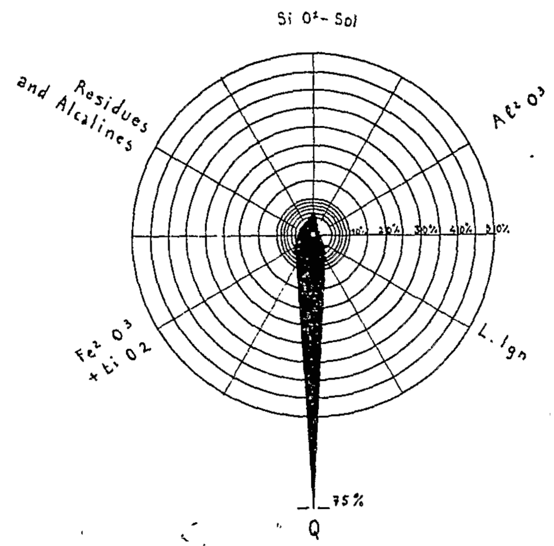


Fig. 5. SAVANNAS SANDS SERIES—Yellow sand sample from an old coastal bar, west of Kourou. Compare the logarithmic facies of the curve with the curve on Fig. 3 and the chemical diagram with the surface sample curve on Fig. 4.

Yellow sands also occur beneath the grey-white sands cover, separated by a humic hardpan of few inches, which may represent a buried soil owing to existing remnants of Graminaceae.

The real thickness of these underlying yellow sands are not known but it cannot be great because, at a depth of few metres there are grey-red mottled sandy clays. These clays have been considered until now as representing Coropina clays; but, generally speaking, they are not, except in the estuarine areas. So not all of these clays may be quoted Q.2 on the stratigraphic scale.

In conclusion we can say that in French Guiana there is a preponderance of marine sands with a poor content of clay among Coropina sediments and, as the dry savannas strictly correspond to their extent, we suggest to call them "Savannas Sands".

Q.1 *Upper Continental White Sands*: These white sands are more or less coarse, with a high content of heavy minerals. They are rarely clayey, but sometimes lenses of kaolin

As the white sands occur at higher levels than the Savannas Sands, they are usually considered to represent the middle or the lower Pleistocene. They might be eventually compared with the Upper White Sands in British Guiana or the Zanderij formation in Surinam. But a chronological correlation can't be given exactly because of their different ages which have been recognized by sedimentological evidence.

In fact, the notation Q.1 does not mean a definite sedimentary series but only that a part of these sediments is older than the Savannas Sands. Then two problems remain.

III—MOTTLED CLAYS AND WHITE SANDS:

The problem of mottled clays: The first problem is: why don't we find the typical Coropina clays in French Guiana, except on the main estuaries?

As far as we know, the Savannas Sands usually lie upon a surface levelling an irregular topography of the rock basement, strongly altered. The frequent results of rock weathering is a sort of mottled bicoloured clay (grey and red) with coarse sand in it, comprising grains of quartz always predominant, mica flakes, different heavy minerals, tiny ferruginous concretions, limonite and sometimes visibly gibbsitized feldspars. In several localities we have found relict crystalline structures, for instance in the Moucaya Savanna, near Organabo, where the basement is probably a granite with two micas: muscovite and biotite.

So these mottled sandy clays appear as eluvial or eventually colluvial residues of the weathered basement. The grain size distribution of the sand fraction shows a very badly sorted material. Moreover the diagrams of chemical analysis look very much like those of decomposed crystalline rocks (Fig. 6).

These clays are levelled with the same tilt as the Savannas Sands; such a surface seems to be of a Coropina-Coswine age, something like an abrasion surface on a shore-line of the Eemian sea, but the clays concerned might have been formed previously, during one or several periods of chemical weathering and it is impossible to define their ages precisely.

When such clays occur with a definite sedimentary facies, they appear to be fluvial or, at the most, fluvio-marine sediments, always deposited in lagoons or under mangrove covers. This is the case, for instance, in the bore-hole drilled, under management of the Bureau Minier Guyanais, at Coswine Village,

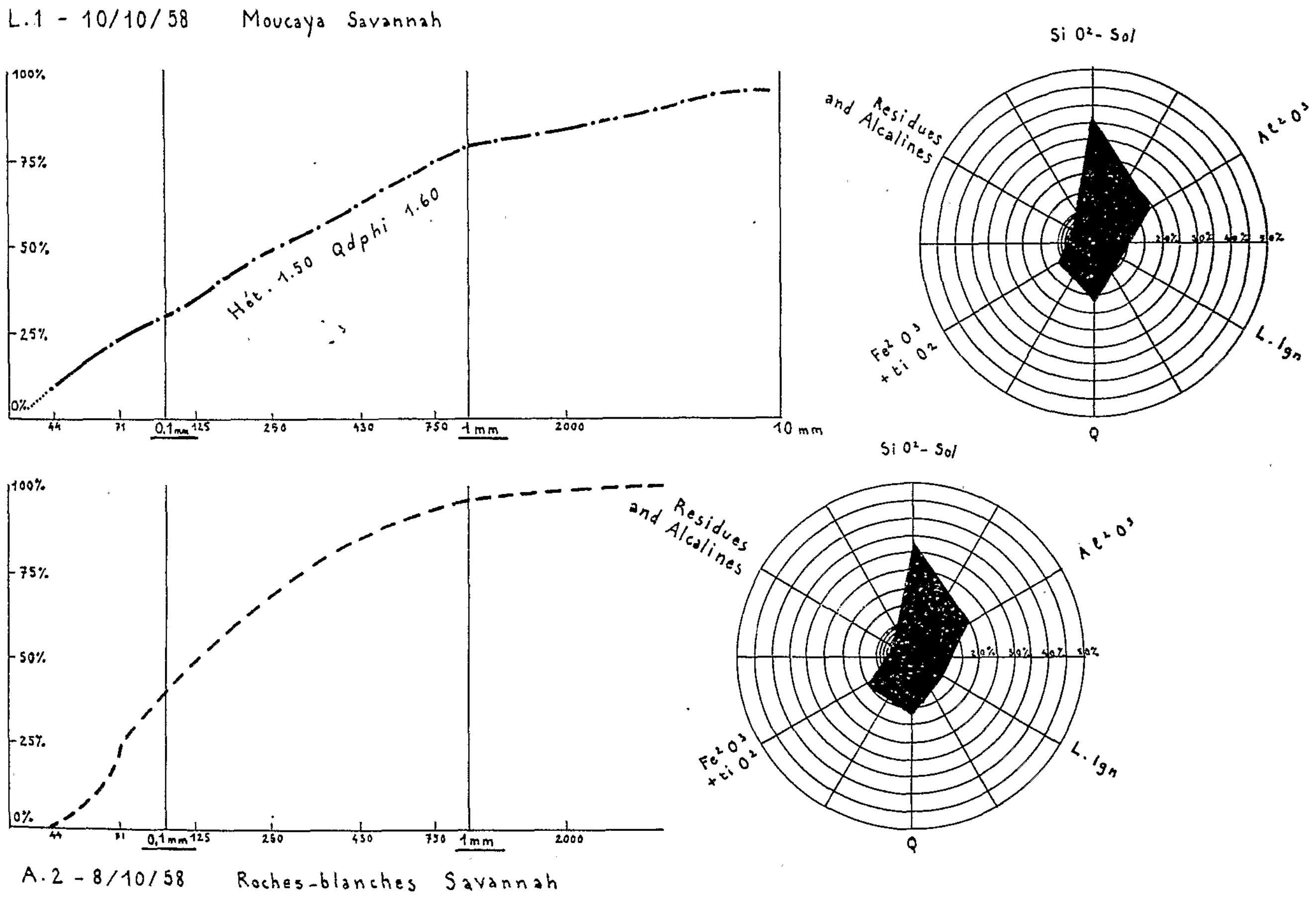


Fig. 6 MOTTLED SANDY CLAYS OF ELUVIAL ORIGIN—samples from savannas East of Organabo.
—L 1 : decomposed granite with two micas.
—A 2 : colluvial clay, probably derived from L. 1.

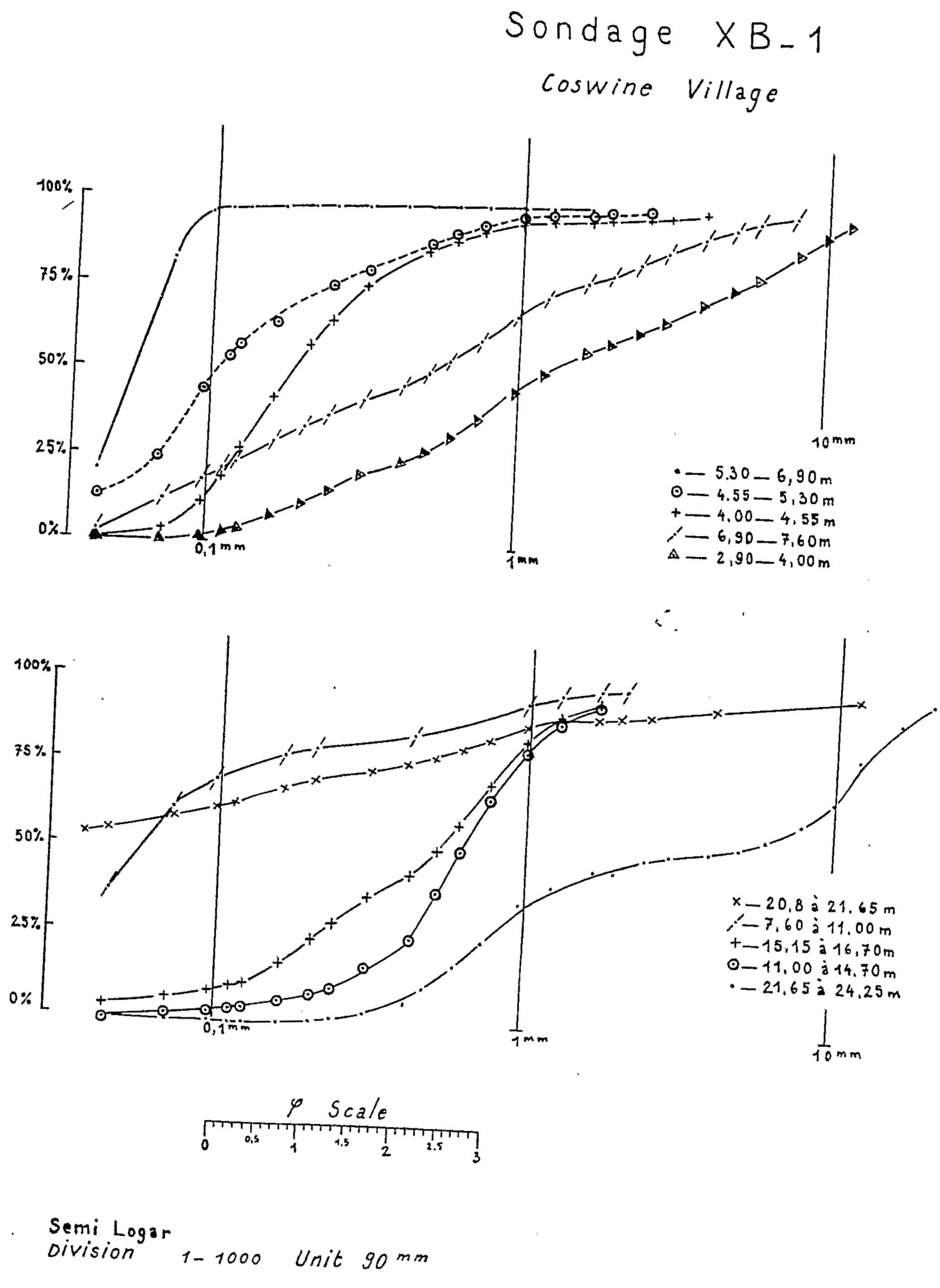


Fig. 7 COROPINA — COSWINE SERIE AND YOUNGER SEDIMENTS.
Several cumulative curves from the borehole at Coswine Village.
To note the bimodal curve of the Zanderij-like sediment (21 to 24 in deep) and the quite perfect logarithmic curve of the Lelydorp-like sand (6,9 to 7,6 m deep.).

in the Maroni estuary. Coswine Village is an Indian settlement, on the top of a steep bank of Coswine Creek, from where B. Choubert (1949) has described the "Coswine Series". The landscape all around consists of several wooden islets which are typical erosional remnants of the Older Coastal Plain.

In the profile at Coswine Village, the Coropina clays lie at 21 m deep, on badly sorted sands and gravels of fluviatile or estuarine type, which we have correlated with the White Sand Series (D. Bleackley, 1956 and 1957) or in preference with what Dr. Doeve* has called "the pre-bauxite Zanderij". Anyway, in the bore-hole the Coropina Series begins by a mixing of mottled clays and the underlying sands (Fig. 7).

Higher in the profile several layers of mottled lagoon clay with gibbsite grains occur more or less rhythmically, alternating with fluviatile sands. This is typical of an estuarine environment. X-ray analysis reveals in the mottled clay the usual kaolinite-illite combined material, with in addition, not very much but always noticeable montmorillonite. The montmorillonite is a good index of a supply of clay minerals coming from a granitic shield weathered under non-lateritizing climatic conditions.

About 7 m deep in the profile, occurs suddenly a two meters thick layer of very unsorted coarse sand, with a plurimodal cumulative curve, which represents a pluvial washout. This sediment stresses, not only a major climatic change but also a regression of the Coropina base-level.

And then again we find a true marine sand, without any clay in it, which is of the Savannas Sands type. This feature means a recurrence of the Coropina transgression reaching its maximum level at the Lelydorp age.

After that in the profile, the upper layers, up to the surface are made of a kind of unsorted white sand of pluvial washed-out type.

As there is no Demerara sediment in this profile, we can conclude that there were two main stages in the Coropina Series. The regression, towards 7 m, must be correlated with the buried soils between grey sands and yellow sands of the Savanna Series. The maximum thickness of the Coropina formation in the North-West of French Guiana seems to be of about 15 to 20 metres.

We suggest Q. 2b as notation for the under Coropina-Coswine formation, strictly correlated with the Coropina clay in Surinam. The age must be Eemian, that is to say corresponding to the interglacial Riss-Wurm times.

Consequently we may note Q. 2a the upper Coropina-Coswine marine sands, correlated with the Lelydorp Sands in Surinam. the age of which may be more recent than usually admitted. According to the conclusions of van der Hammen (1959) in Colombia through pollen analysus results, the Lelydorp transgression might occur during the "interstadial" melting of ice-caps, between the Wurm I and the Wurm II. So, Lelydorp sands should be dated from 30,000 to 40,000 years before the present time.

Therefore the unsorted white sands lying in the upper part of the profile at Coswine appear younger. Their washed-out character is in a good accordance with the last pluvial period corresponding in the intertropical latitudes, to the last glacial Wurm II. Thus we are led to discuss the second point.

The significance of detritic white sands: What is exactly the significance of white sands, because the latest continental white sands in the Coswine Village profile cannot be set in the Q. 1 part of the stratigraphic scale?

In French Guiana, we have very few sediments looking strictly like the cross-bedded white sands we have seen in the Mackenzie Mines for instance. The main reason is that we have no Roraima sandstone east of Table Mountain in Surinam. The supply is not the same and there is no down-warping of the shield like in the Corentyne-Berbice trough.

Through mechanical analysis evidence, there are three main types of white sands, all the three of continental origin.

1. The first, with a plurimodal distribution of sizes, means usually an eluvium from metamorphic rocks, strongly leached *in situ* by pluvial waters.

* This volume page 53.

If the basement consists of more homogeneous rocks, like the Granites Caraibes or Guyanais, the curve is a straight line, slightly hyperbolic on its end corresponding to the greatest sizes; but owing to the very bad sorting it signifies the same eluvial origin. (Fig. 8).

2. The second type, with a steeper parabolic-shaped curve, represents a transported sediment, sorted by stream action. In the topography such white sands lie on plateaux higher than 15 to 20 m above sea level, as remnants of wide alluvial flats, or sometimes

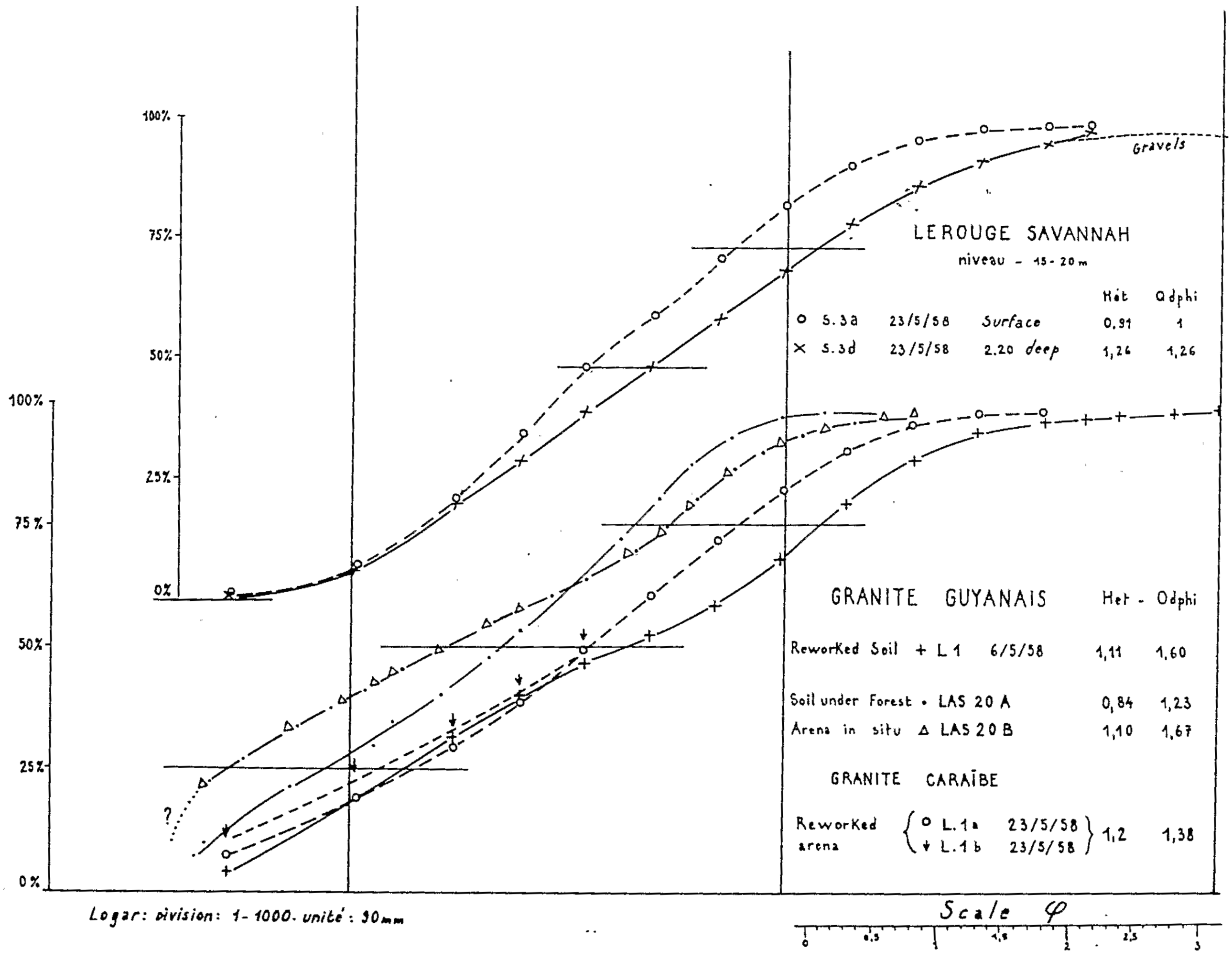
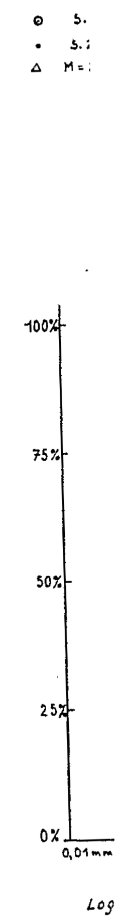


Fig. 8 FROM THE WEATHERED ROCK TO THE DETRITIC SANDS.
At Lerouge Savannah West of Kourou: detritic sands, right on the border of the rain-forest.
Several samples of in situ weathered granites



form ancient fluvial terraces along the main rivers (Sinnamary—Iracoubo—Mana and so on). (Fig. 9).

part of the curve expresses a certain transport; then, around the medium size, the curve becomes steeper and more or less straight.

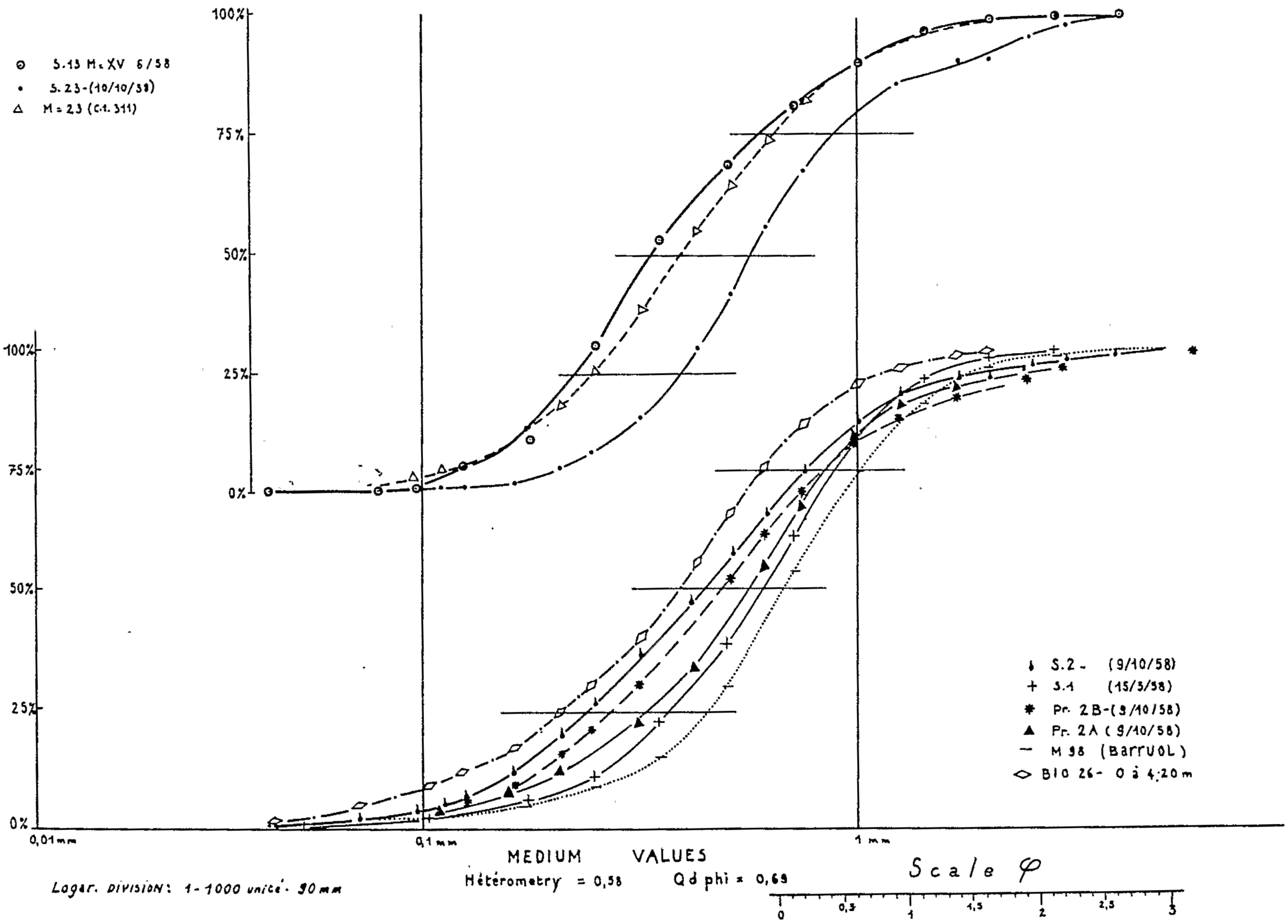


Fig. 9 CONTINENTAL DETRITIC SANDS Alluvial facies (horizon 10—20 m).

3. The third type, with an irregular curve of grain size distribution, is typical of the pluvial washed-out sands. The parabolic

That means the concentration of grains having as size the medium one of the crystals existing in the parent rock. The end of the curve towards the greatest sizes is mostly hyperbolic, but it expresses only a dispersion due to the hazard. (Fig. 10).

this sort are washed down to the coastal plains almost torrentially. Therefore cross-beddings can be formed without signifying a true deltaic

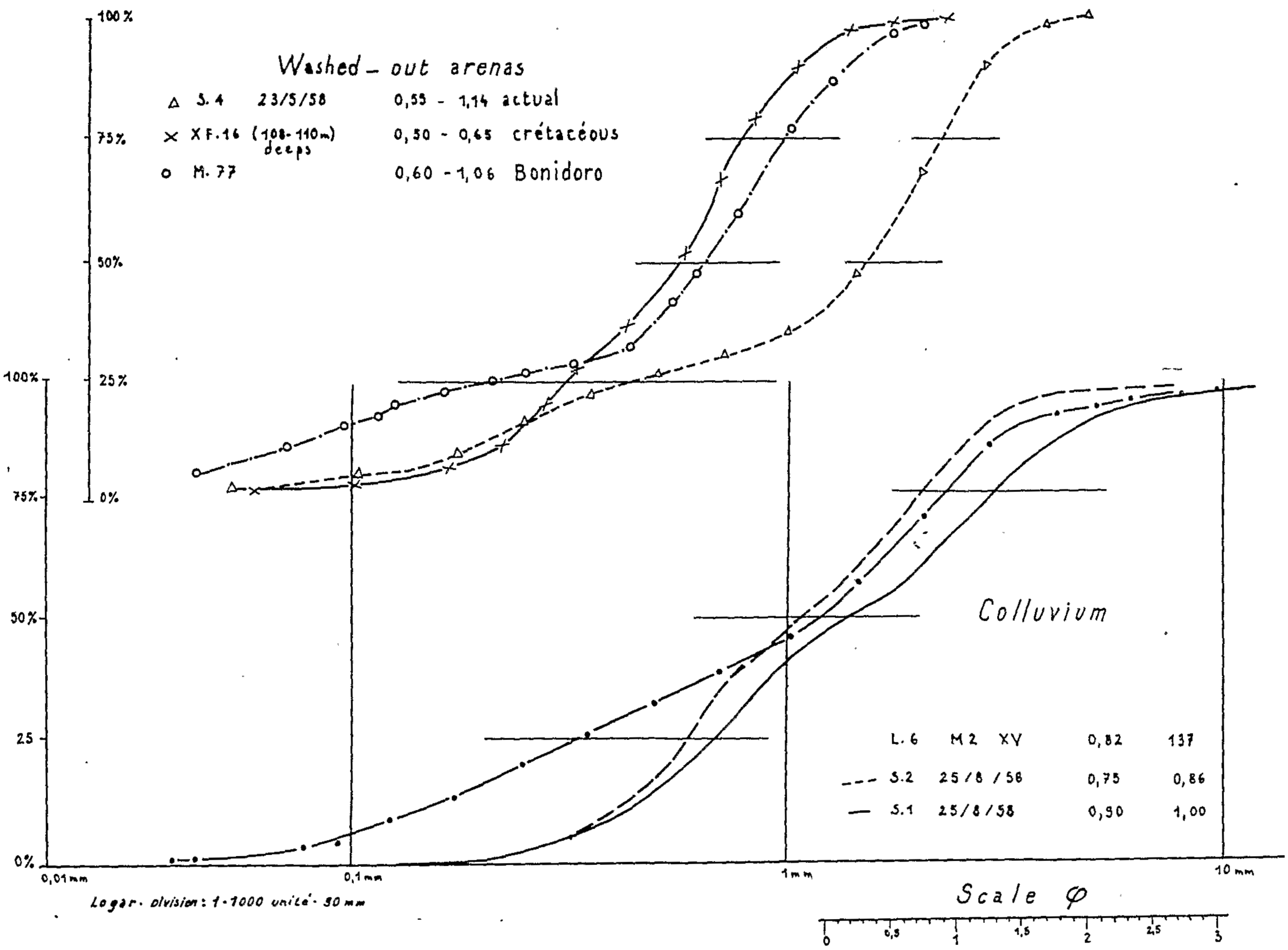


Fig. 10. CONTINENTAL DETRITIC SANDS—Weathered rock reworked by pluvial washing-out ~~or~~ creeping.

Frequently we can find the three types of detritic sands on a hill from the top to the bottom of the nearby valley. This is a common feature in the hilly region of the northern border of the shield, for instance at Organabo. On somewhat lower plateaux, like to the south ~~BLEACKLEY, D. 1956. The geology of the~~ of the Organabo-Mana trail, the washed-out sands predominate.

Thus we may think that each time a heavy pluvial climate occurs, sediments of environment. Usually true deltaic sediments show a bimodal shaped cumulative curve which brings out the competition between fluvial and marine actions. We got certain curves of that type especially in the layers of pebbles associated with white sands in the Saut-Sabbat region, at 45 m above sea level. But the trouble is that the pebbles themselves are partly sugar-like crumbled owing to chemical processes which have occurred after sedimentation. So we may wonder if the bimodality of the curve does express the mixing of a true sedimentary sand with the grains from the crumbling pebbles. Consequently, an estuarine deposit at this 45 m level cannot be defined with certainty.

We found such kinds of washed-out sands at different levels in several bore-holes in northwestern French Guiana and of course their dating involves different ages. For instance, the sands lying just below the Coropina clays may represent the middle or lower Quarternary (Q. 1). Further down we found such sands at different undated levels, but indeed belonging to the Tertiary. We found similar sands again just above the fossiliferous Paleocene limestones and even between the Paleocene and the altered gneissic basement underneath.

In other words, the concept of "White Sands" must be no longer used with a chronological significance. Of course in British Guiana, the White Sands Series have a greater sedimentary significance than the detritic sands of French Guiana. However it seems necessary to get some more data about the conditions of deposition (climates, environment, dynamic action) in order to give better dating, before concluding whether these series represent only Quaternary sediments or older ones.

Henceforth, in our mind, White Sands only signifies a facies of continental detritals in connection with heavy pluvial climates which have occurred several times, at least from the pre-Paleocene to the upper Pleistocene.

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DISCUSSION

Dr. McCONNELL said he would like to compliment Dr. Boye on a most interesting paper. He thought that Mr. Bleackley and others would agree with him that they had been waiting for detailed work of this sort on the coastal deposits of the Guiana territories for a very long time, and they were fortunate that Dr. Boye had come to carry it out for them with such thoroughness, and had given them the results of his work so clearly.

Dr. MARTIN BELLIZZIA asked whether Dr. Boye had related the mechanical and chemical analysis to the shape and surface of the granite beneath the soil.

Dr. BOYE said yes, this was shown in the catalogue which he had passed around. At the end of the catalogue, he said, could be seen several types of profile right on top of the metamorphic rocks. For instance, there was a typical profile on the mica schists which was more or less of *in situ* origin.

Meanwhile, a very uneven sorting could be seen on the curve of sands overlying the mica schists and it could be seen that the curves did not change in shape from the bottom. There were other examples, probably from granite with two micas. Usually there was a kind of curve with a straight line which was called logarithmic representing a sorted granular facies. It meant the deposits at the end of transport. That was a statistical result. There was another kind of quite symmetrical curve with the main part in a parabolic shape which mean transport by rivers or creeks. There was a third kind of curve which was called hyperbolic curve. It meant usually, but not always, a deposition down through a stationary liquid medium. But this kind of curve could be found in weathering crystalline rocks and depended on the previous distribution of the crystals in the original rock. In a curve there were several modes. There were two interpretations possible. The first was that two or three modes could express the competition between several dynamics working on sediments. For instance, in true deltaic deposits, this type of curve meant a trickle between the fluvial transportation and the sea wave action. There was a second interpretation, especially in the alluvial materials. In most of those, owing to differential weathering in the rocks on the quartz and on the resistant silicates and non-resistant silicates, there was as many modes as kinds of silica and quartz to be weathered.

Mr. DOEVE said Dr. Boye had stated that the upper layers of the Zanderij had emerged before and weathered to ferralitic soils. Did that imply that the sand below the bauxite of Surinam would be Zanderij sands or French Guiana pre-Coropina sands in the sense of white sands.

Dr. BOYE said he thought most of the sands underlying the bauxite were true Zanderij and those above were of Quaternary age, to be correlated with the latest transgression.

Dr. DOEVE then asked if Dr. Boye did not think therefore he could correlate the Coropina sediments with the White Sands of British Guiana, to which Dr. BOYE replied it was difficult to say because the age of the different white sands in British Guiana was not known, but as far as could be seen, it seemed that there were two or three main layers in the Surinam white sands and maybe, the upper layer in those white sands were generally all Quaternary, but the lower ones might be Tertiary or older. Above the bauxite he thought that those white sands might be correlated with the Surinam post-bauxite series.

Dr. McCONNELL asked if he would be forgiven for drawing a moral from the discussion, but as stratigraphical problems and stratigraphical rules were being considered, he thought that that question of white sands was a very good illustration of the necessity for the rules laid down by the Stratigraphical Commission, and that is, geographical and not lithological names should be used for geological formations, because if the term White Sand Series was to be used, then wherever white sands were found, there would naturally be a tendency to put them all in the same age group. The same mistakes had been made over the so-called Kalahari Sands of Southern Africa.

Mr. BARRON said that in the bulletin on Bauxite published by the British Guiana Geological Survey a few years ago, some distinction was made between clays and sands beneath the bauxite and loose sands above it. He wished to know if Dr. Boye had noticed the effect of aeolian transport in the studies. Dr BOYE said he had not noticed that at all in French Guiana, but he had heard from Professor Cailleux who had attended the last Conference, Cayenne, 1957, that some samples coming from the Roraima Formation and the white sands at the foot of the Roraima scarp showed some aeolian features, but he had not seen those samples himself.

Mr. BARRON referred to the occurrence of wind distributed beds in the South Rupununi Savannas and asked if they had been detected in Cayenne, for example, among the "Savanna Sands."

Dr. BOYE said that through microscopical examination of quartz grains it could easily be seen if there was aeolian sand or not. Usually in aeolian sands there was a high percentage of rounded grains and they were badly pitted on the surface, so that light did not go through the grain; the grain would have a milky appearance. In tropical countries grains could show a milky characteristic, but this was not due to pitting, but to pock-marking which was the result of leaching. For instance, in the mica schists profile could be seen an increase of the percentage of pock-marked grains from the bottom up to the soil.

Mr. DOEVE asked in which series in French Guiana did kaolin bands occur, to which Dr. BOYE replied in the Younger Detritic Sand Formation which might be of post-Lelydorp age, especially in that area just to the west of the Organabo anticline. There was a straight scarp interpreted as a fault line but it also seemed to be a dead cliff on the seashore.

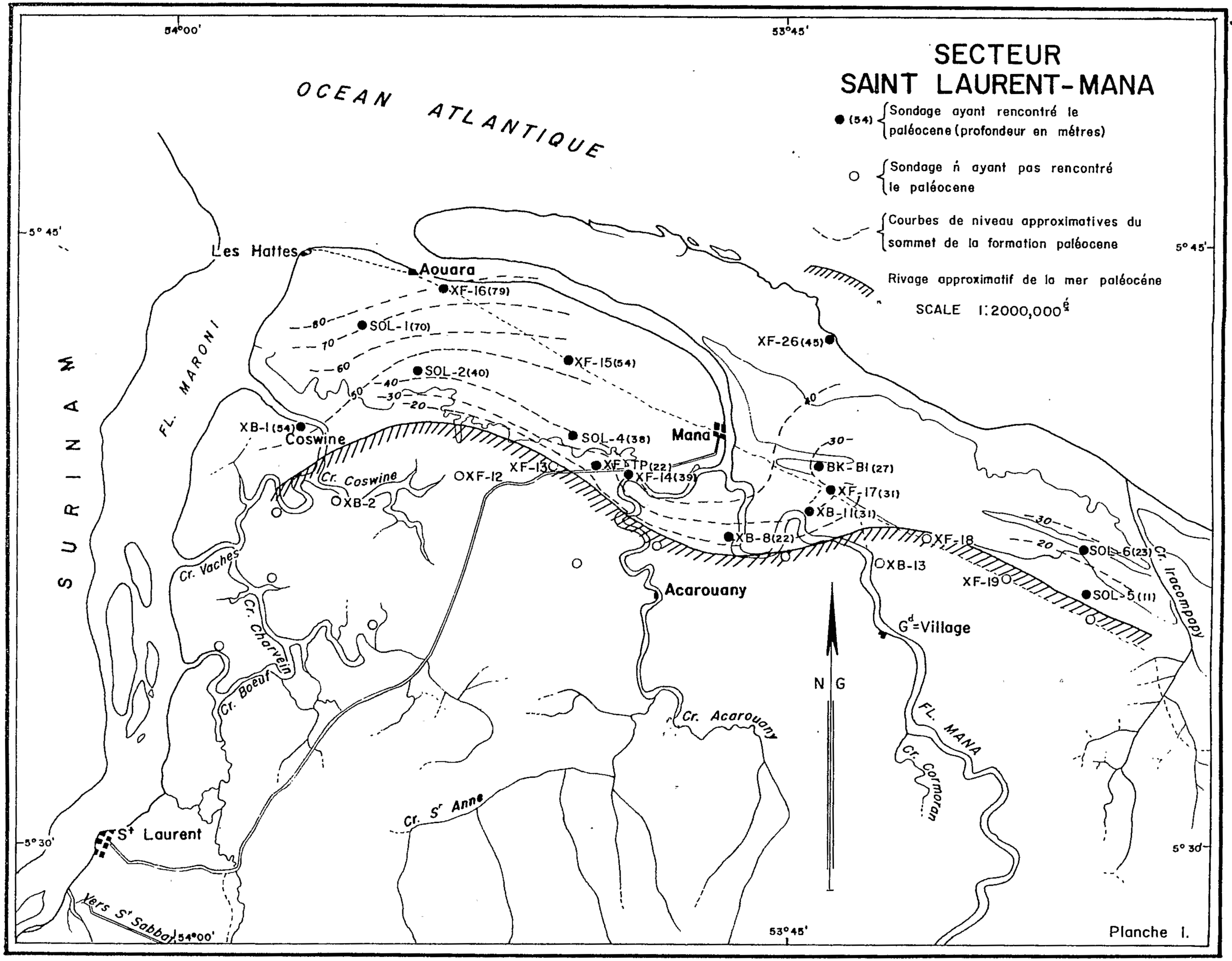
In reply to a further question by Mr. DOEVE as to whether it was Q1 or Q2, Dr. BOYE said it was difficult to say. There was no differentiation in such masses of sands because there was no evidence of sea level in such sands. He said he must point out that in his opinion that special kind of washed out sands must occur in several ages and several sea levels: it was due to heavy rainfall. That was the main problem in distinguishing the White Sand Series in British Guiana. He was interested to see the different kinds of cross-bedding in Tukeit. Usually that meant a very graded system resulting from torrential rain.

The question was asked whether there was a mechanical breakdown. Further, did those sands show peculiar analysis, and could all the white sands be distinguished by that. Dr. BOYE replied in the negative. He said that was because often during this washing-out, different sands were reworked out.

In reply to a further question whether they showed desegregation by sun action Dr. BOYE said he only noticed action of fire which burst the pebbles. After bursting, the pebbles were slightly ferritized on the clastic edges.

Mr. SNIJDERS said he had no clear idea of the position of the various units described in cross section. He asked Dr. Boye if he could show that.

Dr. BOYE said Q4 was represented mainly by marine clays and also silts which were recent sediments. Q3 corresponded strictly to the Demerara Series and Q2 corresponded in the whole to the Coropina-Coswine Series. In this series, there could be two main regional series as in the dry savanna there were several layers of marine sands, but only sands and the so-called "Coswine" clay beneath were mainly residual clays (eluvium).



SECTEUR
SAINT LAURENT-MANA
● (54) Sondage ayant rencontré le paléocene (profondeur en métres)
○ Sondage n ayant pas rencontré le paléocene
Courbes de niveau approximatives du sommet de la formation paléocene
Rivage approximatif de la mer paléocéne
SCALE 1:2000,000
OCEAN ATLANTIQUE
SURINAM
FL. MARONI
FL. MANA
Les Hattes
Aouara
Coswine
Mana
Acarouany
Gd Village
St Laurent
Vers St Sabbat
Cr. Coswine
Cr. Vaches
Cr. Charvein
Cr. Boeuf
Cr. St Anne
Cr. Acarouany
Cr. Cormoran
Cr. Iracompapy
XF-16(79)
SOL-1(70)
SOL-2(40)
XF-15(54)
SOL-4(38)
XB-1(54)
XF-26(45)
BK-B1(27)
XF-17(31)
XB-11(31)
XB-8(22)
XF-14(39)
TP(22)
XF-13
XF-12
XB-2
XF-18
XB-13
XF-19
SOL-6(23)
SOL-5(11)
N G
54°00'
53°45'
5°45'
5°30'
Planche I.