

# STUDIES OF THE VEGETATION OF THE SURINAME SAVANNAHS AND SWAMPS

by

J. LANJOUW.

## I. INTRODUCTION.

Now that the „Flora of Suriname” is in course of publication, many botanists, who are interested in the vegetation of this part of South America, will be anxious to get an outline of the plant-associations as well. However, much work remains to be done in this part of the botanical investigation of Suriname. Thanks to the intensive collecting of the last 30 years, most of the species of the northern part of this country are now known, though new ones may still be expected especially if the collections are made in the interior. Our knowledge of the plant communities, however, is still very limited. There is a general survey in Pullé's Enumeration (21). This deals especially with the general plantgeography, viz. the place which the Suriname vegetable world occupies in that of the whole of America. As at that time little was known regarding plant associations, Pullé could give only general remarks, together with some details collected during his expedition along the Saramacca River. There are some more references from the neighbouring Guianas. Raymond Benoist wrote a series of papers on French Guiana (1). On the vegetation of British Guiana several papers were published during the last century. Schomburgk has given valuable descriptions of the vegetation in „Reisen in British Guiana 1840—44” (23) and in „Botanical remenescences” (24). Jenman, who stayed a long time in British Guiana, wrote several papers on the vegetation (12), and recently there have appeared papers by Martyn (16), Myers (17, 18), Davis and Richards (7). However, many additions are to be desired for this country.

During my travels in Suriname in 1933 (13) I had the oppor-

tunity to collect some facts on the vegetation. These field-notes are mostly restricted to lists of species and are chiefly made in the savannahs and the coastal swamps. Though these records are sketchy observations and rather incomplete I believe they are worthy of publication as our knowlegde of the Suriname vegetation is so scanty and they may rouse interest for this part of the botanical investigation of Suriname.

As I intend only to give my notes made in the savannahs and swamps nothing will besaid of the Suriname vegetation in general. In the first part of this paper a description of some of the savannahs will be given. Only the savannahs of the northern part of the colony are dealt with, as I did not visit those of the interior near the Brasilian frontier. In the second part a short account of the swamps will be given. In several papers these swamps have been confused with the savannahs. They have, indeed, several plants in common, but the dominant species and the general aspect of the swamps are quite different from those of the savannahs, as will be discussed in detail.

## II. CLIMATE.

The following data on the climate of Suriname are taken from Braak (4). p. 91. „Suriname lies very close to the equator, between 2° and 6° northerly latitude. It has consequently a genuine tropical climate, a high temperature during the whole year with a small annual variation, but clearly defined maxima during and shortly after the two epochs of zenith position of the sun. On the Atlantic coast tradewinds blow with great steadiness during the wole year, from directions not differing much from ENE and E. The wind is fairly strong in the coast regions, but the force diminishes rapidly when proceeding inland, and the nights in the interior are very calm. The variations of rainfall in the course of the year are much greater than those of the wind, owing to the changes in the distance to the centres of low and high pressure”.

### a. Airtemperature.

In the following table the monthly mean values at Paramaribo (1899—1933) and at Kabelstation (1919—1920, 1922—1925) are given.

	Paramaribo			Kabelstation		
	Mean	Abs. max.	Abs. min.	Mean	Abs. max.	Abs. min.
January	25.3	34.8	16.9	24.9	32.9	17.4
February	25.4	33.2	17.0	25.0	32.9	16.8
March	25.6	34.7	16.6	25.2	33.7	16.6
April	25.8	34.1	16.9	25.7	34.6	19.7
May	25.8	34.5	17.9	25.6	35.6	18.4
June	25.6	34.7	18.7	25.3	32.6	20.1
July	25.8	34.5	16.7	25.5	33.3	19.2
August	26.6	34.6	18.3	26.1	34.2	19.6
September	27.2	35.0	18.5	27.0	34.7	19.1
October	27.1	36.5	19.4	26.9	35.2	18.5
November	26.8	37.4	18.9	26.8	36.2	18.5
December	25.7	34.4	17.5	25.4	35.7	19.6

The mean minimum temperature at Paramaribo is nearly during the whole year 22.5. In the first three months of the year it is slightly lower (down to 21.8) and in August to November it is a little higher (up to 22.9). The mean maximum temperature at Paramaribo differs from 32.6 in October to 29.3 in January. The mean minimum temperature at Kabelstation is a little lower, about 21.7. It ranges from 22.2 in May to 21.2 in February. The mean maximum temperature at Kabelstation ranges from 33.2 in October and September to 30.0 in January.

#### b. Rainfall.

In the following table the monthly and annual means (in millimetres) are given of three stations, all lying in the region of the savannahs described in this paper. Most of the observations were taken in the period 1911—1930.

	Percentages					
	Rep.	Sect. O	Browns.	Rep.	Sect. O	Browns.
January	172	194	214	8.2	9.3	9.5
February	118	119	152	6.1	6.2	7.4
March	144	154	174	6.9	7.4	7.7
April	226	211	232	11.1	10.4	10.6
May	291	312	330	13.8	14.9	14.6
June	290	286	320	14.2	14.2	14.6
July	215	238	246	10.2	11.4	10.9
August	154	132	131	7.4	6.3	5.8
September	77	72	67	3.8	3.6	3.1
October	64	72	59	3.0	3.4	2.6
November	107	79	98	5.3	3.9	4.5
December	210	188	196	10.0	9.0	8.7
The Year	2069	2056	2219			

May and June are the wettest months, and September and October the driest. Besides the principal maxima and minima, secondary maxima and minima are found, the maximum in December or January, the minimum in February.

B r a a k p. 112. „The whole of Surinam belongs to the region of the tropical rain climates, according to the classification of K ö p p e n, and probably the greater part to that of the tropical rainforest climates (*Af*), which are characterized by at least 60 mm of rain in the driest month. A strip along the coast and scattered regions in the interior belong to K ö p p e n s *Am* climate, that of the monsoon forest, where the drought (less than 60 mm in the driest month) is compensated by the total annual rainfall. The coastregion near Coronie approaches the limit of the savannah climate (*Aw*), marked by 30 mm of rain in the driest month and an annual amount of 1750 mm, 40 mm and 1500 mm for the year, or 20 mm and 2000 mm per annum.”

So only the coastregion near Coronie approaches the savannah climate. In this region no savannahs are to be found. As will be pointed out in this paper I believe that the climate is not the main influence for the origin of the savannahs.

### III. SAVANNAHS.

#### 1 *What is a Savannah?*

As recently by the Sixth International Botanical Congress at Amsterdam (S i r k s 25, p. 401) a resolution on the delineation of the „Savannah” was accepted, it seems to be of interest to say a few words on the interpretation of this term. This resolution reads: „That the programme of the Seventh International Botanical Congress shall contain the study and the delineation of the characters of the various types of steppes, their origin, their development and especially the discriminative criteria for climatic associations and seconady associations which get confused under the names „steppe”, „prairie”, „Savannah” and the definitions of the corresponding phytogeographic regions”.

To get a definition for the term „Savannah”, I think it necessary to study the history of the word. Therefore I have tried to find the origin of it. In Dictionaries and Encyclopaedias of the 19th century one often meets with the following etymology: Spanish Savanna = sheet, from Lat. Sabanum, from Gk. σαβανον, linen cloth, towel. Recently this etymology of the word was given in *The New Intern. Encyclopaedia Sec. ed. vol. XX, New York,*

1926. However, it was already proved in 1914 (Henry Bradley, A New English Dictionary, vol. VIII part II) that *Sábana* = sheet, is not the same as *Sabána* = Savannah. After this Dictionary (and this opinion was given also by E. Littré in 1878 in *Dictionnaire de la langue française* vol. IV) the word Savannah has been used for the first time by Oviedo in 1535, so shortly after the discovery of the New World. I have not been able to study the original edition of Oviedo's work, but I have seen the new edition which was published in 1851—1855 (19). According to Littré he used the word Savannah for the first time in his book in Lib. XXV. Cap. II, where he writes on Venezuela. In this chapter Oviedo just mentions that there are Savannahs, without any explanation of the word. However, he gives already definition and origin of the word in Vol. I. Lib. V. Cap. V. p. 144, where he says: „Entonces el capitán salió de la savana ó monte, echando por los lados del camino por dó yba, algunos compañeros de sus soldados, por yr en órden é saber si avia mas gente de la Enrique en alguna celada. Este nombre *savana* se dice á la tierra que está sin arboledas, pero con mucha é alta hierva, ó baxa.” and in Lib. VI. Cap. VIII. p. 183, „Llaman *savana* los indios, como en otro lugar lo tengo dicho, las vegas é cerros é costas de riberas, si no tienen árboles, é á todo terreno que está sin ellos, con hierva ó sin ella.” Bradley in his Dictionary mentioned above gives the following definition: „A treeless plain; *properly* one of those found in various parts of tropical America”, which he bases on many quotations from literature. Of these quotations I give here the three oldest: 1555. „E den Decades III, iii, (Arb.) 148, Hauynge towards the southe a playne of twelve leages in breadth and very frutefull. This playne, they caule *Zauana*. 1604. E. G(rimstone) D'Acosta's Hist. Indies IV. XXX. 291, The prairies which they call Savanas. 1655. I. S. Brief Jnl. Proc. Army W. Indies 18, Open ground and plaine Fields, or Savanas as they there call them.” I will add here a quotation from one of the oldest Dutch books on Suriname. 1718 Herlein (10). „Tusschen welke Bosschen hier en daar eenige weinige open velden, *Zavanen* geheten, gevonden worden, welker grond, hoewel zandig, zeer bekwaam is tot Wei landen en Boomplantagen.” Why in modern English an h is added at the end of the word, I do not know. So much for what is said about Savannah in non botanical works.

Probably Humboldt was the first botanist who wrote more extensively about the savannah, though he did not use this word as he described Venezuela, where they are called Llanos. (11). The

savannah has been mentioned by earlier botanists, e.g. A u b l e t, but they did not give any definition or description. Also H u m b o l d t did not give a definition or the savannah but he gave a fairly good description. In the older textbooks on plant geography no definitions of the vegetation type Savannah are given. G r i s e b a c h (8) gives a rather good description and says that the savannah originates from the alternation of dry and wet seasons. To give a general survey of the opinions met with in modern textbooks I quote the following: W a r m i n g and G r a e b n e r (27), „Baumsteppen (Savannen, Campos). Unter diesen Namen fassen wir jene tropischen (megathermen) in Gegenden mit Sommerregen und mit Trockenperiode im Winter vorkommenden Grasfluren zusammen, welche mehr oder weniger mit kleineren Bäumen bewachsen sind.... Die Vegetation ist subxeromorph oder xeromorph,.... Bei allen Savannen, Prärien und wohl auch bei Grassteppen hat man immer wieder die Frage aufgeworfen: Weshalb fehlen die Bäume, oder weshalb kommen nur wenige zerstreute Bäume vor? Die Gründe hierfür sind sicher teils geologische, teils klimatische“; H a y e k (9), „Die typische Form, in der in den Tropen die Grasflur auftritt, ist die Baumsteppe oder Buschsteppe, die Savanne. Sie ist in allen Trockengebieten der Tropen verbreitet, wo die jährliche Niederschläge, meist als Gewitterregen, der Hauptmasse nach in die Vegetationszeit der Gräser fallen. Die Grasflur in den Tropen (ist) nur selten eine völlig baumlose Steppe, sondern mit vereinzelt stehenden oder stellenweise zu lockeren Beständen vereinten Bäumen besetzt, wodurch eben die Savanne gegenüber der Steppe charakterisiert ist“; „S c h i m p e r and F a b e r (22), „Die Grasflur besteht aus büschelartig wachsenden, perennierenden Gräsern. Andere Kräuter stellen, auch wenn sie ebenso zahlreich sind als die Gräser, doch nur Begleiter der letzteren dar, da die Existenz der Formation in erster Linie auf ihrer Gasnarbe beruht. Die hygrophytischen und tropophytischen Grasfluren heißen Wiesen, die xerophytischen Steppen, xerophytische Grasflächen mit einzeln wachsenden Bäumen Savannen.“ I do not think that any of these definitions are correct. In the first place they are not historically founded and are used for vegetation types where formerly the term Savannah has been unknown to the people living there. As was stated above, O v i e d o said that Savanna is a Carib word used in Haiti and Cuba for treeless plains. As Northern South America is also inhabited by Caribs it is understandable that they too used this word for such plains. As will be seen from the discussions following below I do not think the climate the most important in-

fluence for the origin of the Savannah. Therefore I propose the following definition of the Savannah:

Savannahs are plains in the West Indian Islands and Northern South America covered with more or less xeromorph herbs and small shrubs and with few trees or larger shrubs. For the origin of this vegetation I refer to the following chapter.

## 2. *Origin and Climax.*

The following savannahs and savannah-forests were visited: Zanderij I, Sectie O, Brownsweg (Patrickssavannah) and between Moengo tapoe and Albina. For the situation I refer to the map published in a previous paper (L a n j o u w 13).

Already Pulle (21) pointed out that these savannahs are of edaphic origin and caused by leaching of the soil. To describe this leaching process I believe it best to give some quotations from I J z e r m a n's excellent treatise on the geology of Suriname (28): „The Savannahs are found particularly in the zone of continental alluvia adjoining the fluvio-marine deposits inland. They form a gently rolling landscape. The sharp and coarse quartz-sand found on the surface is typical of the savannahs; by the side of this sand, sandy clays occupy no insignificant part and both may occur in the same savannah. Let it be borne in mind in the first place that the savannahs do not owe their origin to lack of rain during a great part of the year; the rainfall is not less than that in the surrounding country. The cause of the absence of forest-vegetation must be looked for in the barrenness of the soil, the origin of the Surinam savannahs is to be attributed to edaphic factors. It should be expressly pointed out that the profile of the subsoil in the savannahs shows no difference from that which characterizes the continental alluvia elsewhere; borings made in the savannahs and in the neighbouring forest indicate this clearly. The same sands that characterize the surface of the savannahs also occur beneath them, alternating with sands and clays. It seems that the savannahs, in as far as the data allow us to judge, are on the whole, situated in those areas where the gently rolling ground about reaches its greatest height, belonging partly to the flat watersheds. It is the position of the savannahs that accounts for their barrenness. The rain-water penetrates into the ground, and the groundwater partly flows away to the somewhat lower-lying ground in the vicinity partly into the brooklets that occur in the savannahs. Although the level of the savannahs is but slightly above that of the surrounding country, leaching of the soil takes place year in and year out. The sands

already poor in themselves, and the clays rich in kaolin, will lose what they still contain in alkalies. The result is an extremely barren soil on which nothing will grow. The groundwater, however, draining the deeper strata of the higher-lying parts of the savannahs, which strata have been leached to a smaller extent than the surface, carries dissolved matter with it and renders vegetation along the brooklets that arise in the savannahs, possible. Parts that seem destined later on to give rise to savannahs may also be met with in the forests. The soil there has the same character as in the savannahs, and the trees, among which there are many Euphorbiaceae<sup>1)</sup>, are greatly stunted in growth. Such like forests are known in Surinam under the name of „Moerimoeri-bosch”, and, in as far as they are not caused by solid rock lying close to the surface, they are produced by the same factor as the savannahs.

In works on Surinam the opinion is sometimes expressed that the savannahs are in a period of diminution, and that the forests gain ground. We may assume, however, that the leaching-process is steadily extending not only in a vertical but also in a horizontal direction, which cannot but result in an extension of the savannahs. There are, however, two factors which may act in a contrary sense: viz. the rising of the groundwater level, which will certainly follow a possible subsidence of the soil and the denudation of the surface of the savannah complexes.”

IJzerman has illustrated his facts with some maps of the Suriname Savannahs, of which one is reproduced in fig. 1. The savannah between Republiek and Berlijn is that of Zanderij I, south of Berlijn lies the savannah of Sectie O. This map clearly shows that these savannahs are situated as watersheds between the rivers and creeks. In my opinion IJzerman's theory for the barrenness of the soil caused by this location of the savannahs has to be accepted. However, I do not think that under all circumstances this barrenness will impede tree-growth.

IJzerman certainly overrated this leaching of the soil and did not pay attention to the influence of repeated burning on the vegetation. The cause of this burning, whether by men or by lightning is not important as the result is the same. In the next paragraphs I will discuss this influence of fire upon the development of the vegetation in detail. I will give here some suggestions

<sup>1)</sup> How IJzerman got this impression, I do not know, but I can state that for the savannahs described in this paper such is not true. Euphorbiaceae do not occupy any important place in the vegetation of the savannah-forest.





about the „climax” of this vegetation. Of course they are sketchy and incomplete. In my opinion there are three main influences which gave rise to the Suriname savannahs.

#### A. *Climatic conditions.*

It may be surprising that I number the climate among the main influences for the origin of the savannahs, as I started with IJzermanna's quotation from which it is obvious that the Suriname savannahs are of edaphic origin. Nevertheless I think we have to take the climate into consideration. In the first place it is due to the climate that during part of the year heavy rains make it possible that the soil on the watersheds is leached and secondly the dry seasons with long dry periods cause the presence of a xerophytic vegetation, consisting of herbs and low shrubs. Of course we can not say that the climate is the primary influence because under the same climatic conditions the tropical rain forest is also growing and developing.

#### B. *Edaphic conditions.*

In my opinion these are doubtless the main agents in forming the savannahs. If the extensive flat watersheds did not exist there would be no further reason for the originating of the Suriname savannahs. So the primary cause for their existence is of edaphic origin. How far these conditions are different in the neighbouring Guianas and in Brazil I can not judge. By most botanists the inland savannahs of British Guiana the llanos of Venezuela and the Brazilian savannahs in the Amazone River region are thought to be of climatic origin. I do believe the climate is not the same as in Suriname, but on the other hand most of these regions are surrounded by monsoon forest and I think it highly probable, that the edaphic conditions are also of some importance in the origin of these savannahs. Bouillenne (2, 3) published in his papers a map of the situation of the savannahs in the Amazone River region. Though one can understand that he could give only a sketchy map, it is clearly shown that most of these savannahs are situated on the watersheds between the rivers, just as in Suriname. For this reason I can not accept his idea, that one of the causes of the origin of these savannahs may be found in a locally diminished rainfall. It is possible that it is of some importance, but I do not think it a strong argument.

#### C. *Repeated Burning.*

Many Guiana travellers have mentioned this burning. Schom-

burgk (23) writes about it in his books. Benoist (1, p. 1074) says: „les incendies annuels auxquels sont soumises les parties les plus sèches depuis très longtemps contribuent à les maintenir dans leur état actuel”. Benoist also drew attention to the peculiar abrupt transition of the forest in the savannahs, without changes of the relief or nature of the soil. I have seen that also in several places and it is clearly shown on the photographs No. 11, 12 and 13, and I never did notice any change in the nature of the soil to explain such abrupt transitions. Many authors have pointed out the importance of the influence of fire upon the climax of a vegetation. For details I refer to Phillips (20), Clements (6), Tansley and Chipp (26), Myers (17, 18), Marshall (15) and many others. I will quote some botanists, who studied savannahs of the surrounding countries. Bouillenne (3), states: Nous pensons que d'ordinaire on n'accorde pas aux incendies l'importance qu'ils méritent comme causes modificatrices des dispositions végétales”. And a recent statement made by Myers (18): „I have never seen in South America a savannah which did not show signs of more or less frequent burning.” I think it highly probable that this repeated burning is the cause that the savannahs can not be recovered again by the forest. On the photographs (11, 12 and 13) one may observe in the savannah and especially along the border many dead trees and shrubs, which were destroyed by fire not long ago. Many plants e.g. those with a thick rootstock show nearly always evidences of fire. This is very clearly shown in herbarium specimens of *Bulbostylis lanata* Clarke, of which all Guiana specimens are burnt at the base (cf. Bouillenne 3, p. 154, 155 and planche XXXIII). In my opinion fire is the sole reason for the maintenance of the vegetation in its present condition. I am convinced that without this repeated burning the vegetation would change rapidly in most places. I can wholly agree with Myers (18) who regards the present vegetation of these savannahs as a „fire climax” (cf. Tansley and Chipp 26, p. 147). One will understand that I do not mean to say that everywhere in Suriname the boundaries of the savannah are limited by the fire. Certainly in some places the constitution of the soil determines the kind of vegetation, so e.g. there are extremely barren places, where the settlement of trees is impossible. Moreover, some of these extremely barren places are covered with water during part of the year, which gives rise to another flora.

In my opinion the history of the vegetation of these savannahs must have been the following:

- a. The flat watersheds between the rivers were covered with rain forest.
  - b. The soil is leached by the heavy rains during part of the year. The forest became less dense and especially the undergrowth changed. This change gave rise to the savannah forest.
  - c. This less dense forest with a changed undergrowth is more exposed to heat during the dry seasons and gives rise to a more or less xerophytic vegetation in the undergrowth.
  - d. This vegetation is more exposed to damage by fire. The trees do not recover so rapidly as the herbs, which partly survive the fires by rootstocks etc., and a new vegetation consisting for the greater part of herbs takes possession of the soil.
  - e. The repeated burnings maintain this vegetation as a „fire climax”.
3. *Type of the vegetation and characteristic plants.*

The general aspect of the Suriname savannahs is a slightly rolling landscape, for the greater part covered with herbs, most of them with a more or less xerophytic habit or with a short and rapid vegetation period, and here and there some shrubs or low and often deformed trees. An important part of this vegetation is occupied by the *Cyperaceae*, while in most places the *Gramineae* come on the second plan, though there are savannahs where the *Gramineae* are dominant. The dominance of the species changes often on short distances and in many places sharp lines can be drawn between the „associations”. I have noticed that nearly always one can assign 1 or 2 species are dominant. I mention this especially for those who wish to make sociological studies in these savannahs. Also the „characteristic species” are of importance for the study of this vegetation, as one can often find these species, and they will be valuable for the recognition of the kind of vegetation. Especially if one is botanising in the forest, one can judge from these „characteristic species” if one is entering the „savannah forest”. I will not try to give here a list of these „characteristic species”, as I have not been able to make sufficient study of it, but, I can number here some „characteristic genera”. Among the *Cyperaceae*: *Bulbostylis*, *Rhynchospora*; *Gramineae*: *Panicum*, *Andropogon*, *Paspalum*; *Xyridaceae*: *Xyris*, *Abolboda*; *Eriocaulaceae*: *Paepalanthus*, *Syngonanthus*; *Lentibulariaceae*; *Utricularia*; *Rubiaceae*: *Perama*, *Sipanea*; *Malpighiaceae*: *Byrsonima*; *Dilleniaceae*; *Tetracera*, *Curatella*; *Humiriaceae*: *Humiria*; *Polygalaceae*: *Polygala*, and many others. I have mentioned the most important only, and I think these genera will be of use for the

determination of the kind of vegetation. The soil in the savannah is often sandy (often quartz sand), sometimes clayish. In many places the soil is only partly covered by the vegetation, largely consisting of herbs, partly annual, for the greater part perennial, and here and there shrubs with climbing plants. The savannah is sharply marked off from the forest. In this „savannah forest” there are often also some „characteristic Genera” represented, such as: *Rosaceae*: *Licania*; *Loganiaceae*: *Antonia*; *Melastomataceae*: *Miconia*; *Proteaceae*: *Roupala*; *Apocynaceae*: *Plumeria*, *Rauwolfia*; *Rubiaceae*: *Retiniphyllum*, etc. Here and there one finds in the savannahs lower situated parts with another vegetation, more *Xyridaceae*, *Burmanniaceae* and *Lentibulariaceae*, *Drosera* and *Sphagnum*. Also inundated parts with *Mauritia flexuosa* L. f. I have visited the savannahs at the end of the major rain season (July and the beginning of August) when most of the herbs and shrubs are in flower, and in the major dry season (September–November), when part of the trees are still in flower, part of them in fruit just as the herbs and shrubs are, while of many of the genera such as *Polygala*, *Utricularia*, etc. nothing has been left. The soil is extremely dry during this period, and the vegetation too is bone dry and can be fired easily.

#### 4. Details on the vegetation of some Savannahs.

I will give here some details of the savannahs visited, together with some lists of species found there. One must bear in mind that these lists are compiled of collections made by me during some short visits, so they do not pretend to be exhaustive. Several important savannah plants do not occur on these lists!

##### a. Savannah near Zanderij I. (Photographs 1–6).

Several types of savannah are represented near Zanderij I. I will give here first a species list of a rather wet (end of July) savannah in which two vegetation types were noticed distinctly. There is an extremely wet part (still covered at the end of July with about 5 cm water) chiefly occupied by *Utricularia*, *Lagenocarpus tremulus* Nees, *Lycopodium meridionale* Underw. & Lloyd, *Drosera pusilla* H.B.K., *Sawagesia Sprengelii* St. Hil., *Burmannia bicolor* Mart., *Paepalanthus polytrichoides* Kth. The complete list of species follows below. In doubtful cases no species name is given.

Herbs:

*Utricularia* (*Lentibulariac.*).

Three or four species with very slender stems with minute

scale-like leaves and small yellow or white flowers in terminal inflorescences.

*Polypompholyx* (*Lentibulariac.*)

More robust than the *Utricularia* species.

*Burmannia bicolor* Mart. (*Burmanniaceae*).

A small erect herb with terminal blue flowers.

*Xyris jupicai* Rich. (*Xyridaceae*).

*Xyris eriophylla* Reichenb.

*Xyris guianensis* Steud.

Caespitose plants with long-stalked, small spikes with brownish bracts and yellow flowers. The tufts of these plants are scattered through the association.

*Abolboda Poeppigii* Kunth (*Xyridaceae*).

A small c. 5 cm high plant with narrow xerophytic leaves and a small stalked inflorescence of light-blue flowers.

*Lycopodium meridionale* Underw. & Lloyd (*Lycopodiaceae*).

A creeping clubmoss, very similar to our common *Lycopodium clavatum* L.

*Catasetum* (*Orchidaceae*).

A robust ground orchid with big bag-shaped succulent greenish or yellowish flowers in a tall erect inflorescence. Plants mostly growing in small groups.

*Drosera pusilla* H.B.K. (*Droseraceae*).

A small sundew species which was found in the extremely wet places and in such cases quite a number of solitary plants were growing at short distances from each other.

*Paepalanthus polytrichoides* Kth. (*Eriocaulaceae*).

Plants with a 2-4 cm high stem with numerous linear leaves and bearing at the top several small, stalked flower-heads, bearing minute flowers surrounded by bracts. Plants growing in groups or solitary.

*Lagenocarpus tremulus* Nees (*Cyperaceae*).

Plants with a thick stem-base, which is often covered with numerous charred leaf-bases. Leaves long and narrow. Inflorescence c. 1 m high. Plants solitary, frequent.

*Rhynchospora cyperoides* Mart. (*Cyperaceae*).

Plants c. 50-80 cm tall, with long narrow leaves. Several stalked, brownish bracteate flower-heads at the top of a long peduncle.

*Panicum micranthum* H.B.K. (*Gramineae*).

A low densely tufted plant, with numerous narrow leaves and small open panicles with minute spikelets. Not common.

*Digitaria*. (*Gramineae*).

A grass 30-40 cm high. Not common.

*Polygala variabilis* H.B.K. (*Polygalac.*).

A c. 30 cm high, erect many-branched milkwort with short terminal inflorescence with small pink flowers.

*Polygala adenophora* D.C.

In habit very similar to the preceding species, but less-branched and with some small differences in the flower.

*Perama hirsuta* Aubl. (*Rubiace.*).

A small, branched perennial, hirsute shoots and leaves. Inflorescences capitate-spicate, with minute yellow flowers. A characteristic plant of the savannahs, but nowhere frequent.

*Lisianthes coerulescens* Aubl. (*Gentianac.*).

An erect herb with small narrow leaves and 1-3 campanulate, blue or violet flowers. Solitary and not frequent, though rather common.

*Blechnum serrulatum* Richard (*Polypodac.*).

A fern with creeping rootstock and big leaves up to 1 m high.

#### Shrubs:

*Cassia uniflora* Spreng. (*Leguminosae.*).

A low shrub, 10-20 cm high with rather thick, 3-foliolate leaves with scariosse stipules and big solitary flowers with long, lanceolate scariosse sepals and a fine yellow corolla.

*Sauvagesia Sprengelii* St. Hill. (*Ochnac.*).

A low shrub up to 50 cm high, with lanceolate subcoriaceous leaves, and pink or purplish flowers.

*Comolia lythraroides* Naud. (*Melastomatac.*).

A c. 40 cm high, widely branched small shrub, with small leaves and pinkish flowers.

*Clusia nemorosa* G. F. W. Meyer (*Guttiferae.*).

A small tree or shrub with coriaceous leaves and terminal, few-flowered inflorescences, with big white and pink or purple flowers. This species is not restricted to the savannahs, but is often found there and then nearly always as low shrubs, whereas it forms often small trees with stilt-roots in other localities.

*Dimorphandra conjugata* (Splitg.) Sandw. (*Leguminosae.*).

A small tree with thick, shining leaves and small flowers in terminal, dense panicles of spikes. A characteristic tree for open sandy places.

*Myrtacea* spec.

A small shrub with narrow-elliptic, shining and coriaceous leaves.

As may be seen from the photographs n. 1, 3 and 5 the soil.

is only partly covered by the vegetation. In the wettest places the part covered by the vegetation was estimated 30-40%, and in the drier places 20-30% only.

In another savannah just in the neighbourhood, at the other side of a small creek, though separated from the one described above by a narrow strip of forest, the soil was drier, but more covered by the vegetation, so apparently less sterile. Here and there were lower and wetter places, where *Sphagnum* was found and where a row of the decorative Mauriesie-palms had settled. The list of species follows below. As I did not always collect all species, which were found, but only those which were not collected in the neighbourhood and duplicates only of the most important plants of the association, the list is not complete.

#### Herbs:

*Panicum micranthum* H.B.K.

*Trachypogon plumosus* (H.B.K.) Nees (*Gramineae*).

A tall perennial grass, with a long „plumose” panicle. Often a dominant species in the savannahs.

*Rhynchospora barbata* Kunth.

A caespitose plant with narrow leaves, and one terminal flower-head. Common in all Suriname savannahs.

*Rhynchospora graminea* Uitt.

A caespitose plant with long stolons, rigid leaves and slender stems. Spikelets in loose corymbs. This plant has only been found in this savannah, where it is rather frequent.

*Bulbostylis conifera* Kunth (*Cyperac.*).

A tall plant with filiform leaves.

*Scleria cyperina* Willd. (*Cyperac.*).

A rather tall species, with triquetrous sheaths, and spikelets in a terminal, ovate and very dense panicle. Often found in the savannahs, but nowhere frequent.

*Utricularia* spec.

*Abolboda Poeppigii* Kunth.

*Abolboda grandis* Griseb. (*Xyridac.*).

A robust plant 40-50 cm high, with long, flat, rather thick leaves, and a robustly peduncled, globose inflorescence of blue flowers. A common plant in these savannahs, though not frequent.

*Paepalanthus polytrichoides* Kth.

*Syngonanthus umbellatus* (Lam.) Ruhl. (*Eriocaulac.*).

A fine species with a rosette of linear leaves, and a peduncled umbel of small, subglobose flower-heads. Often in wetter places.

*Polygala adenophora* D.C.





Photograph 1. Savannah near Zanderij I. Dry Savannah with *Cyperaceae* and shrubs of *Humiria floribunda* Mart. Only part of the soil is occupied by the vegetation.



Photograph 2. Savannah near Zanderij I. Dense vegetation of *Rhynchospora barbata* Kunth and *Rhynchospora graminea* Uitt. with small shrubs of *Tibouchina aspera* Aubl. and *Humiria floribunda* Mart. In the background the edge of the forest.



Photograph 3. Savannah near Zanderij I. *Paepalanthus polytrichoides* Kth. with on the left *Xyris* spec. and in the centre *Rhynchospora cyperoides* Mart.



Photograph 4. *Utricularia* spec. with *Lagenocarpus tremulus*. Nees and *Drosera pusilla* H.B.K. in Savannah near Zanderij I.



Photograph 5. Savannah near Zanderij I. *Lycopodium meridionale* Underw. & Lloyd, with on the right *Sauvagesia Sprengelii* St. Hil., in the centre a small shrub of *Clusia nemorosa* G. F. W. Mey., many plants of *Lagenocarpus tremulus* Nees and some Lichens.



Photograph 6. Savannah near Zanderij I. *Xyris eriophylla* Reich.



Photograph 7. Savannah near Sectie O. *Polygala appressa* Benth. with *Panicum nervosum* Lam. On the right *Scleria cyperina* Willd.



Photograph 8. Savannah near Sectie O. *Syngonanthus umbellatus* (Lam.) Ruhl. In the background *Polygala appressa* Benth.



Photograph 9. Dense vegetation of *Gymnopogon foliosus* Nees in the Savannah near Sectie O.



Photograph 10. Savannah near Brownsveg: Savannah for the greater part covered with various *Rhynchospora* species and small shrubs of *Humiria floribunda* Mart., *Byrsonima crassifolia* (L.) Rich. and *Tibouchina aspera* Aubl.



Photograph 11. Savannah near Brownsveg. In the background the Savannah forest with a.o. *Licania*, *Rawolfia*, *Roupala*. The dead trees and shrubs in the Savannah and along the edge of the forest clearly show that these savannahs are often exposed to fires.



Photograph 12. Savannah near Brownsveg. Edge of the forest with burnt trees.



Photograph 13. Savannah near Brownsweg. Edge of forest with burnt trees.



Photograph 14. *Typha augustifolia* L. Swamp near Nieuw Nickerie. In the background small treegroups of *Erythrina glauca* Willd.



Photograph 15. Swamp near Nieuw Nickerie. *Cyperus giganteus* Vahl in the *Typha* Swamp.



Photograph 16. Swamp near Coronie. *Homalocenchrus hexandrus* (Sw.) Kuntz-*Rhynchospora corymbosa* (L.) Hitch. Swamp.



*Polygala longicaulis* H.B.K.

Two closely related erect *Polygala* species, with pink flowers.  
*Paspalum polychaetum* Mez (*Gramineae*).

A 40 cm high perennial, with narrow leaves, densely clothed with greyish hairs. Not frequent.

*Lycopodium cernuum* L. (*Lycopodiaceae*).

The „Prati lobi” of the natives is a clubmoss with rooting horizontal stems, throwing up erect stems, 30-50 cm high, with many lateral branches bearing at the ends the pendulous strobili. Often found in the savannahs, but not frequent.

*Sphagnum antillarum* Schimp.

This species has been found in Suriname only in the savannah near Zanderij I. It is found in wet lower situated places in a dense vegetation.

*Aeschynomene hystrix* Poir. (*Leguminosae*).

A creeping or climbing perennial with small-foliolate leaves and small white flowers. A common savannah plant, though not frequent.

*Büchnera palustris* (Aubl.) Spr. (*Scrophulariaceae*).

An erect narrow-leaved herb with a terminal inflorescence of purple flowers. Solitary growing plants, not frequent.

*Cassytha filiformis* L. (*Lauraceae*).

Parasitic, perennial climber, with reddish stems and scale-shaped leaves and minute flowers. Common in the savannahs, though not frequent.

## Shrubs and Climbing Plants:

*Tibouchina aspera* Aubl. (*Melastomaceae*).

Shrub 0.5—2 m high, with lepidote stems, ovate-oblong, rigid, setose leaves. Flowers in clusters terminating the upper branches, with purple or pink petals.

*Turnera ulmifolia* L. (*Turneraceae*).

A low shrub, with pubescent, serrate leaves and solitary flowers with white and purple veined petals. Common in sandy places.

*Clusia nemorosa* G. F. W. Meyer.*Humiria floribunda* Mart. (*Humiriaceae*).

Shrub with coriaceous, elliptic leaves. Characteristic shrub for these savannahs, often frequent.

*Myrcia spec.* (*Myrtaceae*).

Shrub with coriaceous, suborbicular leaves. Not common.

*Centrosema angustifolium* Benth. (*Leguminosae*).

A small climbing plant with lanceolate, subcoriaceous leaflets, and large, blue flowers. Not frequent, but often found in the

savannahs.

*Mandevilla scabra* (R. et Sch.) K. Schum. (*Apocynac.*)

A climbing perennial twih elliptic, at the underside pubescent leaves, and rich-flowered inflorescences with big funnel-shaped, yellow corolla. A common climber in savannah trees and shrubs.

In this savannah three distinct types with different dominant species were noticed.

1. Dominant *Trachypogon plumosus* (H.B.K.) Nees, with many shrubs of *Tibouchina aspera* Aubl. and some other shrubs, in the background *Mauritia flexuosa* L.f.).

2. Dominant *Rhynchospora barbata* and much *Rhynchospora graminea* Uitt. *Utricularia* spec. and rather frequent shrubs of *Humiria floribunda* Mart. (See photograph 2).

3. The following association is separated from the preceding ones by a lower situated strip of *Sphagnum antillarum* Schimp. Dominant is *Rhynchospora barbata* Kunth, but in two different „facies” viz. one with much *Panicum micranthum* H.B.K. and one with much *Bulbostylis conifera* Kuth, *Syngonanthus umbellatus* (Lam.) Ruhl. is frequent in this association and in the „Bulbostylis facies” rather abundant *Polygala longicaulis* H.B.K. and *Polygala adenophora* D.C. The part of the soil covered by the vegetation was estimated at 40%.

b. *Patricksavannah near Brownsweg.* (Photographs 10—13).

This savannah extends at the foot of the hills called „Brownsberg” on the watershed between the Mindrinetti Creek and the Suriname River. It is crossed by the Railway to Kabelstation. I have visited this savannah during the dry period in the first weeks of November. Of course part of the plants were then not in flower and were not collected. The general aspect of this savannah was not much different from that of Zanderij I, though it seemed to me to be drier also during the rainy season. Especially in this savannah the evidences of recent fires were noticed. The list of species follows.

Herbs:

*Utricularia* (2 species).

*Lagenocarpus tremulus* Nees.

*Scleria cyperina* Willd.

*Rhynchospora barbata* Kunth.

*Rhynchospora cyperoides* Mart.

*Rhynchospora glauca* Vahl.

A rather tall plant, with leaves much shorter than the stem.

Corymbs loose. Common plant in the Suriname savannahs, though not frequent.

*Rhynchospora curvula* Griseb.

A small species with linear, rigid leaves and minute spikelets. Not common.

*Rhynchospora globosa* Roem. et Sch.

A caespitose plant c. 50-60 cm high, with long, narrow and rigid leaves. Peduncle slightly exceeding the leaves, with a terminal globose head. At the base of the stem, often charred leafbases. Not common in the Suriname savannahs.

*Hypolytrum pulchrum* Pfeiff. (*Cyperac.*)

A tall plant with long rhizomes, which are densely clothed with rigid brownish scales. Leaves long and narrow; peduncle with a terminal head of spikelets. A common plant in these savannahs and often frequent.

*Bulbostylis lanata* Clarke.

Plants with a thick woody rootstock, usually surrounded by charred leafbases. Leaves linear and rigid. One oblong spikelet at the top of a peduncle, which is about two times as long as the leaves. This plant was collected only in this savannah, where it is rather frequent.

*Polygala adenophora* D.C.

*Perama hirsuta* Aubl.

*Sipanea pratensis* Aubl.

An erect, pubescent perennial herb, with yellowish flowers. A common plant for sandy places.

*Coutoubea ramosa* Aubl.

Perennial herb, sometimes shrubby, with lanceolate leaves, and whitish or purplish flowers in racemes. A species common everywhere in Suriname, not typical for the savannahs.

Shrubs, Trees<sup>1)</sup> and Climbers:

*Humiria floribunda* Mart.

*Tibouchina aspera* Aubl.

*Clusia nemorosa* G. F. W. Meyer.

*Licania incana* Aubl. (*Rosac.*)

Shrubs or trees, with ovate or lanceolate leaves, which are grayish tomentose beneath. Flowers tomentose in tomentose spikes. A characteristic species for the savannahs and the savannah forest.

*Licania heteromorpha* Benth.

A small tree with glabrous, elliptic leaves. Often found in

<sup>1)</sup> I have listed here also trees growing along the border of the forest and savannah, which in my opinion belong to this association without any doubt

sandy places, but not typical for these regions, as the tree is not rare in the rain forest.

*Rawwolfia paraensis* Ducke (*Apocynac.*)

A shrub with 3—4-whorled, coriaceous, elliptic-oblong leaves, and many-flowered, axillary inflorescences, with white and purplish flowers. A rare species, probably belonging to this association.

*Plumeria bracteata* A.D.C. (*Apocynac.*)

A tree with obovate, glabrous, shining and coriaceous leaves. Inflorescence fasciculate; corolla white. A rare species, in my opinion undoubtedly belonging to the savannah vegetation. Recently also collected in the savannahs of Southern Suriname near the Brazilian frontier by R o m b o u t s.

*Roupala montana* Aubl. (*Proteac.*)

A small tree with ovate to oblong, glabrous, coriaceous leaves. Flowers white, fragrant in axillary loosely flowered inflorescences. A rather rare species, but characteristic for this kind of vegetation.

*Tetrapteris squarrosa* Griseb. (*Malpighiac.*)

Climbing shrub or liane, with ovate or lanceolate, leathery leaves, which are covered with long sericeous hairs beneath. Flowers yellow, in axillary racemes. A beautiful species often found in the savannahs, and other sandy places, climbing in the lower shrubs or trees.

*Byrsonima crassifolia* (L.) Rich. (*Malpighiac.*)

A shrub or small tree in the young parts with rufous-velutinous hairs, with variously shaped, coriaceous leaves, which are velutinous beneath. A characteristic shrub for these savannahs. Known in Suriname as Savanna kwarie.

*Miconia albicans* (Sw.) Triana (*Melastomac.*)

A shrub with ovate-oblong, subcoriaceous leaves which are cinereous-tomentulose beneath and adult shining above. Inflorescence branched, densely tomentose. This species seems to be rare in Suriname and probably belongs to the savannah vegetation.

*Retiniphyllum Schomburgkii* (Bth.) Müll. Arg. (*Rubiace.*)

Shrub with elliptic-oblong leaves and terminal inflorescences, with pink or white flowers. This species is not uncommon in the savannah forest.

*Antonia ovata* Pohl (*Loganiac.*)

Trees or shrubs with elliptic-oblong, coriaceous leaves and terminal, almost corymbose inflorescences of yellow, fragrant flowers. Though it is not a characteristic species, it is often found in the savannah forest.

The great number of species of *Rhynchospora* is striking. It

was already noticed that this genus takes an important place in the vegetation of the Savannah near Zanderij I, but here it is dominant not only in the frequency of the plants but also of the species. Another important fact which is shown by the list is that this savannah is a „pure” *Cyperaceae*-savannah. Not one single species of *Gramineae* has been collected. Of course my collections are far from complete, but at any rate the *Gramineae* are unimportant for the composition of this vegetation. It is striking that no *Xyridaceae* and *Eriocaulaceae* were collected, though it is highly probable that these species which are in my opinion characteristic for the savannah vegetation were not noticed because I visited this savannah at the end of the major dry period. The list shows that more typical savannah trees and shrubs were noticed here than in the savannah near Zanderij I. Especially the genera *Roupala*, *Retiniphyllum*, *Miconia* and *Licania* point to a relation with some savannahs in British Guiana, e.g. the Wiruni-Ituri savannahs (Marty n, 16, p. 24).

c. *Savannah near Sectie O.* (Photographs 7—9).

The following lists of this savannah were made during some short visits. It is for this reason that these lists must be still less complete than those given above.

Herbs:

*Gymnopogon foliosus* Nees (*Gramineae*).

An annual with ascending culms with numerous short leaves and a subdigitate inflorescence. Plants in tufts, characteristic for sandy places.

*Perama hirsuta* Aubl.

*Paepalanthus bifidus* (Schrud.) Kunth (*Eriocaulac.*)

A small pilosy plant with several heads at the top of the stem. Just as the other species of this family typical for the savannah vegetation.

*Borreria verticillata* G. F. W. Mey. (*Rubiaceae*.)

A glabrous erect herb with quadrangular shoots and sessile, linear leaves. Flowers in involucrate terminal or axillary glomerules. This species is often found in the savannahs, though apparently not typical.

*Cassia uniflora* Spreng.

*Centrosema angustifolium* Benth.

*Stylosanthes angustifolia* Vog. (*Leguminosae*).

An erect, shrubby herb, with rigid, linear leaves and stiff spicate inflorescences, with hairy bracts and yellow flowers. Not uncom-

mon in the savannahs.

*Zornia diphylla* (L.) Pers. (*Leguminosae*).

An herb with spreading or ascending branches; leaves with a single pair oblong-lanceolate leaflets; flowers pale yellow. Common in dry sandy places.

*Solanum* spec.

A robust herb with rusty pubescent, thorny stems, and leaves densely tomentose beneath.

Shrubs and Climbers:

*Licania incana* Aubl.

*Clusia nemorosa* G. F. W. Mey.

*Tetracera rotundifolia* Smith (*Dilleniaceae*.)

Shrubs with tortuous branches and oblong or elliptic, coriaceous leaves, and terminal and axillary inflorescences. A characteristic savannah shrub, which apparently replaces in some of the Suriname savannahs that other typical savannah *Dilleniaceae*, *Curatella americana* L.

*Byrsonima crassifolia* (L.) Rich.

In a wetter place in the neighbourhood were noted:

Herbs:

*Panicum polycomum* Trin. (*Gramineae*).

A low perennial, with small open panicles. Not uncommon in the Guiana savannahs.

*Panicum nervosum* Lam.

A perennial much like the preceding species, but stronger. Also typical for the savannah vegetation.

*Burmannia bicolor* Mart.

*Utricularia* (several species).

*Scleria cyperina* Willd.

*Perama hirsuta* Aubl.

*Syngonanthus umbellatus* (Lam.) Ruhl.

*Polygala appressa* Benth.

An erect herb with linear leaves, the upper part of the stem branched, with rather long terminal inflorescences of white or yellow flowers. Plants solitary but often with a high frequency, and dominant though not over large areas.

*Blechnum serrulatum* Rich.

*Pteridium arachnoideum* (Klf.) Maxon (*Polypodiaceae*.)

A species related to our common *P. aquilinum* Kuhn, but with narrower pinnules and coriaceous leaves. Often abundant in wetter places.

In the savannah of the first list the grass *Gymnopogon foliosus* Nees is dominant with many shrubs of *Tetracera rotundifolia* Smith (photograph 9).

In the savannah of the second list are the grasses (*Panicum polycomum* Trin. and *P. nervosum* Lam.) also dominant with much *Polygala appressa* Benth. (Photograph 7), and here and there many plants of *Syngonanthus umbellatus* (Photograph 8), especially in wet places. It is striking that the grasses are dominant and the *Leguminosae* too are well represented, while neither *Cyperaceae* nor *Xyridaceae* take an important place in the composition of the vegetation.

d. *Savannah Forest between Moengo tapoe and Albina.*

The following list of species I have made along the Weyne road, which traverses this savannah forest. An open savannah was not seen in this region, though several persons have told me that there are some in that region.

Herbs:

- Diodia hyssopifolia* (H. B. K.) C. & S. (*Rubiaceae*.)
- Coccocypselum guianense* (Aubl.) K. Schum. (*Rubiaceae*.)
- Perama hirsuta* Aubl.
- Hypolytrum pulchrum* (Rudge) Pfeiff.
- Rhynchospora cephalotes* (L.) Vahl
- Xyris Uleana* Malme
- Xyris macrocephala* Vahl
- Syngonanthus gracilis* (Bong.) Ruhl.
- Paepalanthus congestus* (H.B.K.) Kth.
- Lycopodium cernuum* L.
- Catsetum* spec.
- Nepsera aquatica* (Aubl.) Naud. (*Melastomataceae*.)
- Aciotis laxa* (L. C. Rich.) Cogn. (*Melastomataceae*.)
- Lisianthus uliginosus* Aubl.

Trees, Shrubs and Climbing Plants:

- Blechnum serrulatum* Richard
- Blepharodon Steudelianum* (Miq.) Pulle (*Asclepiad.*)
- Dioscorea truncata* Miq.
- Passiflora* spec.
- Banisteria leptocarpa* Benth. (*Malpighiaceae*.)
- Cassia chrysocarpa* Desv. (*Legumin.*)
- Miconia guianensis* (Aubl.) Cogn.
- Miconia ciliata* (L. C. Rich.) D. C.
- Comolia veronicaefolia* Benth. (*Melastomataceae*.)
- Licania incana* Aubl.

*Tetracera rotundifolia* Smith

Though there are several species in this list, which are usually not represented in the savannah, most of them are indeed true savannah plants. Some typical species are wanting e.g. *Utricularia*.

5. *Conclusion.*

If the lists of species given in this paper are compared with those of British Guiana (Schomburgk, Martin, Myers) and of French Guiana (Benoit) and Brazil (Bouillenne), it is noteworthy that they have many species in common. Without doubt the savannahs described here have the greatest resemblance to those of French Guiana. This is not surprising as the savannahs described by Benoit are also situated in the northern lowland part of the country, while those of British Guiana and Brazil are all lying in the higher inland. As far as can be judged from the collections of the Suriname inland savannahs at the Brazilian frontier near the Sipaliwini River, which were recently sent to Utrecht by a member of the frontier expedition, the species represented in these savannahs are the same as those of British Guiana and Brazil. Many of the species described by Benoit as being dominant are the same as the dominant species in our savannahs. Especially Benoit's Savane blanche, Savane des Roches and Grande Savane show a great resemblance in appearance, species lists and dominant species with the savannahs described above.

## IV. SWAMPS.

1. *General Remarks.*

These swamps extend at about 5—10 km behind the coast-line, especially in the Western part of the country in the environs of Coronie and Nieuw Nickerie (see the map in Lanjouw 13). They are fresh water swamps. The ground is not under water only in extremely dry seasons and then they are perhaps liable to damage by fire. These swamps are also often called „savannahs”, only because trees are lacking. Though the vegetation has several genera in common with the savannah, the species are quite different. Indeed we met here with a true swamp vegetation. Usually these swamps are widely extended and without any tree-growth, though here and there interrupted by the swamp forest. Just as Myers I have noticed that this forest occupies places with rising ground. The plant communities in this vegetation show greater differences



than those of the savannahs. We could distinguish in the Suriname swamps at least three main types of vegetation.

1. *Typha angustifolia* L. — *Cyperus giganteus* Vahl Swamp.

A dense vegetation of the common reed-mace mixed with this really gigantic *Cyperus* species and with many other plants from which I can mention especially *Jussieua nervosa* Poir. *Cyperus digitatus* Roxb. and *Ipomoea subrevoluta* Choisy. This type of vegetation is beautifully developed in the swamp behind Waterloo near Nieuw Nickerie (see photographs 14 and 15), where it extends from the Nickerie river to the Nanny Creek.

From this „sea of bulrushes” rise peculiar, small islands of *Erythrina glauca* Willd., as was already mentioned by Myers (17). These groups of trees are of course accompanied by some other plants, not represented in the *Typha* swamp, e.g. *Entada polystachya* D.C. the „Mokko mokko” *Montrichardia arborescens* Schott., *Mikania* etc.

2. *Cyperus articulatus* L. Swamp.

Often in dense vegetations, but not as „pure” as the *Typha* swamp. The *Cyperus* is accompanied by many other species. This type of swamp goes over into 3.

3. *Homalocenchrus hexandrus* (Sw.) Kuntz — *Rhynchospora corymbosa* (L.) Hitch. Swamp. (Photograph 16).

This type seems to cover the British Guiana swamps described by Schomburgk (23) and Myers (17, 18). Just as is stated by these authors, I have experienced in the swamps near Coronie that the „vegetable decking” is just strong enough to bear the weight of a man, though it is better not to stop too long on this unstable „ground”. As was stated above this vegetation passes into the true swamp. The aeta palm *Mauritia flexuosa* L.f. was also noticed in this type of swamp.

## 2. Species Lists.

Below follow some species lists made in the swamps near Nieuw Nickerie and Coronie.

a. Swamp behind Waterloo near Nieuw Nickerie.

*Typha angustifolia* L. Dominant species.

*Cyperus giganteus* Vahl Rather frequent, but not dominant.

*Montrichardia arborescens* Schott Only along the border of open water.

*Blechnum serrulatum* Richard

*Ipomoea subrevoluta* Choisy

*Jussieua nervosa* Poir.

*Jussieua inclinata* L.f.

- Polygonum acuminatum* H.B.K.  
*Hydrocotyle umbellata* L.  
*Cyperus digitatus* Roxb.  
*Cyperus articulatus* L. Here and there frequent.  
*Andropogon bicornis* L.  
*Panicum grande* Hitchc. et Chase especially in the tree groups.  
*Erythrina glauca* Willd. with the following species.  
*Entada polystachya* D.C.  
*Cordia tetrandra* Aubl.  
*Sesbania exasperata* H.B.K. in the water and also in the swamp.  
*Aeschynomene sensitiva* Sw.  
*Mikania micrantha* H.B.K. var. *congesta* (D.C.) Robinson.  
     b. Swamp in the Western part of Coronie.  
*Typha angustifolia* L. Dominant species.  
*Cyperus articulatus* L.  
*Panicum purpurascens* Raddi  
*Canna glauca* L.  
*Jussiaea suffruticosa* L.  
*Rhabdadenis biflora* (Jacq.) Müll. Arg.  
*Rhabdadenia macrostoma* (Benth.) Müll. Arg. var. *pubescens* Müll  
     Arg.  
*Brachypterys ovata* (Cav.) Small  
*Nymphaea* spec. In open water.  
     c. Swamp behind Coronie.  
*Cyperus articulatus* L. Dominant species in this association.  
*Homalocenchrus hexandrus* (Sw.) Kuntze  
*Crinum erubescens* Solandr.  
*Jussiaea pilosa* H.B.K.  
     This vegetation passes into the following with the grasses and  
*Rhynchospora* as dominant species.  
*Rhynchospora corymbosa* (L.) Hitch.  
*Panicum grande* Hitchc. et Chase  
*Cyperus Haspan* L.  
*Jussiaea nervosa* Poir.  
*Erechthites hieracifolia* (L.) Rafin.  
*Hydromystria stolonifera* G. F. W. Mey. In open water in dense  
     vegetation.  
*Hibiscus sororius* L.  
*Luziola Spruceana* Benth. Often in open water.  
     In a swamp forest in this vegetation I have also seen the  
     following species.  
*Tabebuia longipes* Baker. This tree is dominant. Vernac. name,  
     Panta, and the forest is called „Panta Swamp Forest”.

*Calyptrion arborea* (L.) Blake. Liane.

*Palicourea crocea* (Sw.) D.C. Tree.

*Montrichardia arborescens* Schott

*Blechnum serrulatum* Richard

Along the border of the swamp are frequent:

*Acrostichum daneaeifolium* Langsd. et Fisch.

*Drepanocarpus lunatus* G. F. W. Mey.

In Coronie is also found the *Typha angustifolia* L. — *Cyperus giganteus* Vahl association. Here and there the *Typha angustifolia* L. is found as a dominant species with *Cyperus articulatus* L. and *Homalocenchrus hexandrus* (Sw.) Kuntze, and *Cyperus giganteus* Vahl is then not represented.

d. Aquatic Vegetation in the open water of the Swamps near Nieuw Nickerie.

*Salvinia auriculata* Aubl. Dominant species.

*Pistia Stratiotes* L. Dominant species.

*Neptunia plena* Benth. Frequent.

*Neptunia oleracea* Lour. Frequent.

*Eichhornia* spec. Here and there.

*Paspalum repens* Bergius. Here and there as dominant species in this type of vegetation.

*Ipomoea reptans* (L.) Poir. Often found in this vegetation.

e. Aquatic Vegetation near Coronie.

*Salvinia auriculata* Aubl.

*Pistia Stratiotes* L.

*Azolla caroliniana* Willd.

*Ceratopteris pteridoides* (Hk.) Hieron.

*Eichhornea* spec.

*Utricularia* spec.

The following species are probably of importance for the forming of „land”, as they grow as well in inundated moras and open water, as in wet ground.

*Polygonum acuminatum* H.B.K.

*Panicum grande* Hitchc. et Chase

*Hydrocotyle umbellata* L.

## V. SUMMARY.

1. The following definition is proposed for the term Savannah.

Savannahs are plains in the West Indian Islands and Northern South America covered with more or less xeromorph herbs and small shrubs and with few trees or larger shrubs.

2. It is suggested that the Suriname Savannas have originated from Tropical Rain Forest, modified by Edaphic and Climatic conditions. The Edaphic Conditions being the main influence.

3. This new vegetation is liable to damage by fire, and this gives rise to the true savannah vegetation, which is a „fire climax”.

4. A description and species lists are given of Savannas near Zanderij I, Brownsweg, Sectie O and between Moengo tapoe and Albina.

5. The vegetation of these savannas seems to be most closely related to that of the French Guiana Savannas.

6. A general description of the Swamps in the Western part of Suriname is given. Three main „associations” are recognized. The *Typha angustifolia* L. — *Cyperus giganteus* Vahl Swamp, the *Cyperus articulatus* L. Swamp and the *Homalocenchrus hexandrus* (Sw.) Kuntze — *Rhynchospora corymbosa* (L.) Hitch. Swamp.

7. Species lists are given of the Swamps near Nieuw Nickerie and near Coronie.

8. Species lists are given of the aquatic vegetation in the open water of these swamps.

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