Underside creamy-white; costa of forewing irregularly strigulated with fuscous brown. Large subcircular reniforms in all wings. A brown macula below apex surrounds a small area of ground colour. Postmedial indicated by dark spots on veins. Terminal line very distinct.

♀ Similar, but greyer; marking less distinct.

Genitalia of ♂. Similar in general build to *sabinei,* Prout; but differing in the following points:—

Gnathos of even width, not broadened towards the end. Costa of valve with only one patch of spines, and that at the middle. Anterior end of costal margin produced to a rounded lobe, not to a narrow point. The two cornuti are made up of spine-clusters, as in *sabinei,* but of only half their length. The loose dorsal belt of spines, connecting the cornuti in *sabinei,* is absent in *hyrax.*

Length of forewing, base to apex: ♂ 21 mm.; ♀ 23 mm.

Holotype ♂ and allotype ♀ in my collection: paratype ♂ in the British Museum.

Locality: Nakuru, Kenya. Larva on *Schinus molle.*

I wish to acknowledge gratefully the help that I have received with regard to these species from Mr. D. S. Fletcher, of the British Museum. The notes on genitalia are taken entirely from information supplied by him.

Paracotis hyrax. Natural size.
Eupithecia psiadiata. Slightly enlarged.

OBSERVATIONS ON STOLONIFEROUS GRASSES IN KENYA.

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In Europe and probably also in other temperate regions, stoloniferous grasses, i.e. grasses which produce above-ground creeping stems, rooting from nodes, are rare. In Tropical Africa the stoloniferous type of grass is, however, fairly common. In Kenya, out of approximate total of 430 species of grasses, no less than 25 of them produce stolons. The stolons of different species vary considerably in structure, shape and length, rate of growth etc., and it is mainly the structure, i.e. the distribution of leaves on the axis of stolons and phenomena connected with this feature, which are dealt with in the present paper.

The stolons of all local stoloniferous grasses can be classified into two well-defined types, examples of which are those of (a) *Digitaria* aff. *D.milanjana* Stapf (Bogdan 3003) and (b) *Cynodon plectostachyum* Pilger. The stolons of the *Digitaria* have a structure typical of a normal grass stem: the nodes are more or less evenly distributed on the stem, each bearing a single leaf. The leaf bases, or, to be more exact, the bases of the leaf sheaths, arise at some distance one from another and have well

defined internodes between them. The structure of the stolons of *Cynodon* is different. The leaves are in groups of 2 to 6 (but usually 4) and the leaf bases of each group appear to arise from a single node. These nodes can be regarded, however, as compound nodes or as groups of nodes with very short, undeveloped internodes between them. This supports the view held by A. Volkart and O. Kirchner in "*Lebensgeschichte der Blütenpflanzen Mitteleuropas, Gramineae,* 1,2,p.35 (1908-1912) who state: "bei einigen Gräsern (*Cynodon, Aeluropus*) wechseln an den oberirdischen Ausläufern regelmässig ein gestrecktes Internodium mit 2-4 verkürtzen ab, sodass die Blätter stellenweise gebüschelt erscheinen". The writer is unaware of any further reference in the literature to details of the structure of grass stolons.

The structure of the two types of stolons considered here, which will be referred to in future as "A" (*Digitaria*) type and "B" (*Cynodon*) type, is shown diagrammatically in Figs. 1 and 2.

The difference in distribution of leaves on the two types of stolons is closely connected with character of the branching. Before branching starts the axillary buds which produce side branches are hidden under the basal parts of the leaf sheaths. As soon as a young branch starts growing from the bud it usually depresses the leaf sheath from the stem. In the "A" type of stolons (*Digitaria*), with only one leaf per isolated node, the depression of the leaf sheath leaves the corresponding internode unprotected, the basal part of the internode becomes hard and ceases to grow. Towards the apex of a stolon there are always several internodes growing simultaneously; the branching, therefore, begins at some distance — which may at times be considerable — from the apex of the stolon where the appropriate internodes have ceased to grow. It also naturally follows that, since only one leaf arises from an isolated node, this type of stolon produces only one branch (or none at all) from a node, except at an advanced stage of branching when a side branch may produce branches in its turn.

On the whole the characteristic features of the "A" (*Digitaria*) type stolons can be summarised as follows:—

a) The stolons have structure typical of a normal grass stem, with isolated single nodes each producing one leaf.

b) The stolons produce only one branch per node (or none at all).

c) An internode ceases to grow as soon as the branching from the corresponding node begins.

d) The branching begins at some distance from the apex of a stolon.

A different process of branching has been observed in the "B" (*Cynodon*) type of stolons. It has already been mentioned that the stolons of this type have compound nodes each bearing 2—6 leaves. The branching begins from the axil of the lowest leaf. The young branch depresses the leaf sheath from the stem, but the latter is still protected by the sheaths of the upper leaves of the same compound node. The second branch starts from the axil of the next leaf, etc. until only two (or sometimes one) upper sheaths remain adpressed to the stem. If, for example, four leaves arise from the same compound node, two of them produce branches from axils and two upper sheaths remain adpressed, protecting the corresponding internode. The basal part of the

internode remains soft and proceeds to grow for up to several days after the beginning of the branching. Thus the branching in "B" type stolons does not depend on the longitudinal growth of internodes, and one can expect branching to begin at any time after the appropriate node has been fully formed. In actual fact, in *Cynodon plectostachyum*, as well as in many other species with "B" type stolons, branching begins at an early stage of development of the upper internodes, and therefore, in the growing part of the stolon, very near to the apex.

The characteristic features of the "B" (*Cynodon*) type stolons may now be briefly summarised as follows:—

a) The stolons have a structure a-typical of a normal grass stem, in that they have compound nodes each producing 2—6 leaves.

b) The stolons produce in general more than one branch from a compound node.

c) An internode proceeds to grow after branching from the corresponding internode has taken place.

d) Branching usually begins close to the apex of the stolon.

The actual growth of the stolons of *Digitaria* aff. *milanjana* and *Cynodon plectostachyum* as observed in the grass nursery at the Scott Agricultural Laboratories, Nairobi, is shown in Figs. 3—8.

The difference in structure and branching of the two types of stolons described results in somewhat different pattern for the whole system of stolons which arises from a single plant. It has already been noted that in the "A" type of stolons each node produces only one branch (if any). This, as a rule, becomes a vertical sterile or fertile shoot, and only seldom does it become a side stolon. Thus the whole system of stolons of *Digitaria* or of other genera producing "A" type stolons is rather simple, and consists usually of scarcely branched stolons (Fig.9), each producing a row of vertical shoots. In the "B" type each node of a stolon usually produces 2-4 branches of which one or two may often become side stolons. Thus the whole system of stolons of *Cynodon* and other grasses with "B" type stolons is as a rule more complicated, and it consists of a net of more or less much branched stolons (Fig.10).

The stolon type of a grass species is connected with its taxonomical position in the *Gramineae* and species which belong to the same tribe usually produce the same type of stolons. The following list shows the occurrence of the two types of stolons in the different tribes of Kenya grasses.

I. SPECIES WITH "A" (*DIGITARIA*) TYPE STOLONS.

PANICEAE.

1. *Digitaria* aff. *milanjana* Stapf. (Bogdan 3003)x
2. *Digitaria*? *macroblephara* Stapf (Bogdan 873 and 2257)
3. *Digitaria mombasana* Hubbard
4. *Digitaria scalarum* Chiov. (normally a rhizomatous grass which only occasionally produces stolons)
5. *Pennisetum clandestinum* Hochst. (produces both stolons and rhizomes)
6. *Brachiaria humidicola* Schweickerdt

ANDROPOGONEAE.

7. *Bothriochloa insculpta* A. Camus

SPOROBOLEAE.

8. *Sporobolus helvolus* Dur. & Schinz

II. SPECIES WITH "B" (CYNODON) TYPE STOLONS.

ERAGROSTEAE.

9. *Diplachne caudata* K. Schum.
10. *Diplachne jaegeri* Pilger.
11. *Dactyloctenium geminatum* Hack.
12. *Dactyloctenium scindicum* Boiss.
13. *Dactyloctenium* sp. (Bogdan 866 and 3155)

CHLORIDEAE.

14. *Eustachys paspaloides* Lanza & Mattei
15. *Chloris amethystea* Hochst.
16. *Chloris* aff. *amethystea* Hochst. (Bogdan 1590)[x].
17. *Chloris gayana* Kunth
18. *Chrysochlora orientalis* Swallen
19. *Cynodon dactylon* Pers.
20. *Cynodon plectostachyum* Pilger.

SPOROBOLEAE.

21. *Sporobolus marginatus* Hochst.
22. *Sporobolus spicatus* Kunth
23. *Sporobolus virginicus* Kunth

LEPTUREAE.

24. *Lepturus radicans* A. Camus
25. *Lepturus repens* R.Br.

AVENEAE.

26. *Lintonia nutans* Stapf.

The above list shows that all Kenya stoloniferous species of the *Paniceae* have "A" type stolons.[x]) On the other hand all stoloniferous species of the *Chlorideae, Sporoboleae, Leptureae,* and *Eragrosteae* produce "B" type stolons. In the last group of tribes with the "B" type stolons the *Chlorideae* occupy somewhat central position and have numerous stoloniferous forms. The other tribes and genera of this group are more or less closely related to the *Chlorideae,* with the exception,

*) I have recently come across fresh stolons of *Stenotaphrum dimidiatum* (*Paniceae*) which proved to be essentially of the "B" type!

x Refers to the specimens deposited in the Herbarium of the Royal Botanic Gardens, Kew, England.

of the *Aveneae,* which in Kenya have only one stoloniferous species, namely *Lintonia nutans.* This species in its habit, distribution and ecology approaches, however, more the *Chlorideae* than the rest of the *Aveneae,* and its taxonomic position requires a revision. In the group of tribes characterised by the "B" type stolons, *Sporobolus helvolus* with its "A" type stolons is an exception. The stolons of *Sporobolus helvolus* are not, however, comparable morphologically with those of *Sporobolus marginatus* or *Sporobolus spicatus.* In these two latter species the stolons arise as specialised structures, and grow horizontally from the moment of their formation, while in *Sporobolus helvolus* the young stolons appear as ordinary stems. Initially they grow vertically, and only later on do they bend downwards, acquiring a creeping habit and rooting from nodes. The writer is inclined to believe that the stolons of *Sporobolus helvolus* can be regarded as a structure morphologically independent from the true stolons of other species of *Sporobolus,* a structure which was probably formed at a later date in the evolution of the genus. *Sporobolus virginicus,* although it produces rhizomes and not the above-ground stolons, is also included. Its rhizomes have a structure typical of the "B" type stolons in producing several (usually 3) leaves from a node. Naturally these leaves are in the form of scales, as it is typical of the rhizomes. The rhizomes of *Sporobolus virginicus* produce, however, only one branch from a node which arises from the axil of the lowermost scale as an extravaginal shoot. The branches form vertical, leaf-bearing shoots, while the rhizome itself does not branch. The rhizomes of *Sporobolus virginicus* can be regarded as modified "B" type stolons with its typical structure, which apparently lost its adaptative character.

Although in the *Paniceae* the forms with true stolons are not numerous, many species which produce creeping stems rooting from nodes are encountered in the tribe. These creeping stems terminate, however, in flowering heads, and they cannot be regarded as stolons. They are more comparable with ascending or creeping stem bases which also frequently root from the nodes. In fact, numerous transitional forms between long creeping stems and those with only slightly ascending bases are found. The creeping or trailing grasses of the *Paniceae* are particularly numerous in forests and in bush thickets, and to some extent also on swampy ground. Several species of *Panicum, Pseudechinolaena polystachya* Stapf, *Sacciolepis curvata* Chase, *Chloachne oplismenoides* Stapf, species of *Oplismenus* and many others belong to the forest creeping grasses. On swampy ground the grasses with creeping stems are represented by *Paspalidium geminatum* Stapf, *Panicum repens* L., *Acroceras macrum* Stapf, *Pennisetum dowsonii* Stapf & Hubbard, *Pennisetum salifex* Stapf & Hubbard, and by several others. Even on dry open ground there are several species of the *Paniceae* with long creeping basal parts of the stems. These include mainly species of *Urochloa, Melinis,* and a few others. In the *Andropogoneae* trailing forms are much less numerous although some species of *Andropogon* and *Hyparrhenia* and *Eulalia geniculata* Stapf produce fairly long creeping stem bases.

In the *Chlorideae* group of tribes the number of species producing specialised stolons is comparatively large, much larger than that in the *Paniceae* and *Andropogoneae.* On the other hand, the number of species which produce partly or entirely creeping shoots of the structure normal in a typical grass-shoot, is surprisingly small. Apart from already mentioned *Sporobolus helvolus,* only a few species of this kind are known

to the author, namely two or three species of *Eragrostis* and *Drake-Brockmania somalensis* Stapf, an annual with prostrate stems. Even forms with ascending and rooting stem bases are rare in this group of tribes. In general the *Chlorideae* group of tribes is characterised by highly specialised stolons which differ considerably from the normal fertile shoots of grasses. Even some annual species with creeping stem bases (*Chloris pycnothrix* Trin., *Dactyloctenium aegyptium* Beauv.) repeat, in their basal, spreading parts of the stem, the structure typical of the "B" type (*Cynodon*) stolons, by producing several leaves from each compound node.

The length and rate of growth of stolons vary considerably in different species. In the *Chlorideae* and in the allied tribes, two types of stoloniferous grasses, characterised by the rate of growth of the stolons, have been observed. To one type belong species with rapidly growing stolons which form extensive, though rather thin, nets and in a comparatively short time produce large, open colonies. Being open, these colonies allow the growth of other plants in the areas occupied by the colonies. The actual competition between the species starts only later, when, after having covered a considerable area with a thin net of stolons, the stoloniferous grass begins to form a dense sward. As examples of this type of stoloniferous grass, *Cynodon dactylon, Cynodon plectostachyum, Diplachne jaegeri,* and *Chloris gayana* can be named. The second type is characterised by the comparatively slow growth of stolons. Species which belong to this type produce slowly spreading, but dense, nets of stolons, and form dense colonies from the very beginning of their growth. Grasses of this group occupy an area slowly, step by step, but once in occupation they retain it firmly. Amongst the grasses of this type are *Chloris amethystea, Eustachys paspaloides,* and *Sporobolus marginatus.*

ACKNOWLEDGEMENT.

The author is much indebted to Mr. C. E. Hubbard, Principal Research Officer, Royal Botanic Gardens, Kew, for very valuable advice on taxonomy of the grasses dealt with in the present paper.

Nairobi,
November, 1951.

A LITTLE-KNOWN WATERLILY FROM TANGANYIKA.

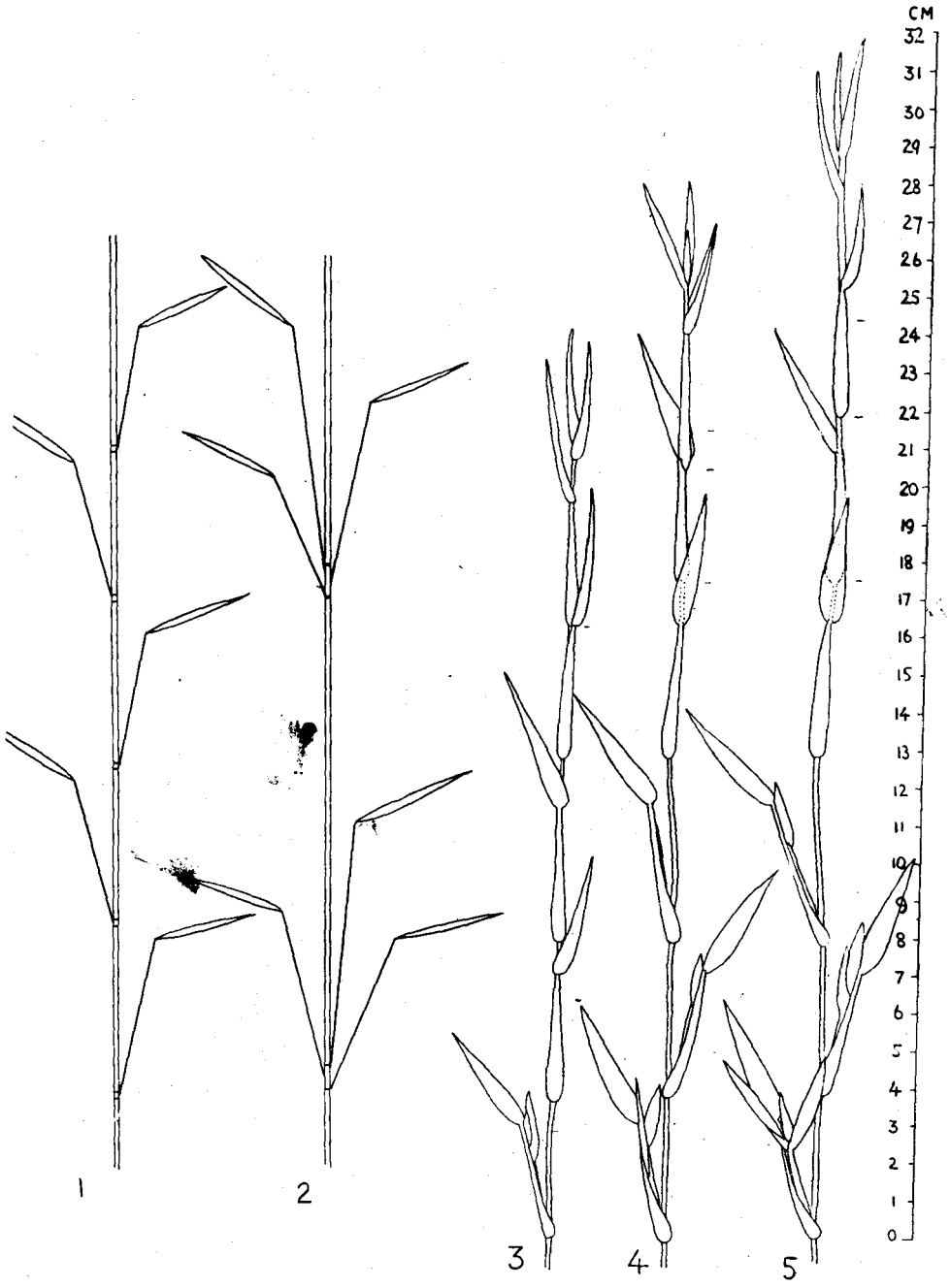
By P. R. O. Bally.

Botanist, Coryndon Museum.

In Unyamwesi and Ussukuma, in Western Tanganyika, grows one of the loveliest and least know of all waterlilies: *Nymphaea stuhlmanni* (Schwfth.) Gilg.

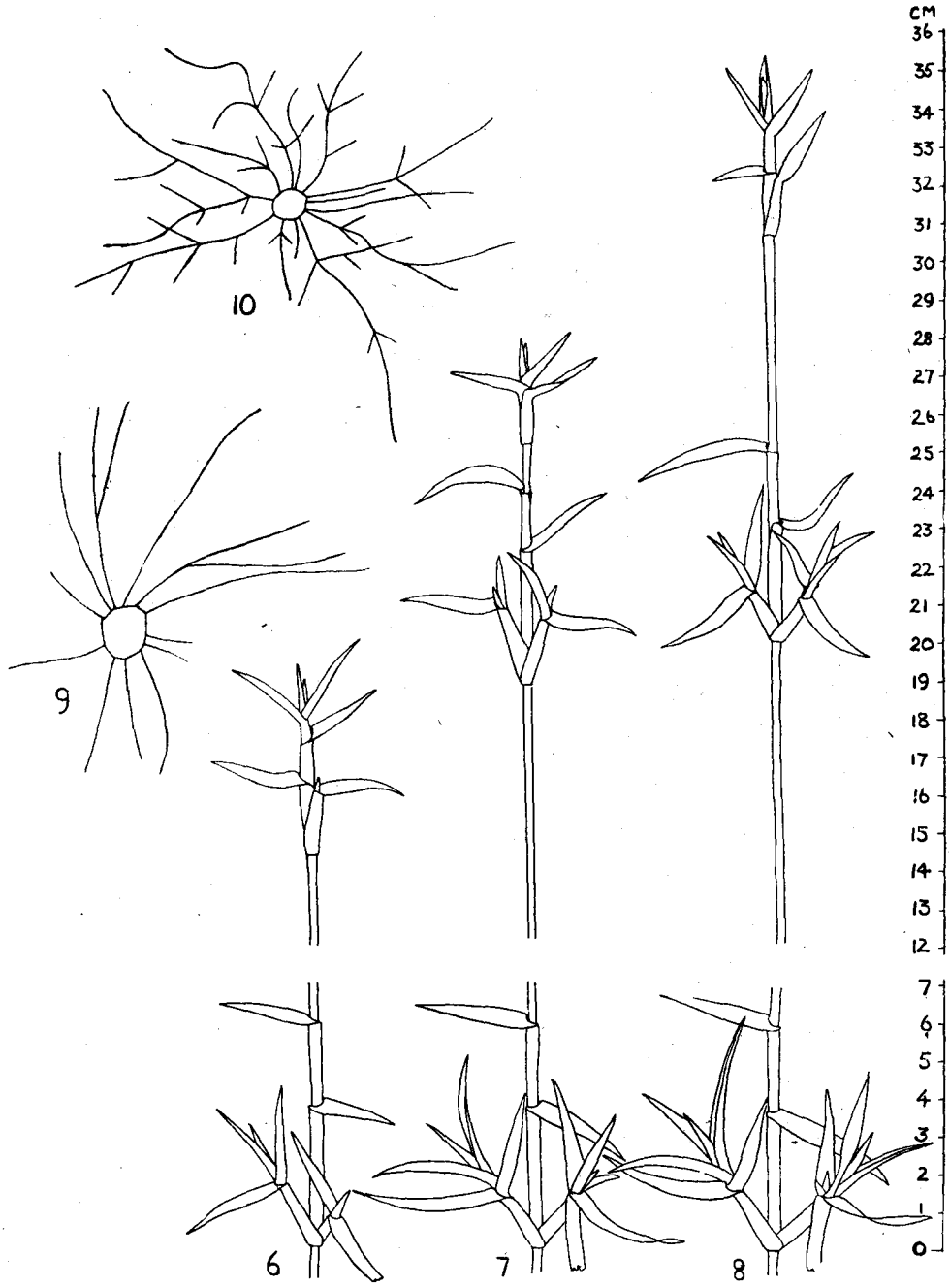
At the end of August, 1942, the writer had the good fortune to see it for the first time, from a railway carriage ,travelling from Tabora towards Dar-es-Salaam. Immediately beside the railway track was a little pond, covered with large, bright yellow waterlilies. The temptation to pull the safety cord was strong; but a sense of propriety prevailed, and a unique opportunity was missed.

Ten years later, almost to the day, on August the 24th, 1952, the occasion arose to visit the area again. My enquiries revealed that the very pond that I had passed in the train was situated a few miles from



Figs. 1—2, Structure of *Digitaria* (1) and *Cynodon* (2) stolons. Diagrammatical.

Figs. 3—5. A stolon of *Digitaria aff. milanjana.* 3—14.11.1950 4—16.11.1950; 5—18.11.1950. (Grass nursery, Scott Laboratories, Nairobi).



Figs. 6—8. A stolon of *Cynodon plectostachyum*. 6—14.11.1950; 7—16.1.1950; 8—18.11.1950. (Grass nursery, Scott Agric. Laboratories, Nairobi).

Figs. 9—10. Nets of stolons of *Digitaria aff.milanjana* (9) and *Cynodon dactylon* (10). (Grass nursery, Scott Agric. Laboratories, Nairobi, 1949).