A MONOGRAPHIC STUDY OF THE GENUS MONELYTRUM HACKEL

by

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(with 6 figures)

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Contents.

1. INTRODUCTION.

In the following account the author of the present paper has endeavoured to compile all available information regarding this interesting member of the *Gramineae-Zoysieae.*

As the genus under consideration has in many cases been incorrectly described, it appeared highly desirable to amend the faults and inaccuracies committed by both the original author of the genus and various subsequent taxonomists. The results of these investigations are being put forward in the following pages.

2. MATERIAL EXAMINED.

Only specimens seen by the author of the present paper have been cited. In addition to the ubiquitous herbarium material, living material was also studied. Plants were raised from "seed", kindly collected and forwarded to the present author by Prof. Dr O. Volk from the Mandate of South West Africa, during the year 1940. It might be of some interest to mention, that many of the caryopses set out for germination, had done so within 18—24 hours. Furthermore, the study of living material provided a clue to the interpretation of the supposed annual species *Monelytrum annuum* Goossens.

Herbarium specimens were prepared from such living plants and are cited along with the remaining material.

The abbreviations used indicate the particular herbarium where the specimens lie deposited.

The following abbreviations are used throughout:

B — Botanisches Museum, Berlin-Dahlem.
BOL — Bolus Herbarium, University, Cape Town.
CTM — South African Museum, Cape Town.
K — Royal Botanic Gardens, Kew.
NH — Natal Herbarium, Durban.
PRE — National Herbarium, Pretoria.
UPR — Herbarium, University, Pretoria.
TRV — Transvaal Museum, Pretoria.
W — Naturhistorischess Museum, Vienna.
Z — Botanisches Museum, Zürich.

The author wishes to express his thanks to the Directors and Curators of the herbaria enumerated for the kind loan of material. Special thanks are due to Prof. Dr A. Bayer of the Natal University College, for allowing the author to undertake the drawing of the anatomical figures in his laboratory. To Dr B. S. Fisher my special thanks for collecting and preserving the cultivated material during my unavoidable absence from the Natal Herbarium.

3. DESCRIPTION OF THE GENUS (AMENDED).

Monelytrum Hackel emend. H. G. Schweickerdt.

Monelytrum Hack. in Verh. Bot. Ver. Prov. Brand. 30, 140 (1888); Thonner, Fl. Pl. Afr. 84 (1915) in clavi; Stapf in Prain, Fl. Trop. Afr. 9, I, 19 (1917) in clavi; Phillips, S. Afr. Grasses 153 cum ic. tab. 26a (1931); Bews, World's Grasses 121 (1929); Schweickerdt in Notizbl. Bot. Gart. Mus. Berl.-Dahlem 14, Nr. 122, p. 198 (1938).

Panicula anguste et densissime spiciformis. *Spiculorum fasciculi* e fere 5 spiculis compositi (usque ad 3 spiculae hermaphroditae, ceterae rudimentariae vel in setas scabridas redactae), erecti, decidui, densissime aggregati. Axis fasciculorum et spicularum longe villosus. *Spiculae* adaxiales, erectae, subsessiles, imbricatae; inferiores hermaphroditae, uniflorae, ambitu plus minusve lanceolatae, acuminatae et valde aristatae; superiores steriles vel in setas scabridas redactae. *Glumae* 2, valde inaequales dissimilesque; inferior rhachi adaxialis, minuta, hyalina, enervis, secundum margines valde ciliata; superior herbacea, lanceolata, acuminata, valde aristata, 5—7-nervis (perraro inconspicue 9-nervis), nervis marginibusque scabridis; arista leviter recurvata. *Lemma* lanceolatum, membranaceum, breviter aristatum, 3-nerve, nervo intermedio excurrente, a dorso et lateribus sparse pilosum; arista erecta, scaberula. *Palea* hyalina, lanceolata, emarginata vel bifida, 2-nervis, margines versus leviter pilosa. *Lodiculae* 2, bene evolutae, fere cuneiformes, carnosulae. *Antherae* 3, lineares. *Ovarium* glabrum, ellipsoideum; styli distincti; stigmata plumosae. *Caryopsis* anguste elliptica, a dorso compressa, pallide-fusca; embryo ad tertiam partem inferiorem endospermii attingens; hilum punctiforme; epiblastus distinctus.

Gramen perenne, caespitosum vel stoloniferum. *Culmi* erecti vel leviter geniculati. *Laminae* foliorum lineares, marginibus rigide ciliatis. *Ligula* in cilia soluta.

Species 1. Africa austro-occidentalis et Angola.

Most of the references cited above contain a faulty description or conception of the genus, which is now rectified by the foregoing emended description drawn up by the present author.

4. DESCRIPTION OF THE SPECIES (AMENDED).

Monelytrum Lüderitzianum Hack. in Verh. Bot. Ver. Prov. Brand. 30, 140 (1888); Dur. et Schinz, Consp. Fl. Afr. 5, 733 (1894); Hack. apud Schinz in Bull. Herb. Boiss. Append. 3, 13 (1896); Dinter in Fedde, Rep. 19, 237 (1923); Garabedian in Ann. S. Afr. Mus. 16, II, 407 (1925); Phillips, S. Afr. Grasses 153 cum ic. tab. 26a (1931); Range in Fedde, Rep. 33, 6 (1933); Schweickerdt in Notizbl. Bot. Gart. u. Mus. Berlin-Dahlem 14, nr. 122, p. 198 (1938) — *M. annuum* Goossens in Kew Bull. 1934, p. 197 cum fig. 3, p. 199.

M. Lüderitzianum Hack. emend. H. G. Schweickerdt (*Fig. 1, a–k*).

Perennial, or rarely flowering during the first year but then persistent, densely caespitose, usually sending out numerous stolons. *Stolons* terete or more or less dorsiventrally compressed, glabrous and smooth, wiry, giving rise to shoots at each node. *Culms* erect or geniculately-ascending, 2—4-noded, including the inflorescence up to 80 cm high, usually much branched from the base, with many persistent lower leaf-sheaths. *Internodes* terete, glabrous, somewhat striate; nodes glabrous, somewhat swollen, well-exserted. *Leaf-sheaths* keeled, somewhat compressed, striate, glabrous, somewhat ciliate along the margin and scaberulous on the flanks upwards. *Ligule* membranous, conspicuously long-ciliate from the back, the membranous nature of the ligule composed of the loosely cohering bases of the long hairs (transition ?); auricles glabrous or somewhat bearded; collar glabrous. *Leaf-blades* extremely variable in length, lanceolate to linear, gradually tapering to a point, up to 50 cm long and 8 mm wide, keeled, striate, sometimes markedly so, glabrous on the lower surface, minutely scaberulous on the upper surface, margin thickened, scabrid and set with conspicuous bulbous-based bristles, green or more usually somewhat glaucous. *Panicle* spiciform, narrow, cylindric, up to 25 cm long, but usually much shorter, well-exserted or at times somewhat sheathed by the uppermost leaf; axis terete below, angled grooved and scaberulous upwards, studded with the persistent short peduncles. *Spikelet-clusters* imbricate, deciduous, falling entire, consisting of 2—4 fertile spikelets with 1—2 additional sterile spikelets or bristles, more or less adpressed to the rhachis. *Spikelets* shortly pedicelled; pedicels conspicuously long-ciliate and thus partly masking the spikelets. *Glumes* markedly dissimilar. *Lower glume* adaxial, 0.5—1.5 mm long, broadly lanceolate to ovate, acute or obtuse, entire or somewhat notched at the apex, hyaline, nerveless, glabrous or long-ciliate from the margin and the back. *Upper glume* lanceolate, acuminate, tapering into a conspicuous bristle-like awn, up to 15 mm long including the awn, markedly 5-nerved and often with 2 additional less conspicuous nerves (thus 7-nerved), dorsally scaberulous along the nerves, ciliate along the margin below; awn scaberulous often somewhat recurved. *Lemma* 4.5—6 mm long, lanceolate-acuminate, submembranous, 1- to weakly

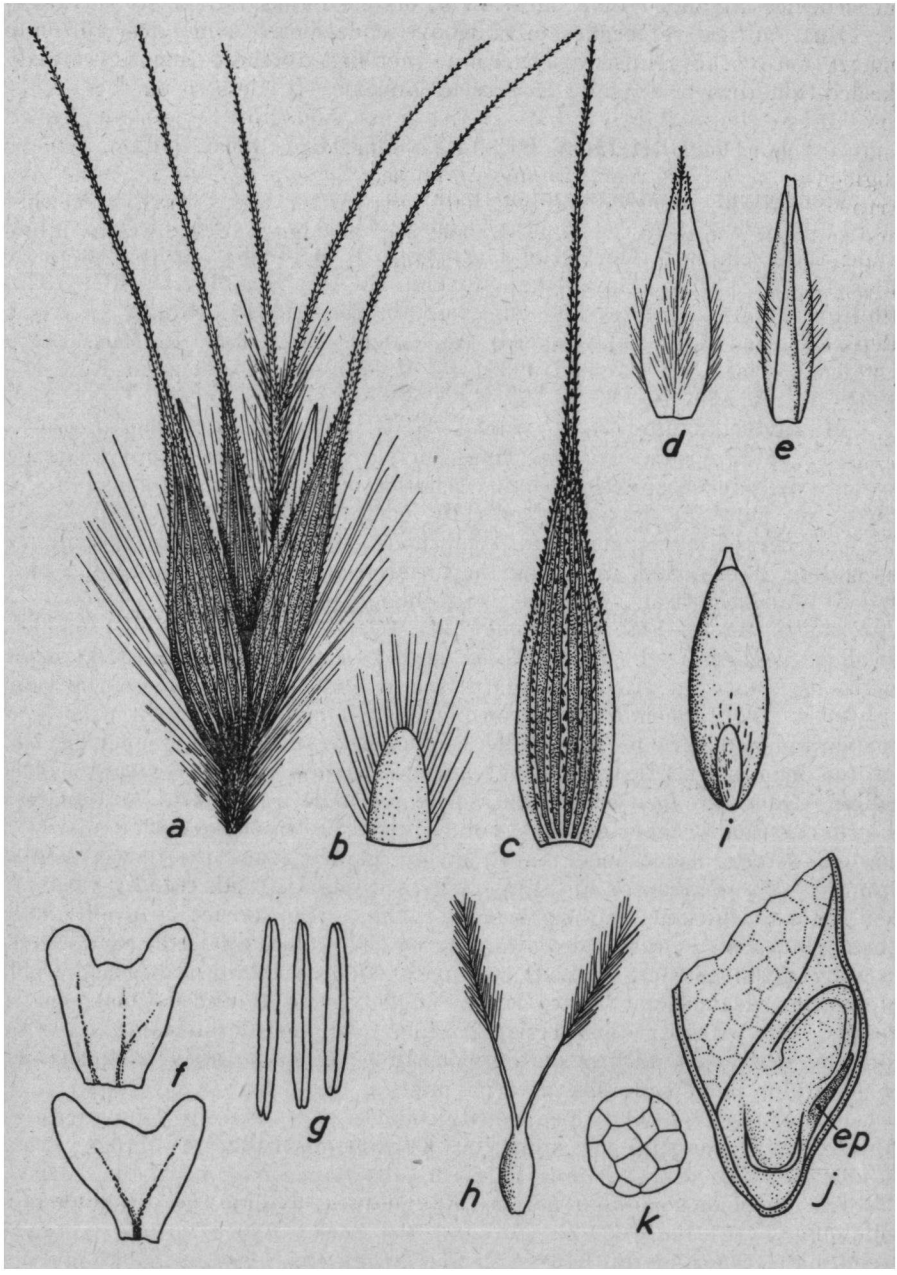

Fig. 1 — M. Lüderitzianum Hack. emend. H. G. Schweickerdt — a. Spikelet-cluster; b. lower glume; c. upper glume; d. valve; e. palea; f. lodicules; g. anthers; h. ovary; i. caryopsis; j. vertical section of embryo showing the presence of the epiblast (ep); k. compound starch-grain — (*Volk 471*).

3-nerved, dorsally long-ciliate and less so on the flanks, scaberulous towards the apex, mid-nerve excurrent into a scaberulous awn 0.5—1.75 mm long. *Palea* 3.5—5 mm long, lanceolate, hyaline, 2-nerved, inconspicuously 2-keeled, glabrous or dorsally weakly long-ciliate, still less so on the flanks, erose and at times slightly ciliate at the apex. *Lodicules* 2, cuneate, fleshy, about 0.3 mm long. *Anthers* 3, 2.0—3.5 mm long, linear, yellow. *Ovary* subglobose; styles distinct; stigmas plumose. *Caryopsis* 2.0—2.5 mm long, narrowly elliptic, tapering towards both extremities, light-brown, somewhat dorsiventrally compressed; embryo about $^1/_3$ the length of the grain; hilum punctiform; epiblast well-developed, about $^1/_2$ as long as the plumule. *Starch-grains* subglobose, compound.

Southern Angola: Open places between KM 109 of the Mossamedes Railway and the Monino Hacienda, V. 1909, *Pearson 2814* (K); near the Monino River on way to Capangombe, V. 1909, *Pearson 2821* (K).

Mandate of South-West Africa: Kaoko, 1885—1886, *Lüderitz 40* (B, W, Z); Quartel bei Rehoboth, IV. 1911, *Dinter 2174* (B, CTM); Onguati, am Kan-ufer, III. 1934, *Dinter 7069* (B); Andoni, I. 1923, *Barnard 808* (CTM 32239); Kurumanas, I. 1934, *Dinter 8546* (B); Onamutoni, VIII. 1911, *Dinter 2292* (B, CTM); Ukuib, anno 1907, *Pogge 6* (B); Awas Mountains, I. 1916, *Pearson 9791* (CTM, K); Karibib, III, 1934, *Dinter 7098* (B); Outjo, Witklip, III. 1940, *Volk 2870* (NH); Okahandja, VII. 1916, *Waibel 144* (B); Waterberg, Quickborn, V. 1928, *Bradfield 290* (K, PRE, TRV); Okatjongeana, anno 1911, *Dinter 1582* (B, CTM); Okosongomingo nr. Otjiwarongo, I. 1939, *Volk 471* et *s.n. (NH 31687)*; without precise locality, I. 1930, *Drinkuth 11* (K, PRE).

Cultivated Specimens: Natal Herbarium, Durban, II. 2. 1941, *Schweickerdt 1539* (NH, UPR).

Type Specimen: *Lüderitz 40* is deposited in the "Naturhistorisches Museum", Vienna. This specimen is fragmentary. Duplicates of the type gathering are also deposited at Berlin-Dahlem and Zürich.

Vernacular Names: "*Kalkpfannengras*".

Economic Notes: Apparently this species never occurs in great masses. It is not very selective as to the nature of the soil, but prefers one that is brackish and calcareous. For this reason it frequently occurs along the margins of pans, and hence also the appropriate vernacular name. Nothing appears to be known as to the actual feeding-value of this species. Several collectors mention that the species is a perennial much liked (eaten) by horses and bovines. The plants raised from "seed" at the Natal Herbarium showed a marked tendency to form a dense sward; lateral shoots developed from and rooted at the numerous many-noded stolons. The plants were fairly leafy. Since this species is eagerly grazed upon by stock, it would perhaps prove to be of value as a pasture grass especially in arid brackish areas.

5. LEAF ANATOMY OF THE SPECIES.

The abbreviations used in the anatomical text-figures designate the following:

lb,	leafblade.	p,	colourless parenchyma.
ls,	leaf-sheath.	c,	chlorenchyma.
1 vb,	first order bundle.	is,	inner bundle sheath.
2 vb,	second order bundle.	os,	outer bundle sheath.
3 vb,	third order bundle.	s,	mechanical tissue or stereome.

ue, adaxial epidermis.
le, abaxial epidermis.
mc, motor cells.
st, stoma.
lc, long ripple-walled cell.
sc, silicified cell.
cc, suberized cell.
tr, two-celled trichome.

Shoot Characters: The young shoots consist of short stems upon which the leaves are crowded. These are protected by the outer sheaths. The shoots are laterally compressed and more or less elliptic in transverse section (*Fig. 2*). The young leaf-blades are rolled in the bud, their margins only overlapping for a short distance.

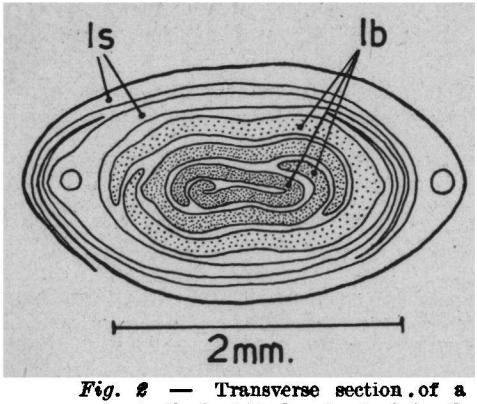

Fig. 2 — Transverse section of a young shoot. lb. leaf-blade; ls. leaf-sheath — (*Schweickerdt 1539*).

The Leaf-blade (*Figs. 3, 4 & 5*): The anatomical characters of the blade are based upon observation of the stripped epidermis in surface view and upon transverse sections cut from the upper part of the lowest third of blades taken as near as possible the base of the plant or shoot arising from one of the stolons. The camera lucida drawings include a plan illustrating the general distribution of the tissues in transverse section as well as a detailed diagram of the portion of the blade including the midrib.

Blade thin, 0.16—0.24 mm thick, both surfaces flat or nearly so; keel inconspicuous and rounded. *Epidermis* with groups of 5 (more rarely 7) motor cells (mc) between the vascular bundles, the central large, almost spherical or somewhat deeper than broad, occupying about one third to one half the thickness of the blade; stomata present on both surfaces of the blade, in two rows between the nerves; adjacent to the vascular bundles several files of short elements, the *silicified cells* (sc) possessing a characteristic shape and alternating with ripple-walled *suberized cells* (cc); asperities present adaxially, these consist of unicellular bulbous-based hairs alternating with the suberized cells; bulbous-based hairs present along the margin; clubshaped bicellular hairs (tr) arising in the vicinity of the stomata on both surfaces; papillae only present on the adaxial surface (motor cells).

Vascular bundles: usually 7—9 first order bundles; inner bundle-sheath lignified; outer bundle-sheath of 13—18 parenchyma cells densely filled with chloroplasts, more or less circular to broadly ovate, or horse-shoe-shaped (or occasionally in 2 lateral arcs interrupted ad- and abaxially by several parenchymatous colourless cells), joined ad- and abaxially to the stereome. Third order bundles 2—4, situated between those of the first order; bundle-sheath single (rarely double), consisting of 8—10 parenchyma cells densely filled with chloroplasts, more or less circular in outline and completely enveloping the bundle. *Midrib* composed of the midvein supported by a small adaxial and a well-developed abaxial strand of

stereome; midvein bundle separated by several colourless parenchyma cells from the stereome adaxially. *Margin* in transverse section obtuse, consisting of a large hypodermal strand of stereome. *Chlorenchyma* consisting

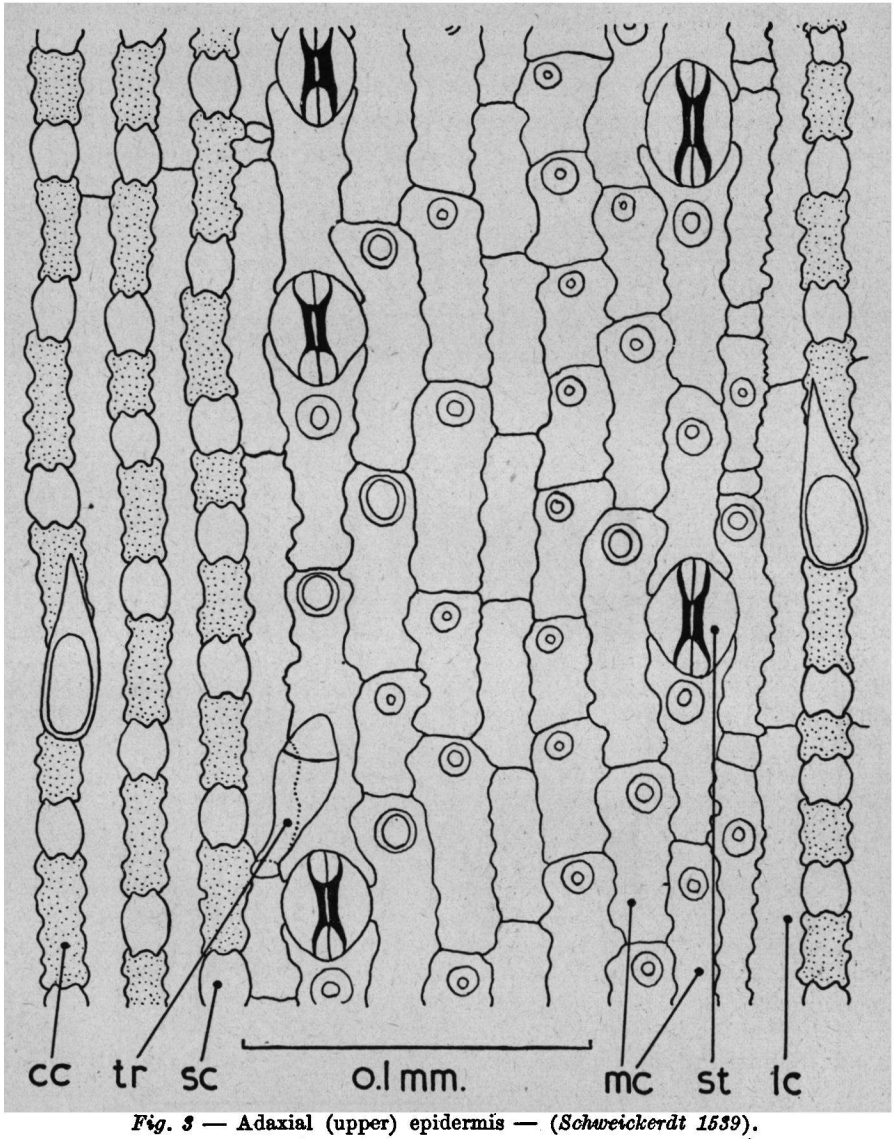

Fig. 3 — Adaxial (upper) epidermis — (*Schweickerdt 1539*).

of one row of radiating cells around the bundles and separated from that of the adjacent bundles by several larger cells containing fewer chloroplasts. *Stereome* well-developed, present in the keel above the midvein, adjacent to all vascular bundles in the lateral region of the blade, developed both ad- and abaxially, but always more strongly developed abaxially.

6. REMARKS AND DISCUSSION.

The present author has elsewhere (1) pointed out that Hackel's diagnosis (2) of both the genus and species of *Monelytrum* contains several errors undoubtedly due to inaccurate observation.

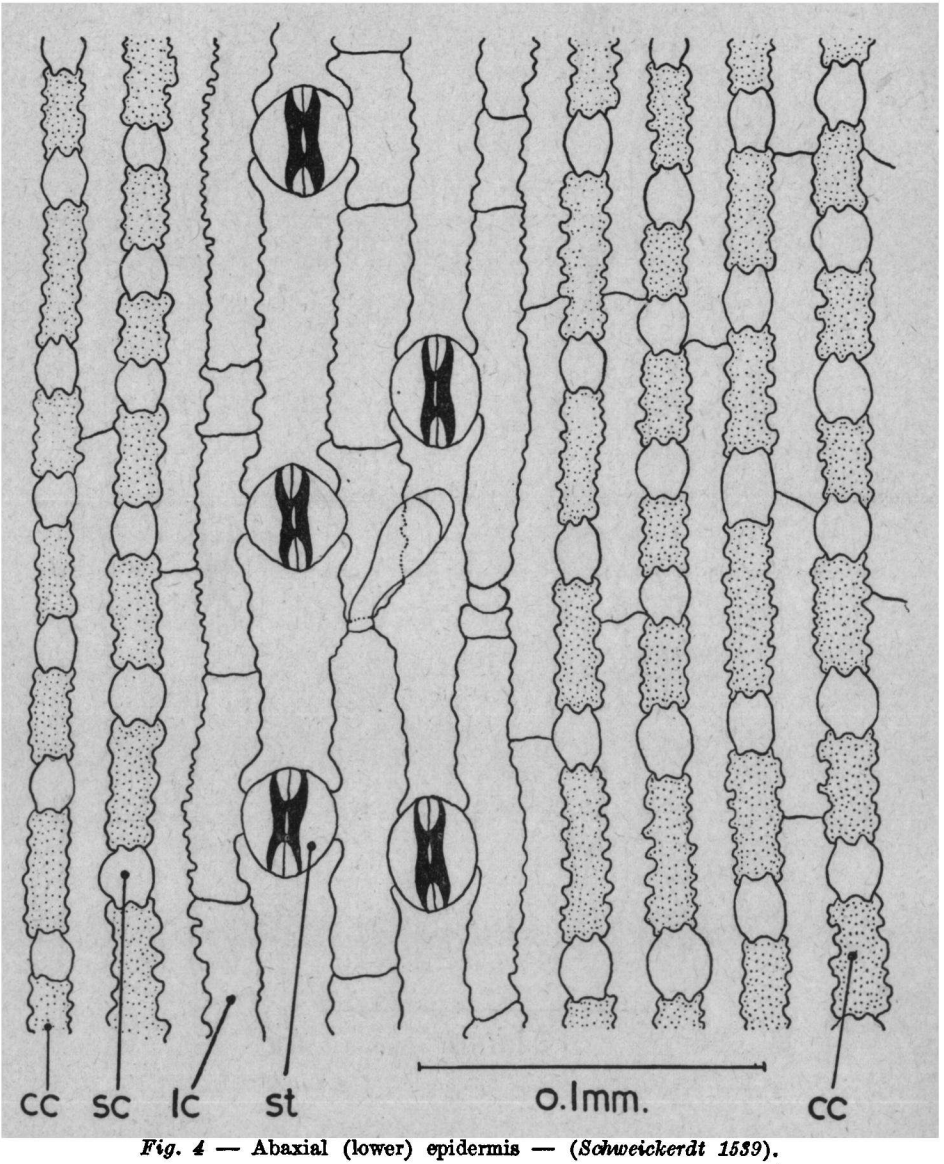

Fig. 4 — Abaxial (lower) epidermis — (*Schweickerdt 1539*).

The examination and study of additional dried as also living material cited in the present account, has confirmed former observations of the author of this paper, that all categories are represented in the spikelet

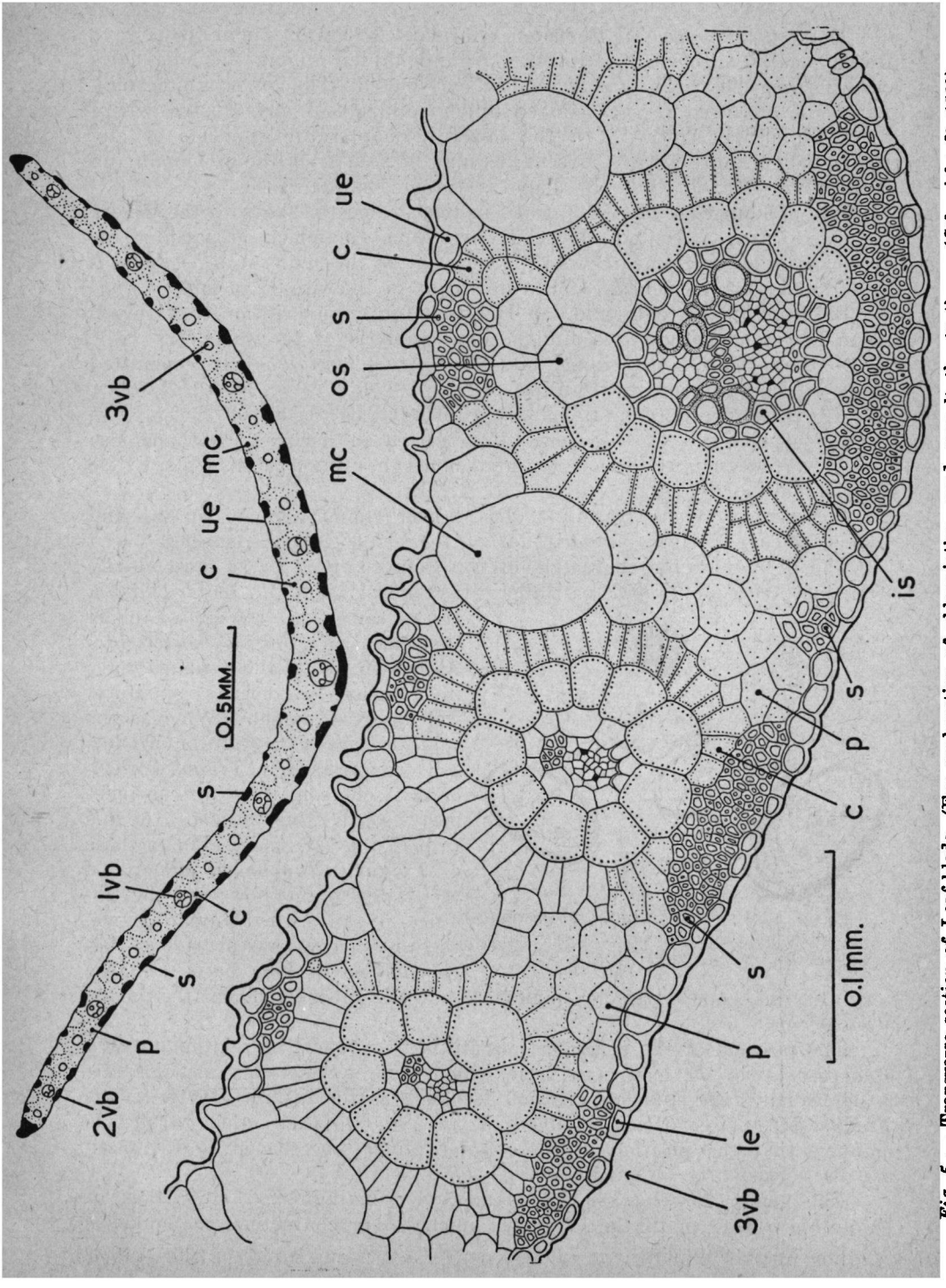

Fig. 5 — Transverse section of Leaf-blade. (For explanation of abbreviations used, consult the text) — (*Schweickerdt 1539*).

and that its structure is therefore normal. A lower glume is always present; as it is generally adpressed to and hidden among the long hairs arising from the rhachis, it is readily overlooked. The lower glume may readily be observed in the reduced upper spikelets of any cluster, where it is also clearly *adaxial*. In the lower hermaphrodite spikelets of any cluster lodicules are always present; as may be seen from the accompanying illustration (*Fig. 1, f*) their shape is rather characteristic.

Both Thonner (3) and Stapf (4) in their respective keys to the genera of grasses, have accepted Hackel's (erroneous) statement regarding the absence of a lower glume. Bews (5) in his key to the genus states "*glume I, with rough nerves, awned.*" This statement is likewise erroneous.

Phillips (6) not only adopted Hackel's faulty description, but in addition thereto has figured a faulty floral analysis of the spikelet.

Goossens (7) in describing his *Monelytrum annuum* has committed errors similar to those of Phillips.

All these misrepresentations are probably the result of the relative scarcity of material of the genus *Monelytrum* in herbaria; perhaps also due to a tendency to accept without much hesitation statements by so great an authority as for instance E. Hackel.

For these obvious reasons it has become imperative to amend and correct Hackel's original description of the genus and the species.

The organographic characters of this genus appear to be most closely related to those of *Tragus* v. Haller. In general habit *M. Lüderitzianum* Hack. somewhat resembles robust specimens of *Tragus koelerioides* Ascherson; both these plants have in common a densely spiciform well-exserted panicle. Whereas the spikelets are somewhat antero-dorsally compressed in *Tragus koelerioides* Ascherson, they are conspicuously so in *Monelytrum*. In this respect they are more akin to those of *Tragus pedunculatus* Pilger. In the latter plant however, the absence of an awned upper glume, the presence of a scaberulous rhachis devoid of long hairs, and the very lax and open panicle immediately distinguish if from the genus *Monelytrum*.

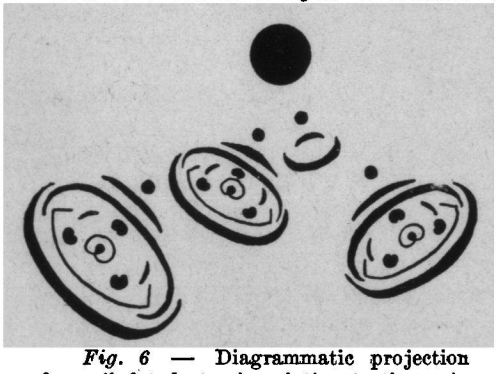

Fig. 6 — Diagrammatic projection of a spikelet-cluster in relation to the main axis of the inflorescence.

The position of the spikelets constituting a cluster, in relation to each other as also to the main axis from which these spikelet-clusters originate, is noteworthy: the spikelets are not decussate as for instance in the genus *Tragus*, but moreover are inclined at an angle to each other in such a manner, that the position of their lower glume in relation to the main axis is consistently obliquely adaxial (*Fig. 6*).

The genus *Monelytrum* may readily be distinguished from that of *Dignathia* Stapf; in the latter genus, among other characters, the spikelets are laterally compressed.

Kennedy (8) in his enumeration of several genera of the *Zoysieae* in connection with the presence or absence of an epiblast in the embryo, does not mention the genus *Monelytrum*. A vertical section of part of the caryopsis (*Fig. 1, j*) clearly shows the presence of a well-defined epiblast. In this connection, *Monelytrum* shows affinities towards the genera *Tragus* v. Haller and *Zoysia* Willd. The starch grains of the endosperm cells are subglobose and compound; they exhibit the normal blue reaction when treated with a solution of iodine in potassium iodide.

The anatomical structure of the leaf-blade (i. e. in cross-section and surface section) is so markedly similar to that found in the genus *Tragus* v. Haller (9), that it is practically impossible to draw a distinction between these two genera on basis of this character. The only point of difference appears to be the number of parenchyma cells composing the outer bundle-sheath of the first order bundles: in *Monelytrum* there are 13—18 such cells present, whereas the number in *Tragus* is usually 8—14. In these two genera the epidermal silicified cells of the leaf are likewise strikingly similar.

The author of the present paper is inclined to believe that the correct taxonomic position of *Monelytrum* is the following:

a) On basis of organographic and anatomical characters the genus is a typical member of the *Zoysieae*.

b) *Monelytrum* is both organographically and anatomically very closely related to the genus *Tragus* v. Haller. It may be distinguished from the latter genus by the oblique orientation of the spikelets constituting a spikelet cluster both in relation to each other and to the main axis of the inflorescence; furthermore by the upper glume which is produced into a well-defined awn.

After much deliberation the present author has come to the conclusion that the type specimen (*Drinkuth 11* in PRE) of *Monelytrum annuum* Goossens (7) does not exhibit the true facies of this species. The sheet represents an incompletely collected specimen i. e. one devoid of the typical horizontal stolon from which it was probably broken off during collecting. From the study and observation of living plants in which lateral shoots develop profusely at the nodes of the creeping stolons, the present author is inclined to believe that it were an easy matter to collect such lateral fertile shoots which in the detached condition would readily simulate an "annual" species. An analogous case was encountered in the perennial *Dactyloctenium australe* Steud. (10) where many herbarium specimens simulated an "annual species" because of the fact that the specimens had been incompletely collected.

The organographic differential diagnostic characters forwarded by Goossens (7) for the annual species do not hold good for the following reasons: — a) study of living material of *M. Lüderitzianum* raised from "seed" has shown that this perennial is capable of becoming quite a luscious leafy plant bearing leaves up to 50 cm long or even longer. — b) the size of the spikelets is somewhat variable in *M. Lüderitzianum*, so that the measurements of the various categories as supplied in the original diagnosis for *M. annuum* are not below those encountered in weak perennial specimens of *M. Lüderitzianum* examined by the present author.

With regard to the leaf anatomy no differences in structure could be ascertained between *M. Lüderitzianum* Hack. and *M. annuum* Goossens. Written communication from Prof. Dr O. Volk to the present author was to the effect, that in the course of his studies of the South-West African Gramineae in the field he has never encountered an annual specimen of *Monelytrum*. Summa summarum, the present author thus believes *M. Lüderitzianum* Hack. and *M. annuum* Goossens to be conspecific. *M. annuum* Goossens has therefore been placed in synonymy under *M. Lüderitzianum* Hack. Thus, according to our present state of knowledge, this interesting genus remains monotypic.

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