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Contributions to West Australian Botany.

By

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Part II.

Stray Notes from the Tropical West Australia.

By

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The flora of the tropical part of West Australia is — as mentioned in the Introduction (p. 3)[1] — not well known. While the flora and vegetation of the extra-tropical, south-western part have been investigated by many botanists, no professional botanist has explored that part of W. A. which lies north of the tropic of Capricorn.

Our main special sources for the knowledge of this flora are some plant lists published by the late F. v. Müller[2] on the material brought home by the late Sir John Forrest from his audacious exploration journeys. Of course, during such expeditions not much attention can be paid to botanical collecting, and it is really admirable how much Sir John Forrest did do in the way of securing herbarium specimens.

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[1] Ostenfeld, C. H.: Contributions to West Australian Botany. Part I. Dansk Botan. Arkiv, Bd. 2. No. 6. 1916.

[2] Müller, F. v.: Plants of North-Western Australia. Presented to the Legislative Council by His Excellency's Command. Perth 1881.
— The Plants indigenous around Sharks Bay and its vicinity. Ibid., 1883.

Besides these lists, many contributions to the flora are to be found scattered in BENTHAM's Flora Australiensis (1863—1878),[1] in F. v. MÜLLER's Fragmenta Phytographiae Australiae I—XII (1858—1882), and in his monographs. The "List of Extra-tropic West Australian Plants" published in the Western Australian Yearbook for 1900—01 (vol. I, Perth, 1902) is a revised and augmented edition by A. MORRISON of an earlier list compiled by F. v. MÜLLER. In spite of its title it contains — according to information in a footnote — also the names of plants "recently recorded from within the tropical line"; but being a mere enumeration of plant-names it does not contain any indication as to which part of W. A. a species has been found in, and it is therefore impossible to decide if it came from the tropical or the extra-tropical W. A. The list states only that it has been taken within the borders of the State of W. A.

In some recent contributions to the flora of Australia we find several records for the tropical W. A.: viz. in K. DOMIN's papers,[2] and in E. CHEEL's list of plants collected by the Swedish Zoologist Dr. E. MJÖBERG in W. A. and Queensland.[3] A paper by B. P. G. HOCHREUTINER[4] on his collections of plants from different parts of the world contains a few records from W. A. where he went on a flying visit in 1905.

Valuable contributions to our knowledge of the flora of the farthest north and north-east of W. A. are afforded by the different papers on the flora of the Northern Territory published recently from S. Australia by A. J. EWART and others.

Most of the records in the papers here given are the results of short and chance visits to the country; Dr. Mjöberg's collection, however, was made during a longer stay in the Kimberley district. It must be admitted that the collection is not large, and it is really a pity that this excellent explorer, who spent

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[1] In BENTHAM's Flora all the earlier records have been incorporated.

[2] DOMIN, K: Additions to the Flora of Western and North-Western Australia. — Journ. Linn. Soc. Botany, XLI, Dec. 1912.
— Beiträge zur Flora und Pflanzengeographie Australiens. I Teil. Bibliotheca Botanica, Heft 85, 1915.

[3] CHEEL, E.: Plants, in Results of Dr. E. Mjöberg, Swedish Scientific Expeditions to Australia 1910—13. Kgl. Svenska Vetensk. Akad. Handl. Bd. 52, No. 10. 1916.

[4] HOCHREUTINER, B. P. G.: Plantæ Hochreutineranæ, fasc. I. — Ann. du Conservatoire et du Jardin botan. de Genève, 15—16. Ann. 1911—1913. See also his paper: Un nouveau Baobab et revision du genre Adansonia. Ibid. 11—12. Ann., 1908.

nearly a year in the most interesting part of the tropical W. A. for zoological and ethnographical studies and travelled far into the interior, did not have a professional botanist with him. —

No doubt the botanical exploring of the tropical part of W. A. — often called "The Nor'west" — would be an interesting and paying object for a scientist who could afford to devote some time (perhaps a year) to it, and could stand the climate. My own flying visits at different places along the coast, made when the steamer stopped for taking in cargo, gave me the impression that a study of the vegetation would raise many interesting problems both with regard to flora, plant-geography and ecology.

It goes without saying that what I could do during such short time and only in the immediate surroundings of the regular stopping places for the steamer, was not much. Still I find it worth publishing, as we know so very little from this part of West Australia, and in the following I shall give some descriptions — I admit only very incomplete — of the vegetation of the coast region, and further enumerate the species collected.[1]

I visited this part of W. A. in the first days of November 1914 and called at the following places (north of the Capricorn): off Onslow (Nov. 1st), Point Samson, near Cossack (Nov. 2nd), Port Hedland (Nov. 3rd-4th), Broome (Nov. 5th) and Derby, King Sound (Nov. 6th-7th).

I. Some general Remarks on the Vegetation.

The tropical part of W. A. is a part of the immense plateau, of which nearly the whole western half of Australia consists.[2] But the surface is not as even or undulating as farther south. We find real mountain landscapes both towards North-west, where Mount Bruce, the highest point of W. A., rises to a height of 1226 m, and towards North (the Kimberley division), the highest point of which is Mount Hann (850 m). In both these regions the coast is more or less indented and provided with islands, and

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[1] It would have been interesting to compile a list of the flora of the tropical W. A., but from what is said above it seems evident that it is not possible to solve this matter, many of the records of the floras and lists being too indistinct as regards their geographical positions.

[2] Jutson, L. T.: An Outline of the Physiographical Geology (Physiography) of Western Australia. Geol. Surv. Bull. No. 61. Perth, 1914.

the mountains reach the coast in many places. In other places a low foreland is present, as is also the case in the intermediate district, especially "the Ninety Mile Beach" from Port Hedland to Broome. This foreland is sandy and covered by dunes; in bays and outlets of the rivers the mangrove sets in.

The climate[1] is tropical and dry. The average temperature for Broome (Lat. 18° S.) is 26° 6 C., the hottest months being December and January with an average of 29° 9 C., and the coldest June—July with 21° 7—21° 8 C. (see Fig. 2). But the maximum temperatures rise much higher, and their effects upon the vegetation must be very pronounced. We learn that a temperature of 49° C is not very rare in the interior, and 38° C not rare at the coast. Especially significant is the fact that periods of uninterrupted high temperature sometimes occur. E. g. the temperature did not sink under 37° 8 (100° F.) in 64 consecutive days in 1902 at Marble Bar, nor in 57 days in 1900 at Nullagine, two places in the interior of the north-western district. No doubt such prolonged heat spells must have a very disastrous result as regards the plant world, at least when not accompanied by rain.

And rain, the second important climatic factor, is scanty. The rainfall increases from the north-western corner towards north-east (see Fig. 1), but in no district does it reach such a degree that a rich tropical vegetation can thrive. The north-western district is in reality a desert, the average annual rainfall not reaching c. 500 mm (20 inches) in any place, while the best part, the northern Kimberley, has a rainfall between 750 and 1000 mm (30—40 inches); Broome, the best meteorological station, at the south western corner of Kimberley has 583 mm (22.96 inches). There is thus a considerable difference in this respect between the north-west and the Kimberley districts, and what makes this difference even more perceptible than the figures show, is the regularity of the rainfall in the Kimberley district and the irregularity in the north-western district. In the latter, the rainfall differs greatly from year to year. The rain here comes usually with the hurricanes, which sweep over the country during the summer, but are very capricious in their occurrence. During year-long periods hardly any rain falls, and then a hurricane brings

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[1] See: Hunt, H. A.: Climate of Australia, in Federal Handbook of Australia, prepared in connection with the 84th meeting of the British Association for the Advancement of Science held in Australia August 1914. Melbourne 1914. See also: W. A. Year-Book for 1900—1901, vol. I, Perth 1902, pp. 135—157.

in the course of a few days a downpour which exceeds the yearly average. Thus I was told in 1914 that Onslow had had practic-

Fig. 1. Rainfall Map of Western Australia showing isohyets (in inches). (From Yearbook of the Commonwealth of Australia, 1913, after Jutson, Geol. Surv. Bull. 61, 1914).

ally no rain during the past 4 years. On the other hand, a rainfall of 928 mm (29.41 inches) in 3 days is recorded, in 1898, for

Whim Creek, not far from Onslow. It is evident that such an instability as regards the rainfall makes it impossible for most plants to exist, and the vegetation must be very poor, only consisting of expressed xerophytes which can endure both drought and high temperature. It is therefore no wonder that this country is a desert, the only green places being the mangroves along the coast.

Much better conditions rule in the Kimberley district, although the rainfall there is not nearly sufficient for a tropical country. The main rain period is in summer (December-March), and very little rain falls during the rest of the year. The diagram (Fig. 2) for Broome of rainfall and temperature shows that both curves follow each other in the main. The rain makes the existence of a richer vegetation possible, while on the other hand, the exceedingly dry winters, with their comparatively high temperature, restrict the luxuriance of the vegetation, the result being — in the best places — a savannah forest, in less favourable places a savannah or steppe or even a desert.

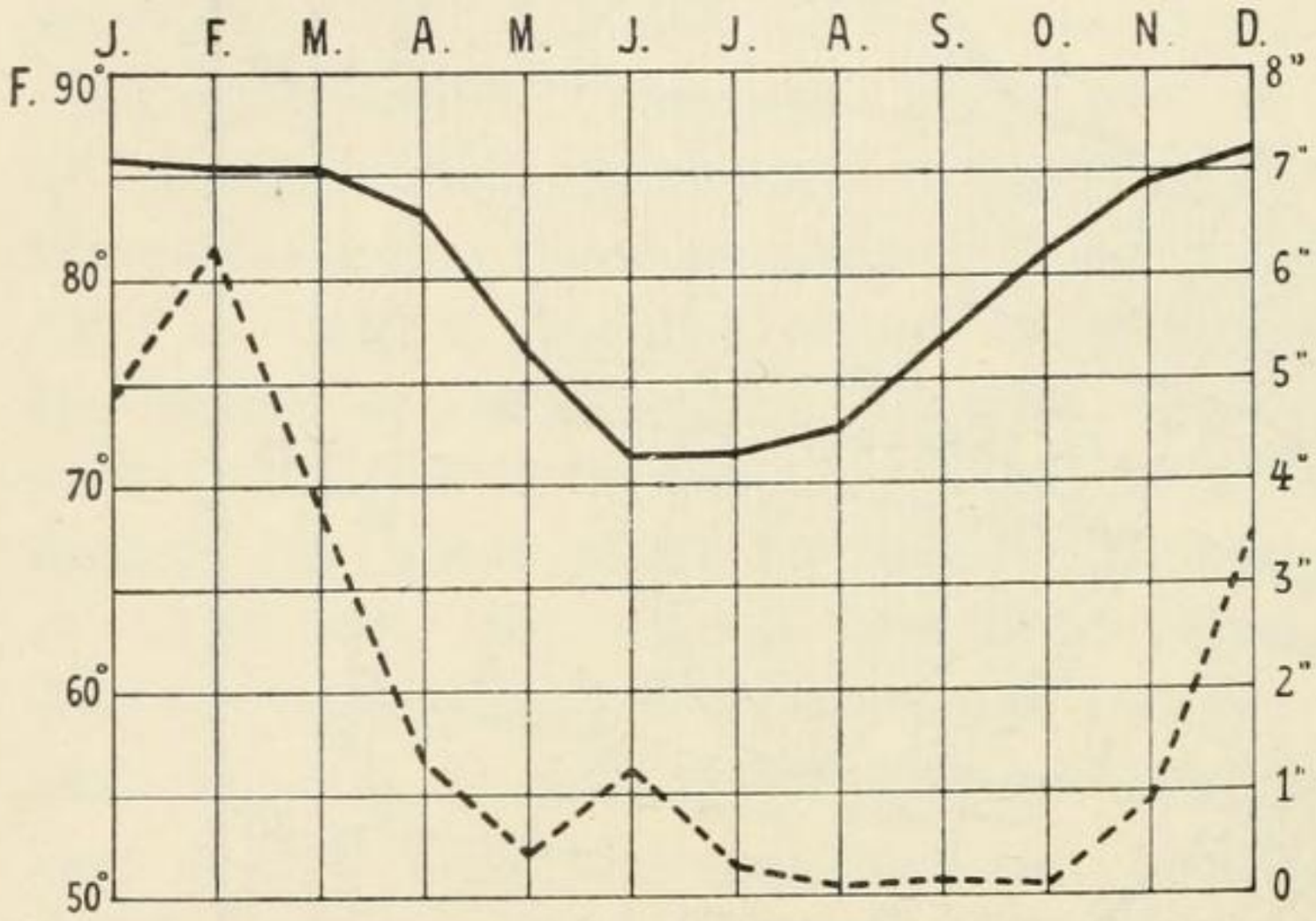

Fig. 2. Diagram, showing mean monthly temperature (the thick line) in degrees of Fahrenheit and mean monthly rainfall (the dotted line) in inches, at Broome.

I have premised these general remarks to make my few notes on the vegetation better understood. They concern only the vegetation of the coastal region, as my short visits at the different ports did not allow me time to travel farther in. The vegetation formations observed by me are the following:

1. The mangrove formation.
2. The sandy sea-shore formation.
3. The salt pan formation.
4. The sand dune formation.
5. The savannah forest.

1. The Mangrove Formation.

The West-Australian mangrove extends much farther south than the tropic of Capricorn. L. Diels[1] mentions it as far south as Bunbury (Lat. $33^1/_2$° S.), near the south western corner of the continent; but south of the tropic it is very monotonous, the Grey Mangrove (*Avicennia officinalis*) being its only wood-plant. This shrub, or small tree, is also the main component of the tropical mangrove of W. A., but it is not the only tree. At Point Samson (near Cossack) the low *Ceriops Candolleana* was common, and at Port Hedland the taller *Rhizophora mucronata* formed extensive growths along the inner part of the estuary, while *Avicennia* ruled at the outer part. At Derby, at the head of King Sound, where the large Fitzroy River has its outlet, the mangrove near the jetty had *Avicennia* as dominating species (Plate I, Fig. 1). But against its dull dark-green and grey foliage the bright and shining green of another low tree, which occurred only in scattered individuals, made a striking contrast. This was *Excoecaria agallocha* (var. *ovalis*), a plant widely distributed in the coast regions of the Old Worlds tropics.

In the higher lying parts of the mangrove at Derby a succulent undershrub formed a green cover under the shrubs; it was a form of *Suæda*. As it was without flowers and fruits, having shed the fertile branches, I could not refer it to its proper place, and am much indebted to Mr. J. H. Maiden for his help in this matter. He has named it *S. maritima*; but it differs greatly from the plant as I know it from the shores of Europe. Here, it is a perennial plant and its lower parts are woody. I think it ought to be taken as a species distinct from our European plant. This is also the opinion of dr. Ove Paulsen who has examined my *Chenopodiaceæ;* he names it *S. australis* (R. Br.) Moq.

The northern part of West Australia is known for its very pronounced tides. It is reported that the tide at Derby reaches to 10—15 meters and at Broome and Port Hedland not much less. The steamer arriving at high water off the head of a jetty, must remain there until next high water; and at low water time the water around it has quite disappeared, and it stands on the sea bottom supported by the logs of the jetty (see Fig. 3). Such a marked difference between high and low water makes a strange impression on the visitor. He sees at high water the mangroves growing in water which reaches the green foliage of their crowns,

[1] L. Diels: Die Pflanzenwelt von West-Australien südlich des Wendekreises. 1906, p. 207.

while at low water the trees stand with their trunks and bases exposed to the sun, and the sea bottom is laid bare for wide distances. In *Rhizophora* and *Ceriops* the arched aërial roots from the branches make, together with the stems, the whole scrub an inextricable confusion of grey stems, while as regards *Avicennia* the sea bottom is covered by its numerous small vertical asparagus-like aërial roots. The two photos (Plate I, Figs. 2—3) from Port Hedland were taken from just the same spot, with an interwal

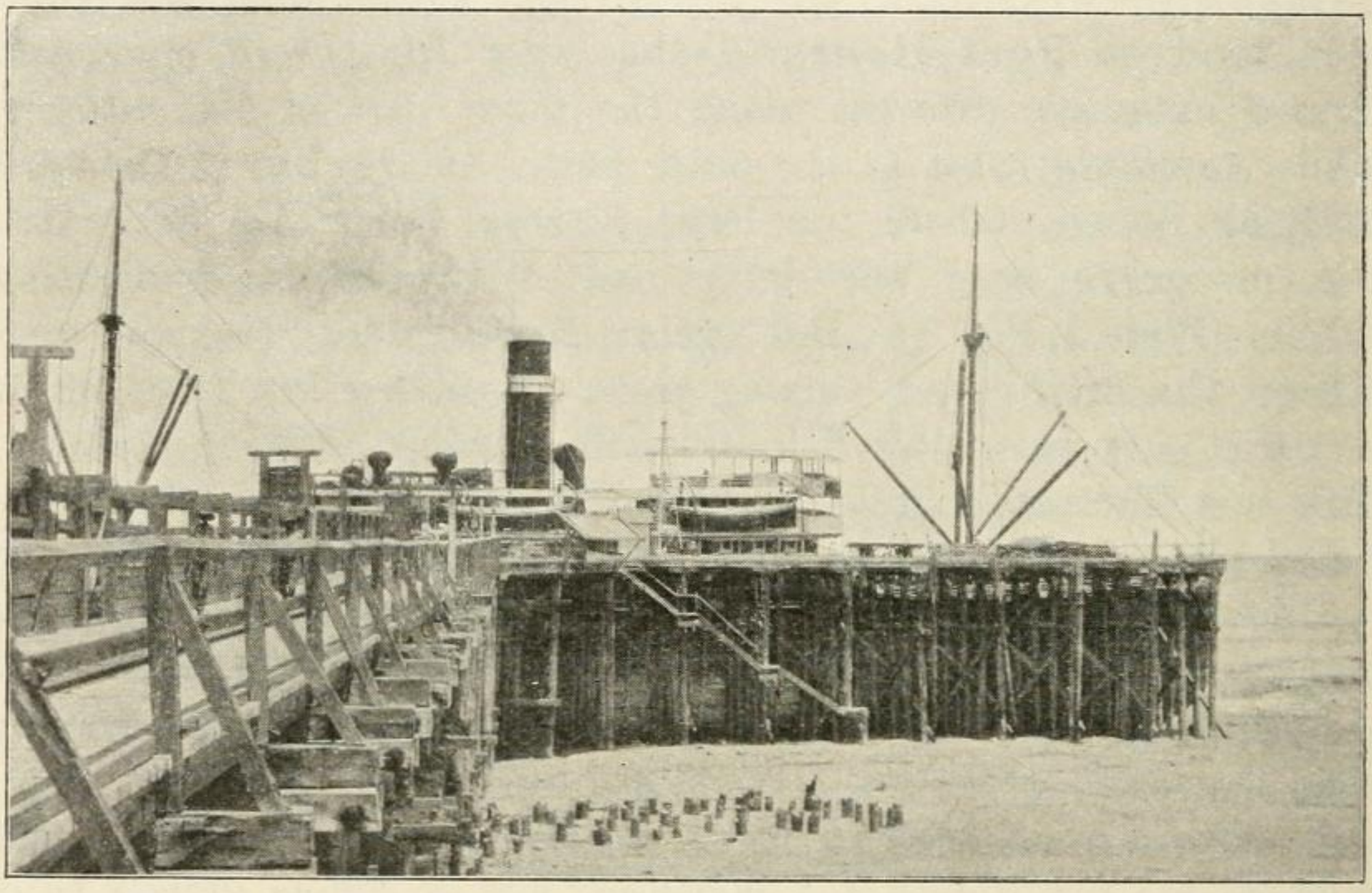

Fig. 3. The steamer at low water leaning against the logs of the jetty at Derby. The sea has retired farther out than the steamer which stands on the naked sea-bottom (Nov. 7. 1914). Photo. by C. H. O.

of 6 hours, and show low *Avicennia* at high water standing in water until the crown, and at low water growing on the dry sea-bottom. (In some depressions water was left by the retiring tide and gives the impression that the bottom is not quite deprived of water).

The tides run with great force (10—12 knots at some places) and only such well fastened plants as the mangrove trees are able to stand it; therefore we do not find much vegetation between their roots. Usually the soil is quite bare, hardly any sea-weeds and no sea-grasses[1] being found. It was an exception to find the green carpet of the *Suæda* mentioned above, and this was only near the high water mark, where, probably, not every high water

[1] Compare: The Sea-Grasses of W. A., in Contr. to W. A. Botany I, p. 7.

reaches it. The mangrove formation of W. A. is consequently rather poor; it does not make such a luxuriant impression as do the Malayan and the West-Indian mangroves. Still, this evergreen fringe bordering the coast and estuaries refreshes the eye in these regions, where the other vegetation is far more reduced owing to the dry and hot climate.

When lying at anchor off Onslow, I saw a low mangrove at the outlet of Ashburton River, and at Broome I observed a large mangrove. They seemed to be of the same type as the mangroves described above, and I think the mangroves along the whole coast of the tropical W. A. are much like each other.

2. The Sandy Sea-shore Formation.

Where the coast is sandy — and this is the case over large distances — a scanty vegetation of halophilous annual herbs occurs. I had not much opportunity to observe this formation, which passes over into the dune-formation or in places into the salt-pan formation. At Port Hedland I saw it at the coast near the township, where it covered the ground just above high-water mark. It was dominated by large specimens of *Salsola kali*, and amongst them some plants of *Ptilotus villosiflorus* and *Trianthema crystallinum*[1].

The poor plantgrowth along the jetty of Derby should perhaps be referred to this formation. The species observed there were: *Cressa cretica*, *Evolvulus alsinoides* (var. *sericeus*), *Neptunia monosperma*, *Trianthema crystallinum* and *Boerhaavia diffusa*.

3. The Salt-Pan Formation.

In depressions and low-lying sandy flats near the coast an open vegetation of halophilous succulent perennial herbs is to be found. This was well developed in depressions at Port Hedland between the town itself and its harbour (Plate II, Fig. 1). The dominating plants were cushion-forming Chenopodiaceæ: *Arthrocnemum leiostachyum*, *A. Benthami*, *A. arbuscula* and *Atriplex exilifolia*. The two first named formed coarse, flat cushions, while *A. arbuscula* was more slender, and its cushions more dome-like; *Atriplex* again, was a semi-globose low undershrub. Together with them grew *Heliotropium curassavicum* in half-buried large specimens, *Trianthema turgidifolium* with its nearly globose leaves and white flowers, *Frankenia ambita*, and a few plants of *Eragrostis Dielsii*.

[1] At Carnarvon, south of the Capricorn, *Salsola Kali* and *Ptilotus* (*villosiflorus*?) also occurred at the sandy sea-shore.

An analogous formation occurred at Point Samson just above the mangrove. The plants recorded from this locality were *Arthrocnemum leiostachyum*, *Frankenia ambita* and *Trianthema turgidifolium*.

I add a list of plants from a salt-pan formation at Carnarvon, south of the Capricorn, as its composition and appearance were very like what is said above. The lower zone consisted of a glaucous, long-branched *Salicornia australis* and the aphyllous *Limonium* (*Statice*) *salicorniaceum;* at the higher level, three dark-green *Arthrocnemum*-undershrubs (*A. arbuscula*, *A. brachystachyum* Pauls. and *A. pruinosum* Pauls.) were predominant; *Salicornia* had thrown off its ripe fruits, while the *Arthrocnemum*'s were with flowers and fruits. Other plants were the aphyllous *Samolus junceus*, *Frankenia pauciflora*, a grass and some small Chenopodiaceæ.

The enumerations given are all characterized by the succulent perennial herbs, many of which are aphyllous, and copious hairiness does not occur in any species.

To this formation rather than to the sand-dune formation I reckon two real shrubs, viz. the glaucous *Nitraria Schoberi*, which I saw at Carnarvon, and the bright-green *Myoporum acuminatum* (var. *angustifolium*) which grew both at Carnarvon and at Point Samson.

4. The Sand-Dune Formation.

The dunes nearest to the sea were covered by the large grass *Spinifex longifolius*, which was seen at all the places visited (except Derby, where I had no opportunity of seing sand-dunes). The big globular spiny inflorescences loosen at maturity from the straw, and are rolled by the wind over the bare sand; in sheltered places one finds them blown together in quantities. No doubt the wind acts as chief agent in the dispersal of this species.

At some little distance from the sea the dune plants become much more numerous. Amongst the different species of grasses I may mention *Triodia pungens* and others. Several annuals were also seen, but as the season was very unfavourable for these ephemeral plants, I am not able to give any information as to them. An interesting feature of the dune-formation is that the shrubs play a great rôle in its composition. At Point Samson the silver-felted *Scævola sericophylla* with small whitish flowers was common; at Port Hedland the characterising species was a low Wattle (*Acacia Wickhamii*), and at Broome other Wattles (*Acacia holosericea* and *A. binervosa*).

From Carnarvon we have a description of the dune-vegetation by DIELS (l. c., p. 292) which agrees well with what I saw (see Plate II, Fig. 2). The common shrubs were *Scholtzia leptantha*, *Acacia spodiosperma* (bright green), *A. coriacea* (silver-grey), *Atriplex rhagodioides*, *Rhagodia baccata*, *Brachycome latisquamea* and the more herbaceous *Pityrodia petiolaris*, and some species not in flower.

In contrast to the salt-pan plants, the dune plants show their xeromorphy in leathery and glossy leaves, in rolled leaves (the grasses), and in densely clothed (felty) leaves, not in succulent leaves nor in aphylly.

5. The Savannah Forest Formation.

During my short visits at the ports of the tropical W. A. I met only one non-halophilous plant-formation, viz. the savannah forest at Derby and (in poorer appearance) at Broome. At the latter place I saw only what was left of it inside the area covered by the township itself, and it was mixed up with introduced species.

The indigenous woody plants noted at Broome were *Gyrocarpus americanus* (var. *acuminatus*), *Bauhinia Cunninghamii*, *Carissa lanceolata*, *Eucalyptus clavigera* (var. *Dallachyana* ?), *E. dichromophloia* and the low shrub *Psoralea Martini*, while the few *Adansonia*'s (*A. Gregorii*) were said to have been planted. Amongst the foreign plants *Poinciana regia* was the most conspicuous, but in gardens (often artificially watered) grew *Nerium Oleander*, *Cocos sp.*, *Bambusa sp.*, *Vinca rosea* etc.

The savannah forest at Derby was more undisturbed by man, still it was not quite virgin. I saw it at a time of the year when the herbaceous undergrowth had quite disappeared owing to the drought. Had I come a few weeks later, when the rain had begun, I should also have been able to study the herbs and grasses. Now only some withered straw and leaves reminded one of the existence of an undergrowth which at times covers the fine red dusty soil. I was forced to content myself with observing the trees and shrubs alone.

More prominent than anything else was the big *Adansonia Gregorii* with its grotesque thick trunk, which has gained it the popular name of "The Gouty Stem" (Plate III, Fig. 2). In the first days of November the trees were mostly leafless, and ornamented only by masses of ripe fruits, but some had new leaves — at least on parts of their crowns — and had just begun flowering; the shedding of the leaves is thus not coincident in all

individuals, nor on all branches of one and the same individual. This *Adansonia* is the characterising tree of the savannah forest of the north-western Australia and gives it a resemblance to the African savannah forest, in which *Adansonia digitata* is the prominent feature.

Also from a plant-geographical point of view its existence is interesting, as the genus *Adansonia*, with this single exception, is confined to tropical Africa including Madagascar. On the African continent only *A. digitata* occurs, and it is an open question whether it owes its ocurrence there to the inhabitants (the negros etc.) or is really spontaneous; but in Madagascar the genus has several species besides *A. digitata.* This distribution suggests that the genus has had its real home in Madagascar or, better, on the sunken continent of which Madagascar is a remainder, and that it has from there outposts both towards east, where *A. Gregorii* arose in tropical North-Australia, and towards west, where *A. digitata* invaded tropical Africa.

Next to *Adansonia* the white-barked "Gums" (*Eucalyptus clavigera* var. *Dallachyana* and *E. pyrophora*) were common. *E. clavigera* var. *Dallachyana*, which was the commoner, had long pendulous outer branches which were moved by the wind. *Gyrocarpus americanus* (var. *acuminatus*) and *Bauhinia Cunninghamii* were also common. *Gyrocarpus* is a low tree with a soft wood and thick, light bark; its leaves are much like those of poplar, and it its a deciduous tree which had just got new leaves at the time of my visit. Its peculiar fruits, with the two long wings (see Fig. 5), resemble very much the fruits of the Dipterocarpaceæ. *Bauhinia* is a low tree with densely branching, dense dark-green foliage and large red-brown pods. Other trees were: *Ficus indecora*, *Santalum lanceolatum*, *Phyllanthus reticulatus* (var. *glaber*), *Atalaya hemiglauca*, *Careya australis*, *Hakea* sp., *Acacia* sp. The vine-like *Tinospora smilacina* was often seen climbing in the trees, and several *Loranthus*-species (see p. 14) infested the trees (noted on *Adansonia*, *Eucalyptus*, *Ficus* and *Hakea*).

The trees stand with open spaces between them, like the trees of a park (see Plate III, Fig. 1), and leave no shade. They do not reach to any considerable height. Some of them are evergreen (*Eucalyptus*, *Atalaya*, *Hakea*, *Bauhinia* etc.), others are deciduous (*Adansonia*, *Gyrocarpus*) and are leafless during the dry winter-time. The evergreen species have, of course, xerophytic leaves, but the xeromorphy consists mainly in leathery consistence, not in coverings of hairs nor in succulence.

II. List of the Species collected.

In the following list I enumerate all the species which I have collected during my short stays at the different places. This list is of course very incomplete, and does not in any respect pretend to give a full impression of the flora.

It was rather difficult for me to identify the plants, as the material at my disposal for comparison was very poor, and I was not able, under the present circumstances, to visit the large herbaria of Kew and London. Nevertheless I trust that the identifications will in most cases prove to be correct, and I think that the notes under many of the species may be useful for later workers on the flora of the tropical Western Australia.

I have arranged the natural families according to Engler's Syllabus der Pflanzenfamilien, 7. ed., 1912.

Gramineæ.

Eragrostis Dielsii Pilger, in Engl. Botan. Jahrb. 35 (1904) 76; Domin, Beitr. Fl. u. Pfl. Geogr. Austral. I. 2 (1915) 391; *E. falcata* Benth. Fl. Austr. VII (1878) 649, non Gaudichaud.

Port Hedland, in dune depression near the coast (No. 1140, 3. Nov. 1914).

The specimens collected seem to agree rather well with the var. *sciurus* Domin (l. c., 392), but I have no authentic specimen for comparison.

Triodia sp., *T. pungenti* R. Br. affinis.

Point Samson (Cossack), the characterising grass on a sandy dune-like area, growing together with *Scævola sericophylla.*

The specimens collected (No. 1139; 2. Nov. 1914) — and all specimens seen — were past flowering and fruiting, and the panicles contain mostly only empty outer glumes, rarely the lowermost flower, and in no case a whole spikelet. The identification is therefore only approximative.

Spinifex longifolius R. Br., Prodr. Fl. Nov. Holl. (1810) 198; Benth. Fl. Austr. VII (1873) 504.

Point Samson (near Cossack) and Port Hedland, common on the dunes near the shore.

Moraceæ.

Ficus indecora Miquel in Hook. Lond. Journ. VII (1848) 426; *F. orbicularis* Benth. Fl. Austr. VI (1873) 175, ex parte.

Derby, a shrub or small tree with deciduous leaves (Nos. 1176 and 1177, 7. Nov. 1914, hardly yet in full leaf).

The small-leaved *Ficus* which I have collected at Derby (in two slightly different forms), belongs to the collective species *F. orbicularis* A. Cunn., as limited by BENTHAM (l. c.). But as far as the descriptions go, my specimens agree better with *F. indecora* Miq., than (1) with *F. orbicularis* in the original narrower sense (as given by MIQUEL, l. c.), or (2) with *F. Beckleri* Miq. (Journ. Bot. Neerl. 1861, 241), and as the reasons for uniting these three species into one are not quite convincing, I prefer to use Miquel's name.

Santalaceæ.

Santalum lanceolatum R. Br. Prodr. Fl. Nov. Holl. (1810) 356; Bentham, Fl. Austr. VI (1873) 214; W. V. Fitzgerald, in Journ. Muell. Bot. Soc. II (1903) 66.

Derby, in the savannah forest (No. 1180, 7. Nov. 1914). A small tree with flexible and pendulous young branches and glaucous leaves.

Loranthaceæ.

As I was not quite sure that my determinations of the *Loranthaceæ* were correct, I sent specimens of the different numbers to Professor A. ENGLER of Berlin, the well-known authority on this family. He was so kind as to undertake a revision of my identifications, which appeared to agree wholly with his views, and I use this opportunity to thank him for his kind assistance.

Elythranthe Exocarpi (Behr) Engler, in Nachträge zu Engler u. Prantl, Natürl. Pflanzenfam. (1897) 126; *Loranthus Exocarpi* Behr, Linnæa XX (1848) 624; Bentham, Fl. Austr. III (1866) 392.

Broome, common on *Acacia binervosa* (No. 1160, 5. Nov. 1914), in full flower, and with some ripe fruits.

Loranthus acacioides A. Cunn., in Benth. Fl. Austr. III (1866) 392.

Derby, common on *Adansonia Gregorii* (No. 1183, 7. Nov. 1914), all specimens in flower. It does not grow on Acacia, as might be thought from the name, which, however, relates to the likeness of the plant to an Acacia.

Loranthus bifurcatus Benth., Fl. Austr. III (1866) 393.

Derby, common on *Eucalyptus clavigera* var. (No. 1181, 7. Nov. 1914); a very characteristic species, with young (unripe) fruits.

Loranthus quandang Lindl. in Mitch. Three Exped. II, 69; quoted from Bentham, Fl. Austr. III (1866) 395.

Derby, specimens with young buds only (No. 1182, 7. Nov. 1914). The host plant was not noted. The specimens have unusually broad and short leaves (broadly elliptic).

Chenopodiaceæ.

Dr. Ove Paulsen is publishing a separate paper on my *Chenopodiaceæ* from West Australia, see p. 56.

Amarantaceæ.

Ptilotus villosiflorus F. v. Müll., Fragm. Phytogr. Austr. III (1863) 125; Benth. Fl. Austr. V (1870) 245; E. Cheel, in K. Sv. Vet. Akad. Handl. 52, No. 10 (1916) 7.

Port Hedland, near the shore (3. Nov. 1914).

Both at Port Hedland and, south of the Tropic of Capricorn, at Carnarvon and Geraldton a small *Ptilotus* was common in the dune depressions near the shore. It agrees well with the above quoted species which E. Cheel (l. c.) records from Port Hedland. But I think that the *Ptilotus* species of the warmer parts of Australia require a thorough revision.

Gomphrena pusilla Benth. Fl. Austr. V (1870) 256.

Nullagine Distr. (I. T. Tunney, June 1901, ex herb. Mus. Perth).

From the botanical collection of the Museum at Perth I obtained — amongst several herbarium sheets from the southwestern part of W. A. — an undetermined *Gomphrena* ("*Ptilotus*"), which I refer to *G. pusilla* Benth., a species which comes near to *G. Maitlandi* F. v. Müller.

Nyctaginaceæ.

Boerhaavia diffusa L., Fl. Zeylan. (1747) 4; Benth., Fl. Austr. V (1870) 277, ex parte.

Derby, on the jetty, a prostrate white-flowered weed (No. 1170, 7. Nov. 1914).

The specimens collected agree well with specimens in our herbarium in Copenhagen named *B. diffusa* L. by Heimerl, the authority on *Nyctaginaceæ*. They differ in some points (of minor importance ?) from specimens named *B. procumbens* Roxb. More widely different (e. g. by the much longer pedicels) is *B. mutabilis* R. Br., if Preiss's No. 2389 from Swan River is to be taken as typical for that species.

Aizoaceæ.

Trianthema crystallinum Vahl, Symbol. I (1790) 32 et in D. C. Prodr. III, 352; Benth. Fl. Austr. III (1866) 330.

Of this variable species (or aggregate of species) a form with long, linear, semiterete leaves was found along the jetty at Derby (No. 1173, 7. Nov. 1914). Another form was collected in a dune depression at Port Hedland (No. 1152, 3. Nov. 1914); it has oblong-linear succulent leaves. (Both determined by Dr. O. Paulsen).

Trianthema turgidifolium F. v. Müll., Fragm. Phytogr. Austr. X (1876) 83.

This interesting succulent species was well described by F. v. Müller (l. c.) upon specimens collected "in plagis sinum Nichol's Bay versus" by M. Crouch. From the same area, Point Samson (near Cossack) I have brought home specimens (No. 1153, 2. Nov. 1914) which agree well with Müller's description.[1] The leaves are very succulent, globose-clavate, downwards attenuated into a short petiole (see Fig. 4). The flower is whitish, sepals long-triangular, acute, stamens 10 with red-brown anthers, ovary nearly globose with one somewhat excentric filiform style; the membranous capsule contains several seeds (somewhat more than "circiter 5", as F. v. Müller says).

Fig. 4. *Trianthema turgidifolium* F.v. Müller. A branch with flowers.(Nat.size).

The species has, as pointed out by F. v. Müller, a striking resemblance to small-leaved succulent forms of *Sesuvium portulacastrum*, and I must admit that I think the two genera ought to be united, or *Trianthema* split up into several genera; the present delimitation at least is very artificial and unsatisfactory.

T. turgidifolium was found inside the mangrove in a salt-pan together with Frankeniæ and Salicorniæ.

In F. v. Müller's 2nd Census (p. 52) the species is given for S. A., Q. and N. A., not for W. A., but there must be some mistake here (printer's error ?) as Nichols Bay is in W. A., and it is doubtful if the species has been recorded from other states.

Menispermaceæ.

Tinospora smilacina Benth., Journ. Linn. Soc. V, Suppl. II (1861) 2; Fl. Austr. I (1863) 55; Diels, Menisperm. in Das Pflanzenreich IV (1910) 136.

[1] I have also noted it from Port Hedland.

Derby, in the savannah forest (No. 1179, 7. Nov. 1914). A coarse climber found climbing in *Bauhinia Cunninghamii* and many other trees. The ripe drupes are orange-red.

Hernandiaceæ.

Gyrocarpus americanus Jacq., Select. Amer. (1763) 282, tab. 178 fig. 80, emend.; F. v. Müller, Sec. Cens. Austr. Pl. (1889) 87; *G. Jaquinii* Roxb. Corom. I (1795) 2, tab. 1; Benth. Fl. Austr. II (1864) 505; W. V. Fitzgerald, in Journ. Müll. Bot. Soc. III (1903) 24, et aliis; *G. acuminatus* Meissner in D. C. Prodr. XVI (1864) 248.

Broome, a rather low tree with light-coloured bark and light wood (No. 1161, 5. Nov. 1914).

Derby, a rather low tree with light-coloured bark and soft wood, in full flower and with ripe fruits (see Fig. 5) and even fully developed new leaves (No. 1174, 7. Nov. 1914).

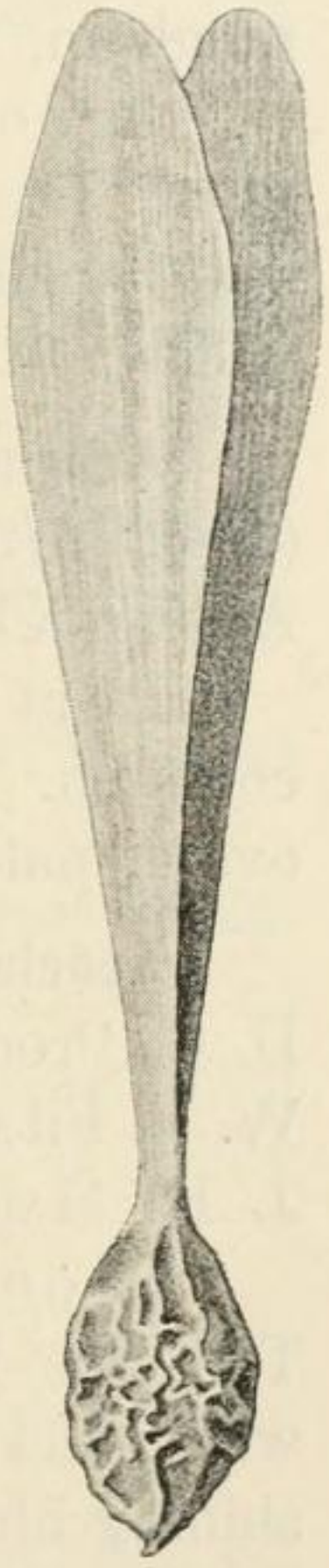

Fig. 5. *Gyrocarpus americanus* Jacq. A ripe fruit from Derby. (Nat. size).

The monotypic *Gyrocarpus* is usually called *G. Jacquinii* Roxb. which name was created to include all the hitherto described forms, as it was suggested that they all belonged to one species; but as the name *G. americanus* Jacq. is the oldest, it must be preferred to all the others, as correctly done by F. v. Müller (Sec. Census., 87).

The specimens collected both at Broome and at Derby agree in the nearly glabrous leaves, which are entire, broadly cordate and distinctly acuminate. If we choose to divide the species into subspecies, they may be named subsp. *acuminatus* Meissn. (l. c.); they seem to differ considerably from the two Australian forms described by R. Brown (Prodrom. Fl. Nov. Holl. 405) the leaves of which are tomentose, at least on the underside.

In E. Cheel's paper (Plants, in Results of Dr. E. Mjöberg's Swedish sc. Expeditions to Australia 1910—13, K. Svenska Vet. Akad. Handl. Bd. 52, No. 10, 1916, pl. I, figs. 3—4) two photos from the Kimberley region, taken by Dr. Mjöberg, illustrate *Gyrocarpus*, the so-called "cork-tree" (on account of the spongy bark), in leafless and leafy stage; they give a very good impression of its general habit.

Capparidaceæ.

Cleome tetrandra Banks, in D. C. Prodr. I (1824) 240; Bentham, Fl. Austr. I (1863) 90.

Port Hedland, in flower (flowers yellow) and with young fruits (No. 1141, 3. Nov. 1914).

Leguminosæ.

Acacia holosericea A. Cunningh, in G. Don. Gen. Syst. II (1832) 407; Bentham, Fl. Austr. II (1864) 411; *A. neurocarpa* A. Cunningham, in Hook. Icon. pl., tab. 168.

Broome (No. 1135, 5. Nov. 1914), a tall shrub, very common. The numerous spirally twisted pods are brown; seeds obovate, somewhat flattened, shining black; funicle folded, orange-yellow.

Acacia Wickhamii Benth., in Hooker, London Journ. Bot. I (1842) 379; Fl. Austr. II (1864) 392; F. v. Müller, Iconogr. Austr. Acacia XI, tab. 6.

Port Hedland (No. 1134, 3. Nov. 1914), a low shrub, very common. The ripe pods are light-brownish, veined, straight; seeds ovate, pale brownish; funicle pale.

Acacia binervosa D. C., Mem. Legum. XII 448 (1825); *A. bivenosa* D. C. Prodrom. II (1825) 452; Bentham Fl. Austr. II (1864) 380; W. V. Fitzgerald, in Journ. Müll. Bot. Soc. II (1903) 18. (Determ. J. H. Maiden).

Broome (No. 1133, 5. Nov. 1914), a medium sized shrub. The ripe pods are light brown, moniliform, but flattened and with thickened margins; seeds somewhat flattened, broadly ovate, shining black; funicle orange-red, much folded.

Neptunia monosperma F. v. Müll., in Bentham, Fl. Austr. II (1864) 300.

Derby: on the jetty (No. 1172, 7. Nov. 1914). A decumbent herbaceous plant with pale inconspicuous flowers aud orbicular coin-like pods.

Bauhinia Cunninghamii Benth., Fl. Austr. II (1864) 295; W. V. Fitzgerald in Journ. Müll. Bot. Soc. II (1903) 14; *B. Leichhardtii* F. v. Müll., Transact. Victorian Inst. III (1858) 50; Sec. Census, Austr. Pl. (1889) 73; *Phanera Cunninghamii* Bentham, in Miquel, Pl. Junghun. I (1851) 264.

Broome (No. 1157, 5. Nov. 1914) and Derby (No. 1178, 7. Nov. 1914); in both places with ripe pods. A rather low tree

with clustered branches and dense foliage, which give it a singular appearance. A good photo of its habit was taken by Dr. E. Mjöberg and published by E. Cheel (K. Svenska Vet. Akad. Handl., Bd. 52, No. 10, 1916, pl. I, fig. 2).

It was common in the savannah forest at Derby and often infested by the climber *Tinospora smilacina*. The somewhat curved and flat brownish pods contain 2—7 seeds. The seeds are flat, oblique-ovate, dull chestnut-brown, 13—16 mm long and 10—12 mm broad.

Crotalaria Cunninghamii R. Br., in App. Sturt Exped. (1849) 8; Bentham, Fl. Austr. II (1864) 182; Hooker, Icon. pl., tab. 829.

The well-known "Bird-flower" of the inhabitants (from the likeness of the flower to a bird) was found in full flower and, on the same individuals, with ripe fruits at Port Hedland (No. 1147, 3. Nov. 1914). It is a shrub or undershrub of medium size.

Crotalaria trifoliastrum Willd. Sp. pl. III (1800) 983; Bentham, Fl. Austr. II (1864) 183; *C. medicaginea* F. v. Müller, Fragm. phytogr. Austr. III (1862) 56, ex parte; vix Lamarck.

Broome (No. 1159, 5. Nov. 1914), in flower and fruit; an erect herb or undershrub.

I agree with Bentham (l. c.) in keeping *C. trifoliastrum* Willd. apart from *C. medicaginea* Lam., with which F. v. Müller (l. c.) has united it. My specimens are much like Indian *C. trifoliastrum* and very different from Indian *C. medicaginea*, which is a decumbent (prostrate) herb with smaller flowers, etc.

Psoralea Martinii F. v. Müll., Fragm. Phytogr. Austr. V (1865) 11.

Broome (No. 1162, 5. Nov. 1914), in flower and with fruit; an erect shrub or undershrub.

F. v. Müller (l. c.) described this very characteristic species from a single specimen without ripe fruits. As I have had good material at hand and have grown the species in the Botanical Garden of Copenhagen from seeds taken at Broome, I am able to give an additional description of the flowers and fruits:

Planta suffruticosa, undique albo-tomentosa, præsertim in pedicellis et calycibus; floribus 3—6, umbellatis. Calycis lacinii inæquales, infimo distincte longiore; corolla parva lilacina, glabra; petalum supremum ovato-rotundatum, emarginatum, breviter unguiculatum, parte centrali lilacina (CC.[1] 511—506), partibus peripericis atque superficie tota externa pallide lilacinis (CC. 0496);

[1] CC = Klincksieck et Valette, Code des Couleurs, Paris 1908.

petala lateralia et inferiora in supremis partibus lilacina (CC. 511—506), spathulata, unguiculata. Filamenta staminorum glabra, antheræ parvæ, ovato-cordatæ. Stylus curvatus, filiformis, glaber; germen parce pilosum præsertim apicem versus. Legumen maturum parvum calyce duplo vel ultra brevius, oblique-ovoideum, ca. 4 mm longum, atrofuscum, tomento albo præsertim apicem versus præditum. Ceterum ut in descriptionem a F. Muellero datam.

The species was first found near Glenelg's River, Kimberley (ca. 124°30′ Long. E, 15°50′ Lat. S.) and now at Broome somewhat farther southwards.

Zygophyllaceæ.

Tribulus cistoides L. Sp. pl. (1753) 387; Bentham, Fl. Austr. I (1863) 288.

Port Hedland (No. 1155, 3. Nov. 1914). A decumbent yellow-flowered herb.

As I have no access to the description of *T. Forrestii* F. v. Müll. (in Wing's S. Sc. Rec. Nov. 1885), and as my only specimen has no fruit, I have given it under the old collective name *T. cistoides* L.

Euphorbiaceæ.

Excoecaria agallocha L. Sp. pl. ed. 2 (1763) 1451; Benth. Fl. Austr. VI (1873) 152; F. Pax, Euphorbiaceæ-Hippomaneæ, in Das Pflanzenreich (1912) 165.

Derby, a small tree in the mangrove (No. 1164, 7. Nov. 1914).

Amongst the *Avicennia's* which make up the main part of the mangrove at Derby near the jetty, single specimens of a small tree with dark green and shining leaves occurred. As I only could get specimens without any flower and fruit, I was not able to refer the plant to its proper place. But at my request, Professor V. A. Poulsen of Copenhagen examined the structure of the leaves and suggested that it might be a species of *Excoecaria*, owing to its extrafloral glands at the base of the leaf-blade and to the milk vessels. This led me to identify it as a variety of *E. agallocha* answering well to the var. **ovalis** (Endl.) Müll. Arg. (D. C. Prodr. XV. 2 (1866) 1221), according to the description of this given by Pax (l. c.): Folia suborbicularia vel orbiculari-obovata, apice rotundato-obtusa.

This variety — as well as the main species — are both known

from North Australia and Queensland. Whether the variety is or is not really an independent species is another question.

Phyllanthus reticulatus Poir., var. **glaber** Müll. Arg. in D. C. Prodr. XV. 2 (1866); Benth. Fl. Austr. VI (1873) 101.

Derby, a shrub with flowers and unripe fruits (No. 1165, 7. Nov. 1914).

The distinctions given by BENTHAM (l. c.) between the glabrous variety of *P. reticulatus* Poir. and *P. baccatus* F. v. Müll. are not very sharp, and my specimens agree in some respects with the latter species. But as the flowers — both male and female — have short filiform pedicels longer than the perianth, and as the filaments of the stamens are more or less united, I prefer to place my specimens under the widely distributed *P. reticulatus*, of which, no doubt, several geographical races will be distinguished in future.

Sapindaceæ.

Atalaya hemiglauca F. v. Müll., in Benth., Fl. Austr. I (1863) 463; W. V. Fitzgerald, in Journ. Müll. Bot. Soc. II (1903) 12. (Determ. J. H. MAIDEN).

Derby, in the savannah forest (No. 1166, 7. Nov. 1914). A small tree without flowers.

Tiliaceæ.

Corchorus Walcottii F. v. Müll., Fragm. Phytogr. Austr. III (1862) 9; Bentham, Fl. Austr. I (1863) 278.

Port Hedland (No. 1151, 3. Nov. 1914). A small densely tomentose undershrub, in full flower.

Malvaceæ.

Abutilon flavum sp. nov. (Fig. 6).

Herba basi sublignosa, undique dense stellato-tomentosa; caulis ramosus pedalis et ultra, insuper — atque petioli pedunculique — pilis simplicibus patentibus instructus; stipulæ parvæ lineares, mox deciduæ; petioli 2.5—3 cm longi; foliorum laminæ ovato-cordatæ, acutæ, 3—4 cm longæ, 2—4 cm latæ, marginibus regulariter crenato-serratis, supra dense stellato-tomentosæ, subtus dense albo-stellato-velutinæ nervis prominentibus, sine pilis longioribus (marginibus exceptis). Flores racemosi, foliis parvis instructi (ut in *A. aurito*); pedunculi 2—2.5 cm longi, in parte superiori articulati; calyx 0.7—0.8 cm longus, 5-lobatus lobis obovato-

triangularibus acutis; petala 2—2.5 cm longa, flava; stamina flava; fructus calyce dimidio vel subduplo longior, truncatus, 1.0—1.2 cm longus; carpellæ 10, dense stellato-tomentosæ, apice contractæ, rostro brevi divergenti instructæ; semina ca. 3 in carpella, subreniformia, brunneo-purpurea, ca. 2 mm in diametro.

Hab. Austr. occid. trop. ad Derby, W. Kimberley.

Ab *A. aurito* (Wall.) Don præcipue differt: calyx, carpellæ et folia dense stellato-tomentosa sine pilis simplicibus longioribus; corolla calycem triplo superans; carpellæ 10, calyce subduplo longiores rostro brevi divergente instructæ; ab *A. indico* (L.) Sweet: inflorescentia racemosa, foliis parvis instructa; caulis, petioli pedunculique præter tomentum pilis longioribus simplicibus; foliorum margines dense et regulariter crenato-serrati; carpellæ ut supra descriptæ.

Fig. 6. *Abutilon flavum* nov. sp. Part of a branch with a nearly ripe fruit. (Nat. size).

Near the jetty at Derby I found a yellow-flowered *Abutilon* (No. 1171, 7. Nov. 1914) which does not agree with any species described, as far as I know. It comes nearest to *A. indicum* (L.) Sweet (sens. lat., incl. var. *australiense* Hochr.) and *A. auritum* (Wall.) Don, but the above given description and the differences pointed out will show that it is quite distinct. Also from the Australian *A. longilobum* F. v. Müll., *A. otocarpum* F. v. Müll. (with its var. *broomensis* Hochr. from Broome) and *A. oxycarpum* F. v. Müll. it seems well separated, as far as can be judged from descriptions without access to any authentical specimens.

Bombacaceæ.

Adansonia Gregorii F. v. Müll., in Hooker, Kew misc. IX (1857) 14; Benth. Fl. Austr. I (1863) 223; W. V. Fitzgerald, in Journ. Müll. Bot. Soc. III (1903) 5; *A. Stanburyana* Hochreutiner. in Ann. Conserv. et Jard. botan. de Genève, 11—12 Ann. (1908) 136, pl. I—II.

Broome, a few trees seen (5. Nov. 1914).

Derby, common in the savannah forest, with ripe fruits and some trees with newly out-folded leaves and in flower (No. 1175, 7. Nov. 1914). The flowers were white with a cream-coloured tinge.

There is considerable variability in the characters of this plant. This has induced B. P. G. Hochreutiner (l. c.) to create a new species upon a specimen which grows at Broome near the

police station. The distinguishing marks of his *A. Stanburyana* are given as: leaflets generally 5—6 in number, about 16 cm long, glabrous (while in *A. Gregorii:* 7—9, not exceeding 13 cm, and white-tomentose underneath), and calyx glabrous outside (in *A. Gr.* tomentose); and the tree is not so thick and clumsy as is the case with *A. Gregorii.*

I do not think that these marks suffice for a distinction between two species, as my material from Derby[1] shows that the degree of indumentum is rather variable. In my specimens, the young leaves are stellate-tomentose underneath, but the tomentum disappears when they are full-grown; further, the number of leaflets ranges from 5 to 9; the calyx is tomentose outside in the buds, glabrous in the fully developed flowers. As regards the trunk of the tree, its clumsiness augments with the age of the individual (see Pl. III, Figs. 1—2). For better information on the question I asked Professor A. J. Ewart of Melbourne about the material preserved in the Herbarium of Victoria (Müller's herbarium), and he has informed me as follows: "specimens named by Baron von Müller range from densely hairy to glabrous calyx (outside), hence *A. Stanburyana* of Hochreutiner might be classed a glabrous form or variety, but hardly as a species". This is just my opinion: We have only one species of *Adansonia*, viz. *A. Gregorii* F. v. Müll., in Australia; but as is the case in many other species, it varies much with regards to its indumentum, and the glabrous form may be named forma *Stanburyana* (Hochr.), but is of very small systematical value.

In one other respect the species varies considerably, viz. the shape of the fruits. I saw specimens with ovoid fruits (f. *typica;* see Fig. 7), some thicker and some more slender (12.5×7; 10.5×6; 10×5.5 cm), but I also met with specimens with completely globose fruits (6.5×6.7 cm): f. *globosa* (see Fig. 8); and what is more remarkable, all the fruits of each tree were of the same shape. This fact is known for many European trees or shrubs (e. g. *Quercus* and *Corylus*), and its existence in *A. Gregorii* corroborates Hochreutiner's suggestion (l. c. 142) that the *A. sphærocarpa* Chév. of Madagascar is only a form of *A. digitata* L. with globose fruit, as it agrees with the latter in all other respects.

The fruits of *A. Gregorii* are densely covered with a yellow-brown tomentum which, when rubbed, loosens and gives place to

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[1] I only saw, but did not collect the species at Broome, as it was said that the specimens were cultivated from seeds brought from Derby.

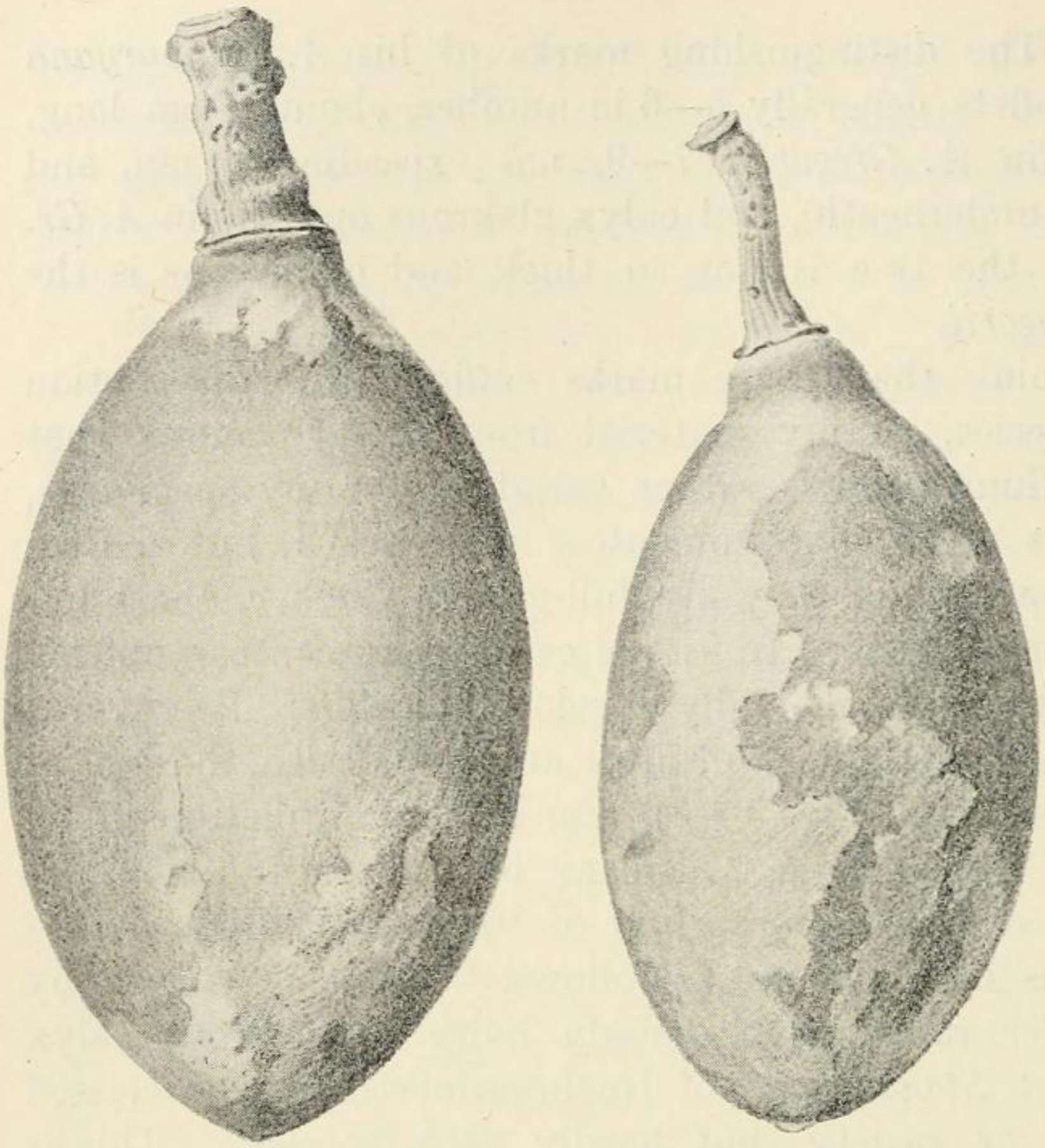

Fig. 7. Fruits of *Adansonia Gregorii* F. v. Müll. f. *typica*, from Derby. ($^3/_5$ nat. size).

the dark-brown, dull and finely granulary surface of the exocarp (see figs. 7—8). This is easily broken — in fact all the fruits blown down by the wind were broken — and the mealy cream-coloured pulp, in which the seeds are imbedded, drops out, — at Derby to be eaten by the goats.

In CHEEL's paper (l. c., Pl. 2, Figs. 1 and 3) two of Dr. MJÖBERG's photos of the species are reproduced, showing a rather tall (Fig. 1) and a very low (Fig. 3) and "gouty" stem.

Frankeniaceæ.

Frankenia ambita sp. nov. (Fig. 9).

Fruticulus decumbens ramosissimus, caulibus sparse (præcipue sub nodis) setuloso-puberulis, internodiis foliis æquilongis vel plerumque multo longioribus. Folia brevia (3—6 mm longa), brevissime petiolata vel subsessilia, revoluta, glabra, punctata, oblongo-ovata (inferiora), oblonga vel lineari-oblonga, obtusa vel subacuta, opposita, floralia 4-verticillata ovato-triangularia; vagina brevissima, ciliata. Flores in cymis aliquoties dichotomis. Calycis pars inferior plus minus (usque fere dimidio calycis) a vagina communi obconica foliorum floralium

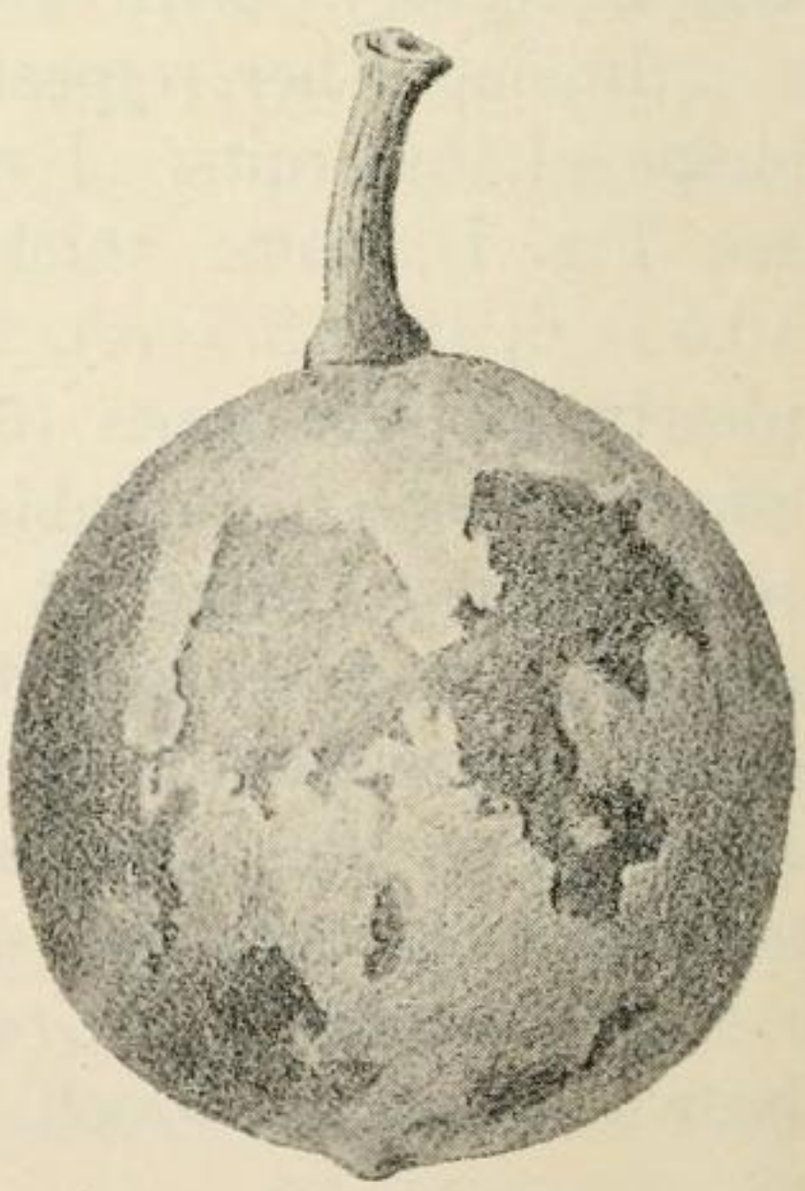

Fig. 8. Fruit of *Adansonia Gregorii* F. v. Müll., f. *globosa*, from Derby. ($^3/_5$ nat. size).

ambita vel cum eadem concreta; pars libera glabra, linearis, 5-nervis, ca. 4 mm longa, foliis floralibus paullo longior. Corolla alba vel pallide-rosea; petala 5 libera, lamina ovato-cordata margine subdentata. Stamina 6, 3 longiora, 3 breviora, medio cohærentia. Styli rami 3; ovula 1—2 in placentis (3) singulis fixa.

Ab omnibus speciebus australiensibus differt: calycis parte inferiori in vagina foliorum floralium occulta.

Hab. Austr. occ. trop.: Port Hedland in depressione inter dunas prope portum (No. 1138, 3. Nov. 1914; typus !); Cossack (L. Diels, Reise in West Austr., No. 2750, 17. Apr. 1901, in Herb. Berol.); Point Samson prope Cossack (No. 1137, 2. Nov. 1914; forma foliis minoribus angustioribus floribusque subsolitariis prædita).

The species of *Frankenia* here described stands near to *F. pauciflora* (as collective species), but it is easily distinguished by the calyx being more or less (sometimes half) imbedded in the obconical sheath formed by the four floral leaves. It differs further

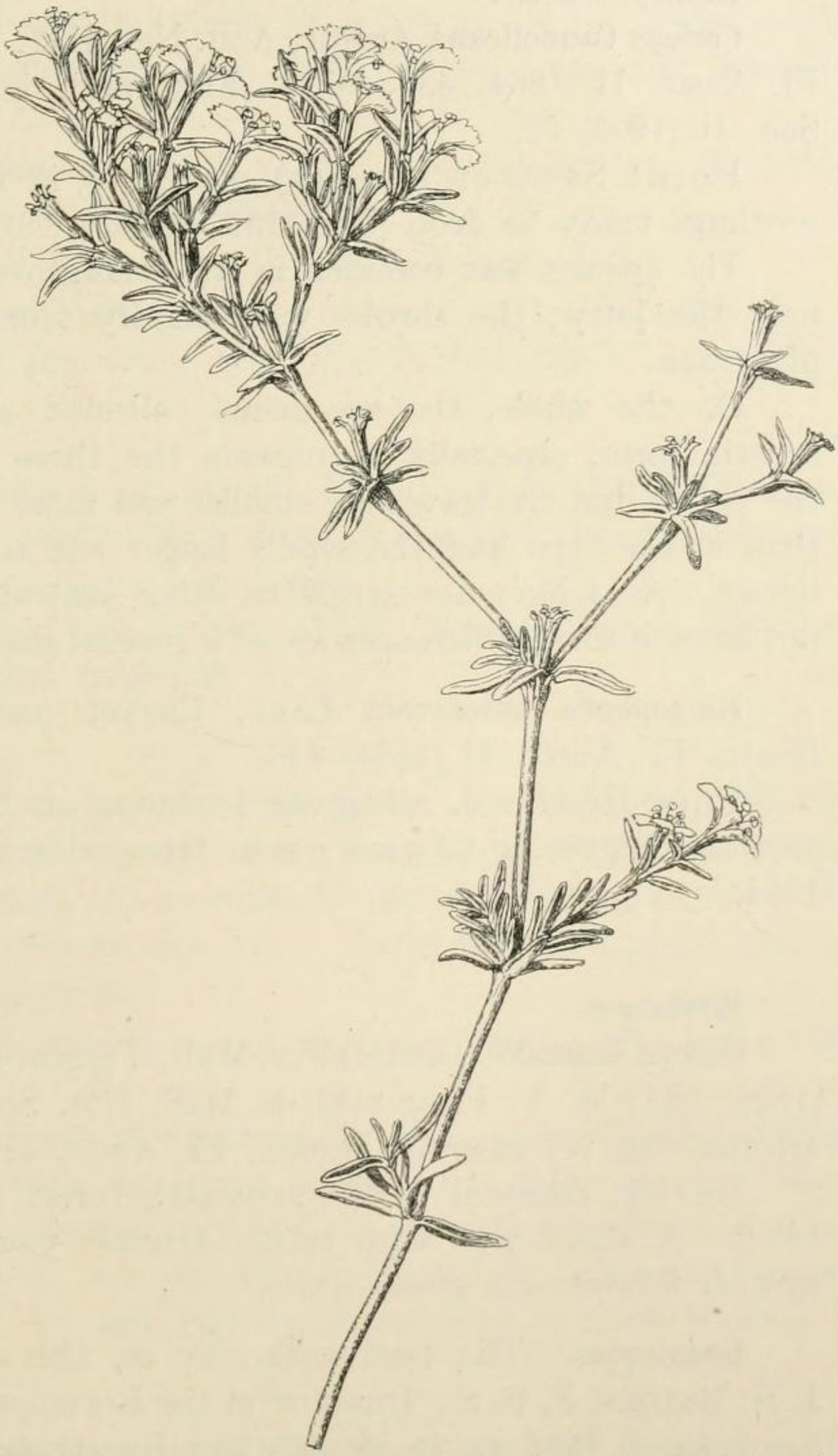

Fig. 9. *Frankenia ambita* nov. sp., from Port Hedland. (1½ nat. size).

in the few (1—2) ovules on the placentas; *F. pauciflora* having several on each placenta. The short and comparatively broad leaves and the paler and smaller flowers are also characteristic.

The Australian (espec. West Australian) Frankenias are a neglected field of investigation, to which I shall return later on when dealing with my plants from the south-western part of W. A. (See pp. 47—55).

Rhizophoraceæ.

Ceriops Candolleana Arnott, Ann. Nat. Hist. I (1838) 363; Benth. Fl. Austr. II (1864) 436; W. V. Fitzgerald, in Journ. Müll. Bot. Soc. II (1903) 22.

Point Samson (Cossack), mangrove, in full flower and with seedlings ready to drop (No. 1150, 2. Nov. 1914).

The species was common in the mangrove of Point Samson near the jetty; the shrubs were hardly more than the height of a man.

On the whole, the specimens collected agree well with the Asiatic form, especially as regards the three capitate bristles of the petals, but the leaves are smaller and more obovate-spathulate than in the type and the sepals longer and narrower (triangular-linear). As I have not access to other Australian specimens I do not know if these differences are of a general character or only local.

Rhizophora mucronata Lam., Encycl. meth. VI (1804) 169; Benth. Fl. Austr. II (1864) 435.

Port Hedland, mangrove (common), in flower and with the seedlings beginning to grow out of the pericarp (No. 1149, 3. Nov. 1914).

Myrtaceæ.

Careya australis (Benth.) F. v. Müll., Fragm. Phytogr. Austr. III (1866) 183; W. V. Fitzgerald, in Müll. Bot. Soc. II (1903) 48; *C. arborea*, var. (?) *australis* Benth., Fl. Austr. III (1866) 289.

Derby, common in the savannah forest (No. 1184, 7. Nov. 1914). A small tree with rather flexible young branches, with whitish flowers and green fruits.

Eucalyptus. The best authority on this difficult genus, Mr. J. H. Maiden, F. R. S., Director of the Botanical Gardens, Sydney, has been so kind as to identify my Eucalyptus, for which I am much indebted to him.

Eucalyptus clavigera A. Cunningh., in Walper, Repert. II (1843) 926; Benth. Fl. Austr. III (1866) 250; W. V. Fitzgerald, in Müll. Bot. Soc. II (1903) 43.

var. **Dallachyana** (Benth. l. c., sub. *E. tesselari* F. v. Müll.) Maiden MS.; *E. papuana* F. v. Müll., Descr. Papuan Pl. I (1875) 8.

Derby, a middle sized tree with white bark and flexible pendulous young branches with nearly open flower buds (No. 526, 7. Nov. 1914), common (see Pl. III, fig. 1).

Broome, with flower buds (No. 528, 5. Nov. 1914). This form differs from the specimens from Derby by the scurfy bark of the young flexible branches and by the somewhat broader leaves.

Eucalyptus dichromophloia F. v. Müll., Journ. Linn. Soc. III (1858) 89; Benth. Fl. Austr. III (1866) 257.

Broome, with ripe fruits (No. 527, 5. Nov. 1914).

Eucalyptus pyrophora Benth., Fl. Austr., III (1866) 257.

Derby, with ripe fruits (No. 525, 7. Nov. 1914).

Apocynaceæ.

Carissa lanceolata R. Br., Prodr. Fl. Nov. Holl. (1810) 468; Bentham, Fl. Austr. IV (1869) 306; *C. Brownii* F. v. Müll., Fragm. Phytogr. Austr. IV (1863) 45, saltem ex parte.

Broome, (No. 1158, 5. Nov. 1914). A small spiny shrub in full flower (fl. white, fragrant).

Convolvulaceæ.

Cressa cretica L. Sp. pl. (1753) 223; Benth., Fl. Austr. IV (1869) 437.

Derby, near the jetty, abundant (No. 1168, 7. Nov. 1914). The Australian plant (*C. australis* R. Br.) is distinguished by its large and broad leaves and other characters from specimens of the northern hemisphere.

Evolvulus alsinoides L., var. **sericeus** Benth., Fl. Austr. IV (1869) 438.

Derby, sparingly along the jetty (No. 1169; 7. Nov. 1914).

This variety with adpressed white hairs (also on the outer side of the calyx) seems fairly distinct from the common *E. alsinoides*. The flowers are sky-blue. Recorded beforehand from Port Walcott (W. A.) and Islands of the Gulf of Carpentaria.

Borraginaceæ.

Heliotropium curassavicum L. Sp. pl. (1753) 130; Bentham, Fl. Austr. IV (1869) 393.

Port Hedland, in low-lying parts of sand-dunes near the shore, partly buried by sand (No. 1156, 3. Nov. 1914).

Verbenaceæ.

Avicennia officinalis L. Sp. pl. (1753) 110; Benth. Fl. Austr. V (1870) 69; R. T. Baker, in Journ. & Proc. R. Soc. of N. S. Wales, XLIX (1916) 257.

Point Samson (Cossack), with young flower buds, very common in the mangrove (No. 1148, 2. Nov. 1914).

Port Hedland, common (3. Nov. 1914); see Pl. I, figs. 2—3.

Broome, common (5. Nov. 1914).

Derby, with young flower buds, very common in the mangrove (No. 1167, 7. Nov. 1914); see Pl. I, fig. 1.

This is the main component of the W. Australian mangrove. It is called "white mangrove" or "grey mangrove". As pointed out by R. T. Baker in his recent monograph of "the Australian Grey Mangrove" the name *A. officinalis* L. covers a great variety of forms.

Myoporaceæ.

Myoporum acuminatum R. Br., Prodr. Fl. Nov. Holl. (1810) 515; Benth. Fl. Austr. V (1870) 3.

Point Samson (Cossack), a bright-green shrub with white flowers and purple drupes; near the shore (No. 1132, 2. Nov. 1914).

I follow Bentham (l. c.) in his treatment of the many closely allied forms of *Myoporum.* The specimens collected answer well to his var. *angustifolium* Benth. (l. c. 4) = *M. Cunninghamii* Benth. in Hügel, Enum. (1837) 78, which latter name ought to be used as it has the priority.

Goodeniaceæ.

Scævola sericophylla F. v. Müll., in Bentham, Fl. Austr. IV (1869) 102; K. Krause, Goodeniaceæ in Das Pflanzenreich IV. 277 (1912) 162.

Point Samson (Cossack) (No. 1154, 2. Nov. 1914).

A shrub with unarmed rather long branches and dwarfy rosulate side-branches bearing silver-clothed leaves and the inconspicuous white flowers. It was the dominating species in a sparsely covered sand-dune area near the jetty.

Compositæ.

Pterocaulon sphacelatus (Labill.) Benth. et Hook. Gen. pl. II (1873) 94; F. v. Müll. Sec. Census (1889) 134; *Monenteles sphace-*

Fig. 1. Mangrove of *Avicennia officinalis*, at Derby; low water, the sea has retired entirely from the mangrove. (7. Nov. 1914). Photo. by C. H. O.

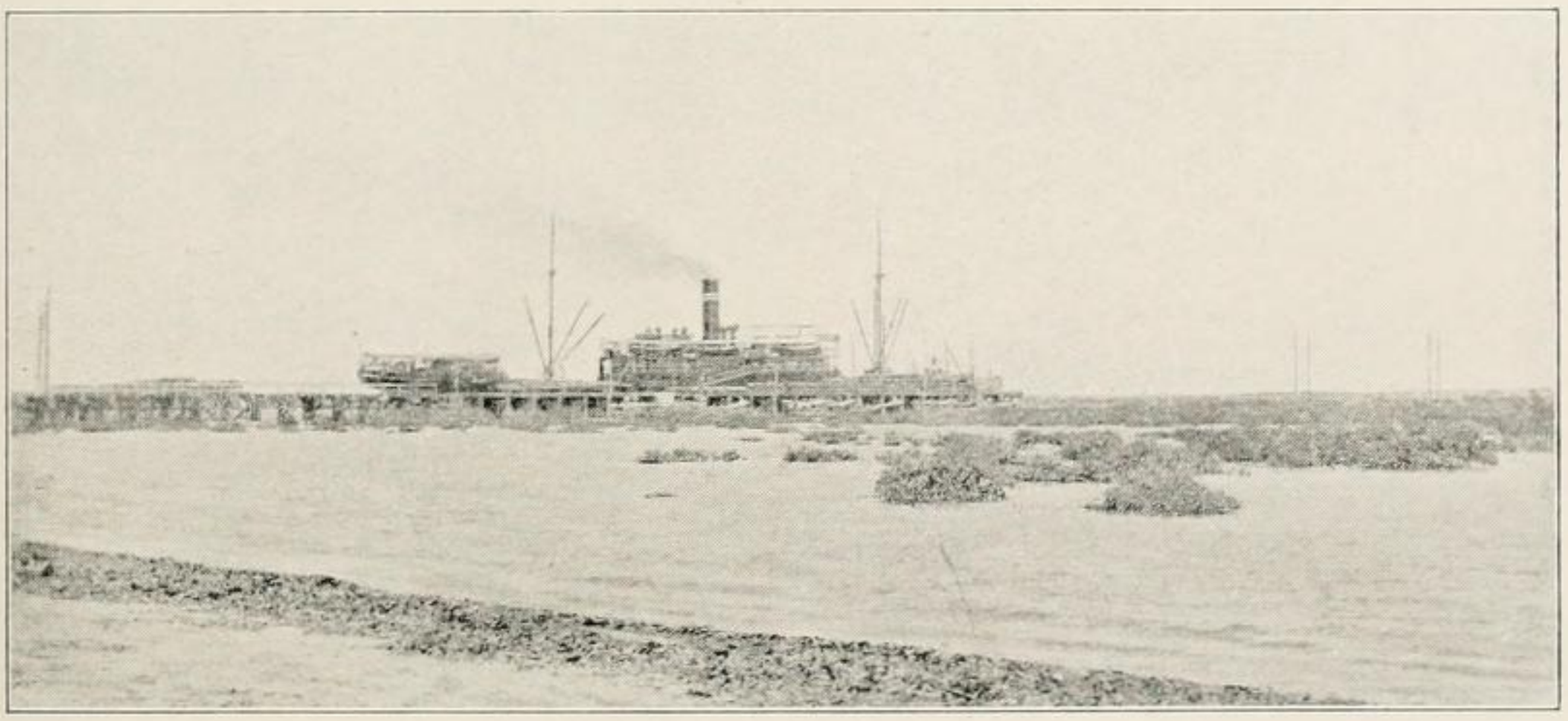

Fig. 2. Mangrove at Port Hedland; high water time, Avicennia's standing in water until the crown. Note: the steamer lying behind the jetty is high on the water. (3. Nov. 1914). Photo. by C. H. O.

Fig. 3. Mangrove at Port Hedland; low water time, Avicennia's free from water. Note: the steamer has sunk behind the jetty. (3. Nov. 1914, taken from the same spot as fig. 36, but 6 hours later). Photo. by C. H. O.

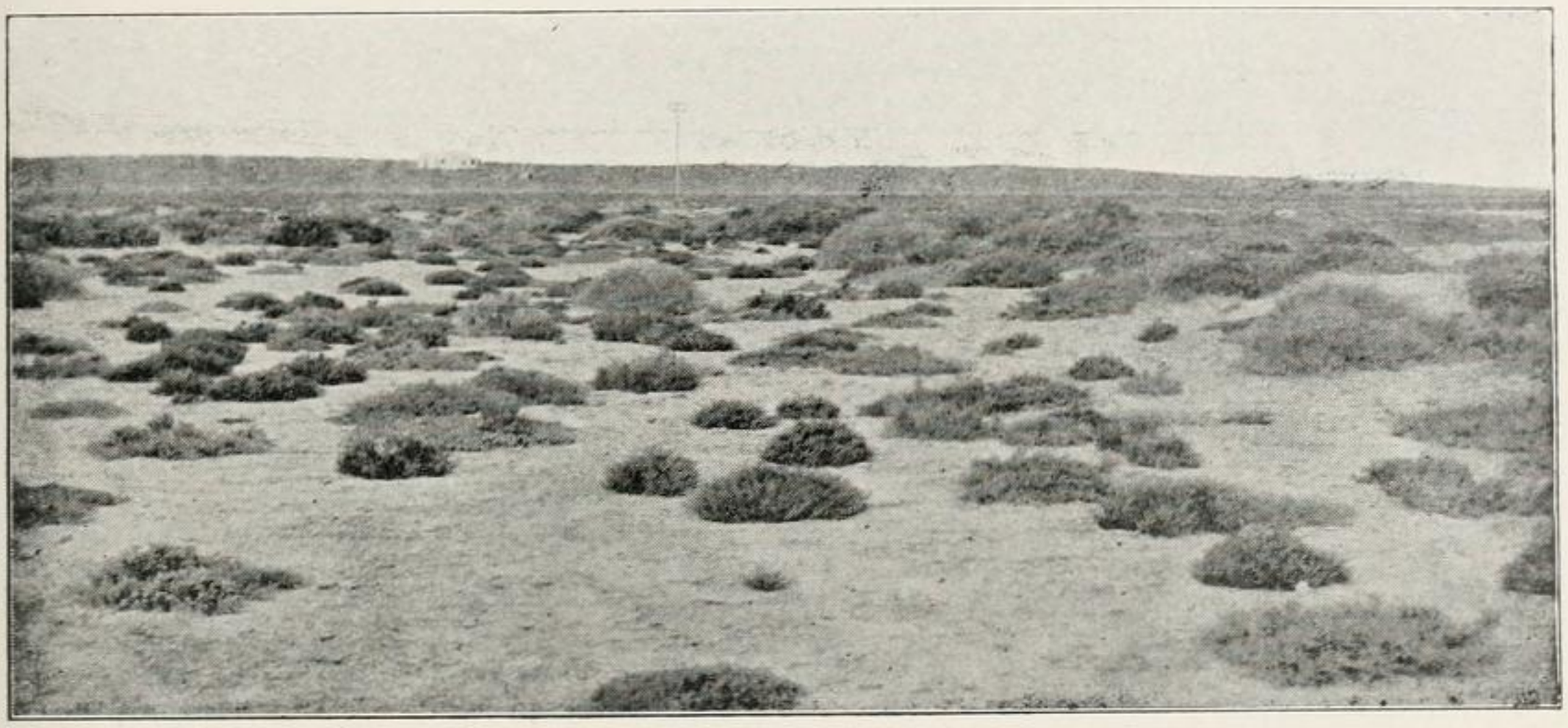

Fig. 1. Salt-pan formation at Port Hedland. Low cushions of *Arthrocnemum* species, higher of *Atriplex elachophyllum*. (3. Nov. 1914). Photo. by C. H. O.

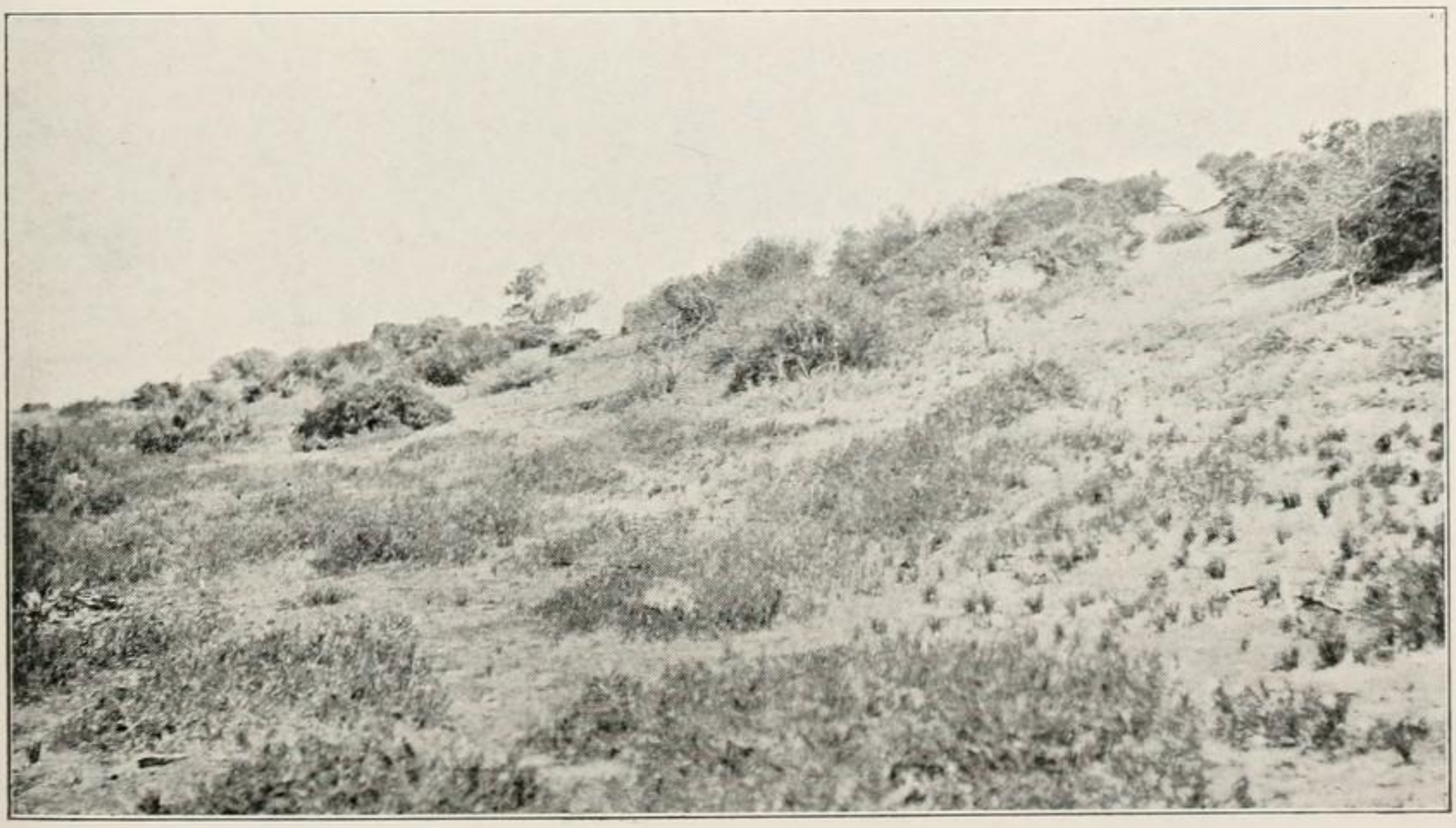

Fig. 2. Sand-dune at Carnarvon: dune depression in the foreground, dune shrubs on the slope. (31. Octob. 1914). Photo. by C. H. O.

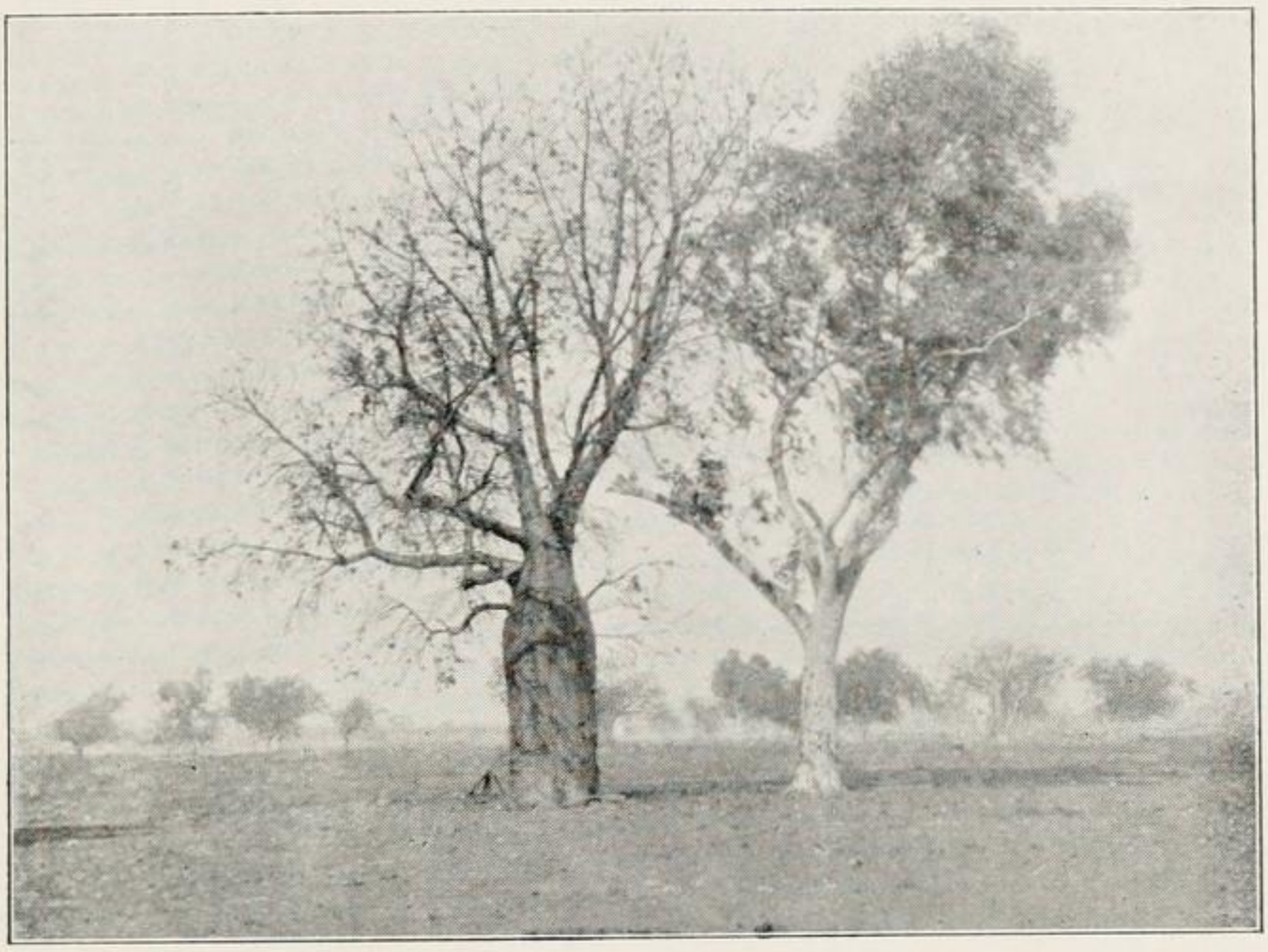

Fig. 1. Savannah forest at Derby. *Adansonia Gregorii* (on left) and *Eucalyptus clavigera* var. *Dallachyana* (on right) in the foreground. (7. Nov. 1914). Photo. by C. H. O.

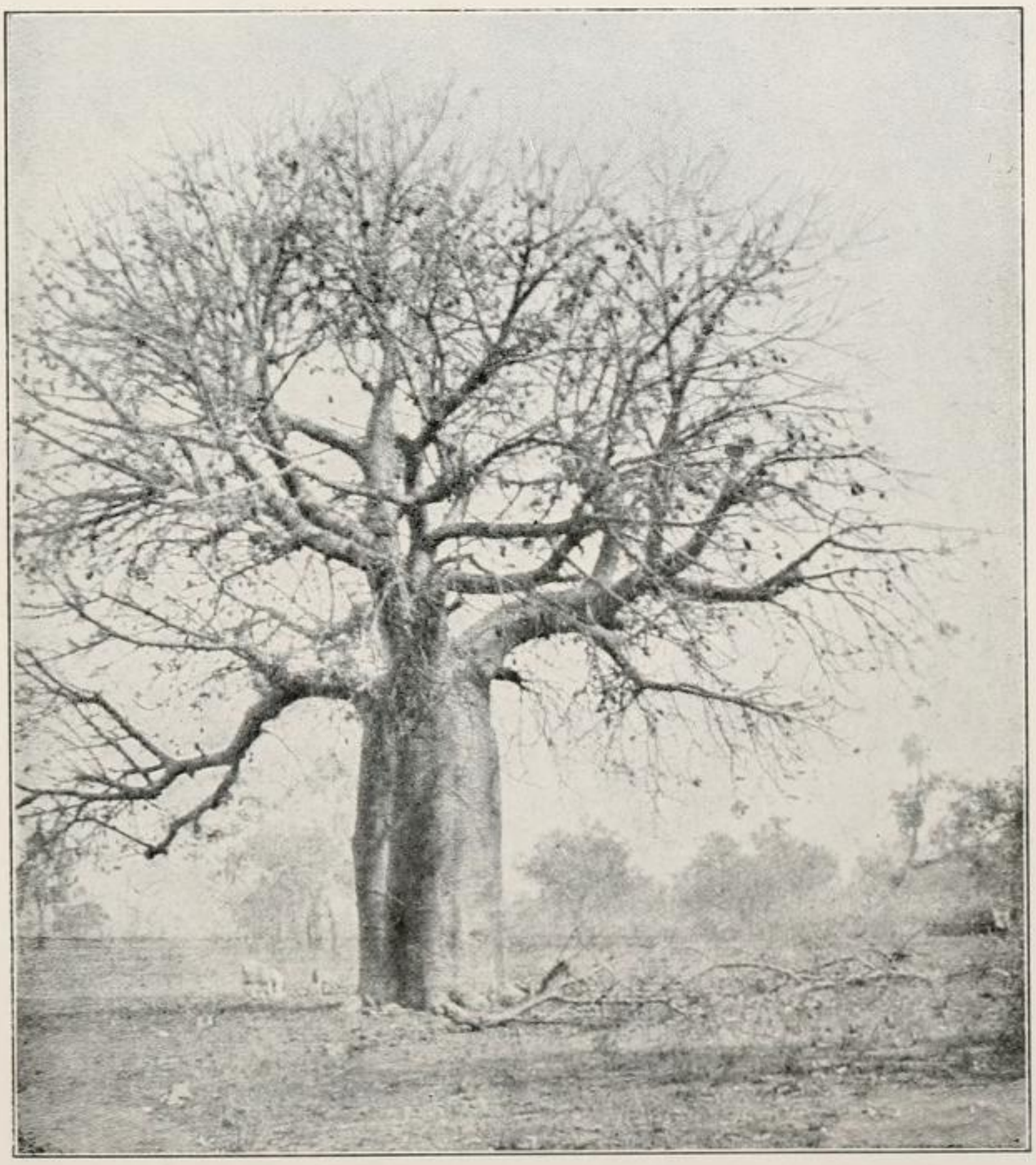

Fig. 2. A big tree of *Adansonia Gregorii* at Derby. (7. Nov. 1914). Photo. by C. H. O.

latus Labill., Sert. Austr. Caled. (1824) 43, tab. 44; Benth. Fl. Austr. III (1866) 523.

Port Hedland, a weed (No. 1136, 3. Nov. 1914).

The specimens do not agree fully with the plants of *P. sphacelatus* from Queensland, and I think De Candolle (Prodr. V, 455) rightly described three species under what is now taken as one. But as my specimens are rather poor with regard to leaves owing to the attacks of some "mining" insects, I leave them at present under the old name.

A Revision of the West Australian Species of Triglochin, Crassula (Tillæa) and Frankenia.

By

C. H. Ostenfeld.

The flora of the extra-tropical region of West Australia — especially that of the south-western part — has been studied by many botanists, and is nowadays well investigated. It is therefore not to be expected that my collection, made in places often visited by collectors, should bring much that is new; and I do not think it worth while to publish a full list of the species of which I have brought specimens home.

Still, when working at the identification of my plants, I find here and there some additions and records which may prove to be of interest, and which I intend to publish later on; and in some cases the examination of my material has brought me into a closer study of groups which seem to have been neglected. When possible, I have then tried to get as ample material for comparison as possible, and have several times succeeded in obtaining sufficient material for a revision of a group or a genus, at least as far as W. A. is concerned. Such has been the case with the three genera *Triglochin*, *Crassula* and *Frankenia*, a revision of which I am publishing here.

I am much indebted to several gentlemen who have procured material for me, as will be acknowledged below. I may especially mention Mr. J. H. Maiden, F. R. S., of Sydney, Professor A. J. Ewart of Melbourne, Mr. J. M. Black of Adelaide and Professor L. Diels af Berlin.

I. Triglochin (Plate IV).

Besides the larger perennial species — viz. *T. striata* Ruiz & Pav. and *T. procera* R. Br. —, several small annual species of the genus occur in West Australia. As I happened to collect some

of them, I became interested in their systematical relations, which are considered in different ways by different authors.

Through the kindness of Professor A. J. EWART and Mr. J. H. MAIDEN I got a good number of duplicates from the rich collections in the National Herbariums of Victoria and New South Wales. I have further had access to the specimens in the Herbarium of Berlin, which have been used by the monographer of the genus, F. BUCHENAU, and I have examined several sets of PREISS's plants, of which especially the herbarium of Lund, Sweden, has a very good one, with labels written by NEES AB ESENBECK. With exception of the collections in Kew and London I have, I think, in this manner succeeded in inspecting all the more important sources of our knowledge as to these plants, and have seen all the Australian species of the genus, in many cases even specimens from the type collection.

The late F. BUCHENAU made a careful study of this genus, and has written several papers about it, his last publication being the monograph in "Das Pflanzenreich" (1903), in which he recognizes 6 annual species. Later, two more annual species have been published.

Amongst these species **Triglochin mucronata** R. Br. differs widely from the others by its turbinate fruit with reflexed mucronate carpel-apices; it seems to be common around Swan Riwer and has a wide range in the extra tropical Australia. I found it in plenty near Bayswater (No. 140, 18. Oct. 1914).

All the other annual species are closely related one to another. BENTHAM (Fl. Austr. VII, 1878) even unites all the then described forms into one species, *T. centrocarpa* Hook., but no doubt BUCHENAU and F. v. MÜLLER were right in splitting these plants into several species.

T. centrocarpa Hook. and *T. calcitrapa* Hook. were published in Icon. pl. VIII (1845) as tab. 728 and 731 respectively. Next year (1846) *T. trichophora* was described by NEES AB ESENBECK in *Plantæ Preissianæ* (II. 1, p. 54). Then follows *T. nana* F. v. Müll. in Trans. Victoria Inst. I (1854) and in Hook. Journ. of Bot. VIII (1856) 332. In 1867 F. v. MÜLLER (Fragm. Phytogr. Austr. VI, 82) gives a new latin diagnosis of his species, explains the differences between the hitherto known species (quoting the nos. of Pl. Preissianæ) and mentions — without any real description — a new species *T. minutissima.* He is much in doubt as to the value of all the species, and writes: Forsan omnes hæ plantæ confluunt.

A few years later F. BUCHENAU (Abhandl. Naturw. Verein Bremen, II, 1871) for the first time makes an elaborate study of the species, clearing up the differences in a very good manner. Later (in Engler's Botan. Jahrb. II, 1882) he comes back to the matter, and has several additions and corrections to make although still in the main at the same standpoint as in 1871. Not much different from this is his monograph of 1903; only he adds a new West-Australian species, viz. *T. Mülleri.*

Since the publication of BUCHENAU's monograph N. E. BROWN (Kew Bull. 1914, 189) has described *T. Stowardii* from Beverley, W. A., and A. J. EWART (Victor. Natur. 23, 1906, 43) raised *T. turrifera* (*T. centrocarpa* var. *turrifera* Luehm.) from Victoria to specific rank.

From my examination of rich material of all these small plants I have arrived at the conclusion that BUCHENAU's delimitation on the whole holds good, and that it is not permitted, as BENTHAM did, to unite them into one "species". But there are some smaller points in which I do not agree with BUCHENAU.

Often two or more species grow together on the same spot, and this has made much confusion, as the older collection numbers sometimes contain more than one species and therefore have been quoted in one way by one author, in another by another; this is specially the case with Preiss's plants.

Such small and simple plants with filiform leaves and small inconspicuous flowers in erect racemes, do not show many distinction marks, and it is, therefore, but natural that all authors have laid stress upon the only more prominent character, viz. the shape of the fruit. In reality we find here very good distinctions between the species, but on the other hand it must be admitted that there is a marked variability, pointing towards the probability that even the now recognized species are collective. Culture experiments will undoubtedly result in the recognition of many micro-species, and it seems that this group of the genus is very polymorphous.

My investigation has led me to keep the following species as distinct:

1. **Triglochin calcitrapa** Hook., Icon. pl. VIII (1845), tab. 731; Buchenau, Pflanzenreich (1903) 12.

This species is easily distinguished by the 3—4,5 mm long, pyramidal-linear fruits with long, curvate basal spurs. The leaves are setaceous-filiform and much shorter than the fruiting scapes. As BUCHENAU (l. c.) has pointed out, some specimens are larger

and have sessile fruits (*α*, *sessiliflora* Buchenau), others are more slender and have pedunculate fruits (*β*, *pedunculata* Buchenau, see Pl. IV, Fig. 7). On the whole the species seems somewhat variable.

I have collected it near the Yallingup Cave House (No. 141; 26. Sept. 1914) and have seen specimens from other places in West Australia, as well as from New South Wales and Victoria.

2. **Triglochin Stowardii** N. E. Brown, Kew Bull. (1914) 189.

Of this species I have only seen a poor specimen (Pl. IV, Fig. 11), kindly sent me by Prof. A. J. Ewart. It is part of the type collection. Evidently this species is very close to *T. calcitrapa*. It has the same filiform leaves and the shape of the fruit is not much different; further, the two species have in common the well-developed basal spurs of the fruit and also the even tapering of the fruit from the base towards the apex; but the fruit is much larger and longer (about 15 mm) and more linear, and the curved spur is shorter.

Up to now it is only known from the type locality: Beverley, W. A. (leg. F. Stoward 1913).

3. **Triglochin turrifera** (Luehm.) A. J. Ewart, Victorian Naturalist, 23 (1906) 43; *T. centrocarpa*, var. *turrifera* Luehmann; *T. calcitrapa* Ewart, Victorian Nat., 24 (1907) 60.

I have not had access to the two literature references quoted, but Prof. A. J. Ewart has kindly given them in a letter, and has further sent me specimens so named from Taylor's Creek, Wimmera, Victoria (J. P. Eckert 1898; Pl. IV, Fig. 10), and another specimen of just the same form, but named *T. centrocarpa* from Little Desert, County of Lowan, Victoria (F. M. Reader, 1892; Pl. IV, Fig. 9). These specimens show that Victoria possesses a well marked species which has not hitherto been found outside this state.

No doubt it is related to *T. calcitrapa*, but widely differing by the linear, flaccid leaves and the shape of the fruit. This is short (3,5—4 mm), pyramidal with an abruptly set apical cone, not pyramidal-linear tapering evenly from base towards apex; further the basal spurs are shorter and not curvate.

4. **Triglochin centrocarpa** Hook., Icon. pl. VIII (1845), tab. 728; Buchenau, Pflanzenreich (1903) 13; *T. nana* F. v. Müller, Trans. Victoria Instit. 1 (1854) 135, et Hooker's Journ. of Bot. VIII (1856) 332; Buchenau, l. c., 12.

Buchenau keeps *T. centrocarpa* Hook. and *T. nana* F. v. Müll. as two distinct species, but I must agree with Bentham (Fl. Austr.

VII (1878) 167) that they are connected by a series of forms which makes it impossible to draw a separating line between them, at least not until growing experiments have been tried, and these would probably result in a fair number of distinct micro-species, not in two. Therefore, I do not find it allowable from systematical and phytogeographical points of view to maintain two forms the extremes of which may be discernible, while the main bulk are indiscernible. That Hooker's *T. centrocarpa* is an extreme form, seems probable from the fact that it has not been collected since DRUMMOND's original specimens; while specimens referred to the less sharply defined *T. nana* have often been found.

The supposed distinction marks are: *T. centrocarpa* has appressed, sessile fruits, 3,8—5 mm long, and the backs of the carpels are subcarinate, while *T. nana* has erect, pedunculate fruits, 2—3 mm long, and rounded backs of the carpels.

Now we have in another species, *T. calcitrapa*, specimens with sessile and larger fruits and others with pedunculate and smaller fruits, without separating them into two species, and consequently there is no reason for doing it here. I have myself collected a number of specimens of *T. centrocarpa* at Armadale, near Perth (No. 143, 20. Sept. 1914) which show in some individuals sessile (see uppermost specimen in Pl. IV, Fig. 2), in others pedunculate fruits (see the larger specimens in Pl. IV, Fig. 2), and the back of the carpels varying from carinate to rounded. The length of the fruits is also highly variable, and there seems, usually, to be a correlation in such a manner that the sessile fruit is larger than the pedunculate one.

Neither does the geographical range show any distinction between the forms: I have seen specimens of *T. nana* collected by F.v. MÜLLER himself in Victoria (Station Peak, 1867; Pl. IV, Fig. 4) and they do not differ in any essential point from West Australian ones; neither do Tasmanian specimens collected by R. GUNN and quoted by F. v. MÜLLER (Fragm. VI (1867) 82) differ. Also from South Australia I have seen specimens (see Pl. IV, Fig. 1).

The only two instances in which my examination leaves a little doubt are the following:

(1) var. *brevicarpa* nov. var. (fructus oblongo-linearis, brevis, 2—2,5 mm longus, basi haud calcarata). Some specimens collected by myself at Yallingup Cave (No. 145, 26.—27. Sept. 1914; see Pl. VI, Fig. 3) are rather large, and have shorter and more long-stalked fruits than usual, and the basal spur of the carpels is much less developed than usually in *T. centrocarpa*, where it is

distinct, although very short. This may be an independent species, but at present I prefer to take it as the opposite extreme both to the original *T. centrocarpa* as figured by HOOKER from DRUMMOND's specimens from Swan River district and to the following form.

(2) var. *longicarpa* nov. var. (fructus anguste linearis, 5—5,5 mm longus, basi haud calcarata). A specimen sent from the Nat. Herb. of New South Wales collected by M. KOCH in W. A.: Watheroo Rabbit Fence (9. 1905) is large (11 cm high) and has unusually long and slender fruits (5—5,5 mm), but does not otherwise differ from the usual *T. centrocarpa*.

I characterize *T. centrocarpa* Hook. in the wider sense in the following manner: Small to medium-sized (3—11 cm), leaves setaceous-filiform, much shorter than the scapes; flowers 4—25, sessile or stalked; fruits erect to erect-patent, pyramidal-linear to shortly linear, 2—4 (rarely 5,5) mm long; carpels slightly dilated at the base, with very short basal (not curved) spur and bluntly keeled or rounded back.

The form with nearly sessile fruits and keeled back of the carpels has usually longer fruits (3—4 mm) and their base a little more dilated; it may be named *α, typica*. Under this comes var. *longicarpa*.

The form with distinctly stalked fruits and rounded back of the carpels has usually shorter fruits (2—3 mm) and hardly any basal dilation, and for this we may use F. v. MÜLLER's name, calling it *β, nana* (F. v. MÜLL. pro sp.). As an extreme of this var. *brevicarpa* may be taken. But as said above, it is in many cases not possible to refer specimens to one form or the other, as they are more or less intermediate.

T. centrocarpa is widely distributed from Victoria and Tasmania to West Australia.

5. **Triglochin minutissima** F. v. Müll., Fragm. Phytogr. Austr. VI (1867) 82; Buchenau, Abh. Naturw. Ver. Bremens II (1871) 498; Pflanzenreich (1903) 14.

F. v. MÜLLER writes (l. c.) that he has distributed a *Triglochin* "sub nomine T. minutissimæ": "quæ a formis minimis et gracillimis T. nanæ jam dignoscitur fructibus pertenuibus ferè sessilibus. Cum T. nana eam consociatam vidi ad portum Philippi, ad montes Stirlingii, ad flumen Murrayi. Ab hac facillime discerni potest T. trichophora (Nees in Lehm. Pl. Pr. II, 54) jam propter fructum turgidulum separanda; præterea hæc ultima sæpe multo robustior est. Planta Preissii 2409 est T. minutissima". To this

very incomplete description BUCHENAU (1871) has given an amendement and later (1903) a latin diagnosis. This minute plant is characterized by the thin and short (1—1,5 mm), linear, patent, nearly sessile fruits with hardly any basal dilation and with flat or faintly rounded back.

I have seen Preiss's no. 2409 (from Perth) which is quoted both by F. v. MÜLLER and BUCHENAU as *T. minutissima*. It contained two different forms: (1) larger specimens (see Pl. IV, Fig. 12) with very young fruits and slender somewhat bent scapes, evidently young *T. centrocarpa*[1]; (2) minute specimens (see Pl. IV, Fig. 13) with ripe sessile fruits and erect scapes — the true *T. minutissima*.

It seems to be a well marked species. According to F. v. MÜLLER and BUCHENAU, its geographical range extends from Victoria to West Australia, but I have not seen any other specimens than the Preiss'ian ones, and am not sure if it has not been confounded with small and young specimens of *T. centrocarpa*.

6. **Triglochin trichophora** Nees ab Esenbeck in Lehmann, Plantæ Preiss. II, 1 (1846) 54; emendata.

It is with some hesitation that I restore the old name *T. trichophora* Nees, but after having seen specimens of the type collection with NEES's own handwriting on the label I feel convinced to do it.

The species was described by NEES in LEHMANN's *Plantæ Preissianæ* upon Preiss's no. 4211 („in arenoso-conchyliosis humidis prope lacum insulæ Rottennest, 20. Aug. 1839") with the following diagnosis: foliis filiformi-setaceis laxis culmo brevioribus, fructibus erecto-patentibus pedicellatis, oblongo-linearibus trisulcis apice leviter angustatis. In the ensuing description we get the explanation of the singular species-name "trichophora". The author thought to have found hairs ("barba seu coma filorum tenuissimorum") inside the fruit; but, as BUCHENAU (1871, 497) has fully explained, this observation was wrong the supposed hairs being loosened cells of the innerside of the fertile carpels.

BUCHENAU has seen a small specimen of Preiss's No. 2411 and identifies it, "obwohl es keine reifen Früchte besitzt", with *T. nana* F. v. Müll., but on account of the incorrectness of Nees's name

[1] In some collections only sterile specimens with leaf-rosettes are present; they probably all belong to *T. centrocarpa*, at least they can not be referred to *T. minutissima*.

he prefers Mueller's younger name. This question of nomenclature has no interest when we unite *T. nana* with *T. centrocarpa* Hook.

Quite apart from this, however, I think Buchenau was not right in referring *T. trichophora* to *T. nana* (i. e. *T. centrocarpa* sens. lat.). In the herbarium of Lund, Sweden, there is a sheet with the following label: "*Triglochin trichophorum* N. ab E. NB, von mir bestimmt ohne dass ich wusste dass Sie diese Familie bearbeiten, N. v. E." This is written by Nees von Esenbeck to Endlicher who was the author of the other *Alismaceæ* in Lehmann's Plantæ Preissianæ, and consequently the specimens present are authentical *T. trichophora.* They show us a small and slender plant (see Pl. IV, Fig. 6) with setaceous-filiform leaves and with slender, more or less bent scapes. The fruits are not fully ripe, most of them even quite young, and each scape bears very few or only one fruit (Nees writes, in Pl. Preiss., "variat scapo uniflora"). The best developed fruits are rather short (about 2 mm), oblong, and differ in essential points from those of *T. centrocarpa.* F. Müller (1867, 82, quoted above) very appropriately writes "fructum turgidulum". In reality the fruit is shorter and thicker than in the foregoing species. It resembles *T. turrifera,* but differs by the smaller dimensions and the very short basal spurs and the shorter apical part.

Preiss's specimens are rather poor and incomplete, and very likely those seen by Buchenau were quite insufficient to show the distinction from *T. nana*; but from those in the Herbarium of Lund it appears evident that F. v. Müller was right in separating it from his species.

This view is further supported by a *Triglochin* which I have collected in a dune-pan near Busselton (No. 144, 30. Sept. 1914) and which I identify with Preiss's plant from Rottnest Island; it is much better developed (see Pl. IV, fig. 5) and with ripe fruit, and differs only from Preiss's specimens in the straight scape bearing several (up to 17) fruits; the shape of the fruit is the same, and this is the main point.

Upon Nees's original plants and upon mine I have based the following short description: A small, until 8 cm high annual; leaves setaceous-filiform, much shorter than the scapes; scapes erect or ascending, with 1—17 stalked flowers; fruits erect-patent, short (2—2.5 mm), when ripe oblong-ovoid, tapering into a conical apex; back rounded and basal spurs very short, but distinct.

The species seems to prefer the coastal region, as it has been found on Rottnest Island off Freemantle on coral-sand and at

Busselton in a dune-pan. It is distinct from *T. centrocarpa* sens. lat., but very close to the following species, which perhaps is only an extreme form of it.

7. **Triglochin Muelleri** Buchenau, in Das Pflanzenreich, IV, 15 (1903) 12.

In 1882 Buchenau (l. c. 509) mentioned a *Triglochin* collected by Oldfield at Vasse River, W. A., and sent to him by F. v. Müller, but it was not until 1903 that he, in his monograph, described it. To Prof. A. J. Ewart I am indebted for a part of the type collection. The plant in question (see Pl. IV, Fig. 8) is somewhat larger and coarser than the other species, as far as possible to judge from the rather incomplete specimens. The leaves are flaccid-filiform; the scapes, according to Buchenau, up to 10 cm high, somewhat curved. They bear many, rather distant flowers. The flowers and fruits are sessile or nearly so, and the fruits (not fully ripe) are ovoid or elliptical, hardly 2 mm long; they have rounded backs, a very minute apical part, and no basal spur at all.

The species is only known from the type collection, and from specimens collected at Busselton by F. Stoward (Nov. 1912) and sent me from the Nat. Herb. of New South Wales (exactly resembling the type). Perhaps further investigations will, as said above, result in its being united with *T. trichophora*. The geographical range of the two species seems to be the same (Vasse River is not far from Busselton).

The here given revision of the annual species of *Triglochin* accepts 7 species, besides *T. mucronata*. All occur in West Australia with the exception of *T. turrifera*. West Australia further harbours *T. striata* Ruiz et Pav. and *T. procera* R. Br., both of which seem to be common in the S. W. part of the state. Thus it has 9 species of the genus.

The following key gives a synopsis of the differences between the annual species:

A Key to the Annual Species of Triglochin.

A. Carpels with free apex, the three fertile ones with a reflexed apical mucro; fruit turbinate ..... T. mucronata.

B. Carpels united up to apex; no apical mucro; fruit linear or pyramidal to ovoid.

a. Carpels with well developed, mostly incurved basal spurs: fruit linear-pyramidal or pyramidal.

α. Fruit linear-pyramidal, evenly tapering from base towards apex; basal spurs incurved.

1. Fruit 3—7 mm long, with rather large basal spurs.
T. calcitrapa.

2. Fruit about 15 mm long, basal spurs comparatively small.
T. Stowardii.

β. Fruit pyramidal with a conical apex, 3.5—4 mm long; basal spurs not incurved ..... T. turrifera.

b. Carpels with very short or hardly any basal spurs; fruit linear to elliptic or ovoid.

α. Fruit linear or linear-pyramidal.

1. Fruit mostly linear-pyramidal, 2—4 (rarely 5.5) mm long; carpels with slightly dilated base and very short, but mostly distinct basal spurs ..... T. centrocarpa.

2. Fruit linear, 1—1.5 mm long; carpels with hardly any dilation at the base and no spurs ..... T. minutissima.

β. Fruit oblong to elliptic or ovoid.

1. Fruit oblong-ovoid, 2—2.5 mm long, tapering into a conical apex; very short, but distinct basal spurs.. T. trichophora.

2. Fruit elliptic, about 2 mm long, without any distinct apical part; no basal spurs ..... F. Muelleri.

II. **Crassula** L., emend. Schönl.

(Sect. *Tillæoidea* Schönl.).

I think the authors who include *Tillæa* in the genus *Crassula* are right, and I follow in this respect Schönland in his treatment of the genus in Engler u. Prantl, Natürl. Pflanzenfam. (Crassulaceæ, 1891) and in his recent monograph of the South-African species of the section *Tillæoidea* (Ann. Bolus Herb. II, 2, 1916).

I have found it necessary to restore two of Nees ab Esenbeck's species and to create a new one. Some of the species I have had in culture from seeds taken from herbarium specimens kindly sent by Mrs. M. Davis of Perth, and they have kept their characters very well under cultivation.

In the following key I have given the distinction marks for all the species hitherto recorded for W. A.

A Key to the W. Australian Species of Crassula.

A. Flowers axillary in dense few- to several-flowered clusters (rarely solitary in the axils and then sessile), forming spike-like inflorescences, 5- (rarely 4-) merous; seeds two in each carpel.

a. Carpels broad, short, obtuse with medium-long style, much shorter than the calyx; at least some flowers on pedicels longer than the calyx ..... C. Miriamæ.

b. Carpels long, oblique ovate, acute with a long style; flowers sessile or very shortly stalked.

1. Stem and branches ascending from a decumbent (sometimes rooting?) base; carpels with recurved beak..... C. intricata.
2. Stem straight, erect; carpels with nearly straight beak. C. colorata.

B. Flowers axillary, solitary or few together, 4-merous; seeds 1 — several in each carpel.
a. Flowers few together at the uppermost part of the plant; 1 seed in each carpel. Water-plant ..... C. natans.
b. Flowers solitary in the axils.
1. Leaves 0.5—1.0 cm long; 2 (3) seeds in each carpel. Pedicels shorter than the leaves ..... C. recurva.
2. Leaves not reaching 0.5 cm; several seeds in each carpel. Pedicels much longer than the leaves ..... C. bonariensis.

C. Flowers in rich dichotomous panicles, 4-merous; several seeds in each carpel..... C. macrantha.

D. Flowers subumbellate at the top of the plant. 3—4-merous; several seeds in each carpel..... C. pedicellosa.

1. Group: Helophythum Schönl.

1. **Crassula natans** Thunb., Prodr. Fl. Cap. (1794) 54; Schönland in Ann. Bolus Herb. II. 2, 1916 (1917) 47 (ubi synon.); Diels et Pritzel, in Botan. Jahrb. 35 (1904) 210.

Armadale, on damp soil (dried-up ditches) along the railway, in flower and with ripe fruits (No. 361, 20. Sept. 1914).

This inconspicuous species was first found in W. A. by Diels and Pritzel at Newcastle, distr. Avon; the specimens were floating in a pond. Our specimens grew in dried-up ditches and were small and slender; they agree well with the f. *filiformis* (*Helophytum filiforme* Ecklon et Zeyher no. 1844, 289) as defined by Schönland (l. c. 49).

Geogr. area: South Africa.

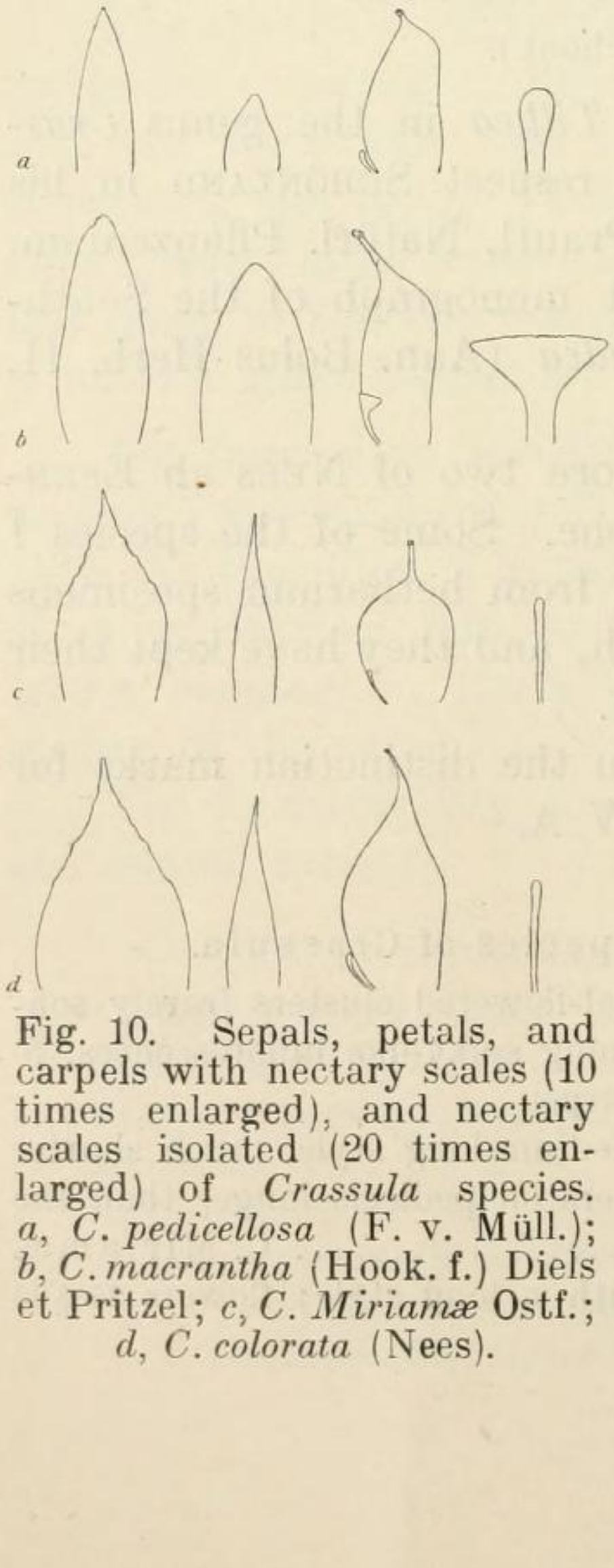

Fig. 10. Sepals, petals, and carpels with nectary scales (10 times enlarged), and nectary scales isolated (20 times enlarged) of *Crassula* species. *a*, *C. pedicellosa* (F. v. Müll.); *b*, *C. macrantha* (Hook. f.) Diels et Pritzel; *c*, *C. Miriamæ* Ostf.; *d*, *C. colorata* (Nees).

2. Group: Vaillantii Schönl.

2. **Crassula macrantha** (Hook. f.) Diels et Pritzel, in Botan. Jahrb. 35 (1904) 210; *Tillæa macrantha* Hook. f. in Hook. Icon. plant. t. 310 (1841);

Bentham, Fl. Austral. II (1864) 457; J. M. Black, in Transact. R. Soc. S. Austr. XL (1916) 63.

Seems to be fairly distributed in damp places in the neighbourhood of Perth. Specimens were collected at Mundaring Weir (No. 363, 13. Sept. 1914), in several places around Armadale (Nos. 358, 359, 362, 20. Sept. 1914) and in the vicinity of Perth (No. 1349, Mrs. M. Davis, 1915). They were in flower and with ripe fruits in September. Often they are more or less red-coloured, especially the sepals and carpels.

The species was first recorded for W. A. by DIELS and PRITZEL. It was originally described from Tasmania, and is, according to F. v. MÜLLER (Sec. Census, 84), further found in N. S. Wales, Victoria and S. Australia.

From HOOKER's description it appears that the original Tasmanian plant has ciliated sepals. All the West Australian have no trace of ciliation, and may be worth giving a varietal name (var. nov. *nuda:* sepala nuda, non ciliata). BENTHAM (l. c.) mentions the sepals as "sometimes, but not always, ciliate".

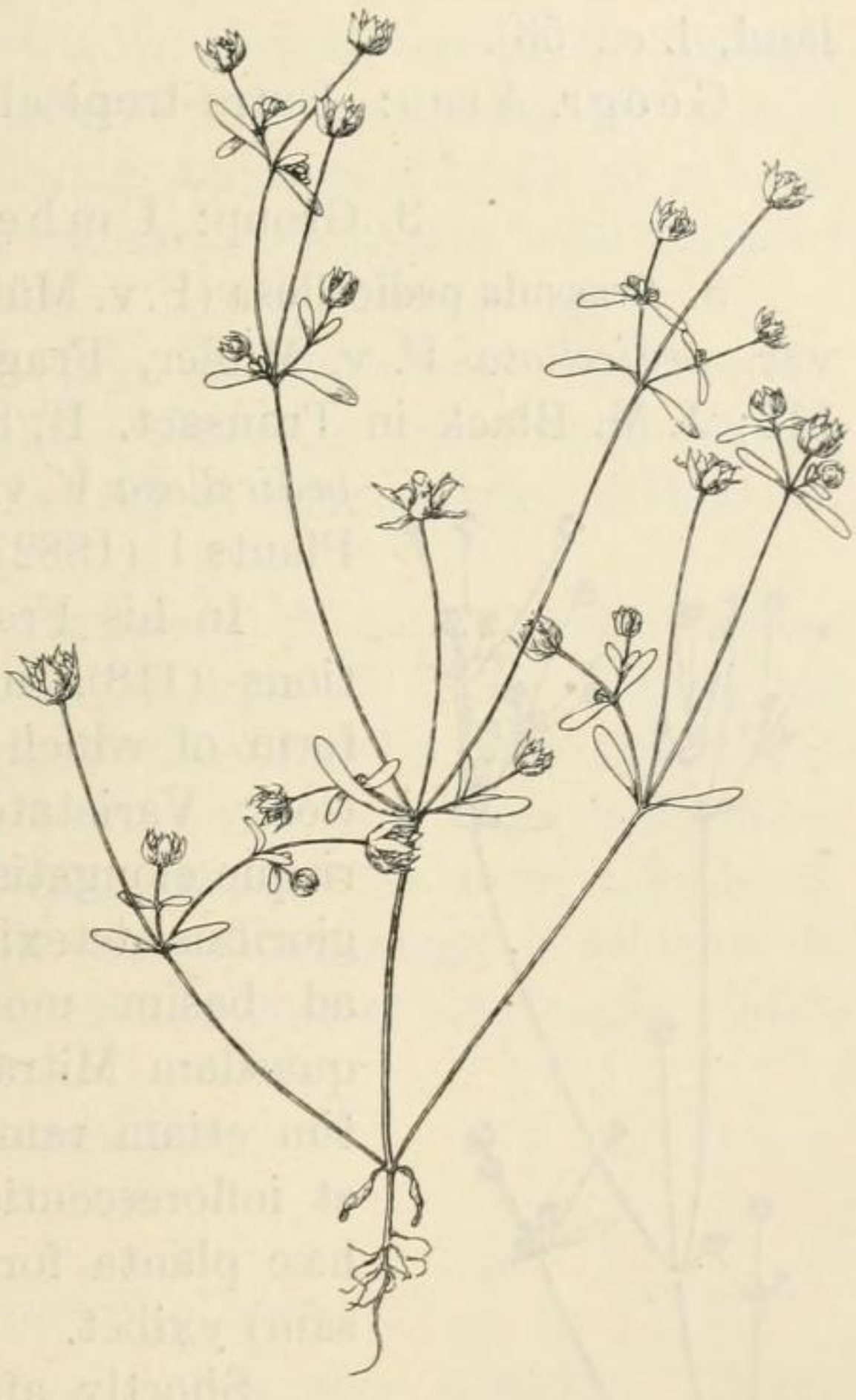

Fig. 11. *Crassula macrantha* (Hook. f.) Diels et Pritzel, var. *nuda* nov. var. Cultivated specimen. (Nat. size)

I have had it in cultivation (in 1917) from seeds taken from plants collected by Mrs. Davis in 1915 (No. 1349). When flowering it has a strong honey-smell.

The cultivated specimens, one or which is drawn (fig. 11), grow to a size of ca. 10 cm, and are somewhat more elongated than the spontaneous ones. The leaves are oblong-linear, semi-terete, acute or acuminate. The flowers are usually 4-merous, larger than in other species; they open when full-grown, the green sepals and white petals spreading (diameter about 3 mm); often the petals, which are about as long as the sepals, have pink-

coloured tips. The stamens have orange pollen. The nectary scales are broadly obcuneate or wedge-shaped (see fig. 10 *b*) and reddish; they secrete large drops of honey. The carpels are green, oblique-ovate with a well developed style and a small stigma; when ripe each contains several (about 6) brown, shortly oblong-cylindrical seeds with a finely rugose testa.

The Australian species comes near to the South-African *C. decumbens* Thunb. (*Bulliarda trichotoma* Eckl. & Zeyh., see Schönland, l. c., 53).

Geogr. Area: Extra-tropical Australia and Tasmania.

3. Group: Umbellata Schönl.

3. **Crassula pedicellosa** (F. v. Müll.) comb. nov.; *Tillæa macrantha*, var. *pedicellosa* F. v. Müller, Fragm. Phytogr. Austr. XI (1881) 118; J. M. Black in Transact. R. Soc. S. Austr. XL (1916) 63; *T. pedicellosa* F. v. Müller, Syst. Census of Austral. Plants I (1882) 48.

In his Fragmenta XI, F. v. Müller mentions (118), under *Tillæa macrantha*, a new form of which he gives the following description: Varietatem pedicellosam, pedicellis plerisque elongatis calyce pluries multotiesve longioribus detexi in pascuis fertilioribus collinis ad basim montium Stirlingi; hæc varietas quasdam Mitrasacmes species simulat præsertim etiam ramificatione parciore v. parcissima et inflorescentia passim quasi umbellata, nisi hæc planta forsan speciem seorsam (pedicellosam) exibet.

Shortly after (1882) he enumerates it as a distinct species, but has, as far as I am aware, not given any more elaborate description of it. As the description quoted is very incomplete, and as I have no authentic specimens of the species at my disposal, it is with some doubt that I identify with it a small *Crassula* found near Armadale; but nevertheless I think the identification a correct one, and my plants agree with specimens kindly sent me by Mr. J. M. Black from S. Australia under the name of *Tillæa macrantha* var. *pedicellosa*.

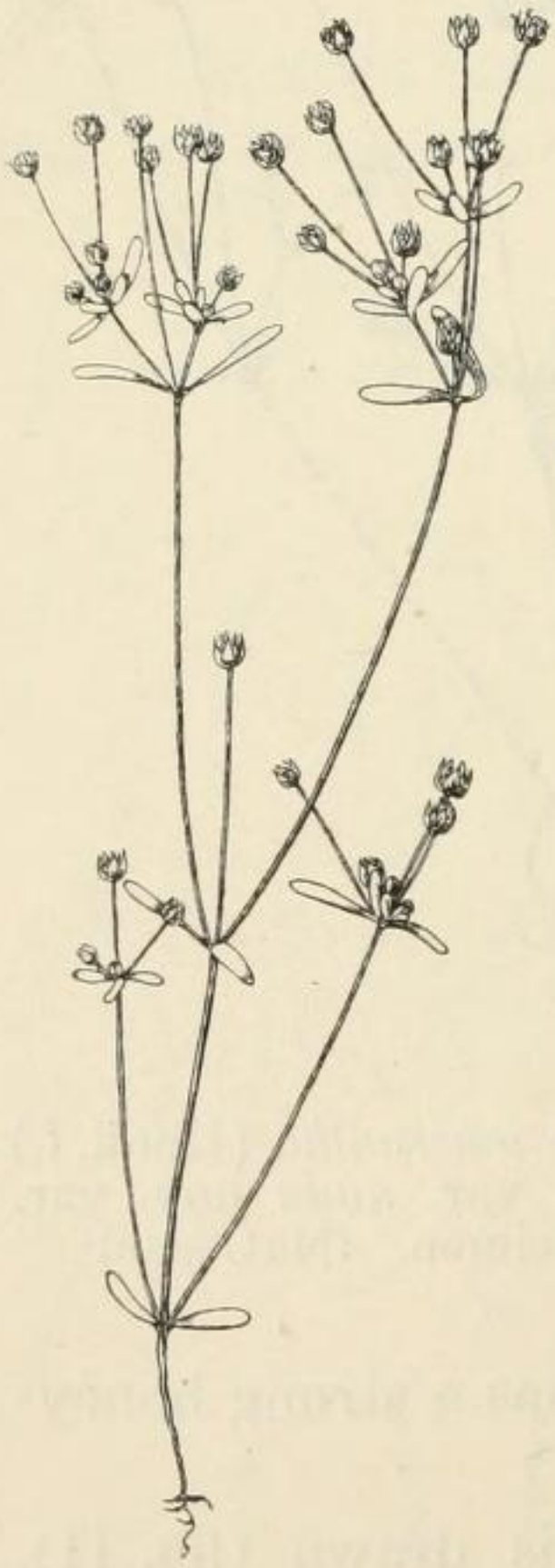

Fig. 12. *Crassula pedicellosa* (F. v. Müll.) Ostf.; cultivated specimen. (Nat. size).

The plant in question is a small erect annual (1—5 cm high),

in the poorest specimens unbranched, but usually branched. Leaves opposite with connate bases, obovate-oblong, obtuse, succulent, and, like the whole plant, more or less tinged with reddish-violet. Flowers in subumbellate cymes at the top of the branches, some with long stalks (up to 1 cm), others short-stalked or nearly sessile. Flowers 4-merous (sometimes 3-merous), sepals (about 1.5 mm long) broadly lanceolate-oblong, acute to acuminate, succulent, never spreading, longer than the subacute ovate petals (1.0—1.3 mm long). Stamina 4 (3); carpels obliquely oblong-ovate with a very short style (stigma nearly sessile), when ripe exceeding the calyx, each containing many minute (0.3 mm long) brownish seeds. Nectary scales minute, obcuneate with rounded apex (see Fig. 10 *a*).

Undoubtedly this species is quite distinct from *C. macrantha*, but on the other hand it is nearly related to some South-African species (sect. *Umbellata* Schönl.), namely *C. Dodii* Schönl. & Baker f., and *C. umbellata* Thunb.

My specimens were found growing in damp clayey places near Armadale (Nos. 1104, 1105, 20. Sept. 1914) and I hade had it sent from the vicinity of Perth (Mrs. Davis, No. 1451, 1915). Of the latter specimens I have sown seeds and have had plants growing, from which the description above has been completed. They (see fig. 12) differed from the spontaneous specimens in richer branching, more slender growth, flowers on longer stalks, and very little reddish tinge.

Geogr. Area: S. and W. Australia.

4. Group. Muscosa Schönl.

4. **Crassula Miriamæ** nov. sp. (Figs. 10 *c* and 13). Herba annua, parva, 4—8 cm alta, ramosa. Folia succulenta, ovato-oblonga, acuta vel subacuta. Flores in glomerulis axillaribus, sessiles vel breviter pedunculati, 5-meri (rarius 4-meri intermixti). Sepala succulenta, ovato-triangulata, acuta vel acuminata, margine corrodata; petala sepalis subæquilonga, lineari-lanceolata, acuminata, albo-pellucida. Stamina brevia; carpellæ obovato-rotundatæ, obtusæ, stylo mediocri instructæ, maturæ quam sepalis incurvatis multo breviores, inflatæ. Semina 2 in carpella singula. Nectaria minuta, lineari-clavata.

Hab. Australia occid., in vicinitate urbis Perth (No. 1452, leg. Mrs. M. Davis, 1915).

Ex affinitate *C. Sieberianæ* a qua præcipue differt sepalis

brevioribus et latioribus carpellisque obovato-rotundatis, brevibus et inflatis.

Amongst the specimens of *C. pedicellosa* and *C. colorata* collected near Perth by Mrs. M. Davis was a single specimen of another species which I at first took for *C. Sieberiana*,[1] a species recorded for W. A. by BENTHAM (l. c.) and later authors. But on comparison of the specimen with SIEBER's original plant (Pl. Sieberianæ no. 173) and with other specimens of the same species from Victoria (leg. F. v. Müller) and S. Australia (leg. J. M. Black), it soon became evident that it was an undescribed species, although allied to *C. Sieberiana*. This makes it probable that the records of *C. Sieberiana* from W. A. need confirmation. (It reaches as far west as S. Australia, according to J. M. Black, l. c.). The specimen sent had ripe seeds and from these I have grown some plants which have made it possible to give a full description of the species. I have named it in honour of the collector, my friend Mrs. MIRIAM DAVIS to whose indefatigable interest I owe a good deal of my collection of W. A. plants.

Fig 13. *Crassula Miriamæ* nov. sp., cultivated specimen. (Nat. size).

The plant (see fig. 13) is a much branching succulent, ascending or erect annual. The flowers are placed in dense clusters in the axils of the leaves; sometimes, especially on the branches, the clusters form a spike-like inflorescence. Some of the flowers are sessile and some short-stalked; the longer pedicels longer than the flower itself. Sepals from an ovate-triangular base tapering into an acute or acuminate apex and with somewhat corrodate margin. Petals much narrower and inconspicuous, linear-lanceolate, acuminate. Carpels, when ripe, shorter than the adpressed sepals, obtuse with a medium-sized slender style, somewhat inflated,

[1] *C. Sieberiana* (Schultes) comb. nov.; *Tillæa Sieberiana* Schultes, Mantissa in Roemer & Schultes, vol. III (1827) 345; *T. pedunculata* Sieber, Pl. exsicc. no. 173; non *T. peduncularis* Smith, in Rees, Encycl. V. 35, no. 4; *T. verticillaris* D. C., Prodrom. III (1828) 382; Bentham, Fl. Austr. II (1864) 451, ex parte.

broadly obovate or obovate-rotundate; each containing two ellipsoidal brown seeds. Nectary scales minute, linear-clavate (see fig. 10 *c*).

The allied *C. Sieberiana* has few-flowered flower-clusters, not aggregating into dense spike-like inflorescences, longer pedicels (several times longer than the flower), narrower sepals and much smaller and narrower carpels (see the fig. on Pl. VII of J. M. Black's paper in Trans. R. Soc. S. Austr. XL, 1916).

5. **Crassula colorata** (Nees) comb. nov.; *Tillæa colorata* Nees ab Esenbeck, in Lehmann, Pl. Preiss. I 2 (1844) 277; *T. adscendens* Nees, ibid. (non *Crassula adscendens* Thunb., 1778); *T. verticillaris* Bentham, Fl. Austr. II (1864) 451, ex parte; *T. acuminata* F. M. Reader, Vict. Naturalist XV (1900) 96; J. M. Black, Trans. R. Soc. S. Austr. XL (1916) 63, pl. VII.

Bentham (l. c.) included Nees's *T. adscendens* and *T. colorata* in his *T. verticillaris* (= *C. Sieberiana*), but was evidently wrong in this respect. I have examined Preiss's plants no. 1931 and 1932, upon which the two species were based, (specimens in the herbarium of Lund, Sweden), and have found them much different from Sieber's plant. On the other hand, the two species do not differ in any essential point from each other, and I consider them as one species only; for this I use the name *C. colorata* as *C. adscendens* is preoccupied by *C. adscendens* Thunberg (1778).

Some specimens sent by Mrs. Davis from the vicinity of Perth (No. 1350, 1915) agree well with Preiss's plants, and from them I have had cultivated specimens grown here in Copenhagen for examination. From these different sources I have been able to form a rather full idea of the species in question.

Nees's descriptions of the two plants are very exact and elaborate, and I have not much to add. He doubted himself the independence of the latter of his species ("simillima T. adscendenti, cujus nescio an sit varietas"), and the distinctive marks given are rather valueless, mostly merely modications dependent on external circumstances.

Recently F. M. Reader has created a new species, viz. *Tillæa acuminata* (Victorian Naturalist XV, 96) to the description of which I have no access. But J. M. Black has (Trans. R. Soc. S. Austr. 1916, 63) given some remarks on it, and he has sent me a herbarium specimen of it. It shows that it is the same plant as Nees's *C. colorata*, and consequently Reader's name must be reduced to a synonym. According to Black, it is widely

distributed in S. Australia, and as Reader's plant came from Victoria, the species seems to be distributed in the southern extra-tropical Australia from east to west.

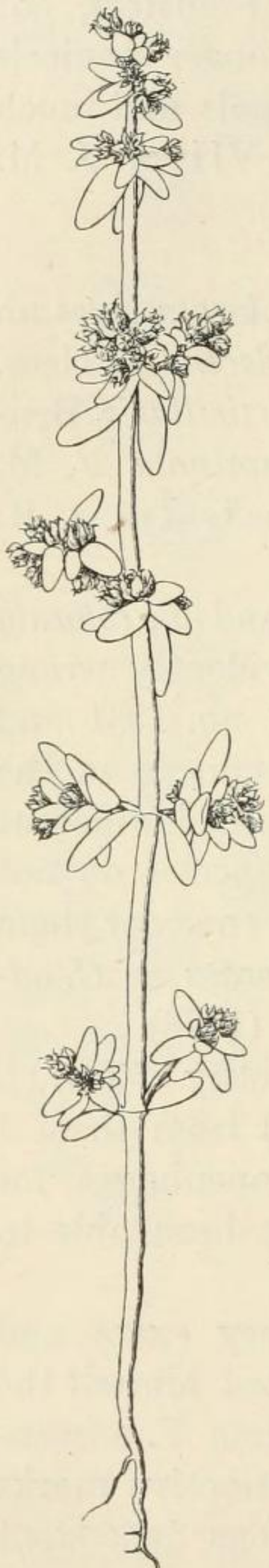

Fig. 14. *Crassula colorata* (Nees) Ostf., cultivated young specimen. (Nat. size).

Combining what the descriptions give with my examination of the specimens collected by Preiss, J. M. Black and Mrs. Davis, and the cultivated plants, I give the following description of the plant (see fig. 14): An erect 5—8 cm high, branched succulent annual, branches and stem ending in ± long (often very long) and somewhat interrupted inflorescences. Leaves very succulent, ovate-oblong, obtuse, often mucronate, 2—3 mm long. Flowers in axillary dense clusters, sessile, or the older ones very shortly stalked, 5-merous. Sepals very succulent, broadly triangular-ovate, very acute with somewhat corrodate margin; petals linear-lanceolate, acuminate, white-pellucid, about as long as the sepals. Carpels, when ripe, much exceeding the sepals, oblique-ovate, acute-aristate with a nearly straight beak; seeds 2 in each carpel, brown. Nectary scales minute, linear-clavate (se fig. 10 *d*).

The species is related to the following, and to some South-African species of the *Muscosa* group (Schönland, l. c.), e. g. *C. campestris* Endl. In W. A. it is known from Preiss's two localities ("In arenosis haud longe ab opp. Freemantle" and "In arenosis silvæ prope opp. Perth") and from Mrs. Davis's collection, all three localities lying near Perth.

Geogr. area: Victoria, S. and W. Australia.

6. **Crassula intricata** (Nees) comb. nov.; *Tillæa intricata* Nees ab Esenbeck, in Lehmann, Pl. Preiss. I 2 (1844) 278.

In the herbarium of Lund (Sweden) I have examined a specimen of Preiss's no. 1929: "*Tillæa* (*Bulliarda*) *intricata* N. ab E. In arenoso-conchyliosis humidis prope lacum insulæ Rottennest, Aug. 19. 39". The specimen is a rather poor one, but careful observation makes it possible to compare the plant with Nees's description (l. c.). On the whole they agree with each other, but in one

important point the description is erroneous, viz. the number of ovules is not several ("ovula plura"), but only two, as in the preceding species. No doubt Preiss's plant is very near his two other species, and the only reason for placing *T. intricata* under the subgen. *Bulliarda* (while the two others are placed under *Tillæa* proper) was the supposed differences in the number of ovules, and this is wrong.

Near the Yallingup Cave House I collected a *Crassula* on sandy open places (No. 360, 26. Aug. 1914) which is identical with Preiss's plant, and my richer material allows me a fuller conception of the species, which is, in reality, very close to *C. colorata*. The main differences are the quite different habit, owing to the decumbent and rich branching, the solitary or few flowers in the axils, and the recurved beak of the fruiting carpels. A short description runs as follows:

A much branched annual with decumbent bases of the stem and branches, and ascending upper parts, 2—5 cm high. Leaves succulent, ovate-oblong, obtuse, 2—3 mm long. Flowers axillary, solitary or in few-flowered clusters, sessile or nearly so, 5-merous, forming long interrupted spike-like inflorescences. Sepals broadly ovate, acute-acuminate; petals linear-lanceolate, acuminate, as long as or a little longer than the sepals. Stamens somewhat shorter. Carpels, when ripe, much exceeding the sepals, oblong-ovate, acute, tapering evenly into a recurved beak; seeds two in each carpel, brown. Nectary scales minute, linear-clavate.

The species seems to belong to the coastal area and may be a coastal vicarious species for *C. colorata*. Hitherto known only from Rottnest Island off Freemantle and Yallingup Cave House.

There are two more species of *Crassula* recorded for W. Australia, viz. *C. bonariensis* Cambes (= *Tillæa purpurata* Hook. f.) and *C. recurva* (Hook. f.); but whether these records are correct or not, I do not know, as I have not seen DRUMMOND's plants, among which they are found (according to Bentham, l. c. 452). I have included them in the key to the W. Australian species of *Crassula* given above (see p. 39). In the Eastern states there are further *C. Sieberiana* (Schultes), mentioned above, and the newly described Victorian species *C.* (*Tillæa*) *exserta* (F. M. Reader in Vict. Naturalist XIV, p. 83) which I have not seen.

III. Frankenia.

The Frankenias of West Australia are rather difficult to extricate. The treatments by the different authors (TURCZANINOW,

Bentham and Diels) show great uncertainty with regard to the delimitation of the species. Niedenzu, in his survey of the *Frankeniacæ* in Engler u. Prantl., Natürl. Pflanzenf. (III, 6, 1895, pp. 283—289) divides the subgenus *Oceania*, to which all the Australian species belong, into two sections, according to the number and place of the ovules. After examination of a number of specimens of West Australian Frankenias in the herbaria of Copenhagen and Berlin, I have found this distinction mark a good one.[1] I distinguish between: (1) ovules on 2—3 parietal placentas, more than two on each placenta; (2) ovules 1—2 on each parietal placenta; and (3) ovules only 2—3, basal on long funicles. These three groups fit in for the West Australian species, but I have examined a plant from Port Pirie, S. Austr., which seemed to have 9 basal ovules. My two first groups are Niedenzu's *Toichogonia*, and my last group his *Basigonia*.

Using these characters as the principal ones, and then those given by Bentham in his very good treatment of the genus in Fl. Austral. vol. I, I have arrived at the conclusions given in the following.

I have found it necessary to describe some new species, and I feel convinced that further researches will result in still more new discoveries. As Diels, in his Fragm. Phytogr. Austr. occ., remarks, *F. pauciflora* belongs to "einen polymorphen Formen-Kreis", and my examination of specimens labelled *F. pauciflora* have shown that some belonged to sect. *Toichogonia* and others to *Basigonia*; these must of course be separated from each other.

It is not possible yet to arrange the species of *Frankenia* into natural groups, as our knowledge is too restricted, and the following key to the West Australian species must, therefore, be taken only as an arrangement according to the characters most easily used for distinction.

A Key to the West-Australian Frankenias.

A. Placentas parietal, each bearing several (more than 2) ovules. Stems decumbent to erect; flowers large or smaller.

a. Leaves shortly, but distinctly petiolate; flowers in leafy dichotomous cymes.

1. Leaves linear, with margins revolute until the midrib; flowers large; stem decumbent or ascending, glabrous or pubescent; calyx glabrous or pubescent ..... F. pauciflora.

2. Leaves, at least the lower ones, ovate with only the margins re-

[1] Niedenzu, by the way, not having sufficient material at his disposition, has arranged the Australian species wrongly under his headings.

curved; flowers smaller; stem erect or ascending, densely pubescent; calyx pubescent ..... F. serpyllifolia.

b. Leaves sessile, linear, short; flowers in dense heads (aggregated cymes) at the top of the branches, rather small; stem, leaves and calyx puberulous ..... F. conferta.

B. Placentas parietal, each bearing 1—2 ovules; stems decumbent; flowers small, solitary or in dichotomous cymes.

a. Stems quite glabrous; leaves linear-terete, distinctly petiolate; flowers solitary ..... F. Drummondii.

b. Stems more or less puberulous; leaves subsessile or sessile; flowers in leafy dichotomous cymes.

1. Calyx more or less imbedded in a sheath formed by 4 floral leaves, glabrous; stems sparingly puberulous, lower leaves oblong-ovate, floral leaves triangular-ovate ..... F. ambita.

2. Calyx sessile (not imbedded), with 4 linear floral leaves, hairy; stems densely hairy with a short pubescence; leaves linear-terete. F. Maidenii.

C. Ovules 2—3, basal, on long funicles.

a. Flowers in dense heads (contracted cymes) at the top of the branches; leaves distinctly petiolate with ciliate sheaths; stems erect, internodes much longer than the linear-terete, glabrous, revolute leaves.

1. Floral leaves ovate-lanceolate, flat and strongly ciliate, much broader than the stem-leaves ..... F. bracteata.

2. Floral leaves like the stem-leaves, linear-terete.

† Glabrous or nearly so ..... F. glomerata.

†† Branches, young leaves and calyx hairy with short bristly hairs ..... F. setosa.

b. Flowers solitary or in leafy dichotomous cymes at the top of the branches; stems decumbent (or rarely erect?).

1. Leaves sessile, shortly linear-terete (under 5 mm long); stems decumbent; flowers small.

† Leaves not produced below their insertion, acute or obtuse; stamens 4, style 2-cleft, ovules 2 ..... F. tetrapetala.

†† Leaves produced below their insertion into a free, closely adpressed appendage; stamens 6, style 3-cleft, ovules 3 (2—4?). F. punctata.

2. Leaves distinctly, but often minutely petiolate on the margin of the sheath.

† Leaves very short (not exceeding 2 mm), terete-oblong, much revolute, obtuse, glabrous; sheath rather long (half as long as the blade), with strong cilia ..... F. parvula.

†† Leaves longer (3—6 mm); sheath much shorter than the blade.

o Leaves more or less hairy on the upper surface; branches and calyx densely hairy ..... F. Interioris.

oo Leaves glabrous on the upper surface; branches sparingly pubescent; calyx glabrous.

+ Leaves oblong, flat with revolute margins and densely hairy lower surface; internodes much shorter than the leaves; styles 3, ovules 3 ..... F. compacta.

++ Leaves linear, revolute; internodes longer than the leaves; styles 2, ovules 2 ..... F. Georgei.

1. **Frankenia pauciflora** D. C. Prodr. I (1824) 350; Curtis, Botan. Magaz. tab. 2896; Benth., Fl. Austr. I (1863) 151; maxima ex parte.

The specimens from the coastal region are decumbent shrubs with internodes several times longer than the leaves. Stems

Fig. 15. *Frankenia serpyllifolia* Lindl., from W. A. (Herb. Berol., ded. F. v. Müller). ($1^1/_2$ nat. size).

glabrous or, especially the younger, somewhat pubescent. Leaves oblong or linear, obtuse, revolute, glabrous, distinctly petiolate, 8—10 mm long; sheaths ciliate. Flowers in leafy dichotomous cymes. Corolla pink. Several ovules on each of the three parietal placentas (I have counted 21—24 ovules in the ovary).

Specimens examined: Carnarvon, common in dune depressions: Diels 1901 (No. 3722, herb. Berol.); Dr. I. B. Cleland (ex herb. Mus. Perth); C. H. Ostenfeld (No. 1101, 31. Oct. 1914). In arenosis exsicc. inter Restiones ad ripam fluvii Cygnorum prope Peninsulam, Herb. Preiss No. 1283.

A coarser, nearly erect form has the same floral characters, but has larger (broader and thicker) calyx and shorter, thicker leaves (only 3—5 mm long); this is, probably, the original form described by De Candolle. It is present in Herb. Berol: (1) Nova Hollandia, Côte occid. Ex Museo Paris 1819, Hb. Kuntze. (2) Inneres West-Australien, Murrin-Murrin, W. J. George 1902, comm. L. Diels.

2. **Frankenia serpyllifolia** Lindley, in Mitchel, Trop. Austr. (1848) 305; *F. pauciflora*, var. *serpyllifolia* Benth., Fl. Austr. I (1863) 152.

An erect much branched shrub (20 cm high) with elongated densely pubescent internodes and divaricate dichotomous cymes (Fig. 15). Leaves short and broad, especially the lower, broadly ovate to linear-ovate (the floral ones), with revolute margins (but not so much as in other species), glabrous on both surfaces. Flowers smaller than in *F. pauciflora*; calyx hairy. Floral characters otherwise as in *F. pauciflora* (several ovules etc.).

In Herb. Berol. a specimen presented by the late F. v. Müller and labelled »West Austr.« has been named *F. serpyllifolia* by Bray [1]), and I think with good reason. It is near *F. pauciflora*, but the differences in the vegetative parts are so great that I think it a good species.

3. **Frankenia conferta** Diels, in Diels et Pritzel, Fragm. Phytogr. Austr. occ., Botan. Jahrb. 35 (1904) 389.

I have seen part of the type specimen (in Herb. Berol.) and refer to Diels' exhaustive description. No doubt it is near to *F. pauciflora*, the floral characters of which are the same.

4. **F. Drummondii** Benth. in Fl. Austr. I (1863) 152.

I have not seen any specimens of this species, and have placed it in the key according to the description.

5. **F. ambita** Ostf., see above p. 24 (Fig. 9).

Seems to be restricted to the north-western part of the state.

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[1]) cfr. Bray, W. J.: The geographical Distribution of the Frankeniaceæ considered in connection with their systematic Relationships. Engler, Bot. Jahrb. XXIV (1897).

6. **Frankenia Maidenii** nov. sp. (Fig. 16).

Fruticulus decumbens ramosissimus, caulibus calycibusque dense breviterque setuloso-puberulis, internodiis foliis subduplo longioribus. Folia brevia (3—4 mm longa), crassiuscula, sessilia, omnino revoluta, brevissime setuloso-puberula (saltem juniora, seniora concretione calcarea (?) alba tecta), basi ciliata, subteretia, linearia, false 4-verticillata vel inferiora opposita vagina brevissima ciliata vel nulla. Flores in cymis aliquoties dichotomis, sessiles. Calyx linearis, 4—5 mm longus. Corolla parva, rosea; petala, ut stamina, infra medium cohærentia, lamina obovata; stamina 6, inæqualia; styli rami 3; ovula 2 in placentis (3) singulis fixa.

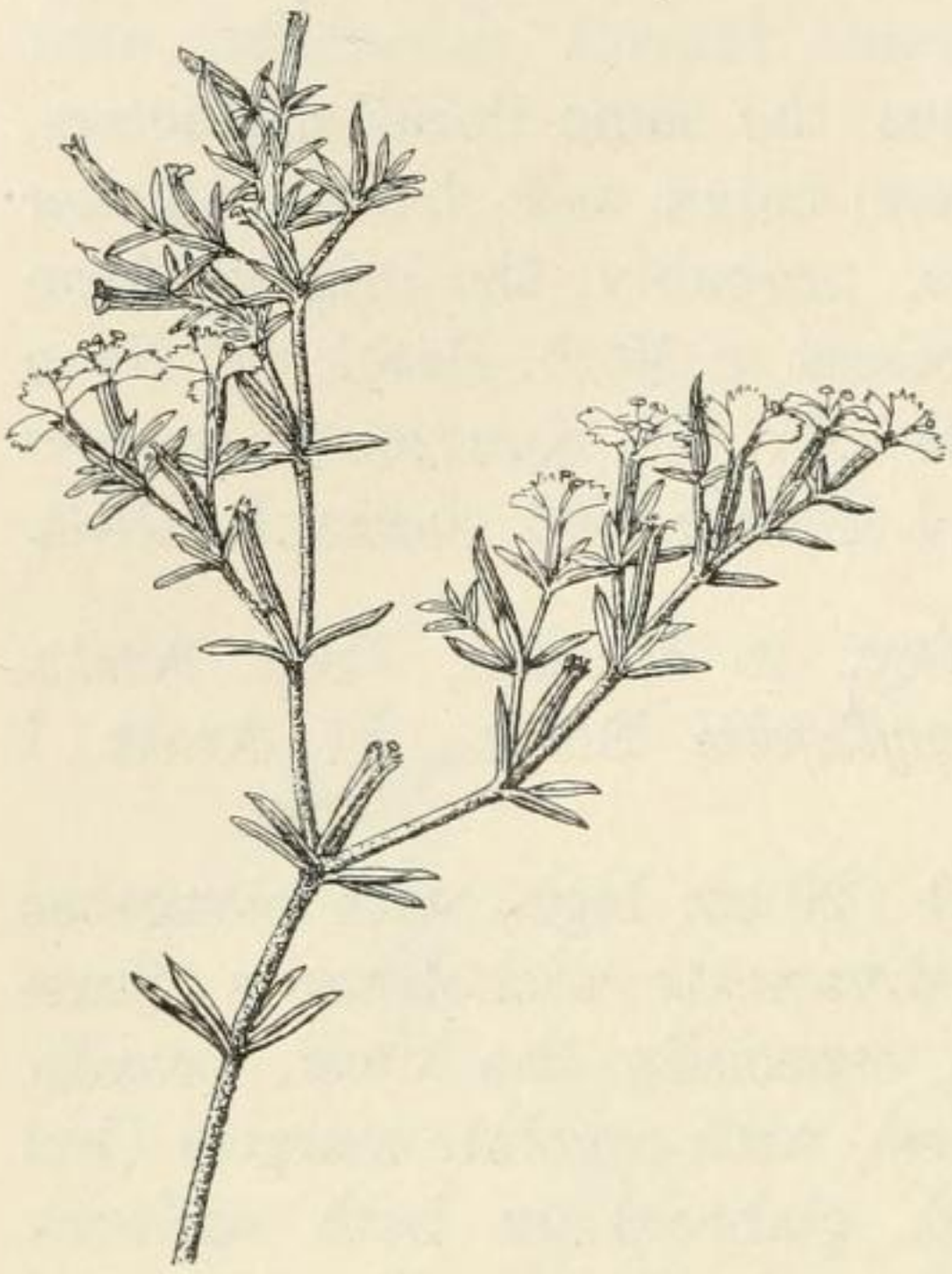


Fig. 16. *Frankenia Maidenii* nov. sp., from Cue, W. A. ($1^1/_2$ nat. size).

Hab. Austr. occ. interioris ad Cue (leg. J. H. Maiden, Oct. 1909, ex herb. Nationali New South Wales, sub. nom. *F. punctatæ*; typus in Herb. Copenhagen).

In habit this species resembles *F. ambita*, from which it differs in the dense clothing of very short hairs and in the sessile leaves and sessile (not imbedded) calyx. From *F. pauciflora* D. C. it differs in the short sessile leaves, the few ovules, the short and dense clothing etc. From *F. punctata* it is easily distinguished by wanting the basal appendages of the leaves and by the lateral placentas. The later character as well as the 5-merous flowers distinguish it from *F. tetrapetala*.

7. **Frankenia bracteata** Turcz., Bull. Mosc. XXVII (1854) 367; Benth. Fl. Austr. I (1863) 150; Diels et Pritzel, Fragm. Phytogr. Austr. occ., Botan. Jahrb. 35 (1904) 389.

I have seen the specimens quoted by Diels and Pritzel (l. c.) and collected by Pritzel (No. 816) at Waeel (dist. Avon).

8. **Frankenia glomerata** Turcz., Bull. Mosc. XXVII (1854) 368; Benth. Fl. Austr. I (1863) 151.

To this species I refer some specimens in Herb. Berol. named *F. pauciflora*, namely: No. 5707, Northampton, L. Diels. They agree in all points with the description given by Bentham (l. c.).

9. **Frankenia setosa** W. V. Fitzgerald, in Journ. W. Austr. Nat. Hist. Soc. no. 1 (1904) 3.

Known to me only from the description; perhaps only a hairy variety of *F. glomerata.*

10. **Frankenia tetrapetala** Labill., Nov. Holl. Plant. spec. I (1804) 88, tab. 114; Benth., Fl. Austr. I (1860) 152; Diels et Pritzel, Fragm. Phytogr. Austr. occ., Botan. Jahrb. 35 (1904) 390.

I have only seen the specimens collected by Diels (quoted by Diels and Pritzel, l. c.) near Esperance (no. 5450).

11. **Frankenia punctata** Turcz., Bull. Mosc. XXVII (1854) 367; Benth., Fl. Austr. I (1860) 153; Diels et Pritzel, Fragm. Phytogr. Austr. occ., Botan. Jahrb. 35 (1904) 390.

Only the specimens quoted by Diels and Pritzel (l. c.) from Cummening (distr. Avon) were seen.

12. **Frankenia parvula** Turcz., Bull. Mosc. XXVII (1854) 368; Benth. Fl. Austr I (1860) 152.

Of this species I have only seen a fragment of Drummond's 5th Coll. Suppl., no. 81.

13. **Frankenia Interioris** nov. sp. (Fig. 17).

Fruticulus ramosissimus decumbens; rami dense setoso-pubescentes, foliis longiores vel breviores. Folia brevia (3—4 mm longa), lineari-teretia, obtusa vel acuta, valde revoluta, plus minus dense pilis brevissimis curvatis vel rectis patulis prædita, brevissime petiolata, vagina haud manifesta ciliataque. Flores in cymis dichotomis paucifloris, parvi; calyx linearis (5—6 mm longus), dense setoso-pubescens, 5-dentatus; petala 5 rosea, unguibus cohærentibus, laminis obovatis, margine dentata; stamina 6 inæqualia; styli rami 3; ovula 3, basalia.

Fig. 17. *Frankenia Interioris* nov. sp., from Kalgoorlie (no. 1110). ($1^1/_2$ nat. size).

Hab. Austr. occid. interioris: in deserto ad Kalgoorlie (No. 1110, 7. Octob. 1914, typus); ad Bullabulling (L. Diels, no. 5202, in Herb. Berol., sub nom *F. pauciflorae*).

This decumbent small-leaved shrub seems to be common in the arid interior of the southern part of the State, perhaps taking the place of *F. pauciflora* of the coast region. It is easily distinct from the latter by the three basal ovules and the dense hairiness as well as by the smaller leaves, shorter internodes etc.

Fig. 18. *Frankenia Interioris* var. *conspicua* nov. var., from Coolgardie. ($1^1/_2$ nat. size).

From *F. Georgei* Diels it differs in the dense hairiness, the cohærent petals and the three ovules and three style-branches.

var. **conspicua** nov. var. (Fig. 18). Differt a typo dimensionibus majoribus; internodiis foliis longioribus; foliis latioribus oblongo-ovatis vel oblongis, margine solum revoluta, subtus glabris, 5—7 mm longis, obtusis, distincte petiolatis; calycibus majoribus, 6—7 mm longis; corollis conspicuoribus; ceterum ut in typo.

Hab. Austr. occ.: Coolgardie Goldfields, J. Wood, Oct. 1908 (Herb. Copenh., ex Herb. New South Wales, sub nom. *F. pauciflorae*).

A plant kindly sent me by Mr. J. H. Maiden of Sydney, I consider as a luxuriant variety of *F. Interioris*. It has a rather different habit, but agrees in all essential characters with the main species.

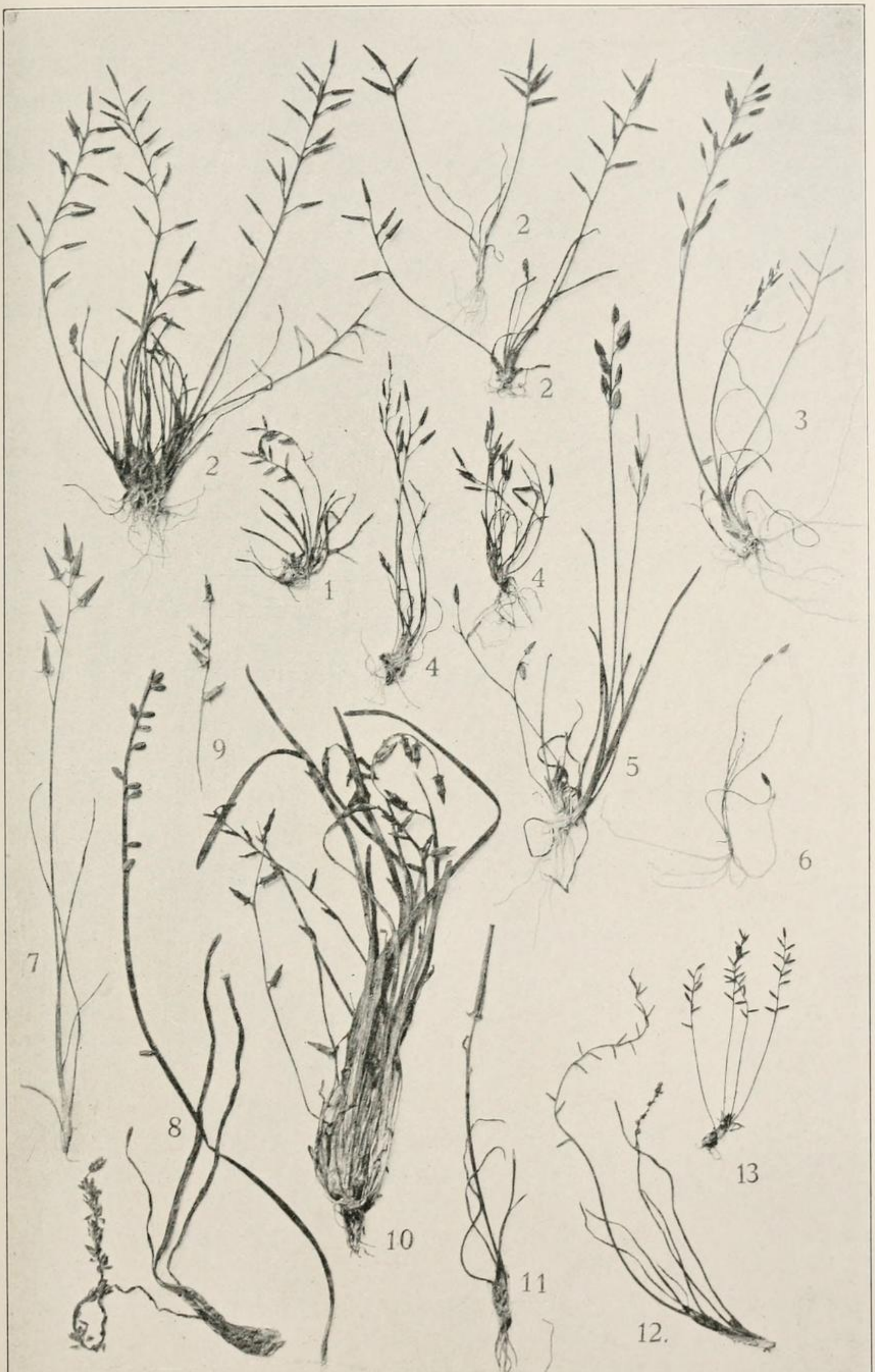
14. **Frankenia Georgei** Diels, in Diels et Pritzel, Botan. Jahrb. 35 (1904) 389.

I have not seen this species, which was based upon specimens collected at Murrin-Murrin (Distr. Austin) by W. J. George, 1902.

15. **Frankenia compacta** nov. sp. (Fig. 19).

Fruticulus decumbens et repens, ramis brevibus, dense foliatis superne sparse setoso-hirsutis, internodis foliis multo brevioribus. Folia oblonga, obtusa, plana, margine solum revoluta, supra glabra, subtus dense hirsuta, distincte petiolata, vagina ciliata, 4—5 mm longa. Flores in densis cymis dichotomis, sessiles, mediocri; calyx linearis, ca. 5 mm longus, glaber; corolla (an pallide-lutea?); petala

Fig. 19. *Frankenia compacta* nov. sp., from Wagin Lake. ($1^1/_2$ nat. size).



Australian Annual Triglochins.

1. *T. centrocarpa* var. *nana*, from S. A., Port Elliot. 2. *T. centrocarpa*, typica, 3 specimens from W. A., Armadale. 3. *T. centrocarpa*, var. *brevicarpa*, from W. A., Yallingup Cave. 4. *T. centrocarpa*, var. *nana* from Vict., Station Peak (leg. F. v. Müller). 5. *T. trichophora*, from W. A., Busselton. 6. *T. trichophora* (spec. authent.), Preiss no. 2411 (from the herb. of Lund). 7. *T. calcitrapa*, var. *pedunculata*, from W. A., Yallingup Cave. 8. *T. Mülleri*, from W. A., Vasse River (part of type collection). 9. *T. turrifera* from Vict., Little Desert. 10. *T. turrifera*, from Vict., Taylors Creek. 11. *T. Stowardii*, from W. A., Beverley (part of type collection). 12–13. Preiss no. 2409 (from the Melbourne herb.) containing young *T. centrocarpa* (12) and *T. minutissima* (13), part of type collection. (Photo. of herbarium specimens; nat. size).

5; lamina obovata, margine dentata; stamina 6, subtus cohærentia, styli rami 3, ovula 3 basalia.

Hab. Austr. occid.: ad Wagin Lake (leg. Miss Crown 1891, Diels no. 7835 in Herb. Berol., ex Herb. Melbourne).

This species is very distinct from the others by the nearly flat oblong leaves with densely pubescent lower surfaces, by the short internodes, the dense foliage and inflorescence and by the floral characters.

Chenopodiaceæ from West Australia.

By

Ove Paulsen.

The Chenopodiaceæ collected by Dr. C. H. Ostenfeld in Western Australia and handed over to me for identification are of importance, because every contribution to the botany of those little-known countries must be welcomed. But especially with regard to this family our knowledge is scarce, and most of all this applies to the group Salicornieæ, which has been very much neglected. — Several doubtful or difficult questions have arisen; in such cases I have figured the material; and if the species concerned are thus rendered recognisable for others with certainty, an advance is made, even if my decisions be not correct in every case.

I. Rhagodia R. Br.

1. **R. Gaudichaudiana** Moq., in D. C. Prodr. XIII 2 (1849) 53; Benth. Fl. Austr. V (1870) 154.

Kalgoorlie (No. 335, 7. Oct. 1914).

2. **R. baccata** (Labill.) Moq., in D. C. Prodr. XIII 2 (1849) 50; *Chenopodium baccatum* Labill. Nov. Holl. pl. spec. I (1804) 71, tab. 96; *Rhagodia Billardieri* R. Br. Prodr. (1810) 408; Benth. Fl. Austr. V (1870) 152; F. v. Müll. Iconogr. Austr. Sals. 3 (1890) tab. 21.

Leaves opposite. Fruits fleshy, red.

Carnarvon, in dunes (No. 344, 31. Oct. 1914).

3. **R. parvifolia** Moq., in D. C. Prodr. XIII 2 (1849) 52; *R. crassifolia* R. Br. var., Benth. Fl. Austr. V (1870) 155.

An undershrub; leaves small (5—8 mm long), obovate to oblong, mealy; inflorescence very open, spiciform. Flowering.

Kalgoorlie (No. 327, 8. Oct. 1914).

II. Chenopodium.

4. **C. nitrariaceum** F. v. Müll., in Benth. Fl. Austr. V (1870) 158; F. v. Müll. Iconogr. 3 (1890) tab. 28.

Leaves mostly opposite. Plant pubescent, by characteristic hammer-shaped hairs (Fig. 20). Suffrutescent; in No. 328 there are long dead shoot-systems, and the year-shoots are only about 5 cm long. In No. 343 they attain a length of 15—20 cm. Both bear young fruits and single ripe ones.

Tammin, in heath (No. 328, 6. Oct. 1914); Geraldton, in sand dunes (No. 343, 28. Oct. 1914).

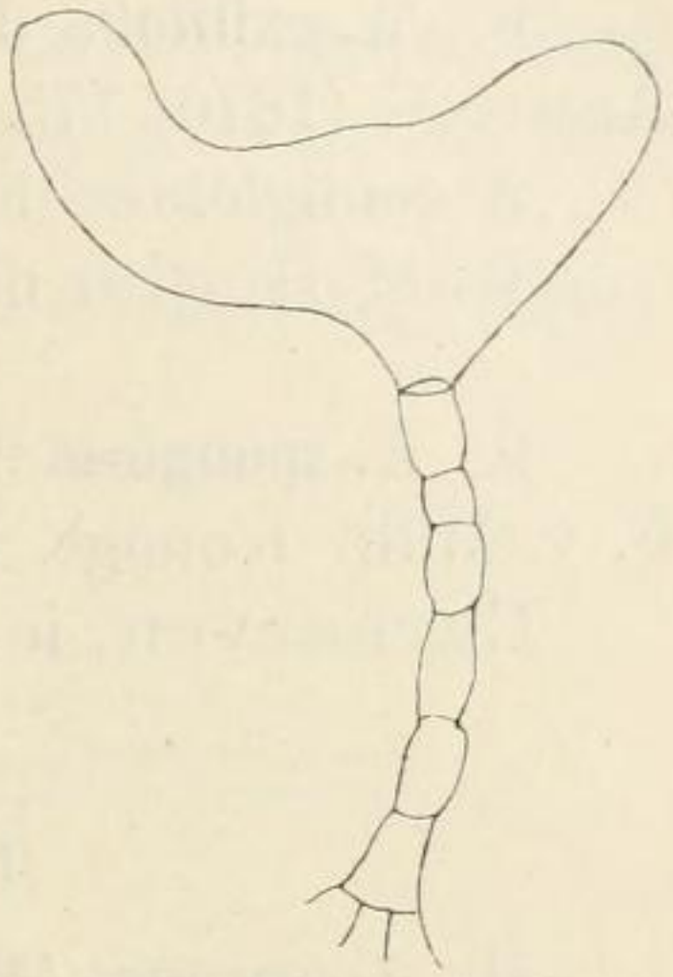


Fig. 20. Hair of *Chenopodium nitrariaceum.*

III. Atriplex L.

5. (?) **A. stipitatum** Benth. Fl. Austr. V (1870) 168.

The specimens collected being male only, they are not discernible from *A. Moquiniana* Web., which species according to Bentham differs from *A. stipitatum* by its fruiting bracteoles.

Male clusters in open spikes. Flowers yet unopened.

Kalgoorlie (No. 336, 10. Oct. 1914).

6. **A. rhagodioides** F. v. Müll., Benth. Fl. Austr. V (1870) 172.

Of this frutescent and mealy-white species two specimens are present in the collection. The first, No. 346, is a female specimen without any male flowers, but whith numerous fruits clustered along the branches. The bracteoles are without dorsal appendages, thickened to the top or nearly so, a narrow strip of thin tissue being sometimes left. The outline varies from rhomboid to nearly semiorbicular and broader than long; a medial point or blunt angle is always present. Width of bracteoles about 5—6 mm. — Most of leaves in this plant are hastate-lanceolate, but entire ones are also found.

The second plant, No. 347, is male, nevertheless some few fruits are found. The male flower-clusters are terminal, globular; only on the main shoots more are combined, so as to form something like a spike or panicle. — The leaves are lanceolate and entire, only the uppermost ones are angular below.

Carnarvon, in dunes (No. 346, 347, 31. Oct. 1914).

7. (?) **A. angulatum** Benth. Fl. Austr. V (1870) 174; F. v. Müll. Iconogr. 2 (1889) tab. 11.

No flowers or fruits present. The plant seems to be an erect shrub.

Kalgoorlie (No. 337, 7. Oct. 1914).

8. **A. exilifolia** F. v. Müll. Fragm. VII (1869) 9; Benth. Fl. Austr. V (1870) 175.

A semiglobose low undershrub. Flowering.

Port Hedland, in dune depressions (No. 1145, 3. Nov. 1914).

9. **A. spongiosa** F. v. Müll., in Benth. Fl. Austr. V (1870) 179; F. v. Müll. Iconogr. 2 (1889) tab. 20.

Carnarvon, in sand dunes. Fruiting (No. 345, 31. Oct. 1914).

IV. Chenolea Thunb.

10. **C. carnosa** (Moq.) Benth. Fl. Austr. V (1870) 190; *Echinopsilon ? carnosus* Moq., in D. C. Prodr. XIII 2 (1849) 136; *Bassia carnosa* F. v. Müll. Cens. Austr. pl. (1882) 30.

The perianth being spineless and wingless, this species must be named *Chenolea* and not *Bassia*. Suffrutescent; fruits unripe.

Kalgoorlie (No. 334, 7. Oct. 1914).

V. Bassia All.

11. **B. sclerolænoides** (F. v. Müll.) F. v. Müll. Cens. Austr. pl. (1882) 30; *Echinopsilon sclerolænoides* F. v. Müll. Fragm. VII (1869) 13; *Chenolea sclerolænoides* (F. v. Müll.) Benth. Fl. Austr. V (1870) 192.

Suffrutescent; fruiting.

Kalgoorlie (No. 333, 7. Oct. 1914).

12. **B. diacantha** (Nees) F. v. Müll. Cens. Austr. pl. (1882) 30, Iconogr. 8 (1891) tab. 78, *Anisacantha diacantha* Nees, in Lehm. pl. Preiss. I (1845) 635; *Kentropsis diacantha* Moq., in D. C. Prodr. XIII 2 (1849) 138; *Sclerolæna diacantha* Benth. Fl. Austr. V (1870) 194.

Fruiting.

Kalgoorlie (No. 338, 7. Oct. 1914).

13. **B. Drummondii** (Benth.) F. v. Müll. Cens. Austr. pl. (1882) 30; *Anisacantha Drummondii* Benth. Fl. Austr. V (1870) 199.

Stem and leaves strigose-tomentose, otherwise the plant agrees with BENTHAM's description. Fruiting; perianth bearing two long spines and one very short; seed vertical.

Kalgoorlie (No. 339, 7. Oct. 1914).

VI. Kochia Schrad.

14. **K. villosa** Ldl., in Mitch. Trop. Austr. (1848) 91; quoted from Benth. Fl. Austr. V, (1870) 186; F. v. Müll. Iconogr. 6 (1890) tab. 53; Diels in Engl. Jahrb. 35 (1905) 185.

A low erect shrub, young stems white-tomentose, leaves

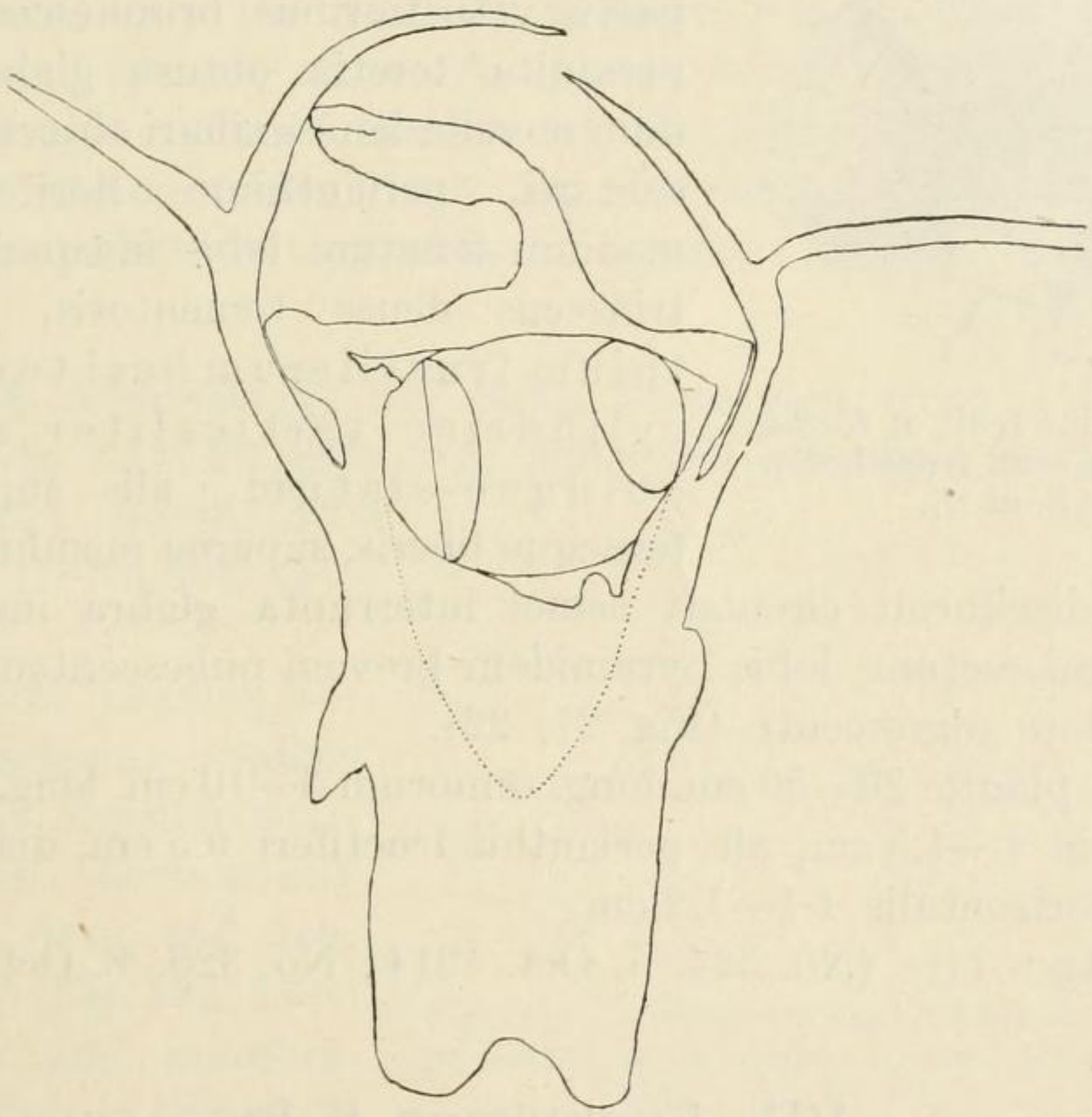


Fig. 21. Fruit of *Kochia Ostenfeldii* in longitudinal section. The section was somewhat excentric; the stipled line shows the extent of the inner cavity in center. About $^4/_1$.

terete, silky-tomentose, glabrescent; fruiting perianth 17—19 mm diam., glabrous, yellowish-brown.

Kalgoorlie (No. 342, 7. Oct. 1914).

15. **K. villosa** Ldl. var. **humilis** Benth. Fl. Austr. V (1870) 187.

Agrees with F. v. MÜLLER's specimens from Murray desert (Herb. Berlin). A low suffrutex, very hairy. Flowering and fruiting; fruiting perianth lanate, with reddish tint, diameter 7—9 mm.

Kalgoorlie (No. 325, 7.—8. Oct. 1914).

16. **K. sedifolia** F. v. Müll., Journ. of Bot. 8 (1856) 205; Iconogr. 6 (1890) tab. 54; Benth. Fl. Austr. V (1870) 187.

Leaves clavate tomentose, in dried state perfectly brown. Fruits few, fruiting perianth 6 mm diam.

Kalgoorlie (No. 329, 7. Oct. 1914).

17. **K. Ostenfeldii** n. sp. (Pl. V fig. 1).

K. ut videtur annua, caule stricte erecto ramis numerosis brevibus erecto-flexuosis munito et obtecto, dense lanato-tomentoso, tomento in ramis junioribus albo breviusculo (axillis tamen longe lanatis), in partis vetustioribus brunnescenti; folia permulta teretia obtusa glabrescentia, dum novella lana axillari obtecta. Flores solitarii, perianthium floriferum ad medium lobatum lobis inæqualibus extrinsecus dense tomentosis, perianthium fructiferum basi turbinato-cylindrico verticaliter anguste quinque-alatum, alis superne inferneque liberis, superne membrana horizontali disciformi circulari semel interrupta glabra instructum, apice semierectum, lobis pyramidem brevem pubescentem formantibus colore nigrescenti. (Fig. 21, 22).

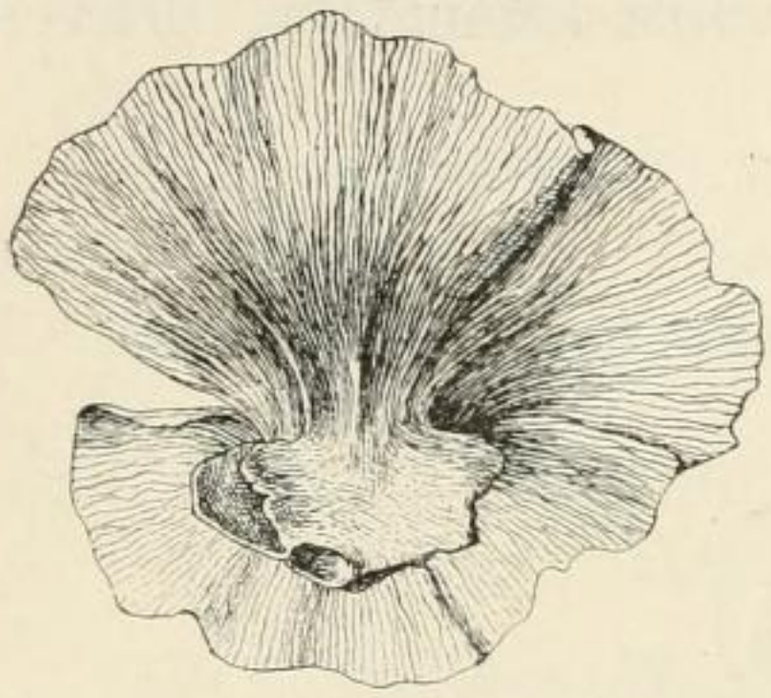


Fig. 22. Ripe fruit of *Kochia Ostenfeldii* seen from below. About $^{2}/_{1}$.

Alt. plantæ 20—50 cm, long. ramorum 3—10 cm, long. foliorum adultorum 1—1.5 cm, alt. perianthii fructiferi 0.5 cm, diam. membranæ horizontalis 1.1—1.2 cm.

Kalgoorlie (No. 324, 7. Oct. 1914; No. 326, 8. Oct. 1914).

VII. Enchylæna R. Br.

18. **E. tomentosa** R. Br. Prodr. (1810) 408; Benth. Fl. Austr. V (1870) 181; F. v. Müll. Iconogr. 9 (1891) tab. 85.

Fruiting.

Kalgoorlie (No. 331, 7. Oct. 1914).

VIII. Threlkeldia R. Br.

19. **T. diffusa** R. Br. Prodr. (1810) 410; Benth. Fl. Austr. V (1870) 197; F. v. Müll. Iconogr. 9 (1891) tab. 86.

A small shrub; fruiting.

Geraldton, in sand-dunes (No. 348, 28. Oct. 1914).

IX. Arthrocnemum Moq.

Since 1870, the year when Vol. V of BENTHAM's Flora appeared, no original treatment of Australian Salicornieæ has been published. Only some of BENTHAM's species have been given generic rank by HOOKER (*Tecticornia*, *Pachycornia*) who adds "analysis florum ob mollitiem organorum difficillima". It is true that it is a difficult tribe, and it seems to be disliked by systematists.

In trying to identify the species collected by Dr. OSTENFELD I have been able to compare them with Australian specimens from the Berlin Museum, kindly placed at my disposal by Professor DIELS. For the rest, no material was at hand for comparison, so I had to name the plants mostly after descriptions.

Allthough some of the species are not known to belong to the genus named above, they are enumerated here; when their seeds become known they may, if needed, be removed to other genera.

20. **A. Arbuscula** (R. Br.) Moq., Chen. mon. enum. (1840) 113; D. C. Prodr. XIII 2 (1849) 152; *Salicornia arbuscula* R. Br. Prodr. (1810) 411; Benth. Fl. Austr. V (1870) 203. (Pl. VI, fig. 1).

A shrub forming dome-like cushions. Spikes short; the fruiting perianths are horizontally emerging, free, and dentate above (Fig. 23). Pericarp thin and membranaceous, radicle below, albumen lateral and embryo curved.

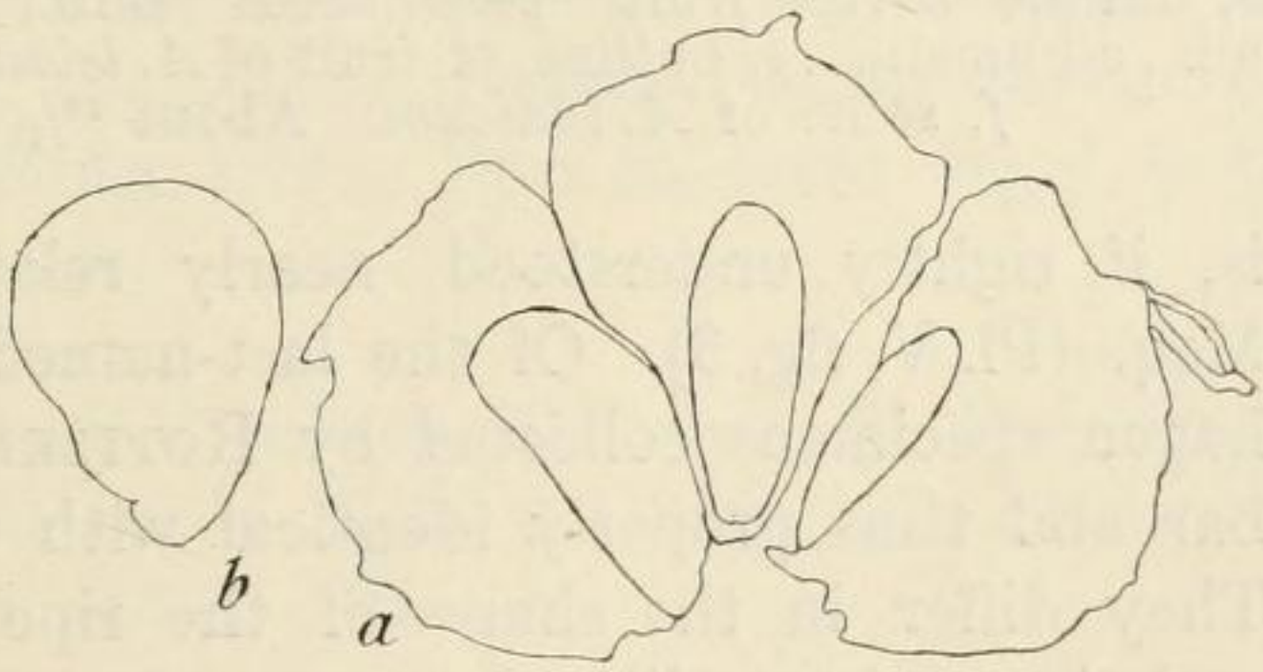


Fig. 23. *Arthrocnemum Arbuscula*. *a*, ripe perianths with seeds. *b*, seed seen from the side. About $^{10}/_{1}$.

Fruiting, only No. 330 not, this was apparently dying.

Kalgoorlie (No. 330, 7. Oct. 1914); Carnarvon (No. 351, 31. Oct. 1914); Port Hedland, in dune pans (No. 1142, 3. Nov. 1914).

21. **A. leiostachyum** (Benth.) comb. nov.; *Salicornia leiostachya* Benth. Fl. Austr. V (1870) 203. (Pl. V., fig. 2).

Shrubby, articles thickened upwards, shortly and bluntly bidentate, with scarious margins. Even between the nodes bearing ripe spikes the internodes are still covered by assimilatory tissue.

Ripe spikes nearly sessile, 1—3 cm long, 0.5—0.7 cm thick, blunt, cylindric or tapering upwards, with oblique depressed rings and no acuminate points. When the spike is broken, the fruiting perianth remains with the article below it. Flowers in threes, wholly immersed, perianth flattened above, without indentations. Ripe pericarp hard and brown, compressed, seen from the side broadly ovate (Fig. 24*e*); style withering, not persistent. Radicle below, albumen lateral.

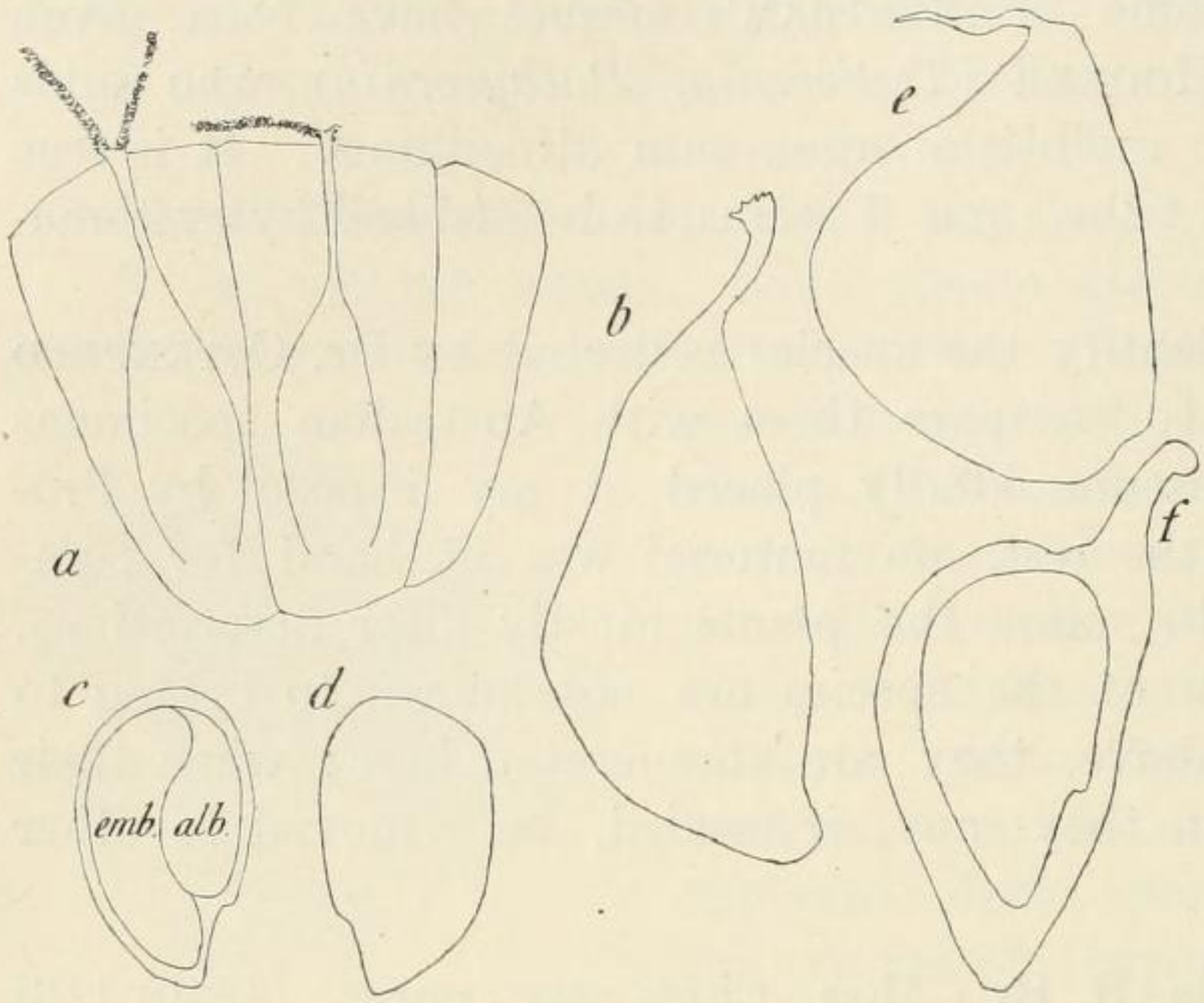


Fig. 24. *a*—*d*, *Arthrocnemum Benthami*. *a*, 3 fruiting perianths, the one on the right hand lacks ovary. *b*, outline of ripe fruit. *c*—*d*, seeds (emb., embryo, alb., albumen). *e*, outline of fruit of *A. leiostachyum*. *f*, same of *A. indicum*. About $^{10}/_{1}$.

This species has been identified from BENTHAM's description only. It is, if rightly understood, nearly related to *A. indicum* (Willd.) Moq. (Pl. V, fig. 3). Of the last-named species we have in Copenhagen specimens collected by ROTTLER on the plains at Tranquebar and thus properly identical with those seen by WILLDENOW. They differ in the shape of the ripe fruit. In *A. indicum*, the style is persistent like the rest, and placed obliquely (see Fig. 24, *f*), and the pericarp is obovate. As stated by UNGERN-STERNBERG (Versuch einer Systematik d. Tribus Salicornieae, Diss. Dorpat 1866, p. 70), the pericarp is easily fissuring in the sagittal plane. Were it not for these differences, the two species would seem to be identical. A study of a larger material, however, might perhaps reveal other differences.

Port Hedland (No. 1144 bis, 3. Nov. 1914).

22. **A. Benthami** n. sp. (Pl. VI, fig. 2).

Fruticosum erectum carnosum ramis oppositis internodiis superne vix dilatatis margine scarioso bifido lobis acutiusculis. Spicæ 0.8—2 cm longæ maturæ 0.4—0.5 cm crassæ breviter vel longiuscule pedunculatæ 8—12 articulatæ, articulis brevibus in

spicis junioribus margine scarioso leviter bifido, in spicis maturis lineis depressis leviter curvatis limitatis, curvaturis binis superioribus convexis oppositis in dentibus minutis productis.

Flores terni immersi articulo superiori arcte adhaerentes, perianthio superne dilatato edentulo, stamine uno anthera ad medium lobata, pericarpio indurato brunneo ovato-lanceolato, semine uno radicula infera albumine laterali (Fig. 24 *a*—*d*).

This species distinguishes itself from the preceding by the following characters: The stem bearing ripe spikes has as a rule lost its assimilatory tissue, the spikes are smaller, and the rings between the articles bear small acumens, the shape of the ripe pericarp is different, and the style is persistent. It may be that this is the true *A. leiostachyum*. The two species were collected in the same place and at the same time; Dr. Ostenfeld took them for the same species. He remarks that *A. Benthami* forms coarse flat cushions. On the other hand, a Berlin specimen is labelled: about $^3/_4$ m high. Dr. Ostenfeld has observed that broken off spikes of this and the foregoing species are carried by the wind, and thus sow out the seeds.

Point Samson (Cossack), outskirts of Mangrove (No. 1143, 2. Nov. 1914); Port Hedland, dune depression (No. 1144, 3. Nov. 1914). In the Berlin herb. the species is present from: Carnarvon (L. Diels, No. 3739), and South Austr., Port Adelaide, leg. J. G. O. Tepper.

23. **A.** (?) **bidens** Nees ab Esenbeck, in Lehm. Pl. Preissianae I (1845) 632; Moq. in D. C. Prodr. XIII 2 (1849) 151; *Salicornia bidens* Benth. Fl. Austr. V (1870) 203.

A sterile specimen only. It has been named on account of its relatively long and distinct foliar scales. Fruit and seed are not known, and thus it remains doubtful to which genus our species belong. — Preiss' original specimen was also from Swan River.

Swan River at Perth (No. 340 A, 6. Sept. 1914, E. Dorph-Petersen).

24. **A.** (?) **pruinosum** n. sp. (Pl. VI, fig. 3).

Erectum fruticosum ramosissimum ramis oppositis ramulorum articulis pruinoso-glaucis 1 cm brevioribus apice scarioso-dilatatis, lobis 2 oppositis quam collo laterali paullo majoribus acutatis vel angulatis. Spicæ 1—3.5 cm longæ 8—17 articulatæ articulis brevibus superne scarioso-dilatatis margine fere annularibus. Flores

terni non cum foliis cohærentes brevissime exserti, perianthio infundibuliformi superne bidentato, stamine uno, pericarpio membranaceo debili. Semina non adsunt (Fig. 25).

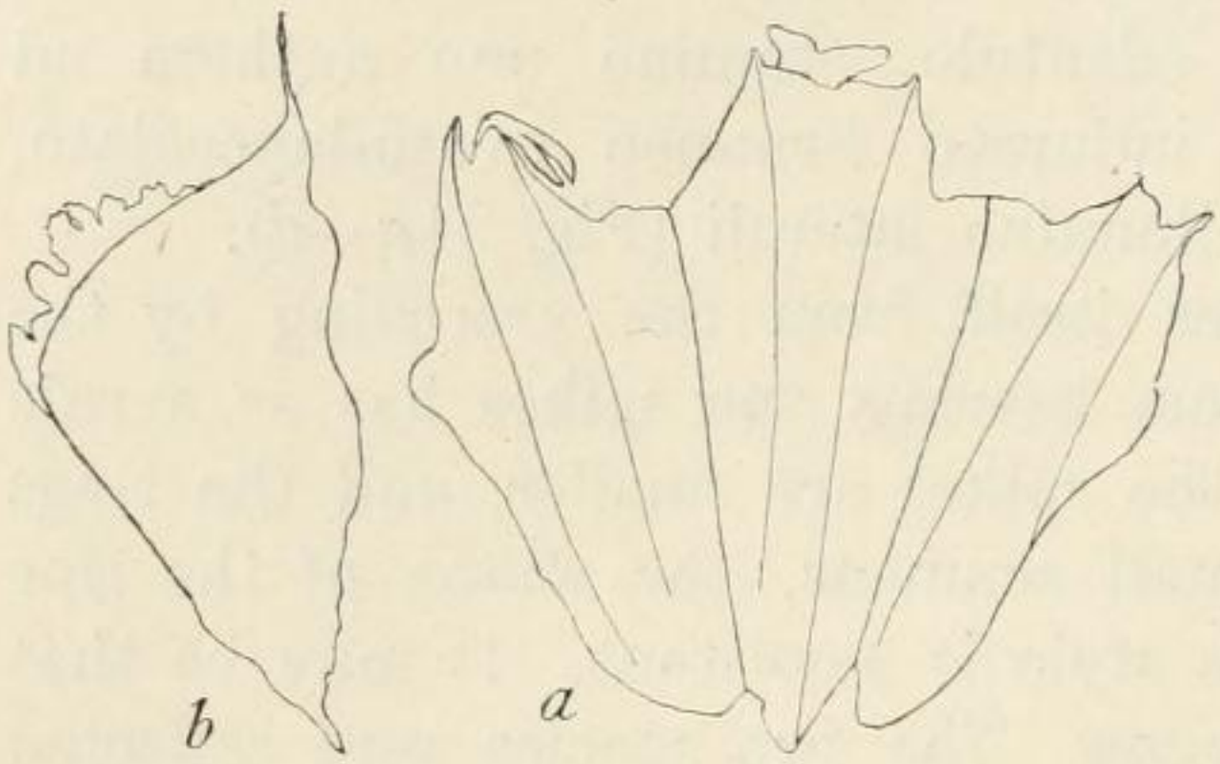


Fig.25. *Arthrocnemum pruinosum*. *a*, 3 flowers seen from outside. *b*, a flower seen from the left side, with hairs on its top. About $^{10}/_{1}$.

The bluish-green colour and the long spikes with unlobed margins are characteristic for this species. Flowering.

Carnarvon, on the beach (No. 349, 31. Oct. 1914).

25. **A. brachystachyum** n. sp. (Pl. VI, fig. 4).

Erectum fruticosum ramosissimum ramis oppositis ramulorum articulis viridibus (in sicco cinereo-viridibus) 1 cm brevioribus v. longioribus apice dilatatis et in dentes 2 distinctos acutos productis margine anguste scarioso. Spicæ 0.5—1.2 cm longæ ca. 0.3 cm crassæ articulis 4—8 brevibus inferioribus leviter et obtuse lobatis, superioribus margine fere annulari. Flores terni cum foliis non cohærentes, et juniores et vetustiores longe exserti perianthio superne breviter dentato, pericarpio cum stylo indurato brunnescenti semine uno albumine laterali radicula infera. Stamina non adsunt (Fig. 26).

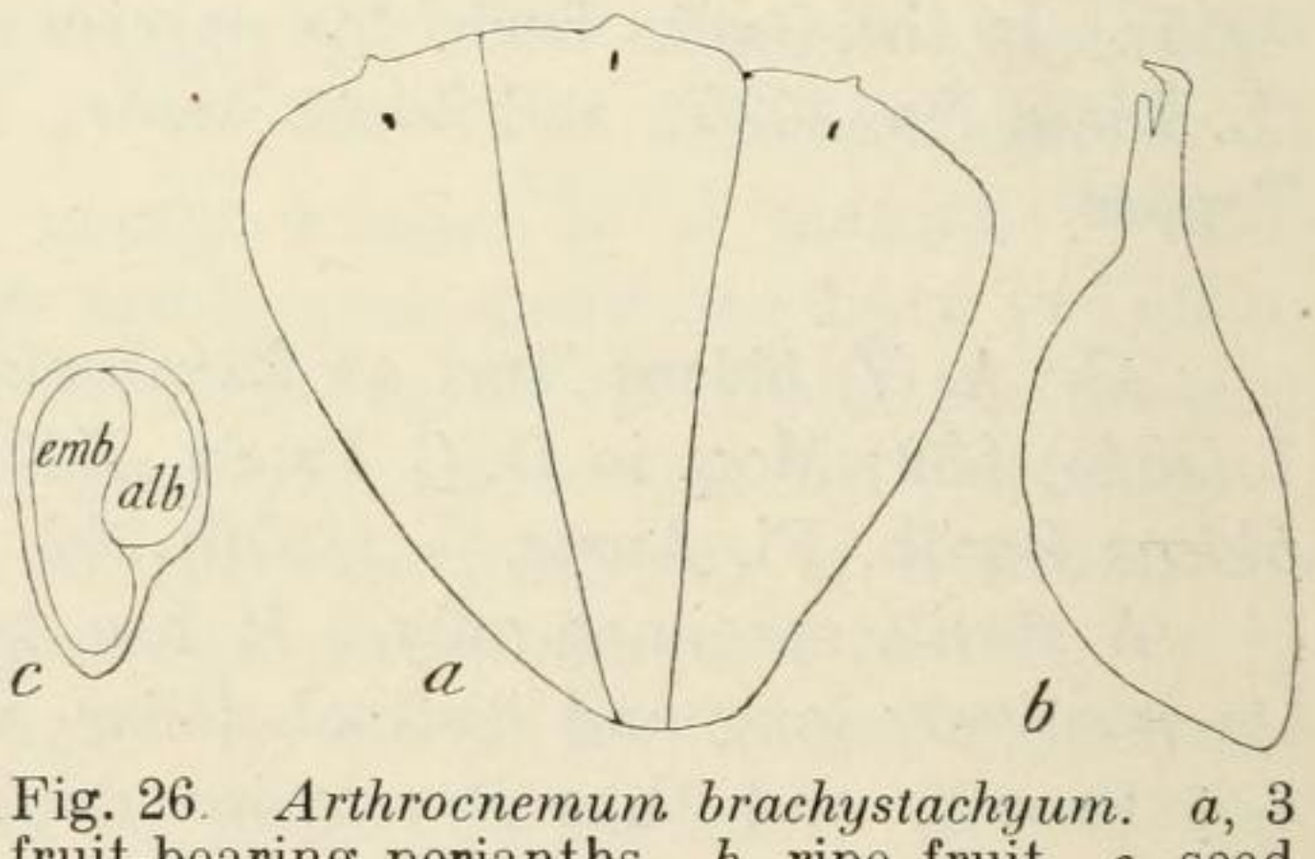


Fig. 26. *Arthrocnemum brachystachyum*. *a*, 3 fruit-bearing perianths. *b*, ripe fruit. *c*, seed (emb., embryo, alb., albumen). About $^{10}/_{1}$.

Characteristic especially by the shape and appearance of the spikes. Fruiting.

Carnarvon, on the beach (No. 352, 31. Oct. 1914).

X. Salicornia L.

26. **S. australis** Solander in Forster, Flor. insul. austral. prodrom. (1786) 88; Benth. Fl. Austr. V (1870) 205; *Salicornia indica* R. Br. Prodr. (1810) 411, non Willd.; ? *Halocnemum australasiacum*

Moq. in D. C. Prodr. XIII 2 (1849) 149; *Salicornia quinqueflora* Bge. in Ung. Sternberg l. c. (1866) 59.

A low bluish-green shrub. Flowers in fives, whereby this species is easily recognisable. The specimens have lost their fruits, the axes remaining. Here, then, the spikes are not tumbled about by the wind (comp. *A. leiostachyum*). From the deficiency of fruit and seed it is uncertain whether the species is a *Salicornia*, or an *Arthrocnemum*.

Carnarvon, in salt pans (No. 350, 31. Oct. 1914).

27. **S. sp.**

A slender, sterile specimen.

Swan River at Perth (No. 340 B, 6. Sept. 1914, E. Dorph-Petersen).

XI. Suæda Forsk.

28. **S. australis** (R. Br.) Moq., Ann. sc. nat. 23, (1831) 318; *Chenopodium australe* R. Br. Prodr. (1810) 407; *Chenopodina australis* Moq. in D. C. Prodr. XIII 2 (1849) 163; *Suæda maritima* Benth. Fl. Austr. V (1870) 206.

The specimens have been named *Suæda maritima* by Mr. J. H. Maiden. They are shrubby below, sterile, having thrown off their fruits, but the branches are shooting freely. Having had no opportunity to examine flower and fruit, I have made cross-sections of leaves. The anatomy of the leaf is, as a whole, like that of *S. maritima* from our North-European coasts, but there is one difference, namely that the epidermis is very papillose on all sides of the leaves[1]). Thus, both the shrubby habit of the plant and the shooting after flowering show that it is perennial, and the papillæ on the leaves give further proof for the assumption that *S. australis*, if derived from *S. maritima*, is no longer identical with it, but must be regarded as a distinct species.

Swan River at Perth (No. 341, 6. Sept. 1914, E. Dorph-Petersen). Derby, dominant in mangrove (No. 1163, 7. Nov. 1914).

29. **S. sp.**

A fragment.

Kalgoorlie (No. 232, 7. Oct. 1914).

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[1] On the value of anatomy in identification of the species of *Suæda*, see the present writer's book: Studies in the Vegetation of the Transcaspian Lowlands. Copenhagen 1912.

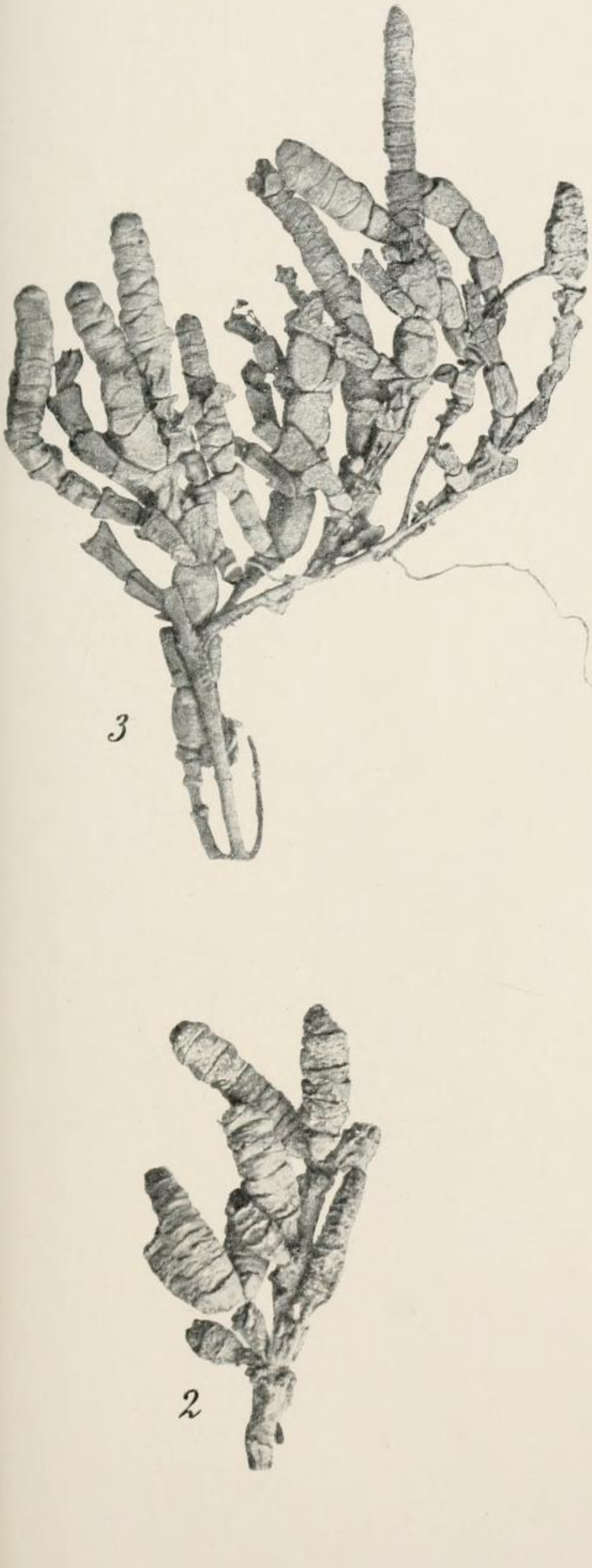
XII. Salsola.

30. **S. Kali** L. Spec. plant. (1753) 222; Benth. Fl. Austr. V (1870) 207.

A somewhat long-leaved and coarse orm. The anatomy of the leaves is like that in northern specimens.

Carnarvon, on sandy beach (No. 353, 31. Oct. 1914); Port Hedland (3. Nov. 1914).

(Issued 22th May 1918.)



1. *Kochia Ostenfeldii*, from Kalgoorlie. 2. *Arthrocnemum leiostachyum*, from Port Hedland 3. *Arthrocnemum indicum*, from Tranquebar, India. ($^2/_3$ nat. size).

1. *Arthrocnemum Arbuscula*, from Port Hedland. 2. *A. Benthami*, from Port Hedland. 3. *A.* (?) *pruinosum*, from Carnarvon. 4. *A. brachystachyum*, from Carnarvon. ($^2/_3$ nat. size).