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Australian Grasses

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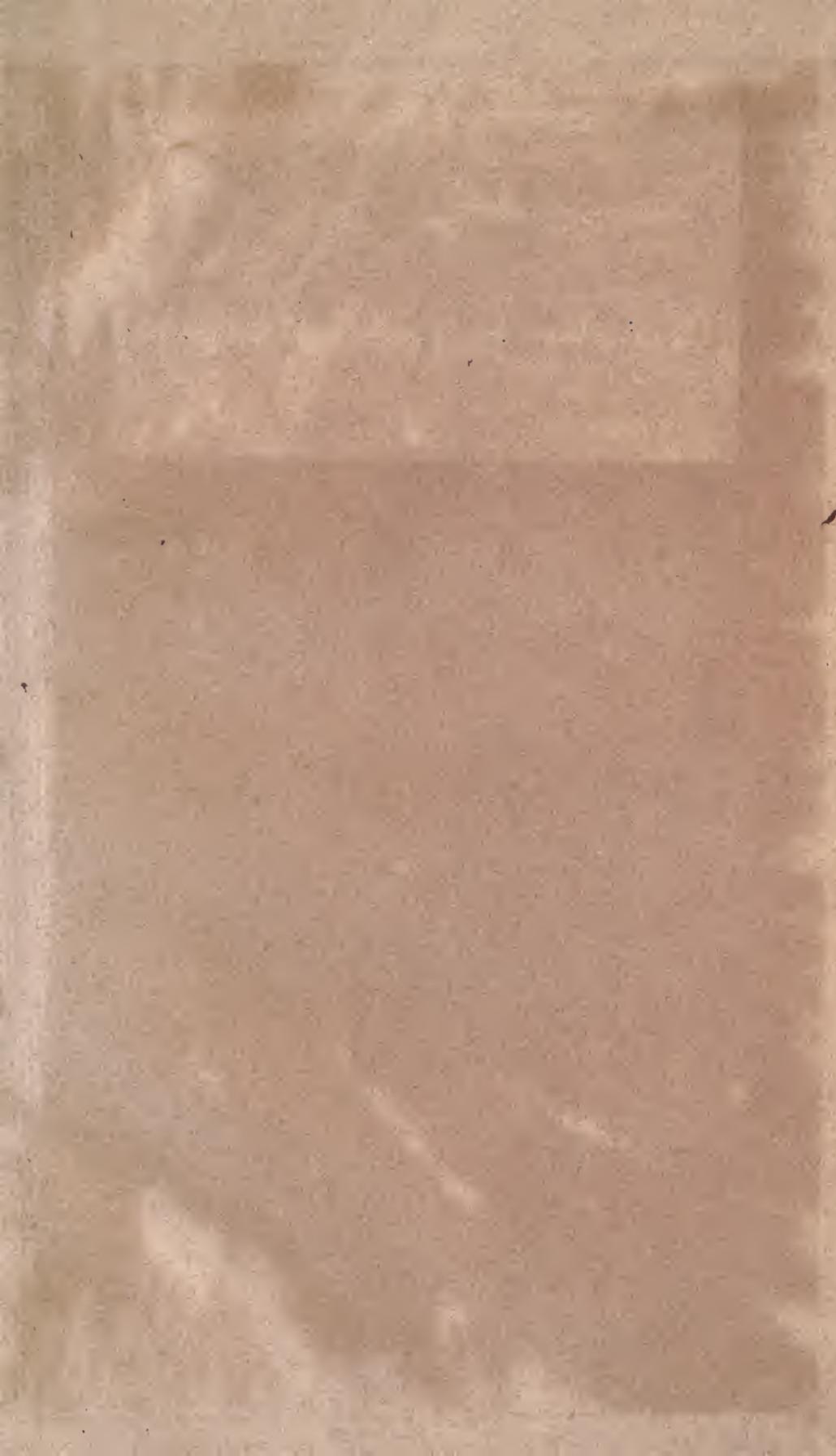
F. TURNER, F.L.S., F.R.H.S.

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NEW SOUTH WALES.

AUSTRALIAN GRASSES

(WITH ILLUSTRATIONS),

BY

FRED. TURNER, F.L.S., F.R.H.S.,
" ETC., ETC.,

Author of the "INDIGENOUS FORAGE PLANTS OF AUSTRALIA" (illustrated);
"A CENSUS OF THE GRASSES OF NEW SOUTH WALES";
"NEW COMMERCIAL CROPS FOR NEW SOUTH WALES" (illustrated); "NOXIOUS WEEDS:
INDIGENOUS AND EXOTIC" (illustrated);
"SUPPOSED POISONOUS PLANTS OF NEW SOUTH WALES" (illustrated); etc.

VOL. I.



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PREFACE.

THIS volume of Australian Grasses is published under the authority of the Honorable Sydney Smith, M.P., Minister for Mines and Agriculture, New South Wales.

During recent years I have been often asked by scientists and pastoralists to publish an illustrated and descriptive work on Australian grasses for general information, and in some of the press reviews of my work on the "Indigenous Forage Plants of Australia" (non-grasses), a hope was expressed that at no distant date a similar work on Australian grasses would be forthcoming from the same writer. Through the New South Wales Government I have the opportunity of placing such a work before the public, and I venture to think it will not only be a text-book on the subject but a medium of making Australian grasses and their economic properties better known throughout the world. My descriptions of Australian salsolaceous plants (salt-bushes) have been widely republished in this and in other countries for general information, and there is now a great demand for salt-bush seeds; not only for sowing in places on this continent; where the plants have become scarce, but for sowing in South Africa, India, South Europe, and some of the warmer States of North America.

During the past twenty years I have travelled over thirty thousand miles in New South Wales, Queensland, and Victoria. Some of this time was devoted to botanical excursions. For some time I was inspecting and reporting on the capabilities of Crown lands, and the best way of utilizing them, for the Government of New South Wales, and last, but not least, I have written many special reports on the pastoral areas of this country. A synopsis of three of these reports, on important grazing districts, is embodied in this book. I have also grown in an experimental way upwards of one hundred species of Australian grasses, which, I believe,

cannot be said by any one else in Australia who has written anything about them. It will be gathered from the above that the facilities for acquiring information and making observations have given me the necessary qualifications to write with authority on the subject. Since the experiments already referred to were carried out, the publication of my essay on the "Forage Plants and Grasses of Australia," which I read at the Melbourne University before the Australasian Association for the Advancement of Science, and the publication by the New South Wales Government of my "Census of the Grasses of New South Wales," and of my work on the "Indigenous Forage Plants of Australia," together with figures and descriptions of some Australian grasses, there has certainly been a great amount of interest awakened in the subject, not only in Australian scientists and pastoralists, but in those resident in other countries. Not long since I wrote a voluminous report on the herbage of this country, at the request of the American Consul, for the information of the United States Government.

Many successful pastoralists have told me that they knew little or nothing about the economic value of the herbage on their grazing areas until they saw my figures and read my descriptions of it, and are now convinced that the indigenous herbage is better suited to the conditions of the climate than a great many of the exotics which have been introduced and recommended for cultivation in many parts of the country. What are known as English grasses will succeed well enough in those parts of Australia which have a climate and rainfall somewhat similar to those of Northern Europe; but these comprise an exceedingly small area in comparison with the whole of the continent. To sow such grasses on most of the grazing areas in this country would only be courting failure.

It would appear that in the early days of settlement the value of the native forage plants and grasses occupied some attention, and different views were entertained on the subject. Sir Joseph Banks, to whom Australia is so much indebted for its early settlement, and for the development of its vegetable resources, remarks in one of his papers:—"The herbage of the Colony is by no means so well adapted to sheep farming as that of Europe, and therefore the progress of the flocks will be slow." This opinion, however, was

soon controverted, for Captain Waterhouse, in writing to Captain Macarthur in the early part of the century, says :—" That he had kept sheep, and found them do well on the natural pasturage, and he believed that good pasturage would be found for any number of sheep that may be raised. He, therefore, ridiculed the idea of artificial grasses being necessary." The opinions entertained by Captain Waterhouse nearly 100 years ago have been amply verified by subsequent experience.

Those who have done original work to popularise Australian grasses are :—Mr. Walter Hill, late Colonial Botanist of Queensland, and Director of the Brisbane Botanic Gardens, who was, I believe, the first person in Australia to recommend the systematic cultivation of, and carry out experiments with, the indigenous grasses. Mr. F. M. Bailey, F.L.S., and the late Mr. K. T. Staiger, F.L.S., who published electrotypes of some Queensland grasses, with a few notes on their importance in pastures. The late Mr. W. H. Bacchus, who published figures of some Victorian grasses, with notes of his observations of them, and the late Rev. Dr. W. Woolls, F.L.S., who published a paper on the grasses of New South Wales. In none of these illustrations are any anatomical drawings shown.

It would be superfluous in this preface to enter upon the present condition of Australian pastures and pasture plants, for in the introduction, and in the synopsis of three special reports already referred to, this subject is treated in a comprehensive way.

In the present volume I have not only endeavoured to show the habit of growth of each grass that is figured and described—a very important matter from a pastoral and agricultural point of view—but to give full dissectional details of the inflorescence of each species, so that no possible mistake can occur in identifying it. The anatomical drawings are the first that have ever been made of Australian grasses, and I have no doubt that they will be fully appreciated by scientists, students, and others who have a desire to be better acquainted with this important part of the Australian flora. There is both a scientific and a popular description of the economic value of each species that is figured ; the etymology of the scientific names is also a feature of the book, it being my desire to make it as popular as possible without in any way taking from

its value as a standard work upon the subject. A glossary of the technical terms used in the description of Australian grasses is also embodied in the book, so that any person can soon become thoroughly acquainted with the subject should he be desirous of so doing.

All the drawings, from which the engravings were taken, were made from herbarium specimens which I have collected, or have had collected, in their native habitats. The anatomical parts have been greatly magnified and drawn with the aid of the *Camera lucida*, so that they can be depended upon as being correct. Those persons who have had experience know the difficulty there is in making accurate botanical drawings from herbarium specimens, and will, I think, agree with me that great credit is due to Mr. E. M. Grosse, the artist, for the careful way in which he has done his part of the work.

To Messrs. F. and C. Bennett, the proprietors of the *Town and Country Journal*, my thanks are due for the excellent engravings which have been prepared at their establishment. The printing and binding have been done at the Government Printing Office, and it affords another proof of the excellence of the work performed at that establishment.

The nomenclature adopted is the same as that used in Bentham's "Flora Australiensis," and I am indebted to that valuable work for the botanical diagnosis of genera and species.

FRED. TURNER.

September, 1895.

INTRODUCTION.

It is an old proverb that says—"comparisons are odious," but I think I will be pardoned if I preface this introduction by quoting the following official figures from Mr. T. A. Coghlan's, "Seven Colonies of Australasia, for 1894," which show at a glance the value of five of the principal products that were raised in Australia during the year 1892:—Wool, £17,855,824; gold, £5,703,064; silver, £2,520,220; coal, £1,605,740; copper, £301,241. These figures clearly indicate from what product the principal wealth of this country is obtained. The number of sheep in Australia in 1892 was estimated at 101,637,179; and the number of cattle in the same year at 11,351,967. The value of the pastoral property was estimated in 1893 at over £200,000,000 (two hundred millions) sterling. If this enormous sum represents the value of the pastoral industry, what must be the value of the indigenous forage plants and grasses which provide feed for the millions of animals that are now grazing in this country? I think it may be safely said that very few, even amongst the most experienced pastoralists, ever look at the matter from this point of view, yet it is the most important one. It is the valuable herbage that is growing in this country, though it is not so plentiful and varied in some districts as it used to be, that has made Australia noted throughout the world for its rich pasturage. Shrewd business men have been often heard to make the remark, "What would Australia do without its wool"? but very few persons, however, ever pause to think what Australia would do without the indigenous herbage, which is really the principal factor in creating this valuable product. It is also often remarked, that the Australian climate is peculiarly favourable for the production of high class wool. Admitted that this may have some influence, thoughtful persons cannot close their eyes to the fact that good pasture is a more essential factor.

Considering that the prosperity of the people on this continent greatly depends, and will do so for many years to come, upon the quantity and also the quality of the wool, beef, mutton, butter, tallow, hides, &c., that are raised here, both for home consumption and for export; it has been a subject for remark that so little practical information, with the exception of my own publications, about the comparative merits of the different species of forage-plants and grasses that are indigenous to this country has been disseminated. Many successful pastoralists and dairymen have admitted to me that they knew very little about the forage-plants and grasses in their districts until they saw my figures and read my descriptions of them.

As a means of giving reliable information to the rising generation, the comparative merits of the indigenous forage-plants and grasses, indeed the vegetation in general, might form a part of the curriculum of the national education. If there were placed in all country State schools an enlarged drawing of each valuable species of forage-plant and grass, that is peculiar to the district in which the school was situated, with its botanical and common name, together with a short popular description, and if possible analysis, it might make a lasting impression upon the young mind, and would, most probably, lead to valuable results in after years.

As long as a greater portion of this continent is devoted to depasturing sheep and cattle and Australia intends to hold her own against the world in the production of high-class wool, also in the matter of the frozen meat export trade, it becomes of vital importance to the population that more attention should be paid to the native forage plants and grasses than has hitherto been the case and that some of them should be saved from extermination by a proper system of conservation and even cultivation. There is no gainsaying the fact that during the past twenty years or so large tracts of country in the interior have been so overstocked and overrun with rabbits and many valuable pasture plants have become so scarce that it would take some years of careful conservation to bring many of them back to anything like their original state. Being so closely fed down and often trampled under foot the plants have little chance to recuperate, and their only natural means of reproduction—namely, by seed—is also partially destroyed, and every decade under present conditions will make matters worse. Moreover, the paddocks being so constantly trampled upon are sometimes as hard as the roads throughout the country. Under these circumstances it can hardly be wondered at that some of the native grasses often present a harsh appearance, and if it were not for the sharp points on many of their seeds some of them would probably have been extinct long ago. These sharp-pointed seeds naturally penetrate the earth and when rain falls to soften it they germinate, and so the grasses are perpetuated in a sort of way. An occasionally good season may to a slight extent remedy this, but observant and thoughtful persons can see that in the near future more vigorous action will have to be taken to keep the pastures up to something like their pristine condition or the number of sheep and cattle will have to be considerably lessened, which of course means the production of less marketable produce. It should also be borne in mind that every fleece of wool which is produced takes a certain amount of potash and other fertile substances out of the earth, and very little so far has been done to restore these elements to the soil, except the little that is returned in a natural way.

Overstocking and the rabbit pest on certain pastoral areas in the interior of this country have already had an injurious effect upon some of the natural herbage. On such areas some of the more valuable plants have been so persistently eaten down that they are gradually dying out. Nor is this all, for many noxious weeds, both indigenous and exotic, bad grasses, and pine scrub are gradually occupying their place. So plentiful, indeed, have some of these pests become that laws have been directed towards their extermination. In certain parts of the interior the native "spear," "corkscrew," "wire," and "three-awned spear" grasses, and also the "burr" weeds are increasing. It is easy to account for the ever-widening area of their occupation, because when old they are seldom or never eaten and are allowed to seed at their own sweet will. The ground in many places being bare of more nutritious herbage, the seeds of these noxious plants germinate readily under ordinary conditions, and soon take possession of any unoccupied land. Their dissemination in many parts of the country may be accounted for by the fact that sheep and other animals will carry the "burrs" and "spear-grass seeds" in their wool and often deposit them miles from the plants that bore them. I have recorded and published the names of over 200 exotic weeds that have become acclimatised in this country. All these, of course, have not a prejudicial effect on wool or on the health of stock, therefore I shall only list a few of the really bad ones. Should any persons be desirous of consulting my published list of exotic weeds I would refer them to the *Agricultural Gazette* of New South Wales for 1890, vol. I, page 303.

Exotic Weeds.

Botanical Name.	Common Name.
<i>Argemone mexicana</i> , Linn.	Mexican Poppy.
<i>Bidens pilosa</i> , Linn.	Cobblers' Pegs.
<i>Centaurea calcitrapa</i> , Linn.	Star Thistle.
<i>Centaurea melitensis</i> , Linn.	Cockspur Thistle.
<i>Centaurea solstitialis</i> , Willd.	Cockspur Thistle.
<i>Cirsium arvense</i> , Scop.	Corn Thistle.
<i>Cirsium lanceolatum</i> , Scop.	Burr Thistle.
<i>Emex australis</i> , Steinh.	Three-cornered Jack.
<i>Galium aparine</i> , Linn.	Burr-weed, Cleavers.
<i>Kentrophyllum lanatum</i> , D'C.	Woolly Thistle.
<i>Medicago minima</i> , Willd.	Burr medick.
<i>Nicotiana glauca</i> , Grah.	Tree Tobacco.
<i>Onopordon acanthium</i> , Linn.	Scotch Thistle.
<i>Opuntia vulgaris</i> , Mill.	Prickly Pear.
<i>Rosa rubiginosa</i> , Linn.	Sweet Briar.
<i>Tagetes glandulifera</i> , Sch.	Stinking Roger.
<i>Xanthium spinosum</i> , Linn.	Bathurst Burr.
<i>Xanthium strumarium</i> , Linn.	Ditch Burr.

The following is a list of some of the worst of the indigenous weeds:—*Acæna ovina*, A. Cunn., *Acæna sanguisorbæ*, Vahl, *Anisacantha bicupsis*, F.V.M., *Anisacantha divaricata*, R. Br., *Anisacantha muricata*, Moq., *Calotis cunefolia*, R. Br., *Calotis dentex*, R. Br., *Calotis hispidula*, F.V.M., *Calotis lappulæa*, Benth., *Calotis scabiosifolia*, Sond., *Calotis scapigera*, Hook, *Sclerolæna bicornis*, Lindl., *Tribulus terrestris*, Linn., *Tribulus cistoides*, Linn., and *Tribulus hystrix*, R. Br.

Undesirable grasses.—It has been often remarked that several of the native grasses whilst young are really good pasture plants, but at the season of ripening their seeds, the latter are irritating and dangerous to the eyes of sheep and often cause blindness. Moreover, the seeds with their adherent awns not only become entangled in the wool which somewhat depreciates its value, but they often enter vital parts and cause death, and no doubt this, in a great measure, is correct. Unfortunately, when the grasses that bear these long seed-awns become old, cattle and sheep seldom or never eat them, consequently they grow and produce seed almost undisturbed. After many years of careful observation, I have arrived at the conclusion that the following species are most to be dreaded on account of their seed-awns or sharp-pointed leaves:—*Aristida arenaria*, Gaud.; *Aristida behriana*, F.V.M.; *Aristida calycina*, R. Br.; *Aristida depressa*, Retz.; *Aristida hygrometrica*, R. Br.; *Aristida leptopoda*, Benth.; *Aristida ramosa*, R. Br.; *Aristida stipoides*, R. Br.; *Aristida vagans*, Cav.; (these *Aristidas* are commonly known as “three-awned spear grasses”); *Heteropogon contortus*, Roem. et Schult.; *Heteropogon insignis*, Thu.; *Pollinia irritans*, Benth.; *Stipa aristiglumis*, F.V.M.; *Stipa flavescens*, Labill.; *Stipa micrantha*, Cav.; *Stipa pubescens*, R. Br.; *Stipa scabra*, Lindl.; *Stipa semibarbata*, R. Br.; *Stipa setacea*, R. Br. (these *Stipas* are commonly known as “spear,” “corkscrew,” and “wire” grasses); *Triodia cunninghamii*, Benth.; *Triodia irritans*, R. Br.; *Triodia mitchellii*, Benth.; *Triodia microstachya*, R. Br.; *Triodia procera*, R. Br.; *Triodia pungens*, R. Br. (these *Triodias* are commonly known as “porcupine” and “spinifex” grasses; the latter term, however, is a generic one given to quite distinct grasses, therefore, must not be confounded with

them); and *Eriachne squarrosa*, R. Br.; thus making, in all, twenty-six species, which is a little over 7 per cent. of the total recorded for the whole of Australia—not a very formidable array it must be admitted, still, of sufficient importance to make their position felt, and somewhat dreaded, by the sheep-owner.

Supposed poisonous plants and fungoid growths.—There are many trees, shrubs, and herbs, which are largely used as fodder, especially so during long droughts; though there is still much to be cleared up with respect to the actual value of certain of them. Even in the same district some persons will assert that a particular species of plant is poisonous, while others, whose testimony is equally reliable, will assert that it makes capital feed. There are, perhaps, no more conflicting statements made than with regard to the species of the genus *Eremophila*; and of the allied one *Myoporum*. Whilst I must admit that very little is known of the physiological properties of the order *Myoporineæ*, still I cannot close my eyes to the fact that both cattle and sheep kept in country where these shrubs are plentiful eat them with avidity and thrive on them, without any ill effects. Some persons assert that these *Myoporinous* plants develop their poisonous properties when in fruit, but whoever has studied the habits of the birds of Central Australia will assure them that certain of these greatly depend upon the fruits of these plants for their sustenance, which, in fact, are, in some seasons, their principal food supply. Moreover, the aborigines, before they tasted the sweets of civilisation, used to eat the fruits of several *Myoporinous* plants.

There is no doubt that when cattle and sheep are taken from one district to another where the natural herbage is somewhat dissimilar, it must have, for a time at least, some effect upon their systems, especially when they are taken from rolling downs of grass to country where shrubs and herbs predominate; and this brings to mind a question which I think has not received that attention from stock-owners that its importance justifies. It is the mechanical action that hard-foliaged shrubs have upon the larynx of both cattle and sheep which are not used to eating them. This irritation of the larynx not only brings on laryngitis, but sometimes tends to bring on inflammation of the intestines. Farther, when hungry sheep or cattle have partaken too freely of some leguminous plants, especially when in flower or seed, they have died. But this is caused during the process of digestion, when great quantities of gases are made, which cause an abnormal distention of the stomach, thus preventing the lungs working freely, and, of course, strangling the animals. On this account many leguminous plants are called poisonous which are not really so. Still these causes could not account for all the sheep that die somewhat mysteriously. I use the word mysteriously advisedly, for many plants have been received by me marked poisonous which, on examination, have proved to be quite harmless. Nor is my case a singular one. Others have had the same experience. No doubt there are some poisonous plants in the country; but unless animals are sickly, weakly, or hard pressed for food, their natural instincts will lead them to avoid browsing upon them. There is a far more insidious enemy to contend against in the parasitic fungi which affect certain grasses and other herbage, not only in the damp coastal districts, but even into the far interior. Some years ago I drew attention to the increase of parasitic fungi on certain valuable grasses, and I then said, what I think now, that fungoid growths on grasses and other herbage is the primary cause of many sheep dying so mysteriously. For there is abundant proof of the destructive agency of microscopic fungi both on animals and flowering plants that have not sufficient vigour to repel

them. The life history of these native fungoid growths is well worth studying by specialists, if only to show what their effects are upon animals. The following is a list of the native grasses which I have seen badly affected with parasitic fungi:—*Aristida ramosa*, R. Br., “Three-awned spear grass”; *Chloris truncata*, R. Br., “Star” or “windmill grass”; *Eragrostis leptostachya*, Steud., “Love grass”; *Eriochloa punctata*, Hamilt., “Early spring grass”; *Hierochloa rariflora*, Hook., “Sweet-scented holygrass”; *Panicum effusum*, R. Br., “Branched panick grass”; *Panicum mitchellii*, “Mitchell’s panick grass”; *Paspalum scrobiculatum*, Linn., “Ditch millet”; *Sporobolus indicus*, R. Br.; and the variety *elongatus*, “Parramatta” or “Tussock grass.”

I have been often asked whether I favour the annual burning off of grasses. Except in three cases, I am decidedly against burning off, for the following reasons:—1. It destroys millions of grass seeds which occasional good seasons may have brought to maturity, thereby destroying the only natural means for the reproduction of the grasses. A fire also destroys many valuable salsolaceous and other plants. 2. After burning off, if favourable weather ensues, new growth is made quickly, and sheep turned into such pasturage eat greedily of it, which often gives them what is commonly termed the scours or diarrhœa, which sometimes becomes chronic, and of course has such a weakening effect upon them that many die. Nor is this all, for in biting out the young growth from the heart of the grass, much of the latter is often brought with it, which, of course, partially destroys it. If a fire should take place, sheep should never be turned into the pasture until it has made considerable growth, though cattle may be turned in without any serious damage being done, for they never eat grasses so low as do sheep. I may here mention the fact that sheep destroy the natural grasses and herbage in much less time than horses, and the latter much sooner than cattle.

I am in favour of burning off annually under three such conditions as the following:—(1st) Where grasses and other herbage are much diseased with parasitic fungi; (2nd) where there is a predominance of “spear,” “corkscrew,” “wire,” and “three-awned spear” grasses; and (3rd) where rank-growing grasses are abundant, which is generally on wet or undrained land, for along with this coarse growth many noxious plants and fungoid pests are destroyed (very rarely good pasture plants, other than grasses, will grow in such situations). Pasturage treated in this way becomes more healthy, the fire acting as a disinfectant, and contagious diseases disappear. Grasses that grow in low, damp situations are often a valuable stand-by for stock during protracted droughts.

The practice of wholesale and indiscriminate ringbarking, I feel certain, exercises a most injurious effect upon both animals and the herbage which they browse upon. Do not let it be understood that I condemn judicious ringbarking, because experience has proved the beneficial effects of it when carried out in a systematic way. What I wish to impress upon pastoralists is the necessity for leaving large groups of trees here and there as we see them in English parks, but, of course, on a much more extensive scale. This would not only give shelter to animals against the fierce heat of the tropical sun in summer, and the other extreme in winter, but would be a means of checking bush fires and mitigate the blighting effects of the hot parching winds that periodically blow over the interior, besides forming a pleasing feature in the landscape.

Having considered the state of the pastures and pasture plants, I shall now review the grasses and salsolaceous plants (salt bushes) and offer suggestions which I think would make a decided improvement in, and help

to bring, many of the grazing areas to something like their pristine condition. It cannot be said that we have no material to work upon, for there are upwards of 360 species of grasses indigenous to this country. All these, of course, are not valuable for fodder, but they have their uses in the economy of nature, which will be afterwards referred to. Amongst many other native fodder plants the most numerous and valuable are to be found in the natural order *Chenopodiaceæ*, numbering as they do for all Australia about 112 species, arranged under fifteen genera, eight of which are endemic. Some of them are found on the littoral sands, while others grow on the arid plains of the interior, and are remarkable for their drought-enduring qualities.

By the following figures some idea may be formed of the number of grass seeds required for 1 acre, supposing it to be sown at the usual rate of 36 lb. which, approximately stated, is equal to about 22,000,000 of grains. This applies to ordinary grass seeds, such as some species of *Andropogon*, *Chloris*, *Eragrostis*, *Panicum*, &c. The number of grains vary somewhat one way or the other (no other seeds in the vegetable kingdom vary more, either in weight or number) according to the good or bad season they were harvested in. An acre well clothed with grass would contain from 15,000,000 to 20,000,000 plants, though in some exceptional cases as many as 40,000,000 plants have been recorded to the acre. Such facts as these are suggestive, and cannot be trifled with, and it is no wonder that thinking persons are apprehensive as to the future condition of our pastures, unless some radical change takes place. The present system of eating out the best native grasses on some sheep runs cannot go on for ever. Many persons have thought that by introducing exotic fodder-plants and grasses these would, in a great measure, supersede, and be an improvement upon, the indigenous ones. But it has often struck me as being a most remarkable thing that those persons who have written up the supposed virtues of exotics have given no guarantee that our high-class wool, beef, and mutton, would be maintained under this new diet. Keeping these circumstances in view, is it not much better to systematically conserve, and even cultivate, the best of our native forage-plants and grasses than introduce others of which we have only a superficial knowledge? Many exotic species have been introduced as good forage plants, which have proved a positive pest to the country. Every one must be painfully reminded of this fact when they see that ubiquitous Cape-weed (*Cryptostemma calendulaceum*, R. Br.) which already covers large areas of pasture land, and the area of its occupation widens from year to year to the gradual extinction of some of our native herbs and grasses. The prickly comfrey (*Symphytum asperinum*, Bbrst.) was heralded throughout Australia a few years ago as a fodder plant that was to supersede all others. What is the consequence, after years of careful nursing? It has proved a positive failure in the country after all the money expended in introducing and cultivating it. A Canary Island shrub called Tagosaste (*Cytisus proliferus*, Linn.) has occupied much attention for some years past in certain places, which experience will eventually prove to have been misdirected. I have observed this shrub for a number of years, having raised from seed some of the first plants ever seen in Australia. I once had a shrub under my charge which was about 15 feet high; but I can firmly assert that the "old man" salt-bush (*Rhagodia parabolica*, R. Br.) would at the same age have produced about twice the amount of a superior forage, and would even grow in more adverse seasons of drought and heat. Of late a great deal of attention has been directed to another exotic forage plant, called *Lathyrus sylvestris*, Linn., and commonly known as "Wagner's Flat Pea." Seeds of this plant were imported into New South Wales, but it is reported from nearly every part of the Colony

where the seeds were distributed that the plants raised from them have proved a comparative failure, notwithstanding the soil being carefully prepared previous to the sowing taking place. Do not let it be understood that I decry all the plants that have been introduced for forage purposes, because that would not be in accordance with facts. What I do mean to say is, that hundreds of pounds have been sent out of this country to introduce seeds of exotic forage plants and grasses which, after careful cultivation, have proved a failure. To give even a synopsis of all the exotic forage plants and grasses which I know have been introduced and, when cultivated, proved unsuitable to the climate would occupy too much space. If the money and the labour that have been expended upon such plants had been devoted to the systematic conservation of the best of our native forage plants and grasses, many of our pastures would be in a better condition than they are at present.

I must confess that at one period I held the views of those persons who thought to supplant the native herbage by a free introduction of exotics; but after an observation extending over twenty years, during which time I have travelled over thousands of miles in this country and conversed with many interested persons in New South Wales, Queensland, and Victoria, I have outlived those erroneous ideas. My first observations were made some years ago when Mr. W. Hill, late Colonial Botanist of Queensland, and Director of the Brisbane Botanic Gardens, gave me charge of a series of experiments that were carried out with both native and exotic forage plants and grasses, with a view of proving their true qualities by comparison. The exotic forage plants and grasses experimented with were some of the best that could be obtained in Europe, Asia, Africa, and America. All of them were sown or planted in spaces exactly 1 yard square, which gave an accurate way of computing the yield of produce per acre of each species. When they arrived at maturity they were cut and weighed whilst in a green state, and also when they were dry. To enumerate all the species experimented with—nearly 100—together with a detailed description, would occupy many pages; but to sum up briefly, I may state that the native ones yielded more at the rate per acre than did the exotics, with the exception of such tall-growing grasses as *Panicum maximum*, Jacq., "Guinea grass"; *Panicum spectabile*, Nees, "Angola grass"; *Reana luxurians*, Dur., "Teosinte"; *Sorghum vulgare*, Pers., "Guinea corn"; *Zea mays*, Linn., "Maize"; and some of the larger kinds of millet. But these were run very close by the following native ones:—*Anthistiria avenacea*, F.V.M., "Tall oat grass"; *Astrebla pectinata*, F.V.M., "Mitchell grass"; *Heteropogon insignis*, Thu., "Giant spear-grass"; *Panicum crus-galli*, Linn., "Barn-yard grass"; *Pollinia fulva*, Benth. "Sugar grass"; *Rottboellia ophiuroides*, Benth. "Barron River grass," *Sorghum halepense*, Pers., "Aleppo grass;" and *Sorghum plumosum*, Beauv., "Wild sorghum." It is a well-known fact, however, amongst agriculturists, that tall growing grasses are not always, in fact, scarcely ever so useful in pastures as the more dwarf ones, though they are of the greatest value for ensilage, where bulk is a great consideration. Another fact to be related with regard to these forage plants and grasses I experimented with is, that horses picked out and ate the native ones in preference to the exotics after they were mixed together and given to them, which I think proved conclusively that with cultivation, native grasses will become as succulent and tempting to the appetite and as nutritious as the best of exotics. The species experimented with that were indigenous to Northern Europe and North America proved most unsuitable, with two exceptions, one an annual growth in some situations, *Ceratochloa unioloides*, D'C. "Prairie grass," a capital winter and spring species, and the other a perennial—*Poa pratensis*,

Linn. Var. *virginiana*, the "Kentucky blue grass." This species has underground stoloniferous roots like our native *Cynodon dactylon*, Pers. "Couch grass," so on this account it is not easy to exterminate, whilst it affords excellent forage for sheep. The grasses from South Africa did fairly well, especially *Tricholæna rosea*, Nees, the "Red-topped grass" of Natal, which has become quite acclimatised in some situations. Its ripe seeds, being light, are easily disseminated by every wind that blows. Some South American species did well, as also did the "Californian bunch grass," *Elymus condensatus*, Pers.; but it must be borne in mind that all these exotic grasses were tested in the coastal districts, and it is a question whether they would have grown at all if they had been sown or planted on the arid, central plains of Australia. All these experiments were carried out on a black, loamy soil, but I saw other experiments carried out on different soils, and the results were much the same, except in the case of pure sand, which appears less favourable to their growth than any other. Even this has species peculiar to itself. I mention these facts, for undue importance has been given by some persons to the different geological formations necessary for the growth of particular pasture plants. Of course, where soils are naturally very light, or very heavy, very dry, or excessively wet, it is than necessary to make a selection of the most suitable species for such situations; but to advise fifty different geological formations for growing the same number of pasture plants is mere pedantry.

Grasses and other forage plants have been recommended by persons who had formed their judgments of their merits upon imperfect trials or upon everyday evidence. This has caused much disappointment and has discouraged many persons from further endeavours at improvements of their pastures. To this also may be attributed the general indifference towards obtaining a knowledge of the comparative merits of grasses and other forage plants. There is one good thing, however, those persons have done for the country who have recommended exotic grasses for cultivation: they always give directions for the soil to be broken up and brought to a fine tilth before the sowing takes place. But what a contrast this is to the continual struggle for existence the native grasses have to undergo, for the paddocks are often as hard as the roads throughout the country.

There is no doubt that the pastures in the coastal districts and colder parts of the country can be improved by introducing some exotics, especially those that make their growth during winter and early spring, for as a general rule most of the grasses make their growth during the summer season. Amongst the exceptions are *Agropyrum scabrum*, Beauv., "Wheat grass"; *Andropogon affinis*, R. Br., "Blue grass"; *Bromus arenarius*, Labill., "Barley grass"; *Eriochloa annulata*, Kunth., "Early spring grass"; *Eriochloa punctata*, Hamilt., "Early spring grass"; *Echinopogon ovatus*, Beauv., "Rough-bearded grass"; *Danthonia semiannularis*, R. Br., "Wallaby grass"; *Deyeuxia billardieri*, Kunth., "Bent grass"; *Deyeuxia forsteri*, Kunth., "Bent grass"; *Dichelachne crinita*, Hook., "Long hair plume grass"; *Dichelachne sciurea*, Hook., "Short hair plume grass"; *Festuca bromoides*, Linn., "Barren fescue"; *Lappago racemosa*, Willd., "Small burr grass"; and *Microlæna stipoides*, R. Br., "Meadow rice grass."

Many have thought to improve their grazing areas by introducing English grasses; but a number of these grasses have been sown in districts and on soils quite unsuited to their growth. Hundreds of acres have been sown with such grasses in this country, and notwithstanding all the money and labour that have been expended in this way over a series of years, there are hardly half a dozen species of agricultural importance that have been successfully

introduced and acclimatised in our pastures even in the most favoured districts. The only districts in this country where English grasses are at all likely to succeed are those having a climate and rainfall similar to those of Northern Europe; but these districts form only an extremely small portion of the country compared with the whole. It will be readily inferred from this that we shall have to look for grasses other than English ones to provide good feed for the majority of our stock. The valuable indigenous forage plants and grasses hitherto have been, are now, and will be the principal mainstay of the pastures. Without them, the millions of sheep, cattle, and horses that are depastured in this country would die of starvation, and the country would then be deprived of its greatest wealth in the form of wool, tallow, hides, beef, mutton, and butter. It has been observed that the native grasses are wild. Of course they are, and so are the cultivated grasses wild in their native habitats.

Before an attempt is made at the systematic cultivation of the indigenous forage plants and grasses, it will be necessary to have some data to work upon. For the benefit of those persons who desire to enter upon their cultivation, I will divide them into groups, and give a synopsis of those species which, after twenty years' study, have led me to believe will be most suited to the requirements for general pasture and hay-making, cultivating for grain, species suitable for wet or undrained soils, also for dry soils, and for binding the littoral sands. I have already mentioned those species most suitable to cultivate for ensilage.

Those species suitable for general pasture and hay-making are:—*Agropyrum scabrum*, Beauv., "Wheat grass"; *Andropogon affinis*, R. Br., "Blue grass"; *Andropogon erianthoides*, F. V. M., "Satin heads"; *Andropogon intermedius*, R. Br., "Blue grass"; *Andropogon pertusus*, Willd., "Pitted blue grass"; *Andropogon refractus*, R. Br., a "Kangaroo grass"; *Andropogon sericeus*, R. Br., "Blue grass"; *Anthistiria ciliata*, Linn., "Kangaroo grass"; *Anthistiria membranacea*, Lindl., "Landsborough grass"; *Astrebula clymoides*, F.V.M., "Mitchell grass"; *Astrebula pectinata*, F.V.M., "Mitchell grass"; *Astrebula triticoides*, F.V.M., and the variety *lappacea*, "Mitchell grasses"; *Chloris acicularis*, Lindl., "Spider grass"; *Chloris truncata*, R. Br., "Star" or "Windmill grass"; *Chloris ventricosa*, R. Br., "Blue star grass"; *Chrysopogon gryllus*, Trin., "Golden beard"; *Cynodon dactylon*, Pers., "Couch grass"; *Danthonia longifolia*, R. Br., "White top"; *Danthonia pallida*, R. Br. "Silver grass"; *Danthonia pilosa*, R. Br., "Hairy oat grass"; *Danthonia semiannularis*, R. Br., "Wallaby grass"; *Dichelachne erinita*, Hook, "Long hair plume grass"; *Eleusine ægyptiaca*, Pers., "Finger grass"; *Eragrostis brownii*, Nees., "Brown's love grass"; *Eragrostis leptostachya*, Steud., "Love grass"; *Eragrostis pilosa*, Beauv., "Weeping grass"; *Eriochloa annulata*, Kunth., "Early spring grass"; *Eriochloa punctata*, Hamilt., "Early spring grass"; *Microlæna stipoides*, R. Br., "Meadow rice grass"; *Panicum decompositum*, R. Br., "Australian millet"; *Panicum distachyum*, Linn., "Two-spiked panick grass"; *Panicum divaricatum*, R. Br., "Umbrella grass"; *Panicum effusum*, R. Br., "Branched panick grass"; *Panicum flavidum*, R. Br., "Warrego summer grass"; *Panicum gracile*, R. Br., "Slender panick grass"; *Panicum leucophæum*, H. B. et K., "Cotton grass"; *Panicum macractinium*, Benth., "Roly poly grass"; *Panicum melananthum*, F.v.M., "Black seeded panick grass"; *Panicum reversum*, F.v.M., "Reversed panick grass"; *Panicum mitchellii*, Benth., "Mitchell's panick grass"; *Panicum prolatum*, F.v.M., "Rigid panick grass"; *Panicum trachyrhachis*, Benth., "Coolibar grass"; *Poa caspitosa*, Forst., "Tussock poa"; and *Setaria glauca*, Beauv., "Pigeon grass".

GRASSES TO CULTIVATE FOR GRAIN.

It is a most remarkable fact that the native countries of wheat, oats, and barley, should be entirely unknown. Many eminent botanists are of opinion that all our cereals are artificial productions, obtained accidentally, but retaining their habits, which have become fixed in the long course of ages, and the following observations seem to bear out this theory. It has been observed that when oats are grown on poor land and shed their grain, the progeny will, if left uncultivated for a generation or two, revert to the wild form, but that cultivation will bring the grain back to its proper standard. *Egilops ovata*, Willd., (of which I have cultivated specimens of three generations in my herbarium, two of which show a marked tendency towards improvement,) is said to be the origin of all our cultivated wheats, and as a convincing proof of this it is remarkable that this genus of grass is subject to the attacks of the same species of parasitic fungi which affect the wheat crops of the present day, and render them somewhat precarious in some districts during certain seasons.

When these plants can be so changed with cultivation as to afford us useful grain, it seems a most feasible thing that out of 360 species of grasses found on this continent, some could be cultivated that would yield good grain without its attendant drawbacks, in the way of parasitic fungi, especially in some parts of Australia where wheat and other cultivated cereals are often a precarious crop. During the experiments already referred to, I observed that the grains of some of the native grasses developed very much under cultivation, more especially in the case of one species, *Astrebala triticoides*, F.v.M., var. *lappacea*, (*Danthonia lappacea* of Lindley). This grass produced ears nearly 6 inches long, well filled with a clean-looking, firm grain, which separated easily from the chaff, somewhat like wheat. During long observation I have never seen any species of parasitic fungi attack either the straw or grain of this grass, nor from enquiries made have I ever heard that it is affected with fungoid growth. All our common cereals are of annual growth, but this species is perennial, and attains a height of about 3 feet. It has a stout clean straw which would, after the grain was thrashed out, make good fodder. Other native grasses that might be cultivated for grain are:—*Anthistiria avenacea*, F.v.M., "Tall oat grass"; *Leersia hexandra*, Swartz., "Native rice grass"; *Eragrostis pilosa*, Beauv., "Weeping-grass"; *Panicum decompositum*, R.Br. "Australian-millet"; *Panicum flavidum* Retz., "Warrego summer grass," *Panicum semialatum*, R.Br., "Cockatoo grass"; *Panicum trachyrhachis*, Benth., "Coolibar grass"; *Setaria glauca* Beauv., "Pigeon grass"; and *Setaria macrostachya*, H.B. et. K., "Large-headed millet."

The following species are the most suitable for growing on wet or undrained lands:—*Anthraxon ciliare*, Palis, "Swamp grass"; *Diplachne fusca*, Beauv., "Brown-flowered swamp grass"; *Elionurus citreus*, Munro, "Lemon scented grass"; *Glyceria fluitans*, R.Br., "Manna grass"; *Glyceria fordeana*, F.v.M., "Sweet grass"; *Glyceria ramigera*, F.v.M., "Cane grass"; *Hemarthria compressa*, R.Br., "Mat grass"; *Imperata arundinacea*, Cyr., "Blady grass"; *Isachne australis*, R.Br., "Swamp millet"; *Ischænum australe*, R.Br., "Southern grass"; *Leersia hexandra*, Swartz., "Native rice grass"; *Leptochloa chinensis*, Nees, "Weeping grass"; *Leptochloa subdigitata*, Trin., "Finger grass"; *Panicum indicum*, Linn., "Indian panick grass"; *Panicum melananthum*, F.v.M., "Black-seeded panick grass"; *Paspalum distichum*, Linn., "Water couch"; *Paspalum serobiculatum*, Linn., "Ditch millet"; *Pennisetum compressum*, R.Br., "Swamp foxtail grass"; *Phragmites communis*, Trin., "Common reed"; *Pollinia fulva*,

Benth., "Sugar grass"; *Sporobolus diander*, Beauv., "Tussock grass"; *Sporobolus virginicus*, Kunth., "Salt-marsh couch grass"; and *Sporobolus indicus*, R.Br., "Parramatta grass". The latter is an exceedingly tough grass which I have often recommended for paper-making.

Grasses suitable for growing on dry stony ridges, or on poor soils, are:—*Amphipogon strictus*, R.Br., "Bearded heads"; *Andropogon lachnatherus*, Benth., "Hairy blue grass"; *Anisopogon avenaceus*, R.Br., "Oat grass"; *Arundinella nepalensis*, Trin., "Nepal grass"; *Chrysopogon parviflorus*; Benth., "Golden beard"; *Deyeuxia quadriseta*, Benth., "Bent grass"; *Echinopogon ovatus*, Beauv., "Rough heads"; *Eragrostis chatophylla*, Steud., "Love grass"; *Eragrostis eriopoda*, Benth., "Love grass"; *Eragrostis falcata* Gaud., "Love grass"; *Eragrostis laniflora*, Benth., "Love grass"; *Eragrostis lacunaria*, F.V.M., "Never fail"; *Eriachne obtusa*, R.Br., *Lappago racemosa*, Willd., "Burr grass"; *Neurachne mitchelliana*, Nees., "Mulga grass"; *Panicum gracile*, R.Br., "Slender panick grass"; *Pappophorum nigricans*, R.Br., "Black heads"; *Spinifex paradoxus*, Benth., "Curious spinifex"; and *Tetrarrhena juncea*, R.Br., "Scrambling grass."

Grasses that will grow on the littoral sandy wastes of this continent, are of especial value, not only as forage plants, but because they assist in binding, and thus preventing the loose sand from being blown inland by the fury of sea winds. The following are amongst the best for this purpose:—*Distichlis maritima*, Rafn., "Sea-side couch grass"; *Imperata arundinacea*, Cyr., "Blady grass"; *Lepturus repens*, R.Br., "Salt-marsh grass"; *Paspalum distichum*, Linn., "Water couch"; *Schedonorus littoralis*, Beauv., "Coast fescue"; *Spinifex hirsutus*, Labill. ♂, ♀, "Spiny rolling grass"; *Sporobolus virginicus*, Kunth., "Salt-marsh couch grass"; *Thuarea sarmentosa*, Pers., "Coast couch grass"; and *Zoysia pungens*, Willd., "Coast couch grass".

SALSOLACEOUS OR CHENOPODIACEOUS PLANTS.

Salt-bushes—These most valuable plants are becoming more scarce on the inland plains of this continent, from year to year. Being so closely fed-down, and often trampled down, they get little chance to mature seed, which is their only natural means of reproduction. When left unmolested for a time, however, they quickly recover, and after a time produce seed in abundance, which germinates readily under ordinary conditions. Many of them are also readily increased by cuttings, so that it would require no great outlay to enter upon a proper system of conservation, or even cultivation of these most useful plants. Moreover, once the plants are well established, they will continue to grow under the most adverse circumstances of drought and heat. In fact, very few kinds of plants so useful for forage purposes could exist under such adverse conditions as do most kinds of the salt bush family. There is abundant proof that when sheep are depastured in country where plenty of salinuous plants are growing amongst the natural grasses, fluke and other allied ailments are almost unknown. It has been said that horses which are subject to swamp cancer on the low coast lands, when turned into pasture where salinuous plants are growing plentifully, soon lose this disease. While on the subject of distoma diseases and other allied ailments, I may mention another genus of plants which should not be overlooked in any system of conservation. It is that of *Zyophyllum*, some species of which act as vermifuges. There are very few plants arranged under the order *Chenopodiaceæ* which are not available for forage, though exception might be taken to the following species. During protracted droughts balls of cotton-like substance form on *Kochia aphylla*, R. Br., *Enchlytæna tomentosa*, R. Br., and a few other plants of the order. It is

generally supposed that this adventitious growth is caused by some insect. The fulvous tomentum on some species of *Sclerolœna*, and the woolly covering of the fruits of some species of *Chenolea* have been known to kill sheep when they have partaken too freely of this indigestible stuff, along with parts of the plants. The dorsal spines of all species of *Anisacantha* often cause some trouble to the salivary glands of sheep and other small herbivora, if they eat too greedily of these plants when the fruits are near maturity. *Anisacantha muricata*, Moq., when dry, makes the troublesome "roley poleys" of the plains. The following is a synopsis of those species which I have had long experience with, and observation of, and can, therefore, recommend as being worthy of conservation, and even cultivation:—*Rhagodia billardieri*, R. Br., "Coastal salt bush"; *Rhagodia hastata*, R. Br., "Halbert-leaved salt bush"; *Rhagodia nutans*, R. Br., "Nodding salt bush"; *Rhagodia parabolica*, R. Br., "Old man salt bush"; *Chenopodium carinatum*, R. Br., "Rough-leaved goose-foot"; *Chenopodium auricomum*, Lindl., "Blue bush"; *Chenopodium atriplicinum*, F.v.M., "Atriplex-like goose foot"; *Chenopodium triangulare*, R. Br., "Triangular-leaved goose foot"; *Atriplex cinerea*, Poir., "Gray salt bush"; *Atriplex halimoides*, Lindl., "Halimus-like salt bush"; *Atriplex holocarpa*, F.v.M., "All fruited salt bush"; *Atriplex muelleri*, Benth., "Mueller's salt bush"; *Atriplex nummularia*, Lindl., "Round-leaved salt bush"; *Atriplex rhagodioides*, F.v.M., "Silver salt bush"; *Atriplex semi-baccata*, R.Br., "half-berried saltbush"; *Atriplex leptocarpa*, F.v.M., "Slender-fruited saltbush"; *Atriplex vesicaria*, Hew., "Bladder saltbush"; and *Atriplex stipitata*, Benth., "Kidney-fruited saltbush." Many of these *Atriplexes*, when cooked, are excellent table esculents. *Kochia aphylla*, R.Br., "Cotton-bush"; *Kochia ciliata*, F.v.M., "Hairy-fruited saltbush"; *Kochia pyramidata*, Benth., "Grey bush"; *Kochia planifolia*, F.v.M., "Broad-winged saltbush"; *Kochia sedifolia*, F.v.M., "Blue bush"; and *Kochia villosa*, Lindl., "Silky saltbush". All these and many more valuable salinus and other forage plants are figured and fully described in my work on the "Indigenous Forage Plants of Australia."

It will be gathered from this review of the indigenous herbage that there is in this country some splendid material to conserve and cultivate, and it only awaits intelligent management to clothe our pastoral areas with herbage if not like their pristine grandeur, to, at least, make them far more valuable possessions than they are at the present time. As a preliminary undertaking towards the conservation of indigenous grasses, salt-bushes and other herbage, reserves should be established in various parts of the country for the purpose of raising seeds to be disseminated in places where the herbage has been eaten out. Such reserves need not occupy large areas. It is astonishing the quantity of seed that can be harvested from a few acres. It would be a wise thing for the Governments of the Australian colonies to make grass reserves a compulsory undertaking when granting new leases for Crown lands. That such reserves would have a most beneficial effect upon the pastoral areas in this country cannot be gainsaid by thinking persons. In fact, there is already valuable data to work upon. All the railway enclosures throughout the country are excellent reserves for the preservation of the indigenous grasses and other herbage, and the most superficial observer cannot fail to have seen the amount of seed that is matured and distributed on the adjacent land by winds and other agencies. When this seed germinates it cannot fail to enhance the grazing capabilities of the pastures for miles around.

The present system of keeping sheep on the pastoral areas of this country will have to be much improved upon before the herbage becomes as luxuriant as it was some years ago. I would recommend the small-paddock

system in country that is suited for pasturing sheep, and where the natural herbage is still fairly plentiful. For those areas which have deteriorated so much that sheep have a difficulty to eke out an existence it would be a wise thing to rest them for a period until the better kinds of herbage recuperate. It may not be generally known, but it is an almost invariable fact, that where horses are constantly allowed to graze such undesirable plants as the "spear" and "three-awned spear" grasses are not nearly so plentiful as they are on those areas from which these animals are excluded. Sheep, on the contrary, that are allowed to roam over large areas, eat out the very best grasses and other herbage, and it is not until they become pressed with hunger that they will eat of the coarser vegetation. It is this constant "nibbling off" of the superior kinds of herbage that has made them scarce in some parts of the country. Having so little chance to recuperate and perfect seed, their only natural means of reproduction is partially destroyed.

It would depend upon the size of the pastoral holding and the number of sheep that is grazed upon it as to the size of the paddocks to be adopted, but I would certainly not recommend any larger than 2,000 acres, smaller areas being preferable. The paddocks should be so arranged that each one should have at least from three to four months' rest in a year. This would give the herbage an opportunity to produce seed, which in time would germinate, and new plants would spring up to cover the ground. Unless the paddocks were in a very bad state before the system was adopted, it is astonishing how quickly some of the herbage would recuperate, drought time, of course, excepted. Another very great advantage to be taken in consideration by adopting the close-paddock system is that sheep could be kept, if not near shearing time, a little longer than usual in any paddock which might have a number of noxious plants growing in it, during which time they would trample most of them down. This would give a better chance for the superior grasses and other herbage to grow when that particular paddock was resting. By adopting the close-paddock system it would also be found that fine crops of grass could be cut in some of the paddocks in propitious seasons, which could be made either into hay or ensilage. Some pastoralists may say that this idea is all very well in theory, but would not pay in practice. Notwithstanding this, however, many experienced pastoralists think with me that some such means will have to be adopted to provide feed for stock during adverse times, unless stock-owners are prepared to lose thousands of cattle and sheep during every recurring drought. With the appliances, in the shape of labour-saving machinery, that are now obtainable at a moderate cost, thousands of tons of fodder could be saved in times of plenty. Whether the grass or other herbage is turned into hay or ensilage it would be advisable to make the stores of fodder some distance apart, so that when it became necessary to artificially feed stock the animals would not be congregated in such large numbers at any particular point. It is easy to imagine, if such a thing did take place, that scores of the weaker ones would be trampled to death. The stacks should, of course, be protected with fencing, in order to keep the animals off during the time that herbage was plentiful in the pastures. Another plan might also be adopted to provide feed for stock during drought time. It is a well known fact to most Australian pastoralists that a great number of the salt-bush family are exceedingly tenacious of life, and withstand a phenomenal amount of dry weather; in fact, the drier the season the more luxuriant many of these grow, provided that they are not persistently eaten down. I would recommend salt-bush reserves to be made from half a mile to a mile in length, about 2 chains in width, and from 3 to 6 miles apart, according to the size of the

“Run,” and for the reasons stated above. The land might be broken up with a disc-harrow, spade-harrow, or scarifier, preparatory to sowing the seed. The best time to sow salt-bush seed is in the spring of the year if the weather and the soil are favourable; failing this, early autumn will do. It is not advisable to sow the seed all over the land—all that is necessary is to sow a few together at distances of about 9 feet for the tall-growing kinds, and 5 feet for the dwarf-growing sorts. The seeds should be left only lightly covered with soil. Under ordinary conditions the seeds will germinate readily enough, and the seedlings will soon grow into good-sized plants. If the soil should be of a light, friable nature it will not be necessary to scarify the whole of the area; portions broken up with a hoe and a few seeds dropped in will answer very well. Many of the salt-bushes are readily propagated by cuttings if made of the half-ripened wood and inserted in the soil in the usual way. They strike root best in autumn if the weather is favourable. It is astonishing the amount of excellent forage that can be cut, if done in a systematic way, from a few acres of salt-bush even in the driest of seasons.

A Synopsis of three specially written Articles on Important Grazing Districts in New South Wales.

ILLAWARRA PASTURES.

ALTHOUGH a great deal has been written about the dairying industry in Australia, the question of pasture plants and grasses has hitherto been entirely ignored by most writers, or has been dismissed with a few commonplace remarks. Why this should be so it is hard to conceive, since herbage is the principal factor in creating this great industry. From the number of inquiries that are now being made it is quite evident that at no previous time in the history of this country has the subject of forage plants and grasses occupied so much of the attention of those who have stock to feed as it does at the present time. Even those dairymen who are fortunate enough to possess homesteads in the South Coast district, where the average rainfall is good, and where the pasturage grows on the naturally rich, basaltic hills and alluvial flats, have assured me that the continuous grazing has had a serious effect upon some of the best of the herbage, and the more thoughtful of them are now beginning to see that unless the grazing areas are periodically rested, manured, and otherwise attended to, they will further deteriorate.

It cannot be expected that herbage which is continually cropped down will always be rich and succulent, and most experienced dairymen are now convinced of the fact that unless milch cows are regularly supplied with good herbage they will not yield a great quantity of milk. It becomes, therefore, very necessary, if the industry is to be carried out on successful commercial lines, for many consecutive years, to pay a great deal more attention to the pastures than has hitherto been the practice. In going through the Illawarra district it was my good fortune to converse with dairymen who had been carrying on their vocation for very many years. Therefore, when I refer to some of their remarks it will be a sufficient guarantee that the information is the result of many years' practical experience.

PRESENT CONDITION OF PASTURES.

Some of the grazing areas are in a very good condition, and show that they have been carefully attended to, whilst others are in a very bad state. Many dairymen destroy all noxious plants immediately they make their appearance, whilst others appear to let them grow at their own sweet will until they become a nuisance on the areas they occupy, and a menace to the adjacent land. When the seeds of these noxious plants are ripe they are often distributed by various agencies on clean paddocks, where they

germinate, and it is only by constant care and watchfulness that the plants are prevented from spreading and injuring the healthy pasturage. Several paddocks are so infested with large tussocks that their grazing capabilities are considerably below what they would be under better management, and it is no exaggeration to say that quite two-thirds of some areas are, for all practical purposes, rendered almost useless for grazing on account of the tussocks. Paddocks were shown to me that had been once greatly infested with tussocks, but since they had been taken out the pasturage had become very good and healthy. Next to the tussocks the so-called dandelions (*Hypochaeris radiata*, Linn., and *H. glabra*, Linn.) are the most common pests in pastures. The leaves of these plants lie flat on the surface, and where the plants are very plentiful they choke out the more tender and nutritious grasses. Singular to say, so far as I could find out, no dairymen have ever observed any bad effects on cattle that have eaten these plants, although I have received scores of specimens for identification from other parts of the country, with letters stating that both horses and cattle show signs of great distress after eating the plants. In some pastures "Paddy's lucerne" (*Sida rhombifolia*, Linn.) is very plentiful. A few dairymen seem to think that "Paddy's lucerne" is a good forage plant. The majority of the persons I spoke to, however, spare no pains to destroy the plant, as they contend it occupies the place where much better herbage would grow, which is very true. Lantana and sweetbriar have become established in some places, and also the English blackberry; but, so far as I saw, none of these pests are very plentiful. Sorrel (*Rumex acetosella*, Linn.) is very plentiful, and in some places it has become a great pest. Many persons seem to think that this plant gives cattle the scours when they eat too ravenously of it. The "vervain" (*Verbena venosa*, G. et H.) and the "blue top" (*Verbena bonariensis*, Linn.) are spreading in places. The former is likely to prove a great pest if no check is put upon its growth. This pretty flowering plant has escaped from gardens, and being of prostrate habit chokes out the more nutritious herbage. Once it becomes well established it is difficult to exterminate, since its underground roots ramify in all directions, and from the smallest particle of roots a new growth will develop, which soon forms a large plant. In places the "blue top" is a great pest, and some persons seem to think it gives red water to cattle that eat it. Some beekeepers also complain that when the plant is in bloom bees work it very industriously, but the honey secreted by the flowers is not of good flavour. On some of the rich flats the "bushy starwort" (*Aster dumosus*, Willd.) is very plentiful, and on many of the hillsides there is a dwarf plant with grass-like leaves called the "yellow rush lily" (*Sisyrinchium micranthum*, Cav.), which is said to be spreading very fast. In addition to these weeds there are docks of various kinds, which are generally found growing near moist places, and a number of other undesirable plants of less account.

THE BETTER CLASS OF PASTURAGE.

This is composed of different kinds of herbage in varying proportions. In newly-laid down pasture perennial rye predominates, but the reason is that a greater percentage of seeds of this grass is generally sown in mixture for permanent pasture. Cocksfoot forms a fair percentage of the herbage in some permanent pastures, and it appears to withstand dry weather better than rye-grass. It is coming more generally into favour with dairymen, and where it is well kept down it certainly does not grow into objectionable tussocks, which is characteristic of the grass when it is allowed to grow undisturbed or any length of time. White clover forms a large percentage of the herbage

of many pastures, more particularly those that have been laid down for a few years. Under ordinary conditions it produces an abundance of seed, and when the autumn rains set in they germinate readily. During the spring months, should rain fall at frequent intervals, the clover grows rank, and when cows eat ravenously of it in this state it sometimes produces hoven. With this exception dairymen look upon clover as a valuable pasture plant. Prairie grass is conspicuous in most pastures. It is a valuable winter and early spring grass, and its rich succulent herbage is much relished by stock. *Trifolium procumbens*, Linn. is very common in some pastures, but it is not considered to be of very high feeding value. Rib grass (*Plantago lanceolata*, Linn.) is very plentiful. Most dairymen look upon this plant as excellent feed for cows, and it is considered to increase the flow of milk of dairy cattle that eat it. Perhaps the most useless grass, from a dairyman's point of view, that has ever been introduced to the South Coast is the "meadow soft grass" or "Yorkshire fog" (*Holcus lanatus*, Linn.). During the recent propitious seasons it has spread over large areas, much to the disgust of many persons. Its light seeds are distributed far and wide by every wind that blows, so that it is easy to account for the extensive area of its occupation. It is said that the seeds in the first instance were introduced with cocksfoot seed from New Zealand. These are the principal exotic forage plants and grasses which form a great part of the permanent pasture in the South Coast. In both old and new pastures, but more particularly in the former, there is a large percentage of indigenous grasses and forage plants, and in dry seasons these, especially "couch grass" (*Cynodon dactylon*, Pers.), often prove the mainstay of many of the pastures. *Andropogon affinis*, R. Br., one of the native blue grasses, is highly spoken of. Many plants that I saw were much eaten down, notwithstanding that other herbage was plentiful, "Meadow rice grass," (*Microlæna stipoides*, R. Br.), is another valuable pasture grass which is very common in some places, and so are *Eragrostis leptostachya*, Steud., *Poa cæspitosa*, Forst., and many others. Perhaps the least liked of all the native grasses is the "Parramatta" or "tussock grass" (*Sporobolus indicus*, R. Br.). Whilst young it is really good herbage, but when it becomes old the stems and leaves are very tough and harsh. When cattle eat it in this state for any length of time it often loosens their teeth, so much so that sometimes they drop out. It is said that horses' teeth are also affected though in a less degree, should they be kept on pasture where this grass predominates. In some pastures that had been laid down with exotic grasses many years ago, the "Parramatta grass" and the "couch grass" have almost taken possession of the land. Still, some persons think these plants make fairly good pasture in dry seasons.

SUPPOSED POISONOUS PLANTS.

Fungoid pests.

Much of the original vegetation of the Illawarra district was of a semi-tropical nature when the early settlers took up the land for homestead purposes. On the rich, basaltic hills and in many of the valleys the vegetation formed a perfect jungle, and many of the trees were of gigantic proportions, the clearing of which was very laborious and costly. In stony places, and on some of the steep hill sides, much of the original vegetation is still to be seen growing in all its native luxuriance. Amongst such a diversity of plants it can easily be supposed that when any cattle died in a somewhat mysterious way different kinds of this luxuriant vegetation have at one time or another been suspected of having poisonous properties, and certain plants

are probably not suspected without some reason. Several shrubs and trees were shown to me that are said to have poisoned or caused injury to cattle when they have fed too ravenously upon them, more particularly in very adverse seasons when the pastures become dry and the grasses are hard and wiry. In such seasons many of the native shrubs, by their green appearance, have offered a tempting bait to stock, and when cattle have eaten too freely of certain of them, it may have had some injurious effect upon their systems, and the more weakly beasts may have died, not from actual poisoning, but from the mechanical effects this kind of herbage may have had upon their systems. Should severe irritation take place in the alimentary canal, it would most likely tend to bring on inflammation of the intestines, which in some instances might develop into dangerous gangrene. However this may be, it must be said that there is much diversity of opinion regarding certain shrubs, and although I give a list, with common descriptions of a few of the plants that were shown to me as being suspected of poisoning or causing injury to cattle, it must be left for future careful investigation before anything very definite can be stated.

Croton verreauxii, *Baill.*—This is a tall shrub or small tree with somewhat variable leaves of a rather yellowish green colour and from 2 to 4 or more inches long. The fruit is a three-celled nearly globular capsule, usually containing one seed in each cell. This shrub and also other Euphorbiaceae plants have on several occasions been sent to me for identification as being the cause of red water in cattle. There is, perhaps, no disease in cattle in the South Coast which has caused so much controversy amongst dairymen as red water, and probably no disease upon which there exists such a diversity of opinion. Some persons scout the idea of plants being the cause and attribute the disease to the water the cattle drink, whilst others argue the very opposite. When the disease has assumed an acute form, a change of pasture, with a liberal supply of green succulent herbage, has sometimes had a beneficial effect. Indeed, this appears to be the best remedy yet adopted. The croton is common in some places, more particularly on the banks of streams.

Goodia lotifolia, *Salis.*—This is a rather tall, straggling shrub, with pinnately three-foliolate leaves, and many-flowered racemes of yellow flowers. The pods are nearly an inch long and about a quarter of an inch broad. It is commonly known as "yellow pea" or "yellow indigo." It is not very common, but what there is of it is generally found on hillsides.

Indigofera australis, *Willd.*—This is an erect branching shrub of from two to four or more feet high, with leaves composed of numerous small leaflets and pink or purple flowers arranged on axillary racemes. The pods are about $1\frac{1}{2}$ inches long, terete, and nearly straight. This plant is called "wild indigo," and is suspected of causing red water in cattle, and also of bringing on premature labour. In some places it is fairly plentiful on both high and low lands.

Omalthus populifolius, *Grah.*—This is a tall shrub or small tree, with large poplar-like leaves which often turn beautifully red when they become old. The young shoots, too, have a reddish tint, which gives quite a character to the plant. This shrub is commonly known as "poison poplar" or "poison bush." It is very common in some places, but principally where little clearing has been done.

Trema aspera, *Blume.*—This is a tall shrub or slender tree, attaining sometimes a height of 20 feet or more. It is commonly known as the "peach-leaved poison bush" and is plentiful in some places both on high and low

land. The vivid green of its foliage in the driest of seasons no doubt offers a tempting bait to stock. A successful dairyman told me that he has had cattle poisoned through eating the leaves of this plant. He came to this conclusion after he had made a *post-mortem* examination on a beast that had died somewhat suddenly. Singular to say, the leaves of a very closely-allied tree (*Ficus aspera*, Forst.), are considered by some persons to be good forage; indeed, I saw plants that had been very closely cropped by cattle. Premature labour in cattle has been prevalent in some places, and many theories have been advanced as to the cause of it. One dairyman I spoke to had been very unlucky, and attributed it to planters' friend which he had liberally fed to his cattle. Many experienced men, however, think that something else has been the cause of the trouble, and no doubt think so with reason. Planters' friend, although a very exhausting crop, is largely grown as auxiliary feed for dairy cattle, and is considered very fattening; but, of course, it should always be fed to stock with discretion.

Some years ago I called attention to certain parasitic fungi which affect grasses at certain seasons of the year, and suggested that plants in such a diseased condition might be the cause of some ailments among stock. From observations made in the South Coast during recent years, it would appear that fungi on grasses is really the cause of a lot of trouble. One stock-owner tells me that after many years of observation and experience he is positive that ergot (fungus) on rye grass is the cause of premature labour in cattle. Some time ago he experienced losses from this cause, and again lately. This fungus is more prevalent in wet than in dry seasons. Therefore, it is not always possible to burn any diseased patch in pasture on account of the humid climate. Where the seed stems of grasses, however, are attacked by ergot they should be mown down, raked up and burned, more particularly where breeding cattle are kept. I was shown a paddock of rye grass that was very badly infested with a fungus (not identical with the ergot.) So red was the grass that one dairyman thought it interfered with his milk supply. These fungus diseases are well worth studying, more particularly with regard to their effect upon stock.

IMPROVEMENT OF PASTURES.

There is nothing occupying the minds of progressive dairymen at the present time more than the improvement of their pastures. During my recent visit to the South Coast I was frequently asked for information as to the relative merits of different grasses and pasture plants. In answer to these inquiries I have invariably advised that those grasses which experience has proved to be the best suited for the requirements of the district should not be superseded until it had been proved that better ones could be found to take their place. It will already have been noticed in this series of articles that a good percentage of the Illawarra pastures—more particularly those that have been laid down for a number of years—is composed of indigenous grasses, some of which prove to be the mainstay during very dry seasons. I would certainly recommend the conservation of the best of these grasses, more particularly on the hills and hillsides, where the more tender exotics suffer most during the hottest and driest part of the year. New ones also might be grown in an experimental way, and when found suitable for any particular locality larger areas might be devoted to their cultivation. It should be borne in mind, however, that the best grasses in the world will fail to yield good herbage under bad management. Too much stress cannot be laid on the fact that most of the good and nutritious grasses require as good

cultivation and attention as do most other crops, and unless pastures are manured and periodically rested it cannot be expected that they will continue for ever in a satisfactory condition. In most cases it is simply throwing money away to try and renovate old pastures by sowing grass-seeds on the surface in moist weather, and putting a bush-harrow over the land to settle the seeds in the soil. Generally the seeds germinate readily enough, but the surface becoming hard in dry weather, the delicate roots of the young grass cannot penetrate easily, consequently a great percentage dies off. Should pasture be thought to be too poor to renovate by judiciously manuring it, the best plan would be to plough it deeply and carefully till it as if for any other crop, and sow it down with a good mixture of grass-seeds to form new permanent pasture.

MANURING PASTURES.

Taking into consideration the fertility of the Illawarra District, and the very little competition in the dairying industry until late years, it is not to be wondered at that some persons have ridiculed the idea of using manures on pasture-lands. Things have changed very much of late years, and competition in the dairying industry is now very keen. Creameries and butter-factories have been established in many districts where it was thought such institutions could not flourish, and where land is rented or acquired on easier terms than in the South Coast. With these facts staring the Illawarra dairymen in the face they cannot now afford to be content with a good supply of herbage at one season of the year and a great falling off at another, which, in other words, means a plentiful supply of milk for a season and a diminished supply at another season. Pastures must now yield a good crop of nutritious grass a greater part of the year to make the dairyman's occupation a profitable one. To obtain this end, manures must be judiciously applied to pastures to stimulate the growth of good grasses and other forage-plants. By encouraging the better class of herbage it will enable it to smother and choke out many of the weed-pests that now infest pastures. Some persons seem to have lost sight of the fact that a very large amount of nutritious herbage is required to build up the frame and body of young cattle that are raised for dairy purposes, and also that every gallon of milk takes a certain amount of fertility out of the land. Until this is restored to the soil in some form or another the pasturage, both as regards quantity and quality, must deteriorate sooner or later. Amongst a number of constituents that fodder plants and grasses remove from the soil the most valuable are nitrogen, phosphoric acid, potash, and lime. These should be returned to the land in the form of dried blood, bonedust, and kainit, or similar manures. The proportion to use will, of course, depend upon circumstances, and must be determined by those who use them. Some soils are naturally richer in one or more of these constituents than other soils are, and when this has been ascertained the proportions to apply to the land can be gauged to a nicety. Lime can be applied to heavy or tenacious soils with most beneficial results. Its mechanical and ameliorating effect on such soils are well known to persons who have used it. There are large areas in the South Coast that would be benefited by a dressing of lime, if it was applied at the rate of about 1 ton to the acre. It should not be applied to the same piece of land too often; once in about five years will be found quite sufficient to give the desired results. The natural manure that is made on a dairy-farm is often considerable, and if this was carefully conserved it would be of the greatest value as a top-dressing for pastures, and, in a great measure, replace the losses caused by cattle consuming the herbage.

NEW ENGLAND PASTURES.

INTRODUCTION.

New England, as comprised in that portion of New South Wales which extends northwards along the Dividing Range from Armidale to Tenterfield, is about 120 miles in length by about 40 in breadth, and has an area of about 3,000,000 acres. The configuration of this area consists of a series of plateaux and stretches of both steeply and gently undulating country. It rises from an altitude of 3,313 feet at Armidale to 5,000 feet at Ben Lomond, and falling again to 2,827 feet at Tenterfield. The average elevation is about 3,500 feet. Although the distance is only about 80 to 90 miles in a straight line from the South Pacific Ocean, the high altitude makes the district one of the coldest in New South Wales. The geological formations consist of granitic and porphyritic rocks, which may be said to form the backbone of the range. In some places extensive areas of these rocks are covered with trap and basalt, which have resulted from great volcanic disturbances at some period of the earth's history. Excepting on the bare granitic hills, the soil varies in different localities. A great deal is good and some of it is very rich, and under cultivation is capable of yielding a great variety of crops such as are peculiar to temperate climates. About one-third is composed of a rich, deep, red soil, which has resulted from the disintegration of the basaltic rocks. A large area of the low flat land is composed of a stiff, retentive, black soil, which appears in the form of a deposit, and has most probably been washed down from the surrounding high lands. There is also a large area composed of light, friable loam, which is the result of wash from the granitic hills. These are the principal soils of New England.

TEMPERATURE AND RAINFALL.

Temperature at Armidale.

Mean temperature	...	...	...	...	56·9
Mean summer temperature	...	...	...	...	69·0
Mean winter temperature	...	...	...	...	45·9
Highest temperature (shade)	...	...	...	...	100·0
Lowest temperature (shade)	...	...	...	...	11·2

Temperature at Tenterfield.

Mean temperature	...	...	...	...	57·5
Mean summer temperature	...	...	...	...	67·3
Mean winter temperature	...	...	...	...	46·4
Highest temperature (shade)	...	...	...	...	104·0
Lowest temperature (shade)	...	...	...	...	16·0

These temperatures will give a good idea of the climate of New England. In the vicinity of Ben Lomond of course it will average a few degrees colder on account of the greater altitude.

Rainfall.—The mean annual rainfall is 35·8 inches at Armidale, and 30·8 inches at Tenterfield, which may be considered a fairly good one for a district situated at such an altitude.

WATER.

New England is fairly well watered by several perennial streams, some of which form tributaries to the western rivers. In several localities there are springs of good water, and on some of the low flat lands water is easily obtained by sinking a few feet into the earth. At Guyra, which is situated

at an altitude of 4,328 feet, there is a very large lake which contains a never-failing supply of good water which is as clear as crystal. The only thing that detracts from this grand sheet of water, from an æsthetic point of view, is the quantity of so-called rushes (*Heleocharis sphacelata*, R. Br.) which grow over a greater part of it. It is probable that if the overflow of the lake was raised several feet, which would raise the level of the water, it might prove too deep for these so-called rushes to grow.

PRESENT CONDITION OF PASTURES.

During the summer months many of the grazing areas of New England can hardly be surpassed for the rich, succulent, and varied character of the indigenous grasses and forage-plants which clothe them. It is during the winter months that the want of green succulent herbage in the pastures is most felt, for at this period of the year most of the indigenous vegetation is at rest. One of the most common grasses is the "wild sorghum" (*Sorghum plumosum*, Beauv.) This grass is highly spoken of. Not only are cattle and sheep fond of the herbage, but it is said that horses eat the seed-heads with avidity and fatten on them. The "kangaroo-grass" (*Anthistiria ciliata*, Linn.) is common in many places, and grows to a great height when left unmolested for a time. It is well known all over Australia as a good forage-grass, but does not stand well in pastures that are heavily stocked. *Danthonia semiannularis*, R. Br., the "wallaby-grass," is common in many pastures. It has a high reputation as a forage-plant, and is capable of withstanding a long "spell" of dry weather without its growth being checked to any serious extent. The "blue-grass" (*Andropogon sericeus*, R. Br.) is very prominent in many pastures, and is deservedly held in great esteem both by pastoralists and farmers. It is well worth conserving in places where it is already growing and the seeds disseminating in places where it does not already exist. *Poa caspitosa*, Forst., var., *australis*, the "tussock poa," is common in some places, and whilst young makes excellent forage. When it becomes old it is often rather harsh and tough; then cattle will not touch it if other herbage is plentiful. The "star" or "windmill grass" (*Chloris truncata*, R. Br.) is fairly abundant in some pastures. This is a valuable sheep-grass and stands the dry weather well. *Agropyrum scabrum*, Beauv., the "wheat-grass," is plentiful in many pastures. This is one of the first native grasses to start into growth in spring. The "bent grasses" (*Deyeuxia forsteri*, Kunth., and *D. billardieri*, Kunth.) are very common over nearly the whole of the district. Although these are only annual grasses they yield rich, succulent herbage during the early summer months, and on this account are valuable additions to the pasturage. The native "couch grass" (*Cynodon dactylon*, Pers.) occurs in the warmer and more sheltered parts of the district. *Eragrostis leptostachya*, Steud. is another valuable grass which I saw in several places. The "long hair plume grass" (*Dichelachne crinita*, Hook.) when in flower is a very conspicuous plant in pastures. On good soils it produces a great amount of rich succulent herbage which is greedily eaten by all herbivora. On the banks of some creeks and in low damp places the "water couch" (*Paspalum distichum*, Linn.) is plentiful. This quick-growing grass is highly spoken of both by pastoralists and dairymen. Its rich, succulent herbage is greedily eaten by cattle. Besides these there are other native grasses, which occur in varying proportions and add to the valuable herbage of New England. There are a number of native herbs other than grasses which are eaten by stock; but, perhaps, the most useful are *Geranium dissectum*, Linn., "crow foot," and *Plantago varia*, R. Br., "native rib grass." In most localities these plants are highly spoken of as forage for stock.

Amongst exotic forage plants that have become acclimatised in pastures, white clover forms a very large percentage. Indeed, many of the pastures in spring are literally white with the flowers of this plant. Both pastoralists and farmers look upon clover as a valuable pasture plant. In many localities prairie grass is conspicuous in pastures. It is a valuable winter and early spring grass, and its rich succulent herbage is much relished by stock. *Trifolium procumbens*, Linn., has spread much of late years in pastures, but it is not considered to be of very high feeding value. "Yorkshire fog" (*Holcus lanatus*, Linn.), "soft brome grass" (*Bromus mollis*, Linn.), "burr medick" (*Medicago denticulata*, Linn.), and several other plants are now established in pastures.

NOXIOUS WEEDS.

In New England, as in most of the settled districts of Australia, many exotic weed pests of a more or less aggressive character have found a congenial soil and climate to vegetate in, and certain of them have become so plentiful in some localities as to cause anxiety to land-owners. At first sight it no doubt appears very remarkable to most persons that the worst weed pests Australian pastoralists and farmers have to contend against are either of European or American origin. On reflection, however, it will be noted that most of these plants have no natural enemies in Australia, such as keep them within certain limits in their native habitats, consequently they soon grow and occupy large areas, where the conditions are favourable. Many of these pests have been introduced in an accidental way with agricultural seeds, garden seeds, &c. Some plants have been imported for their supposed usefulness, but on account of the enormous amount of seed which they produce, and the prolific way in which they multiply in this genial climate, they prove a pest instead of a blessing, both in cultivation and in pastures. A few years ago a plant of this description, commonly known in this country as "Hexham scent," and to botanists as *Melilotus parviflora*, Desf., was introduced into the northern districts as a valuable forage plant, but it has now over-run thousands of acres, and the area of its occupation gradually widens from year to year. In some wheat fields it has proved to be a great pest, inasmuch as the seeds ripen about the same time as wheat, and they often get mixed with that grain at harvest time. The "Hexham scent" has a peculiar odour, due to the presence of a chemical principle called "coumarin," which is sometimes imparted to wheat, and, of course, somewhat depreciates its value from a commercial point of view. Indeed, I have been told that millers have sometimes refused to grind wheat owing to the presence of a number of these scented seeds. Some persons assert that the "Hexham scent" plant produces partial paralysis in sheep and horses when they have eaten too ravenously of it. This statement, however, I think, requires confirmation. I have just mentioned these circumstances to show how necessary it is for experimenters to be exceedingly careful in introducing new plants for cultivation in Australia.

Perhaps the most common weed pest in New England is the sorrel (*Rumex acetosella*, Linn.). It seems to luxuriate on almost any kind of soil, and in almost any situation. So far as I could find out, it has produced no ill effects upon stock that have eaten it. In many pastures the so called dandelions (*Hypochaeris radiata*, Linn., and *H. glabra*, Linn.) are very plentiful, and they seem to be spreading in some localities. I was shown pastures where these plants had not made their appearance until a few months ago, but now they appear as if they had come to stay. Although no bad effects on cattle that graze in pastures where these plants occur have been observed, still they are very undesirable weeds, for where they grow very thick the more

tender and nutritious herbage is often choked out. The "sweet briar" (*Rosa rubiginosa*, Linn.) is very common in some localities. There seems to be a very general opinion that this is one of the worst, if not the worst, pest in the district. Once it becomes well established it is both difficult and costly to eradicate. Every one of its long underground roots have to be taken out before the plant can be safely said to be destroyed. It is said to be spreading in different localities, but this is easily accounted for.

Various kinds of birds eat the fruits of the "sweet briar," and often void the seeds miles from the plants that bore them, where they germinate, and form new colonies. The "English blackberry" (*Rubus fruticosus*, Linn.) is growing in several localities, and, although not nearly so common as the "sweet briar," it would be advisable to keep it in check to prevent it spreading in the district. *Verbascum thapsus*, Linn., the "great mullein," has established itself in some places, and although it is not very common, still, as it produces a great amount of seed in most seasons, it might become a great pest if allowed to grow at its own sweet will for a lengthened period. The prickly pods of the "burr medick" (*Medicago denticulata*, Willd.) are sometimes troublesome to get out of wool, with this exception the plant is considered good herbage. It is common in many localities. In addition to these exotic weeds there are docks of various kinds, which are generally to be seen growing near moist places, and a number of other undesirable plants of less account. Two rather undesirable native plants, from a sheep-owner's point of view, appear to be common in some localities. Unfortunately, I never heard any common name given to either of these plants, so that I shall have to record them under their botanical names: 1 is *Acæna ovina*, A. Cunn. The ovoid fruits of this plant are covered with short barbed prickles, which are sometimes troublesome to get out of the wool. 2 is *Acæna sanguisorbæ*, Vahl. The numerous barbed prickles on the fruits on this plant sometimes cause trouble to the salivary glands of the smaller herbivora that browse upon it. I have seen these barbed fruits carried long distances on the backs of sheep and dogs, so that it is easy to account for its distribution in many districts besides New England.

A SUPPOSED POISONOUS PLANT.

Swainsona galegifolia, R. Br., "Indigo," "Cranky Pea," "Darling Pea," &c. There is probably no other supposed poisonous plant in Australia which has caused so much controversy as the one above referred to. As this plant was figured and fully described by me in the *Agricultural Gazette*, and in the *Town and Country Journal*, some time ago, I will just refer to the remarks made by some New England pastoralists whose long experience of the plant entitle them to speak with authority. For analysis of the plant and for further information I would refer my readers to the articles in the above-named journals. Mr. W. H. Walker says "that the 'Darling Pea' is sometimes very troublesome, and cattle, horses, and sheep all suffer from eating it". Mr. G. H. Gordon says: "In the 'Darling Pea' there certainly exists in a most marked degree constituents injurious to stock, which causes an annual and heavy loss to the pastoralist." Captain A. S. Menzies says: "I have had twenty years' experience of the 'Darling Pea,' or 'Indigo,' and am convinced it is nothing else but poison. When stock eat it they will eat nothing else as long as they can get 'Indigo.' They soon fall away, have a wild, distressed look, an awkward, quivering gait, distorted limbs and features, and die at last in an emaciated state. It appears to me a narcotic poison, acting on the nerves and brain. The losses on stock all through these districts are large from this cause, especially among young sheep, and the

plant seems to be increasing. It is worse in sheep country than where cattle are run, probably because the latter country is never so heavily stocked. It should be noted that the poison has a marked effect on the fleece of an 'Indigo' eater. The wool is nearly always very clean, peculiarly soft, light in condition, and fine in quality. The growth of the wool, so far as length is concerned, does not seem to be at all checked; but the fleece generally is much lighter. The effects generally of the poison pea through these districts are simply disastrous. It is impossible to properly stock the country, and even with all precautions, and with constant care, the losses are at all times very large."

IMPROVEMENT OF PASTURES.

Although many of the pastoral holdings in New England are of considerable area, there are a number of farmers who possess fair-sized homesteads, and who combine agriculture with grazing. Until so many fine cattle were fattened in the district, and creameries and butter factories were established in different localities, very little attention appears to have been given to the improvement of pastures. In ordinary seasons the natural herbage always provides an abundance of rich succulent feed in summer; but it is during the cold winter months, when most of the native grasses cease to grow, that the want of green feed in pastures is mostly felt, more particularly so now that New England has entered largely into competition with those districts which have a milder climate in winter, and are more conveniently situated to large centres of population. To keep cattle in good health and condition in the colder parts of the country they must be regularly supplied with good feed during the winter months, as well as in the summer season. In the face of the great competition that there is at the present time, neither graziers, especially those who fatten stock, nor dairy-men, who depend upon a good milk supply, can afford to allow their cattle to fall seriously out of condition at any season of the year. Although a great amount of oats and wheat is grown for hay, and largely used as auxiliary feed for stock during the winter season, cattle that are always allowed to graze in pastures during the summer months, require some green and succulent feed to keep them in a healthy condition during the cold weather. To show how green feed in pastures is valued in the winter-time I will just mention three grasses which are favourably looked upon and encouraged in many localities. They are—(1) "Yorkshire fog" or "meadow soft grass" (*Holcus lanatus*, Linn.); (2) "Barren fescue" (*Festuca bromoides*, Linn.); and (3) one of the "barley-grasses" or "squirrel-tail grass" (*Hordeum murinum*, Linn.) In most parts of the world these grasses are not considered of much value as pasture-plants. The two last-named are annuals, and generally die out on the approach of hot weather. In places where they have grown very thickly on the ground large bare patches are left in the pastures in the summer-time. The Illawarra dairymen look upon "Yorkshire fog" as a great pest in pastures. In some parts of Europe the "squirrel-tail grass" is common by waysides, and its ripe awns or heads are so injurious to the gums of horses in the Isle of Thanet that one of the greatest recommendations of an inn is having "hay without any admixture of squirrel-grass." So one may gather from this that a grass which is considered to be a pest in one country or district proves useful in other localities. Many experienced pastoralists say, and with reason, that there are no better grasses in the world for summer feed than those that are indigenous to New England, and it is only because they do not grow during the winter months that stock-owners are at all anxious about their pastures. The want of green feed in pastures during winter has forced itself very

prominently on graziers during recent years, and it has led some pastoralists to experiment with different kinds of grasses and other herbage that were thought to be likely to grow in cold weather. Probably nowhere in New England has more attention been paid to this subject or more experiments been carried out than at Tenterfield Station. It was my good fortune to inspect these pastures and the experiments which have been carried on for a few years past. Although a great deal of money has been spent on some grass mixtures which have not given the results that were anticipated, still it has proved what kinds are best suited to the district, and has also given valuable data on which to carry on any further work in this direction. The work already accomplished is an object-lesson for the whole of the district, and the example set might be more generally adopted with advantage by both graziers and dairymen. Of the great number of exotic grasses that have been sown on this station the following appear to have grown the best:—Prairie-grass, different varieties of rye-grass, and cocksfoot-grass.

SYSTEM OF GRAZING.

Most of the cattle-stations in New England are not too heavily stocked, so that in any ordinary season the herbage is not only plentiful but it has a chance to produce seed for its perpetuation, which cannot have but a marked effect for good on the pasturage. Many pastures are grazed in rotation, and the effects of such a system cannot be too highly estimated, as it allows the more tender and often most nutritious plants time to recuperate. This plan might be more generally adopted all over the country to advantage. Where the pasturage becomes scanty through unavoidable causes it is a good plan to close paddocks against stock for a time, to allow the grasses and forage-plants to seed. By adopting such a method it is astonishing the good results that would follow in a short time, should the weather be favourable.

Nearly all over New England there seems to be a general interest taken in pasture plants, and grasses, and information is eagerly sought after as to the merits of any particular grass or plant. This augurs well for the future development of both the pastoral and dairying industry of this fertile district.

CAMDEN AND PICTON PASTURES.

Both these districts are situated within an easy distance of Sydney, and are much frequented as health-resorts. The scenery is charming and the climate is salubrious. The configuration of this part of New South Wales consists of steeply and gently undulating country and a considerable area of flat land. Almost since the foundation of the Colony these districts have been noted for their fertility, and at one period they were looked upon as the granary of Sydney and the surrounding settlements. Some years ago wheat was extensively grown, and fine crops were harvested, both on the high and on the low lands; but the "rust" has rendered this crop an uncertain one. Most of these, at one time wheat-lands, are now devoted to pasturage, and the dairying industry is now a very important one. The Picton district supplies Sydney with a great quantity of milk, and creameries and butter-factories are established in the Camden district, and appear to be flourishing institutions. Probably the first person to recognise the value of this part of New South Wales for grazing purposes was the late Captain Macarthur. In a letter written nearly one hundred years ago, and which is now in the possession of Mrs. Onslow, of Camden Park, Captain Macarthur says that "the kangaroo-grass" is so plentiful here that when in

seed it puts me in mind of the wheat-fields in the old country." "Kangaroo-grass" may now be seen growing six or more feet high in places that are protected against cattle and other herbivora; so it would appear that this species has in no way deteriorated during the past one hundred years when it is allowed to grow undisturbed for a time.

PRESENT CONDITION OF PASTURES.

Since the dairying industry has developed into such large proportions many of the pastures have received careful attention. Progressive stock-owners in these districts, as in other parts of the country, have found out by practical experience that unless the pasturage is good, cattle cannot thrive, nor can the dairying and allied industries flourish. Although many of the grazing areas are in a very good condition, some appear to be in a rather neglected state. Many land-owners destroy all noxious plants immediately they make their appearance, whilst others allow them to grow as they like until they become a nuisance on the areas they occupy, and a menace to the adjoining land. Some paddocks are very much infested with large tussocks, and in consequence their grazing capabilities are much below what they would be under better management. The better class of pasturage is composed almost wholly of indigenous herbage, which is plentiful, and of a rich and varied character. The most common grass is couch (*Cynodon dactylon*, Pers.). It grows on both high and low land; on the latter, however, it appears to predominate. In an ordinary summer this grass grows quickly, and it will stand close feeding better than many other kinds. Herbivora of all descriptions are remarkably fond of it, and fatten on it, whilst in a growing state. Couch-grass almost ceases to grow, however, during the winter months, and should only very slight frosts occur the herbage turns brown. When in this state it has not a very high feeding-value. The "kangaroo-grass" (*Anthistiria ciliata*, Linn.) is plentiful in some pastures, but it rarely produces seed unless protected against cattle. It is a valuable grass, and stock keep it closely eaten down in pastures they have access to. *Eragrostis leptostachya*, Steud., is very abundant in most pastures, more particularly on hillsides, where it often forms a very close turf. It grows in bunches, but never develops into objectionable tussocks. Milch-cows are particularly fond of this grass, and they keep it eaten close to the ground even if other herbage is plentiful. This grass should be encouraged on every dairy-farm in the colony. The "blue-grass" (*Andropogon sericeus*, R. Br.), is fairly plentiful in some pastures, and is highly spoken of by dairymen. *Danthonia semiannularis*, R. Br., the "wallaby-grass," is common in most pastures. It has a high reputation as a forage-plant, and is capable of withstanding a long "spell" of dry weather without its growth being checked to any serious extent. The "star" or "windmill" grasses (*Chloris truncata*, R. Br., and *C. ventricosa*, R. Br.), are fairly plentiful in some places. These are valuable grasses, which stock of all descriptions are remarkably fond of, and fatten on. *Deyeuxia forsteri*, Kunth., the "bent-grass" is common over nearly the whole of these districts. Although this is only an annual grass it yields rich succulent herbage during the winter and early spring months, so on this account it is a valuable addition to the pasturage. The "tussock poa" (*Poa caspitosa*, Forst.) is common in many pastures, and whilst young it makes excellent forage; but when it becomes old it often grows into objectionable tussocks, which choke out the more tender herbage. Under the shade of trees this grass keeps beautifully green during the driest of weather. On the banks of some streams and in many low damp situations the "water-couch" (*Paspalum distichum*, Linn.) grows very plentifully. The rich succulent herbage of this quick-growing

grass is greedily eaten by all herbivora. Dairy-cows are said to increase their flow of milk after eating plenty of this grass. The "water-couch" is well worth planting in low, damp situations where it may not already be growing, and where few other good pasture-grasses will grow. The "barn-yard-grass" (*Panicum crus-galli*, Linn.) grows in moist places, and often attains a height of 8 feet. Although it is only an annual grass, it yields, during the summer months, a great amount of rich succulent herbage, which cattle are remarkably fond of. The "long-hair plume-grass" (*Dichelachne crinita*, Hook.) is fairly plentiful in some pastures. On the low flat lands this grass produces a great amount of herbage which is readily eaten by stock. *Sorghum plumosum*, Beauv., "wild sorghum," grows in some pastures that are not heavily stocked. It is a good grass, and well worth encouraging in pastures.

Two "panick grasses" (*Panicum effusum*, R. Br., and *P. gracile*, R. Br.) are fairly plentiful in some situations. On good soils these grasses yield a great amount of succulent herbage which stock are fond of. The "wheat-grass" (*Agropyrum scabrum*, Beauv.) is conspicuous in some pastures. This is one of the first native grasses to start into growth in spring. Besides these there are other native grasses which occur in varying proportions and add to the valuable herbage of these districts. There are a number of native herbs, other than grasses, which are eaten by stock, but perhaps the most useful are enumerated below. Two plants of the saltbush family are fairly plentiful in some pastures. One of them, *Rhagodia linifolia*, R. Br., is a procumbent herb, and appears to be much eaten by stock. The other is *Chenopodium triangulare*, R. Br., which also has procumbent stems, which are readily eaten by cattle. *Geranium dissectum*, Linn., "crow-foot," and *Plantago varia*, R. Br., "native ribgrass," grow in many pastures. Amongst exotic forage-plants that have become acclimatised in pastures, white clover (*Trifolium repens*, Linn.) forms a very large percentage,—indeed, many of the pastures in spring are literally white with the flowers of this plant. The "burr medick" (*Medicago denticulata*, Linn.) is common in some situations, and during the early spring months makes good forage for stock. It is only an annual plant, however, and dies out on the approach of hot weather. *Plantago lanceolata*, Linn., "rib grass," is plentiful in many pastures. Most dairymen regard this plant as excellent feed for cows. "Prairie grass" is conspicuous in many pastures. It is a valuable winter and early spring grass, and its rich succulent herbage is much relished by stock. *Trifolium procumbens*, Linn., is plentiful in some situations, but it is not considered to be of very high feeding value.

NOXIOUS WEEDS AND SUPPOSED POISONOUS PLANTS.

Although most of the grazing areas in these districts are comparatively free from noxious weeds, there are some pastures where these plants are more plentiful than many owners care to see. In some situations, as have already been referred to, few attempts have been made to eradicate them, or even keep them in check. This is not very encouraging to those persons who strive by every means in their power to keep their pastures clean. It is, of course, a rather costly undertaking to destroy weed pests once they have become fairly established, but it is a comparatively easy task to eradicate them, or keep them within bounds, before they make too much headway. All thoughtful stock-owners are fully alive to the necessity of keeping noxious weeds in check, as they contend, and with reason, that such plants occupy land which would grow much more valuable herbage. Where weed pests are growing plentifully in pastures it must, of course, depreciate their grazing capabilities to a considerable extent.

Two common weeds that grow in many pastures are the so-called dandelions (*Hypochaeris radiata*, Linn., and *H. glabra*, Linn.). Although no bad effects have been observed on stock that graze in pastures where these plants occur, still they are very undesirable weeds, for where they grow very thick the more tender and nutritious herbage is choked out. A year or two ago the Cape weed (*Cryptostemma calendulaceum*, R. Br.) was likely to become as great a pest in some of these pastures as it had proved to be in the southern colonies, but owing to the prompt measures taken to prevent the plant from seeding it has not spread very much beyond the railway enclosures. It is still advisable, however, to keep a sharp eye on the plant to prevent any possibility of its spreading to pastures. In some situations "Paddy's lucerne" (*Sida rhombifolia*, Linn.) is fairly plentiful. Some dairymen seem to think it is a good forage plant. The majority I spoke to, however, spare no pains to destroy the plant, as they contend it occupies the place where much better herbage would grow, which is very true. On some of the rich flat lands the "blue top" (*Verbena bonariensis*, Linn.) has become established, but it is not very plentiful, still it would be advisable to destroy such an undesirable plant to prevent its spreading. In some parts of the country the "blue top" is a very great pest, both in pastures and in cultivation. The "sweet briar" (*Rosa rubiginosa*, Linn.), although not nearly so plentiful as it used to be, may still be seen growing in some situations. This is one of the exotic plants that land-owners have made a systematic attempt to get rid of, and with great success. *Aster dumosus*, Willd., the "bushy starwort," has appeared in several pastures during recent years, but it is not very plentiful anywhere, and from observations made it does not appear to spread very fast. In some places sorrel (*Rumex acetosella*, Linn.) is a great pest, but, so far as I observed, it is not so plentiful as in many other parts of the country. In addition to these weeds there are thistles of various kinds, different species of docks which are generally found in or near moist places, and several other undesirable exotic plants of less account. In a few of the pastures the native "blackthorn" (*Bursaria spinosa*, Cav.) is a great pest, and some land-owners have gone to great expense and trouble in trying to exterminate it. Experienced men tell me that it is of little use to cut this prickly scrub down and leave the roots in the ground, for new growths will often spring up from them, and grow thicker than ever on the land. To destroy this plant all the roots should be carefully grubbed up.

SUPPOSED POISONOUS PLANTS.

Altogether only three native plants were pointed out to me that have ever been suspected of having poisonous properties, but as they now occur only very sparingly here and there, it is many years since any ill effects were observed on cattle that had eaten any of them. They are :

1. *Adriana acerifolia*, Hook, is a rather coarse-growing shrub, usually attaining a height of from 3 to 4 feet. The whole plant has a reddish appearance, more particularly when it is in fruit. Its large plane-like leaves are rather ornamental, and give quite a character to the shrub. This plant is diœcious, that is, the male and female organs are borne on separate plants. The male flowers are arranged on rather long spikes, and the females on short spikes or heads. Fruit, a three-celled capsule.

2. *Euphorbia drummondii*, Boiss., is a prostrate growing plant, with vivid green foliage, and very small flowers arranged in the upper leaf axils. This plant is commonly called "milk weed," "spurge wort," &c., and is well-known to most Australian stockmen; and

3. *Indigofera australis*, *Willd.*, commonly known as "wild indigo." It is an erect branching shrub of from 2 to 4 or more feet high, with leaves composed of numerous small leaflets, and pink or purple flowers arranged on auxiliary racemes. The pods are about an inch and a half long, terete, and nearly straight.

IMPROVEMENT OF PASTURES.

Ever since the early settlement of these districts, but more particularly since the dairying industry has become such an important one, there has been a great amount of work done by most land-owners to improve the grazing capabilities of their properties. Many attempts have been made, and some persons have gone to great expense and trouble, to acclimatise exotic forage plants and grasses in the pastures, but after repeated trials all those kinds known as English grasses have been a failure, notwithstanding the land having been carefully tilled preparatory to the seed being sown. Since it has been found out that these exotic grasses do not grow satisfactorily, land-owners have devoted more attention to the indigenous herbage, and it has been proved by practical experience that there are no grasses equal to the native ones either for enduring the climatic conditions of the district or for their fattening properties. Since I published figures and descriptions of Australian forage plants and grasses many land-owners are now able to recognise a great deal of the herbage their pastures are composed of, and are now familiar with many of those plants which are worth conserving and encouraging. In some of those pastures where tussocks are growing plentifully, the owners have already commenced to take them out. Any work that is done in this direction cannot but have a good effect on the pastures, and considerably increase the grazing capabilities of such areas. In ordinary seasons the indigenous herbage is both plentiful and varied throughout a greater part of the year in those pastures that are not heavily stocked, but during a short time in winter, should it be a very cold one, green feed sometimes becomes rather scarce. It is during this period that auxiliary crops are grown and fed to stock to keep them in good condition. Stock-owners and dairymen in these districts, as in other parts of the country, are well aware that if good results are expected cattle must be as well provided with feed in winter as in summer. There are certain auxiliary crops grown for ensilage, and a lot of fodder is preserved by this means on some estates. Pastures have not hitherto received much attention in the way of manuring, though many persons seem to think that something will have to be done to fertilise grass land if the grazing areas are to carry as many animals as they do now for many consecutive years. One or two persons I spoke to have put a chain harrow over their pastures, which pulverises the cow manure, and distributes it evenly over the grass. The results have already justified the labour, and the example set might be more generally practised in these and other districts to advantage.

WATER.

Although perennial streams meander through parts of these districts, there has been a great amount of money expended in making dams, and now there are some splendid sheets of water in many pastures. From some of these dams water is pumped, either by steam or wind power, to higher levels, from which considerable areas are irrigated.

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Alopecurus geniculatus, Linn.
"Knee-jointed Foxtail," "Water Foxtail Grass."



AUSTRALIAN GRASSES.

ALOPECURUS, *Linn.*

(From two Greek words signifying "a fox" and "a tail.")

SPIKELETS one-flowered, flat, densely crowded into a cylindrical spike or spike-like panicle. Glumes three, two outer complicate, keeled, acute but not awned; third under the flower shorter, keeled, with a short slender dorsal awn. No two-nerved palea or lodicules. Stamens three. Styles distinct. Grain enclosed in the scarcely hardened glumes, but free from them.

Alopecurus geniculatus, *Linn.* (Referring to the bent stems.) "Knee-jointed Foxtail," "Water Foxtail Grass."—A perennial or sometimes annual only, glabrous except the spike. Stems usually procumbent at the base, bending upwards at the lower nodes, sometimes only 3 or 4 inches, often 1 foot high or more. Leaves narrow, the upper sheaths broad and loose. Spike 1 inch to 2 inches long, closely imbricate but slender. Outer glumes hairy on the keel, scarcely pointed, usually but little more than 1 line long, free or scarcely united at the base, the hair-like awn of the flowering glume not projecting above 1 line beyond them. No palea or lodicules. Grain enclosed in the scarcely hardened glumes, but free from them.

This annual, though in moist places sometimes perennial, grass is found in all the Australian Colonies, and is common also in the temperate regions of the northern hemisphere. It is found principally in the interior, and generally growing very plentifully around shallow pools of water. In the most favoured situations its stems will sometimes grow 3 feet high. It is essentially a winter and early spring growing grass, so on this account it proves serviceable during the lambing season, when succulent herbage is often scarce, for at that time of the year many of the superior pasture grasses have not started into growth. The "knee-jointed foxtail" is not considered a valuable grass as regards its nutritive qualities, although all herbivora seem very fond of it, and eat it down close to the ground. In the "*Hortus Gramineus Woburnensis*," Mr. Sinclair states "that the produce of this grass per acre was 6,806 lb., which, when dry, amounted to 2,892 lb., and, on analysis, yielded, of nutrient matter, 292 lb." It will therefore be seen from these figures that the grass does not yield a very large amount of herbage in comparison with many other kinds of grasses. Where this species grows naturally, and is in danger of being eaten out, it is worthy of conservation for the reasons stated above; but I would not recommend it for cultivation, as I do not think it would give adequate returns for such outlay, more especially as we have such a number of valuable species that would well repay systematic cultivation. The "knee-jointed foxtail grass" yields a fair amount of seed, which usually ripens in September and October.

Reference to plate.—A, Showing the arrangement of the spikelets on the rhachis. B, A spikelet opened out, showing the three glumes. C, Flowering glume. D, Grain, side and end views. All variously magnified.

AMPHIPOGON, R. Br.

(Referring to the hairs round the rhachis of the spikelet.)

SPIKELETS one-flowered, nearly sessile in a dense panicle contracted into a head or short spike, the rhachis of the spikelet articulate above the two outer glumes, and not continued beyond the flower. Glumes three, two outer persistent, membranous, three-nerved, acute or tapering to an awn-like point, rarely three-fid; flowering glume raised on a short hairy stipes (the rhachis of the spikelet), closed round the flower, deeply divided into three narrow lobes tapering into straight points or awns. Palea usually as long as the flowering glume, deeply divided into two narrow rigid lobes or awns. Styles united at the base, free upwards. Grain enclosed in the slightly hardened upper glume. Perennial grasses with convolute terete or subulate leaves.

Amphipogon strictus, R. Br. (Referring to its upright growth.) "Bearded Heads."—Stems from a horizontal rhizome or tufted branching base, erect and slender, usually above 1 foot high. Leaves rather short, erect, subulate, glabrous. Spike-like panicle dense, oblong or cylindrical, $\frac{1}{2}$ inch to $1\frac{1}{2}$ inches long, but little branched. Outer glumes broad, concave, faintly three-nerved, almost scarious, entire when perfect; the outer one about 2 lines long, the inner one rather longer and more acute. Flowering glume on the short hairy stipes shorter than the outer glume, with two short rows of hairs on the back, divided into three rigid ciliate linear lobes or awns longer than the entire part. Palea narrow, deeply divided into two rigid lobes similar to those of the flowering glume. Seed separable from the membranous pericarp.

This perennial grass is found all over Australia, from the coastal districts to the arid interior. As might be supposed, a grass growing under such varied conditions of soil and climate is very variable as regards its stature and the size of its inflorescence. I have received specimens from the Darling River, in New South Wales, for identification that were over two feet high, and others from different parts of the country that were only about 6 inches high when in flower. This species was collected in the Victoria Desert by the Elder exploring expedition. Although there are several forms of the grass, none of them afford a great amount of herbage, and what there is, is often harsh and wiry. The grass will withstand a phenomenal amount of dry weather, however, and often when many other kinds of herbage are dried up it may be seen beautifully green, then stock will eat it; so that on this account it proves of some value in pastures, especially in the interior, during adverse seasons. Whether there is any nutriment in the herbage, however, I am not prepared to say. It is not a grass which I would recommend for cultivation, though it may be worth conserving with other grasses in the arid interior for the reasons stated above. It produces a fair amount of seed, which usually ripens in the interior during November and December, and in the coastal districts one month or two months later.

Reference to plate.—A, Spikelet opened out. B, Flowering glume, flattened out; C, Palea flattened out. D, Showing grain covered with membranous pericarp. E, Grain, back and front views. All variously magnified.



Amphipogon strictus, *R. Br.*
"Bearded Heads."







Andropogon affinis, R. Br.
"Blue Grass."

ANDROPOGON, Linn.

(From *aner*, a man, and *pogon*, a beard; referring to the tufts of hair on the spikelets.)

SPIKELETS one flowered or empty, in pairs in the alternate notches of the articulate rhachis of simple spikes, one sessile hermaphrodite (or rarely female?) and fertile, the other pedicellate and barren, either male or empty; the spikes either solitary or clustered and sessile or very shortly pedunculate at the end of the common peduncle. Glumes in the fertile spikelet four, the outer one the largest, awnless, several-nerved, but often two nerves near the margin much more prominent than the others; second glume keeled, rarely produced into a short, straight awn; third much smaller, very thin and hyaline, always empty; fourth or terminal glume under the flower very slender, flexuose, and stipes-like at the base, or if dilated very thin and hyaline, entire or bifid at the top, with an awn either terminal or from the notch; rigid and twisted in the lower part, bent back and very fine above the middle. Palea small and hyaline or none. Glumes of the barren spikelets four or fewer, the outer one the largest and many-nerved; the second keeled; the third and fourth when present small, thin, and hyaline, all awnless. Styles distinct. Grain enclosed in the glumes, but free from them. Grasses usually tall, and often scented; simple or paniculately branched.

Andropogon affinis, R. Br. (Affinity to another grass.) "Blue Grass."—Very near *A. sericeus*, and perhaps a variety, with the same habit, the nodes less bearded, and sometimes quite glabrous. Spikes usually three or four, not quite sessile, $1\frac{1}{2}$ to 2 inches long; the spikelets rather longer and narrower than in *A. sericeus*, and not so closely imbricate; the long silky spreading hairs only on the pedicles and at the base of the sessile spikelets, not on the backs of the glumes; the third glume more developed in the spikelets examined; the awn $\frac{3}{4}$ inch to $1\frac{1}{2}$ inches long.

This perennial grass is found in New South Wales, Victoria, and Queensland, but principally in the coastal districts and colder portions of those colonies. It generally grows from 1 foot to 2 feet high, and in many parts of the continent it is fairly plentiful. It is to be found growing on various soils, but it seems to grow best and yield more herbage on moderately strong loams of good depth, where its roots can penetrate the earth easily, and thus get out of the reach of the drying influences of the sun's rays. I have had this grass growing on lawns, and notwithstanding that they were constantly kept mown it was almost irrepressible during the summer and autumn months. It is a valuable pasture grass, and in sheltered situations will make considerable growth during the winter months; therefore it is doubly valuable to the grazier. During the summer months in an ordinary season it yields a fair amount of rich, leafy bottom-herbage, which all herbivora are remarkably fond of and fatten on, sheep particularly so. It makes capital hay if cut when the flower stems first make their appearance. It will stand close feeding, and will continue to grow during a long period of dry weather. The "blue grass" is well worth disseminating in the coastal districts and in the colder portions of the continent where it may not already be growing. When it is allowed to grow undisturbed for a time it produces an abundance of seed, which ripens during the summer months.

Reference to plate.—A, Showing the arrangement of the spikelets on the rhachis. B, The sessile fertile spikelet and the pedicellate barren one. C, The fertile spikelet (opened out), showing the arrangement of the glumes. D, Grain, back and front views. All variously magnified.

Andropogon bombycinus, R. Br. (Referring to the inflorescence resembling masses of silk.) "Silky Heads."—An erect rigid perennial grass of $1\frac{1}{2}$ to 3 feet, usually glabrous, except a little silky pubescence on the lower leaf-sheaths, the nodes glabrous or shortly bearded. Leaves narrow, flat, rather rigid, the ligula very prominent, entire. Panicle shortly branched, 3 to 6 inches long, with sheathing bracts of 1 inch to 2 inches under the branches. Peduncles usually shorter than the bracts, bearing each a narrow sheathing bract and two very densely woolly-hairy spikes of $\frac{1}{2}$ to 1 inch, at first erect, but soon spreading or reflexed. Sessile spikelets two to five, concealed by the silvery-silky hairs. Outer glumes acute, many-nerved, but the two lateral nerves much more prominent, especially as the flowering advances, and the intermediate ones becoming almost obliterated or visible only towards the end of the glume; second glume thin, with a prominent keel produced into a short point; third very thin, faintly three-nerved; terminal flowering glume very thin and hyaline, shortly bifid, with a very fine awn scarcely exceeding the spikelet, or entire without any awn. Pedicellate spikelets reduced to a single, narrow, many-nerved glume of $2\frac{1}{2}$ to 3 lines. Grain enclosed in the glumes but free from them.

This erect-growing perennial grass is found all over Australia, but principally on the plains in the far interior. It generally grows on the richest soils, though I have occasionally seen it growing on stony ridges. It will withstand a phenomenal amount of dry weather in any situation where its strong wiry roots can penetrate easily into the earth. I have seen it flowering in the interior when many other grasses had withered up through drought. The white woolly spikelets give the panicles a singular appearance when seen from a distance, and they are often a feature in the landscape in a fairly good season. Like many other species of the genus *Andropogon*, the base of the stems on being bruised emits a strong aromatic perfume. During the early summer, and sometimes in the autumn months, this grass makes a quantity of succulent, leafy herbage which stock are fond of. When the grass becomes old, however, the herbage is somewhat harsh, and then it is seldom or never eaten unless other feed is scarce. I have had this species under experimental cultivation, where it proved a very prolific grass, and the herbage lost that harshness, even when it was old, that characterises it when grown on uncultivated land. If cut before the flower-stems appear it should make tolerably good hay. It appears to hold its own in pastures, but this may be accounted for by the fact that under ordinary circumstances it produces a great amount of seed, which, when ripe, germinates readily when there is any moisture in the soil during the spring of the year. The seeds usually ripen during November, December, and January.

Reference to plate.—A, Showing the arrangement of the two spikes and sheathing bract. B, Showing the arrangement of the sessile and pedicellate spikelets on the rachis (opened out). C, The sessile and pedicellate spikelets. D, The sessile fertile spikelet showing the four glumes and terminal awn (opened out). E, Grain, back and front views. All variously magnified.



Andropogon bombycinus, *R. Br.*
"Silky Heads."







Andropogon intermedius, R. Br.

A "Blue Grass."

Andropogon intermedius, R. Br. (Intermediate between two other species.) A "Blue Grass."—An erect grass of 2 feet or more, with the narrow leaves and general habit of *A. ischænum*, the nodes varying with or without beards. Spikes slender, 1 inch to 1½ inches long, usually numerous, all shortly pedicellate in an oblong terminal panicle of 3 to 6 inches without sheathing bracts, the common rachis glabrous, and always more or less elongated, the pedicels and base of the sessile spikelets more or less ciliate. Spikelets under two lines long, narrow and acute, or scarcely obtuse, and often purplish, as in *A. ischænum*. Outer glume often, but not always, even in the same spike, marked with a dorsal pit, as in *A. pertusus*. Awn small and slender. Pedicellate spikelet more developed than in *A. ischænum*, and often enclosing a male flower. Grain enclosed in the glumes of the sessile spikelet, but free from them.

This strong-growing perennial grass is found in all the Australian colonies, both in the coastal districts and some distance into the interior; and in some places it is very plentiful. This may be accounted for by the fact that it produces, under ordinary circumstances, an abundance of seed, which, when ripe, germinates readily when there is moisture in the soil, either in the spring or autumn months. It is generally found growing on low-lying, rich soils, bordering rivers or creeks, or on land that is liable to periodical inundations. I have collected the plant, however, on soils of quite an opposite character. During the summer, and often till late in the autumn months, in a good season, this grass yields a great quantity of coarse herbage, which, however, is readily eaten by cattle. It is a good grass to encourage in pastures where dairy cows are kept, and from its great yield it would probably pay to cultivate for ensilage—at least, it is well worth a trial. There would be no difficulty in bringing the "blue grass" under systematic cultivation, to be cut for green feed, or for ensilage, as plenty of seed could be gathered at the proper time of the year from a small reserved area. The seeds usually ripen in December, but in a good season they will continue to ripen during the summer months, and often till late in the autumn.

Some specimens of this grass which I recently received for identification were thought to belong to a new species. I think the mistake arose from the fact that Mr. Bentham, in the *Flora Australiensis*, describes the panicle, most probably from not very well developed specimens, as only from 3 to 4 inches long. Mr. F. M. Bailey, Colonial Botanist, Queensland, in his synopsis of the Queensland flora, however, describes the panicle as being from 3 to 6 inches long. I have not only collected many specimens of this grass with panicles 6 inches long, but I have received such for identification. The dorsal pit in the flowering glume is not to be depended upon as a means to identification. I have examined a number of specimens collected in New South Wales and Queensland from which the pits in the flowering glumes were entirely absent. Mr. Bailey's remarks bearing on this matter are worth quoting. He says: "The length of the panicle varies much even in the same field, so do the dorsal pits; at times these are altogether absent. This is frequently the case with the plants near Brisbane."

Reference to plate.—A, Showing the arrangement of the spikelets on the rachis. B, The sessile and pedicellate spikelets. C, Sessile spikelet opened out, showing the three glumes and terminal awn. D, Grain, back and front views. All variously magnified.

Andropogon lachnatherus, *Benth.* (Referring to the hairy inflorescence.) "Hairy Blue Grass."—Stems rather slender, erect, about 2 feet high. Leaves narrow, glabrous or sprinkled with long hairs. Nodes not bearded. Panicle looser than in *A. refractus*, with slender but not very long branches, solitary or clustered, within sheathing bracts, or floral leaves. Peduncles exceeding the last sheathings bracts, bearing each two spikes, but not digitate, one attached lower down than the other, each $\frac{1}{2}$ to $\frac{3}{4}$ of an inch long without the awns. Sessile spikelets three or four, the lowest sometimes containing only a male flower, the others with a hermaphrodite flower, 2 to $2\frac{1}{2}$ lines long, slightly hairy. Outer glume obtuse, about nine-nerved; second rather shorter, obtuse, three-nerved; third very narrow, thin, and hyaline; awn or terminal glume on a short filiform base, 1 inch to 2 inches long, the lower part rigid and hirsute with rufous hairs. Pedicellate spikelets narrow, acute, $2\frac{1}{2}$ to 3 lines long, usually containing a male flower, the outer glume many-nerved, often produced into a fine point. Grain enclosed in the glumes of the sessile spikelet, but free from them.

This perennial grass is found in the coastal districts of New South Wales and Queensland, but only in the northern portion of the former Colony. It is generally found growing on low-lying, rich soils, but I have occasionally seen it growing on dry stony ridges. On the former class of soils, however, it yields a greater bulk of herbage, which is generally of a more succulent nature. During the early summer, and often in the autumn months, it produces herbage, of which, when young, all herbivora seem very fond. When the stems become old, however, they are generally harsh, and when in that state stock will seldom or never eat them if other succulent herbage is plentiful. I have seen the "hairy blue grass" growing in places from which cattle for a time were excluded, and there the herbage was much superior to that seen in ordinary pastures. This led me to believe that the grass could be improved under cultivation. In the northern coastal districts it is worth encouraging in pastures where dairy cows are allowed to graze. Under ordinary conditions the grass produces plenty of seed, which usually ripens in November and December; but in a good season I have seen the seeds ripen throughout the summer months, and until as late as May.

Reference to plate.—A, Showing the two spikes and sheathing bract. B, The terminal fertile sessile spikelet between two pedicellate male spikelets. C, Sessile spikelet opened out, showing the three glumes and terminal awn. D, Grain, back and front views. All variously magnified. The awn is shortened at B and C.



Andropogon lachnatherus, *Benth.*
"Hairy Blue Grass."







Andropogon refractus, R. Br.
A "Kangaroo Grass."

Andropogon refractus, R. Br. (Referring to the reflexed spikes appearing to be broken.) A "Kangaroo Grass."—A glabrous erect grass about 2 feet, with the narrow leaves paniculate inflorescence and sheathing bracts of *A. schœnanthus*, and the spikes similarly two together about $\frac{1}{2}$ an inch long on short bracteate peduncles, but much more divaricate, soon reflexed, and glabrous, except a small tuft of short hairs at the base of the sessile spikelets. Sessile spikelets 2 to 5, $2\frac{1}{2}$ to 3 lines long; outer glume acute, many-nerved; second narrow and keeled; third thin and hyaline; terminal or flowering glume hyaline, narrow, either two lobed with an awn slightly exceeding the spikelet, or more frequently entire or nearly so and awnless. Pedicellate spikelets neuter or rarely with a male flower, the outer glume many-nerved.

This perennial species, which I have occasionally seen growing from 3 to 4 feet high, is found in New South Wales, Victoria, Queensland, and Northern Australia, but principally in the coastal districts. On one occasion, however, I received a specimen for identification that had been collected in the interior of New South Wales, so that this "kangaroo grass" may have a wider range of growth in this country than is generally supposed. The base of the stems and roots of this grass, like that of several other species of the genus, are highly aromatic. In the summer months during ordinary seasons it yields a great amount of herbage, which while young is relished by all pasture animals; when it becomes old, however, the herbage is harsh, and cattle or sheep seldom or never touch it, if other grasses are plentiful. Under cultivation it is a most productive grass, and, if cut when it shows its flower stems, makes fairly good hay, with a slightly aromatic perfume. It might also be recommended for stuffing mattresses, &c. This grass is not particular as to soil or situation, for it may as often be found growing on dry, stony ridges, as on rich, alluvial flats, but of course on good soils it grows taller and yields a superior herbage. On the uplands it often gets very dry during the summer months, and when in that state it is very inflammable, so that care should be taken when making fires in the bush at such times, or a great amount of damage might be done. Unlike some other species of the genus, this "kangaroo grass" makes little or no growth during the winter months, either on the flats or ridges. It produces plenty of seed, which usually ripens during November and December, but which in a wet season is generally a month or two later in ripening.

Reference to plate.—A, Showing the arrangement of the two spikes and sheathing bract. B, Showing the arrangement of the sessile and pedicellate spikelets on the rachis (opened out). C, The sessile and pedicellate spikelets. (In some strong growing specimens from the Northern districts I have seen two pedicellate spikelets, one arranged on either side of the sessile one.) D, The sessile spikelet showing the four glumes (opened out). E, Grain, back and front views. All variously magnified.

ANTHISTIRIA, *Linn.*

(The Greek name for a species of grass.)

SPIKELETS one-flowered or empty, seven rarely six in a spike or cluster, four male or barren, either sessile or pedicellate in a whorl at the base of the hairy rhachis; two or sometimes one pedicellate and male or barren on the top of the rhachis, with an intermediate sessile fertile one. Glumes in the barren spikelets usually two, the outer one several-nerved, the inner thin and hyaline, in the male spikelets usually a third smaller hyaline one; in the fertile spikelet glumes four, the two outer ones nearly equal, usually rigid and coriaceous, the outer one obscurely five or seven nerved, the second with two prominent nerves, the central one very faint; third glume much smaller, very thin and hyaline; fourth very narrow and thin at the base, thickened into a long twisted awn usually bent above the middle. Palea very small and hyaline, sometimes scarcely conspicuous. Styles distinct. Grain free, enclosed in the hardened outer glumes. Erect, leafy, branching grasses, the spikes or clusters singly pedunculate within sheathing bracts, or sessile in the bracts, and collected many together in compound clusters forming short almost cyme-like leafy panicles.

Anthistiria avenacea, *F. v. M.* (Resembling an Oat.) "Tall Oat Grass."—Stems from a more or less silky-hairy, or woolly base, 2 to 5 feet high. Leaves very narrow, glabrous. Sheathing bracts narrow, membranous, glabrous, 1 inch to 2 inches long. Spikes or clusters all on rather long, slender, glabrous, or ciliate peduncles within the last bract. Barren spikelets either reduced to a single several-nerved rigid glume, with a small hyaline one inside, or more developed, enclosing a male flower, the four involucrel ones sessile. Fertile spikelets about four lines long, the rigid outer glumes, especially the lowest, densely villous with brown hairs. Awn long and rigid as in *Anthistiria ciliata* and *A. frondosa*.

This perennial grass is found all over Australia, from the coastal districts to the far interior, but principally in the latter portion of the continent. It is only found on the richest of soils, and often in a good season may be seen growing 5 feet high. Between Nyngan and Bourke I once saw the "tall oat grass" growing higher than the railway fences. It mostly grows in tussocks, and produces a quantity of leafy herbage at the base, which, when young, cattle are remarkably fond of, and fatten on. During the early summer months, in an ordinary season, its herbage appears to be more nutritious and succulent than at any other time. After the flower stems have developed, however, they soon become hard and cane-like; and when this takes place, if other grasses are plentiful, cattle will leave the plant for more tender herbage. Mr. Bailey says: "This is one of the best fodder grasses of Australia." It will withstand a phenomenal amount of dry weather, but this may be accounted for by the fact that its strong roots penetrate the earth to a great depth, and thus get away from the drying influences of the sun's rays.



Anthistiria avenacea, *F. v. M.*
"Tall Oat Grass."







Anthistiria ciliata, Linn.
"Kangaroo Grass."

It is fairly plentiful in many parts of Australia, especially in the interior. The reason of this, however, is easily explained. Under ordinary conditions it produces a great amount of seed, which, when ripe, germinates readily, if the ground is anyway moist, during the spring of the year. I can highly recommend the grass for systematic cultivation, either in the coastal districts or in the interior. Its rich, succulent herbage, if cut before the flower stems are developed, should make capital hay. I think, if the grass were cultivated for a few consecutive years, it would yield a grain large enough to be classed amongst the cereals we at present cultivate. The seeds are large, and in appearance somewhat resemble oats; and, as they separate easily from the chaff, I think I am justified in classing it amongst those Australian grasses which I have already suggested might be cultivated for the grain they yield. The seeds of this grass are well worth disseminating in those parts of the country where it may not already be growing, and, as before explained, as it produces an abundance of seed, if allowed to grow undisturbed for a time, there would be no difficulty in bringing it under systematic cultivation. The most likely places at the present time to collect the seeds of this grass would be within the railway enclosures in different parts of the country. In the interior the seeds usually ripen during October, November, and December. In the coastal districts they are generally one month or two months later in ripening.

Reference to plate.—A, Cluster of male or barren spikelets, and the fertile one, opened out to show how they are arranged; B, Fertile spikelet opened out, showing the three glumes and terminal awn; C, Male spikelet; D, Grain, back and front views. All the details natural size, with the exception of the cluster of spikelets, which is reduced.

Anthistiria ciliata, Linn. (Referring to the hairs bordering the sheaths.) "Kangaroo Grass."—Stems $1\frac{1}{2}$ to 4 feet high. Leaves narrow, glabrous or the sheaths hairy; ligula very short, sometimes ciliate. Spikes or clusters of spikelets not numerous, sessile, or the lower ones pedunculate in a short terminal leafy panicle; the leafy bracts subtending each spike, sheathing at the base, and tapering into points longer than the cluster; the short rhachis bearded with long brown hairs. Spikelets narrow, 4 to 5 lines long; four male or barren sessile at the base of the bearded rhachis; two or one pedicellate at the top, glabrous or sprinkled with a few long hairs; outer glume the largest, acute, many-nerved; second shorter, thin and three or five-nerved; third thin and hyaline. Fertile terminal spikelet glabrous or shortly pubescent at the end; outer glume broad, obtuse, rather thick, about seven-nerved; second rigid, rather shorter and narrower, with two prominent lateral nerves and a faint central one; third narrow-oblong, very thin and hyaline; awn or fourth glume very long and rigid, the attenuate base not dilated. Grain free, enclosed in the hardened outer glumes.

This is one of the most widely distributed grasses on the Australian Continent, and, at one time, was supposed to be exclusively Australian. It is, however, not only to be found in New Guinea, but Mr. Bentham says it is spread over tropical Asia and Africa. It is very plentiful in many places in the coastal districts of this continent, but it is more sparingly distributed in the interior. It might be supposed that a grass growing under such varied conditions of soil and climate would develop many forms. This is not the

case, however, for, with the exception of such slight differences as some of the forms being darker green, others more glaucous, and some more hairy than others, their qualities are much the same. In good seasons, within the railway enclosures, and on country that is not heavily stocked, this "kangaroo grass" will sometimes attain a height of 6 feet. In the tropical parts of the continent it grows more or less all the year round. In the southern portion of the continent it is essentially a summer-growing grass, for it seldom starts into growth before October or November. In ordinary seasons this "kangaroo grass" remains beautifully green during the summer months. This is to be accounted for by its strong roots, which penetrate the earth to a great depth, thus getting away from the drying influences of the sun's rays. If the grass is cut when the flower stems first appear, it can be made into excellent hay. If it should not be cut for hay, it will, soon after the flower stems have developed, turn slightly brown, when its nutritive qualities are said to be at the highest. It is an excellent pasture grass, of which herbivora of all descriptions are remarkably fond, and fatten on. Horses may frequently be seen browsing upon the young flower panicles, which they eat with great relish. Horses and bullocks, when allowed to graze in pastures where this "kangaroo grass" is growing plentifully, can be worked very hard, and still keep in good condition, which is a proof of its nutritive qualities. This grass will not stand close grazing, and, in paddocks that are heavily stocked all the year round, it gradually becomes scarce. An instance of this may be seen any day along the lines of railway. Within the railway enclosures this grass may be seen growing 3 and 4 feet high, but outside there is often not a vestige of it to be seen.

Although this grass develops a number of flowering stems, and to the casual observer it would appear to mature a quantity of seed, unfortunately this is far from being the case. The most remarkable thing is, as far as my observations have gone, that some plants will produce a little seed, whilst others are completely sterile, the latter very much predominating. The few seeds that are matured will germinate under favourable conditions, but the most reliable way to propagate this grass is by division of its roots when it begins to make growth in spring. This may seem to be a tedious process, but it would well repay—in places where it has become scarce through overstocking—for the outlay by the immense yield it would give in a very short time.

Baron von Müller and L. Rummel give the following chemical analysis of this grass during its spring growth:—Albumen, 2·05; gluten, 4·67; starch, 0·69; gum, 1·67; sugar, 3·06 per cent.

Reference to plate.—A, Compound cluster of spikelets. B, A cluster of male or barren spikelets and the fertile one, opened out to show how they are arranged. C, The fertile spikelet, opened out to show the three glumes and awn. D, Grain, back and front views. All variously magnified.





Anthistiria membranacea, Lindl.
"Landsborough Grass."

Anthistiria membranacea, *Lindl.* (Referring to the thin glumes.) "Landsborough Grass."—Quite glabrous, sometimes forming dense, leafy tufts of 6 inches, the branching stems often elongated to 1 foot or 2 feet. Leaves flat, appearing almost articulate on the short, flat, prominently striate sheaths. Floral leaves or bracts with coriaceous sheaths and short lanceolate laminae. Panicles small, dense, almost cyme-like, as in *Apluda*, with very numerous small spikes or clusters, each subtended by a scarcely longer bract. Spikelets scarcely 2 lines long, glabrous, the four involucrel ones pedicellate, the fertile one rather longer than the two pedicellate barren ones beside it. Glumes all thin, the outer one acute with several green nerves; the second with one or three nerves, the awn very fine, scarcely more than as long again as the spikelet. Grain enclosed in the hardened outer glumes, but free from them.

An annual species found in the arid interior of all the Australian colonies except Victoria. It is fairly plentiful in many parts of the continent, and it is generally found growing on rich soils. It generally grows in small tufts, but in a favourable season the weak stems lengthen out very much, and form an entangled mass often over a foot deep. It is essentially a summer-growing species, and generally makes most of its growth during the hottest part of the season. I have had this grass under experimental cultivation, and raised an excellent crop of herbage in less than three months from seed. It was grown on a black, loamy soil, and during a period of very dry weather it produced a great amount of rich, succulent herbage, which horses were very fond of. When cut, just as the flower stems first appeared, it made excellent hay. It is worthy of extensive cultivation in the arid interior, either for temporary pasture or to be cut at the proper time, and made into hay. It is considered a most nutritious grass, and towards autumn it often gets so exceedingly dry and brittle that it breaks up into innumerable pieces, but even then stock of all kinds are said to be so fond of it that they lick the broken stems and leaves from the ground. There would be no difficulty in bringing this species under systematic cultivation, for, under ordinary circumstances, it produces an abundance of seed, which usually ripens in November, December, and January. If a large quantity of seed is required, it would be advisable to fence off a small area where the grass grows plentifully, from which as much ripe seed could be gathered as would sow an immense area.

Reference to plate.—A, Compound cluster of spikelets. B, Cluster of male or barren spikelets and the fertile one, opened out to show how they are arranged. C, Fertile spikelet, opened out to show the three glumes and terminal awn. D, Male spikelet, opened out to show three glumes. E, Grain, back and front views. All variously magnified.

ASTREBLA, F. v. M.

(Referring to the awn being untwisted.)

SPIKELETS few-flowered, sessile or nearly so in the alternate notches of the continuous rhachis of one or two simple secund spikes, the rhachis of the spikelet articulate above the two outer glumes. Outer empty glumes two, glabrous, acute, many-nerved, unawned. Flowering glumes silky-hairy, three-lobed, the central lobe with a broad base tapering into a straight or curved not twisted awn, the lateral lobes erect, rigid, two or three nerved. Palea with two prominent ciliate nerves or keels. Styles distinct, very short. In the three species the spikes are usually single, very rarely two together at the end of the peduncle.

Astrebla pectinata, F. v. M. (Referring to the comb-like spike.) "Mitchell Grass."—An erect glaucous grass of $1\frac{1}{2}$ to 3 feet, glabrous, except sometimes a few hairs at the orifice of the sheaths. Leaves flat, ending in long points, smooth or scarcely scabrous. Spikelets sessile in the alternate notches of a secund spike of 2 to 3 inches, closely imbricate and turned to one side. Outer glumes 4 to 5 lines long, glabrous, acute, nine or eleven nerved, with scarious margins. Flowering glumes three or four, the entire part scarcely 1 line long, densely villous outside, as well as the broad base of the middle lobe; lateral lobes semi-lanceolate, glabrous, rigid, 4 to 5 lines long, acute, two or three nerved, with the outer margin broadly scarious; central lobe broad, ovate, concave, keeled, tapering into a slender straight awn about as long as, or rather longer, than the lateral lobes. Rhachis of the spikelet articulate only above the outer glumes, very hairy between the flowering ones, continued and less hairy above the perfect flowers, with one or two glabrous glumes and paleæ empty or with rudimentary flowers.

This is one of the famous "Mitchell grasses" which some pastoralists and stockmen in the interior regard as the best of all native grasses, both for its drought-enduring qualities and for its fattening properties. On rich, chocolate soils this perennial grass grows into large tussocks, and in ordinary seasons will yield a great amount of rich, succulent herbage, which is much relished by all herbivora. Its thick wiry roots penetrate the earth to a great depth, which enable the plant to withstand the most protracted drought, and for this reason it is a most valuable stand-by for the pastoralist during adverse times. When the grass becomes so dry, during a long period of drought, that the stems and leaves break to pieces stock may be seen licking them off the ground, and they seem to fatten on this feed notwithstanding its uninviting appearance. An experienced drover once told me that stock would travel further and keep in better condition when fed on this than on any other grass in Australia. Although its natural habitat is on the central plains of the continent it will grow equally as well in the coastal districts



Astrebla pectinata, *F. v. M.*
"Mitchell Grass."



Astrebla triticoides, *F. v. M.*
"Mitchell Grass."

under certain conditions. This I have proved by cultivating it on the eastern side of the Dividing Range, although only in experimental stages; still over a series of years. To ensure the successful cultivation of this grass in the coastal districts the land on which it is grown must be thoroughly drained, if not naturally so situated, for nothing appears to harm the Mitchell grass so much as stagnant moisture. If cut just as the flower-spikes appear, it makes excellent hay, and if left growing a little longer before it is cut, it should make good ensilage. When left undisturbed for a time it produces a great amount of seed, so that there would be no difficulty in collecting any quantity for dissemination in those parts of the country where it may not already be growing.

The most likely places at present to collect the seeds are within the railway enclosures in the interior. Those pastoralists who are fortunate enough to have this grass growing on their runs, would do well, by conserving small areas from which a supply of seed could be obtained, to sow it in places where the plant may have been eaten out through over-stocking. The seeds of the Mitchell grass when ripe are like small grains of wheat, and at one time they formed an article of food for the aborigines.

The seeds usually ripen in November and December.

Reference to plate.—A, Spikelet. B, Floret closed. C, Floret open. D, Grain, back and front views. All variously magnified.

Astrebla triticoides, *F. v. M.* (Wheat-like.) "Mitchell Grass."—An erect glaucous grass of 2 to 3 feet; very near *A. pectinata*, the leaves more or less scabrous or ciliate on the edges. Spikes 3 to 6 inches long. Spikelets alternate, not closely imbricate, and often almost erect, and at some distance from each other. Outer empty glumes usually very unequal, the lowest short, the second 4 or 5 lines long. Flowering glumes shorter, the lateral lobes shorter and more rigid than in *A. pectinata*, and the awn much exceeding them, the dorsal hairs appressed and silky.

A perennial grass found on rich soils nearly all over the interior, but nowhere is it reported to be plentiful. This is to be regretted, for it is one of the best of the native grasses. It is well worth systematic conservation, and even cultivation, in places where it may not already be growing. I have had it under experimental cultivation for a number of years, and can highly recommend it for cultivation either in the coastal districts or in the interior. If grown on the eastern side of the Dividing Range, however, the land must be thoroughly drained, if not naturally so situated, for it is very susceptible to stagnant moisture. Under good cultivation, this grass yields a phenomenal amount of rich, succulent herbage, which herbivora of all kinds are remarkably fond of. Pastoralists and stockmen hold this grass in high repute, and it is said that cattle will fatten on its dry, broken stems and leaves. If it is cut when it first shows its flower stems, it makes excellent hay, and from its great yield when under cultivation it should be valuable for making into ensilage if cut when the flower stems are well developed.

When this grass is allowed to grow undisturbed for a time, it produces plenty of seed, so that there is no difficulty in the way of systematically cultivating it. The most likely places to collect the seed at the present time are the railway enclosures in the interior. So as to have an annual supply of good seed for dissemination on stations, it would well repay pastoralists to have small areas set apart as nurseries for the cultivation of this and many other grasses. This would not be an expensive undertaking; in fact, it is astonishing the quantity of seed that could be saved from a very small area. Some such system will have to be adopted before long, to save many of the most valuable grasses from extermination. The seeds, when ripe, are like small grains of wheat, and at one time formed an important article of food for the aborigines. There is a variety (var. *lappacea*, *Danthonia lappacea*, of Lindley) of this grass which I have often recommended to be cultivated for the grain it yields. These grains are like small grains of wheat, and they separate very easily from the chaff. The ears (which are often more than 6 inches in length) are something like large wheat ears, and where the latter would not grow, owing to great heat, the former might after a few years of careful cultivation and selection, be found an excellent substitute. The grain of this variety also was at one time largely used by the aborigines as an article of food.

The seeds of this species and its variety usually ripen during October, November, and December.

Reference to plate.—A, Spikelet. B, Floret closed. C, Floret open. D, Grain, back and front views. All variously magnified.

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Bromus arenarius, *Labill.* Var. *macrostachya*.
"Brome," "Oat," or "Barley Grass."



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Bromus arenarius, *Labill.*
"Brome," "Oat," or "Barley Grass."

BROMUS, Linn.

(From a Greek name for the Wild Oat.)

SPIKELETS several-flowered, oblong or lanceolate, pedicellate, erect or drooping, in a more or less branched panicle, the rhachis of the spikelet articulate between the flowering glumes, glabrous or scabrous-pubescent. Outer empty glumes acute or fine-pointed, unawned. Flowering glumes convex on the back, five or seven nerved; the hyaline apex usually shortly bifid; the mid-rib produced into a straight or curved awn, free from a little below the apex. Palea nearly as long as the glume, the two prominent nerves usually scabrous-ciliate. Ovary obovate, crowned by a hairy membranous appendage, the very short distinct styles more or less lateral. Grain flattened, adhering to the palea, and often more or less to the base of the glume.

Bromus arenarius, Labill. (Found on sandy soil.) "Brome, Oat, or Barley Grass." An annual, from 1 foot to about $1\frac{1}{2}$ feet high. Leaves flat, flaccid, softly hairy or pubescent. Panicle at first erect, at length drooping; the capillary branches clustered, the longer ones 2 to 3 inches long, with one to four spikelets on capillary pedicels. Spikelets lanceolate, $\frac{1}{2}$ to $\frac{3}{4}$ of an inch long without the awns, flat, five to nine flowered. Glumes all pubescent or glabrous, the lowest about 3 lines long and five-nerved, the second longer and seven-nerved, both empty and acute; flowering glumes rather longer, about seven-nerved, convex on the back, the awn free from a little below the scarious tip $\frac{1}{2}$ to $\frac{3}{4}$ of an inch long.

There is a variety (var. *macrostachya*) of this species with spikelets 1 inch long, each with fifteen to twenty flowers, found only, as far as I know, in the interior. The specimen, from which the accompanying drawing was made, was collected near the Darling River, in New South Wales. Both the species and the variety are annuals only. The former may be found growing nearly all over Australia and also in New Zealand. The variety, however, appears to be restricted to the habitat already indicated. These grasses make their growth during the winter and early spring months, and on this account are good additions to the pastures, especially in the interior, for during that time of the year most of the superior indigenous grasses are in a dormant condition. On rich lands in the interior that are liable to periodical inundations, these grasses, whilst young, yield a fair amount of succulent herbage, of which herbivora of all kinds are remarkably fond. The early spring growths are valuable forage for sheep at the season of lambing, which helps to tide over a critical time, until the superior grasses start into growth. For this reason pastoralists in the interior speak in favourable terms of them. In the coastal districts, however, where most other kinds of grasses are plentiful nearly all the year round, the "brome grass" is not so favourably spoken of. When left unmolested for a time these grasses produce plenty of seed, which usually ripens in the interior in September and October, but in the coastal districts generally one month later.

Reference to plate of *Bromus arenarius*.—A, Spikelet. B, Floret. C, Grain, back and front views. All variously magnified.

Reference to plate of *Bromus arenarius*, var. *macrostachya*.—A, Spikelet. B, Floret. C, Grain, back and front views. All variously magnified.

CHLORIS, *Linn.*(From *chloros*, green, alluding to the colour of the herbage.)

SPIKELETS one-flowered, awned, singly sessile in two rows on one side of simple spikes, either solitary or digitate at the end of the peduncle, the rhachis of the spikelet articulate immediately above the outer glumes. Outer empty glumes two, keeled, persistent, awnless. Flowering glume produced into a fine straight awn, entire or with a tooth lobe or short awn on each side of the terminal awn. Palea folded or with two prominent nerves. Rhachis of the spikelet produced behind the palea, and bearing one or more empty glumes, all awned, and usually with their ends on a level with that of the flowering glume.

Chloris acicularis, *Lindl.* (Referring to the needle-like spikelets.) "Umbrella," or "Spider Grass."—A glabrous erect grass of 1 foot to 2 feet. Leaves flat, the lower sheaths broad and flattened. Spikes 6 to 12 or even more, at first erect but at length horizontally spreading as in *C. divaricata*, 3 to 4 inches long, slender and often purplish. Spikelets rather distant. Outer glumes narrow, keeled, tapering to fine points, the lowest $1\frac{1}{2}$ to 2 lines, the second 3 lines long. Flowering glume about 2 lines, narrow, three-nerved, tapering into an awn of about $\frac{1}{2}$ an inch, with sometimes, but not always, a short point on each side at the base. Palea long, narrow, prominently two-nerved. Terminal empty glume with an awn sometimes as long as that of the flowering glume, but usually shorter.

This perennial grass is found in New South Wales, Queensland, Victoria, South and West Australia, but principally in the interior of those colonies, and generally growing on rather sandy or light, loamy soils, though I have occasionally seen it growing on land of a stiff, loamy nature. Its strong fibrous roots penetrate the earth to a great depth, which enable it to withstand a protracted drought. During the summer months, in an ordinary season, the "umbrella grass" yields a great amount of succulent herbage, of which herbivora of all kinds are fond. Owing to its free-seeding qualities, and the easy germination of its seeds under ordinary circumstances, it is fairly plentiful in many parts of the continent. This grass is well worth conservation, and even cultivation, on the arid central plains of this continent, for pastoralists could nearly always depend upon some herbage from it for their flocks even during adverse times of drought and heat. There would be no difficulty in collecting any quantity of the seed of the "umbrella" grass from a reserved area, for dissemination in those dry parts of the country where it may not already be growing, or for redissemination where the plant may have died out through over-stocking. A few smart boys could collect enough seed in one day to sow several acres. Judging from the succulent herbage this grass yields in an ordinary season, I should think it would pay to cultivate for hay in the interior; at any rate, it is well worth a trial.

The seeds of this grass usually ripen in November and December.

Reference to plate.—A, Showing the arrangement of the spikelets on the rhachis. B, A spikelet. C, Flowering glume and palea. D, Grain, back and front views. All variously magnified.



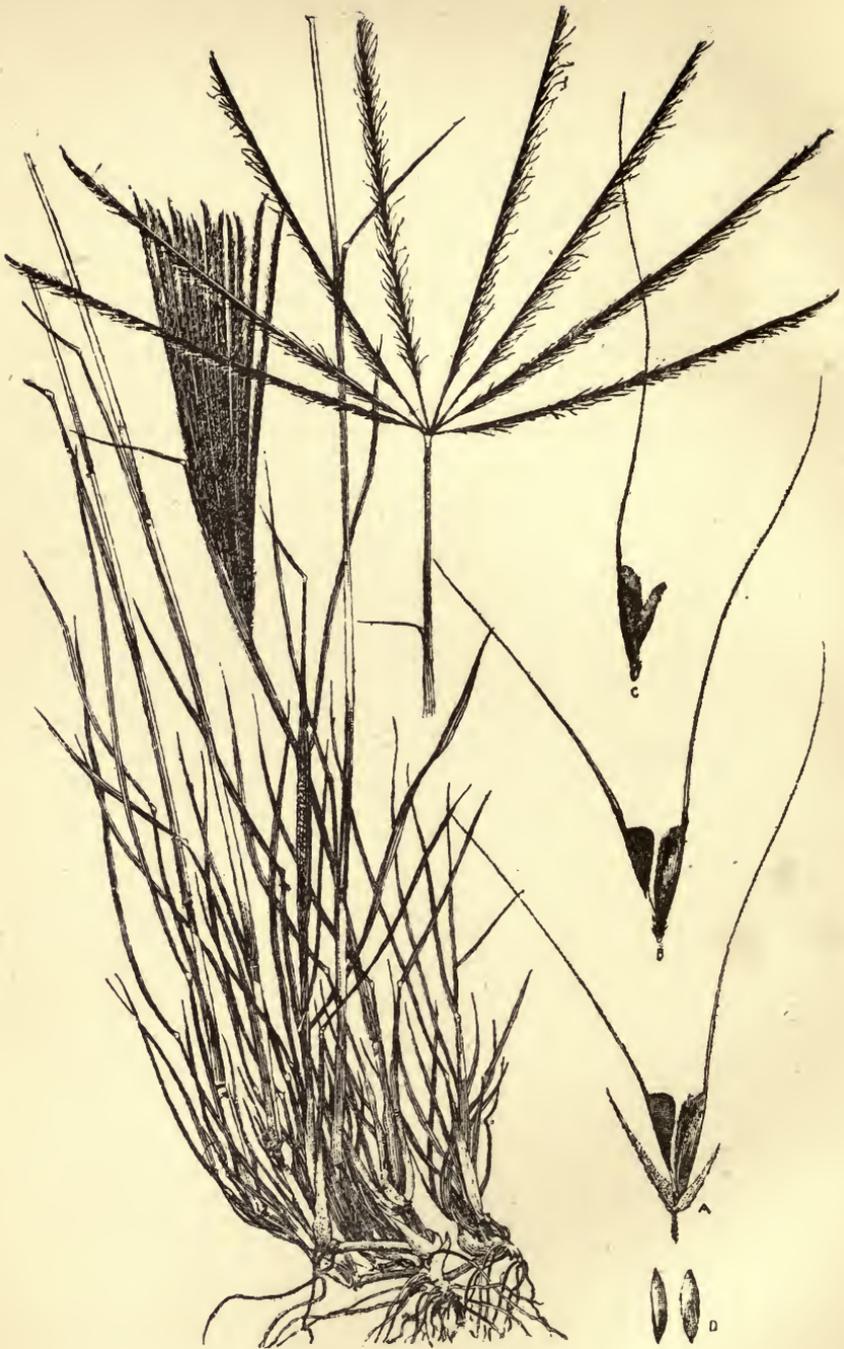
Chloris acicularis, Lindl.
"Umbrella," or "Spider Grass,"



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Chloris truncata, *R. Br.*
"Star," or "Windmill Grass."

Chloris truncata, R. Br. (Referring to the abrupt termination of the glumes.) "Star" or "Windmill Grass."—A glabrous erect grass of 1 foot to 3 feet. Leaves usually flat, but narrow, with flattened sheaths. Spikes, six to ten, slender, 3 to 6 inches long, at length horizontally spreading. Spikelets numerous, but not crowded, cuneate, 1 line to $1\frac{1}{2}$ lines long, without the awns. Lowest outer glume very small, almost setaceous, the second narrow and fine-pointed, about as long as the spikelet. Flowering glumes oblong, obtuse, keeled, slightly ciliate, with a fine awn of 3 to 6 lines. Terminal empty glume much shorter and broader, raised to the level of the flowering glume and flat-topped, giving the spikelet its cuneate truncate form.

This perennial grass is found in South Australia, Victoria, New South Wales, and Queensland, and in some situations it is fairly plentiful. It is generally found growing on the richest of soils, both in the coastal districts and in the arid interior. As might be supposed, a grass growing under such varied conditions of soil and climate is very variable as regards its height and the size of its inflorescence. In some situations it grows 3 feet high, with the inflorescence a foot across. In other situations it grows only from 6 inches to a foot high, with the inflorescence only 4 inches across. The latter form is generally found in the interior. In all its varied forms, however, it yields a rich succulent herbage, which is much relished by all herbivora, sheep being particularly fond of it. On loose soils this grass tillers well. I have had this species under experimental cultivation for several consecutive years, and the quantity of rich succulent herbage it yielded was enormous. When cut just as the flower-spikes appeared it made excellent hay. I can highly recommend this grass for permanent pasture, or to be grown and made into hay. It is well worth conservation in those parts of the country where it is already growing, and redissemination in those parts where it may have become scarce through overstocking. When the "star grass" is allowed to grow undisturbed for a time it produces an abundance of seed. From a small reserved area, or within the railway enclosures, as much ripe seed could be collected in a few hours as would suffice for sowing large areas. The seeds usually ripen in October and November in the interior; in the coastal districts one month or two months later, though occasionally in autumn. I have sown the seeds of this grass in spring-time with excellent results, but, generally speaking, I prefer sowing them in the early autumn months—say March or April, when there is moisture in the soil. Seeds sown at that time of the year usually germinate readily, and the young plants becoming well established in the soil are better able to withstand the succeeding summer, should it prove a dry one, than plants raised from seed sown in the spring-time.

Reference to plate.—A, Spikelet. B, Flowering glume, and the pedicellate terminal empty one. C, Flowering glume and palca. D, Grain, back and front views. All variously magnified.

DANTHONIA, *D' C.*

(Named in honor of M. Danthoine, a French botanist.)

SIKELETS several flowered, pedicellate or rarely almost sessile, in a panicle either loose or reduced to a single raceme, the rhachis of the spikelet articulate above the outer glumes, hairy round the flowering ones. Outer empty glumes two, narrow, keeled, acute, unawned, usually as long as the spikelet. Flowering glumes convex at the back, usually nine-nerved, with two rigid or scarios terminal lobes more or less one or three nerved at least at the base, and a twisted and bent awn between them (almost reduced to a point in one species). Palea broad, as long as or usually longer than the entire part of the glume, obtuse or two-pointed. Styles distinct. Ovary glabrous. Grain free.

Danthonia carphoides, *F. v. M.* (Carpha-like; having some resemblance to Carpha, a Cyperaceous plant.) "Oat-Grass."—Stems from 3 or 4 inches to 1 foot high. Leaves very narrow, not long, glabrous. Panicle ovate, dense, 1 inch to 1½ inches long. Spikelets few, very shortly pedicellate. Outer glumes 4 to 5 lines long, rather broad, with scarios margins. Flowering glumes 3 to 6, with a broad oblique base, as in *D. bipartita*, the ring of hairs almost broken into clusters; lateral lobes shorter than the base, the very fine awn scarcely exceeding them.

This perennial grass is found in New South Wales, Victoria, and South Australia; but it is not reported to be very abundant anywhere, except in the south-eastern portion of New South Wales, where it grows plentifully, and where it is highly spoken of as a forage-grass. It is generally found growing in the colder or mountainous parts of Australia, and in such places it is really well worth conservation, and dissemination where it does not already exist. During the summer months, and under ordinary circumstances, it makes a quantity of fine leafy feed, of which sheep are particularly fond, as also are horses and cattle; but it is not bulky enough to recommend for pasture, except in mixtures, where these larger animals are allowed to graze. The "oat-grass" produces an abundance of seed when it is allowed to grow undisturbed for a time, so that there would be no difficulty in collecting any quantity by those persons desirous of so doing, either for re-dissemination where the grass may have been eaten out through overstocking, or for laying down new sheep-pastures. I have had several species of the genus *Danthonia* under experimental cultivation, and they produced herbage which was much superior to that seen in ordinary pastures. Many of them I can highly recommend as being worth cultivation, either for general pasture or to be grown and made into hay. Most of them produce an abundance of seed if they are allowed to grow undisturbed during the early summer months, so that there would be no difficulty in bringing them under systematic cultivation. The seeds of the "oat-grass" usually ripen during November, December, and January, according to situation.

Reference to plate.—A, Spikelet. B, Back view of floret. C, Open floret. D, Grain, back and front views. All variously magnified.



Danthonia carphoides, F. v. M.
"Oat Grass."







Danthonia semiannularis, R. Br.
"Wallaby Grass."

Danthonia semiannularis, R. Br. (Referring to the half-ring of hairs on the floret.) "Wallaby-grass."—A variable plant, the stems usually 2 to 3 feet high, but sometimes much lower. Leaves very narrow, flat or convolute, never so fine as in *D. setacea*; the sheaths glabrous or hairy, more or less ciliate at the orifice. Panicle sometimes loose and spreading, more frequently narrow and compact. Outer glumes acute, above half an inch, and sometimes nearly 1 inch long. Flowering glumes usually 4 to 8, not exceeding the outer ones; the lobes lanceolate, with a broad or narrow hyaline margin, acute or tapering into a point, or rather short fine awn; the long hairs or cilia copious at the base and margins and forming a ring round the back immediately under the lobes, the twisted awn varying from $\frac{1}{2}$ to 1 inch. Palea longer than the entire base of the glume, often two-pointed. Styles distinct. Ovary glabrous. Grain free.

This perennial grass is found over nearly the whole of Australia, and in some situations it is fairly plentiful. It grows both in the coastal districts and in the arid interior; I have also seen it growing plentifully on some of the high mountain ranges where snow falls occasionally. As might be supposed, a grass growing under such varied conditions of soil and climate is very variable as regards stature. In all its varied forms, however, it is one of the most nutritious grasses of Australia, and, unlike most other species of this genus, it will grow more or less all the year round. Stock of all descriptions are remarkably fond of it, and sheep often crop it so close down in the colder parts of Australia that it gets little chance to perfect any seed. In the warmer parts, however, and under ordinary circumstances, it produces an abundance of seed, which germinates readily after showery weather in the autumn or spring months. I have had this grass under experimental cultivation, and the rich succulent herbage it produced was much superior to that generally seen in pastures. If cut immediately the flower-stems appear it makes capital hay. I can highly recommend the "wallaby grass" for systematic cultivation, either for permanent pasture or for making into hay. On good soils the roots of this grass penetrate to a great depth, which enable the plant, when growing in the arid interior, to withstand long spells of dry weather. Although it is not particular as to soil or situation, for it may as frequently be seen growing on dry ridges as on the better classes of soils, still it produces a superior herbage when grown on moderately rich, strong loams of good depth. As has already been indicated, this grass produces a great amount of seed when allowed to grow undisturbed for a time, and within the railway enclosures, or in any reserved area, enough seed could be collected in a short time to sow large areas. There would, therefore, be no difficulty in bringing it under systematic cultivation in those parts of the country where it may not already be growing, or where it may have been eaten out through over-stocking. In the interior this grass usually ripens its seeds in October, but in the coastal districts and in the colder parts of the country generally one month or two months later.

Reference to plate.—A, Spikelet. B, Closed floret, showing the three semi-annular rings of hairs on the back of glume. C, Open floret. D, Grain, back and front views. All variously magnified.

DEYEUXIA, Clarion.

(Named in honor of Nicholas Deyeux, a French chemist.)

SPIKELETS one-flowered, pedicellate, or rarely sessile in a panicle, either loose and spreading or narrow and spikelike; the rhachis of the spikelet articulate above the outer glumes, usually bearing a tuft of hairs round the flowering glume, and usually produced beyond it in a small ciliate or rarely glabrous bristle, very rarely bearing an empty glume or imperfect flower, sometimes very minute, rarely deficient. Glumes three, two outer ones persistent, keeled, unawned; flowering glume shorter and very thin, about as long or rarely longer and membranous, broad, enclosing the flower, five-nerved, with a fine dorsal awn usually bent and twisted, rarely short and straight, or very rarely deficient. Palea thin, more than half as long as the glume, faintly or prominently two-nerved. Styles distinct, short. Grain enclosed in the glume and palea, and sometimes partially adhering to them.

Deyeuxia billardieri, Kunth. (After J. J. Labillardière.) "Bent-grass." —Stems sometimes very short and tufted, usually about 1 foot high or more; leafy to the inflorescence, which is usually enclosed at the base in the broad sheath of the upper leaf. Panicle when fully out often nearly 1 foot long, though sometimes much smaller, with long capillary-divided branches in regular whorls. Outer glumes very narrow and pointed, about 3 lines long; flowering glume not half so long, quite glabrous, with two narrow pointed teeth; the dorsal awn attached much below the middle, and rather longer than the outer glumes. Palea shorter and narrow. Rhachis produced into a hairy bristle.

This species and *Deyeuxia forsteri* (Kunth.) having many intermediate forms are often closely connected, but in the typical species the plants are so structurally different as to be easily distinguished. The details of the inflorescence of this species are much larger than those of *D. forsteri*. When growing together even the most superficial observer cannot fail to distinguish between the two; *D. billardieri* has wide leaves and a slightly reddish inflorescence, while *D. forsteri* has narrow leaves and a light-coloured inflorescence. The "bent-grass" has an extensive range of growth, being found in the coastal districts and on some of the high table-lands in all the Australian Colonies, also in New Zealand and Tasmania. In some parts of New England, and, indeed, in many other districts, it is very plentiful, and in the summer-time, where it is protected from stock, it is quite a feature in the pastures. It usually grows from 6 to 18 inches high, according to the soil or situation it is found in. On rich moist pasture-land it will grow throughout a greater part of the year, but on high dry land it will die about the beginning of December. It is a capital winter and early spring grass, and on good soils it yields a fair amount of rich succulent herbage, of which sheep are very fond. It produces a quantity of seed, which usually ripens in October, November, and December, according to situation.

Reference to plate.—A, Spikelet. B, Floret. C, Grain, back and front views. All variously magnified.



Deyeuxia billardieri, *Kunth*.
"Bent Grass."





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Dichelachne crinita, *Hook.*
"Long-hair Plume Grass."

DICHELACHNE, Endl.

(From two Greek words signifying a "cloven hoof" and "chaff," in allusion to the bifid palea or glume.)

SPIKELETS one-flowered, numerous in a narrow usually dense panicle; the rhachis of the spikelet articulate immediately above the two outer glumes, and not continued beyond the flower. Glumes three, narrow, the two outer ones persistent, membranous, acute, keeled. Flowering glume raised on a short hairy stipes (rhachis of the spikelet), membranous at the time of flowering, hyaline and entire or two-lobed at the end, with a fine scarcely twisted dorsal awn a little below the end, slightly hardened round the fruit. Palea two-nerved. Stamens three or fewer; anthers glabrous. Styles distinct. Grain enclosed in the glume and palea, but free from them.

Dichelachne crinita, Hook. (Hairy, "Long Hair-plume Grass."—Stems 2 to 3 feet high. Leaves flat, glabrous or softly pubescent, the upper ones rather long with long sheaths. Panicle very dense and spikelike, 4 to 8 inches long; the spikelets imbricate on the short erect branches, but concealed by the numerous long hair-like awns. Outer glumes very narrow, hyaline with a slightly scabrous keel, nearly equal, about $2\frac{1}{2}$ lines long. Flowering glumes shorter, glabrous, the hyaline tip entire but readily splitting. Awn dorsal, very slender, bent but scarcely twisted, above 1 inch long.

A perennial grass, which is found in all the Australian colonies, but principally in the coastal districts and colder parts of the continent. According to Hooker, it is abundant throughout the island of Tasmania. It is fairly plentiful in many parts of Australia, and may be found growing on various soils. On good land I have often seen this grass growing nearly 4 feet high. When in flower it is a prominent feature in the pastures, and it may be easily recognised by its long panicles of flowers with purple hairy-like awns. In the hot, dry districts this grass is often harsh and somewhat scanty of foliage, but in the more humid districts its character is changed for the better. On good soils near the coast and in the colder parts of the continent it produces a great amount of rich succulent herbage, which is greedily eaten by all herbivora. The "long hair-plume grass" will continue to grow throughout the year on good pasture-land that is fairly well sheltered, and where frosts are not too severe. It is a good grass for the dairy-farmer, and if cut when the flower-stems first appear it can be made into excellent hay. It is worth conservation in those parts of the country where it may already be growing, and dissemination in places in the coastal and colder portions of the continent where it may not already exist. It is a prolific seed-bearing grass, so that there will be no difficulty in collecting any quantity of seed by those desirous of so doing, either in the railway reserves or in specially-reserved areas. The seeds usually ripen during October, November, and December.

Reference to plate.—A, Spikelet. B, Floret. C, Grain, back and front views. All variously magnified.

Dichelachne sciurea, Hook. (Squirrel-tailed) "Short Hair Plume Grass." Stems densely tufted, slender, 1 foot to $1\frac{1}{2}$, rarely 2 feet high, quite glabrous, the nodes usually dark-coloured. Leaves short, chiefly at the base of the stem, scabrous-pubescent or glabrous. Panicle narrower and looser than in *D. crinita*, 3 to 6 inches long, the rhachis and filiform branches scabrous. Outer glumes very narrow, about $2\frac{1}{2}$ lines long, the outermost rather shorter than the second. Fruiting glume rather more rigid than in *D. crinita*, and minutely pitted-rugose. Awns 6 to 8 lines long, not nearly so crowded as in that species.

This slender-growing perennial grass is found in all the Australian colonies, but principally in the coastal districts and colder parts of the continent. According to Hooker it is abundant throughout the island of Tasmania. It is fairly plentiful in many parts of Australia, and may be found growing on both rich and poor land, but of course on the former it yields a much superior herbage. It generally grows about $1\frac{1}{2}$ or 2 feet high, but I have often seen it growing nearly 3 feet high in a good season. It is a most variable species as regards the arrangement of its inflorescence; sometimes it is dense and spike-like, at other times it is very loose and somewhat spreading, and to the casual observer the extreme forms would look as if they belonged to distinct species; but it can never be mistaken under close examination. It is a very quick-growing succulent grass, and a valuable one to have in pastures, as it makes considerable growth during the winter and early spring months, ere many of the indigenous grasses show signs of growth. If cut when it first shows its flower stems, it can be made into excellent hay. This grass is worth conserving where it is already growing, and disseminating in the coastal districts and colder parts of the continent where it does not already exist. It produces a fair amount of seed, so that there would be no difficulty in collecting a quantity in any reserved area.

The seeds usually ripen in October and November, but in some of the colder districts as late as January.

Reference to plate.—A, Spikelet. B, Floret. C, Grain back and front views. All variously magnified.



Dichelachne sciurea, Hook.
"Short-hair Plume Grass."

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Diplachne fusca, Beauv.
"Brown-flowered Swamp Grass."

DIPLACHNE, Beauv.

(Referring to the two-lobed flowering glume.)

SPIKELETS several, often many-flowered, linear, sessile or very shortly pedicellate, but distant along the rhachis of a simple spike, or of the elongated branches of a simple panicle, the rhachis of the spikelet articulate and usually hairy under the flowering glumes. Outer empty glumes keeled, acute, unawned; flowering glumes with a hyaline shortly two-lobed apex, the keel produced into a short point or awn between or shortly below the lobes. Palea thin, prominently two-nerved. Styles short, distinct. Grain smooth, free.

Diplachne fusca, Beauv. (Referring to the spikelets having a brownish tinge.) "Brown Flowered Swamp Grass."—A glabrous erect grass of several feet. Leaves narrow, convolute when dry, with long loose sheaths; the ligula jagged. Panicle narrow, 6 inches to 1 foot long, with erect branches, the lower ones long. Spikelets sessile, or nearly so, rather distant, erect, linear, six to ten flowered, about 4 lines long, or rather more, and straw coloured, or longer and dark, the rhachis glabrous, or slightly hairy under each glume. Flowering glumes nearly 2 lines long, shortly ciliate on the margins in the lower part, prominently three-nerved, the keel produced into a short point between or just below the short hyaline terminal lobes. Keels of the palea shortly ciliate. Grain smooth and free.

This annual (?) grass is found in all the Australian colonies, also in Asia and Africa. In the coastal districts of this country it is generally found growing in or about brackish swamps; in the interior, in shallow pools of water, or in damp situations, and in some places it is fairly plentiful. During the summer months, and under ordinary circumstances, it yields a great amount of rich succulent herbage, of which cattle are particularly fond. This grass is worth disseminating on swampy land, where it may not already be growing, and where very few other grasses that are so nutritious would grow. Grasses that will grow in such situations are a valuable stand-by for stock during drought time, when the surrounding country is dried up, and almost destitute of tender herbage. It is at such times that many of the grasses, which are overlooked when herbage is plentiful on the plains, play a most important part in the economy of nature, and are the means by which many animals are saved from dying of starvation during adverse seasons. I have no doubt that this grass would pay to cultivate on low-lying waste lands. From its succulent stems and leaves it should not only make good hay, but also good ensilage. At any rate, it is worth a trial. There would be no difficulty in bringing this species under systematic cultivation, for if it is allowed to grow undisturbed for a time it produces a great amount of seed. From a small reserved area a few boys could collect enough seed in a few hours to sow several acres. On swampy land in the interior the seeds usually ripen during January, February, and March; in the coastal districts about one month later; but in drier places they generally ripen in November and December.

Reference to plate.—A, Spikelet. B, Floret. C, Grain, back and front views. All variously magnified.

ELEUSINE, *Gærtn.*

Mythological; from *Eleusis*, where was a celebrated temple of Ceres, (Demeter.)

SPIKELETS several flowered, flat, imbricate in two rows along one side of the digitate or scattered branches of a simple panicle; the rhachis of the spikelet articulate above the outer glumes. Glumes spreading, keeled and complicate, thin but rigid, the two outer empty ones usually shorter, unequal, obtuse, acute or tapering to a short point. Flowering glumes obtuse or less pointed, the terminal one usually empty or rudimentary. Palea folded. Styles short, distinct. Seed rugose within a loose membranous pericarp, which either persists round the ripe seed or breaks up and falls away, or otherwise disappears as the ovary enlarges.

Eleusine indica, Gærtn. (Indian) "Crow-foot" or "Crab Grass."—A coarse, erect, tufted grass from 1 foot to 2 feet high. Leaves narrow; the sheaths flattened and distichous, ciliate with a few long hairs. Spikes five to seven, 2 to 3 inches long, digitate, with usually one inserted rather lower down; the rhachis prominent on the upper or inner side; the spikelets loosely imbricate on the opposite side. Each spikelet $1\frac{1}{2}$ to 2 lines long, containing three to five flowers. Glumes obtuse, the lowest small and one-nerved, the second an empty one, and the lower flowering ones usually three-nerved. Pericarp persistent, very loose and membranous, enclosing the rugose seed.

This coarse, perennial grass is found in the coastal districts of New South Wales, and Queensland, and also in the warmer parts of the new and the old world. Quite recently I received specimens from New Caledonia for identification, that being, I believe, the first time it was recorded for that island. It is found only in the warmer portions of Australia. I never remember seeing it growing any further south than the Hunter River, in New South Wales. It is generally found growing on rich, moist lands bordering rivers, creeks, lagoons, &c., and in some places it is very plentiful.

The "crab grass" may be recognised by its dark green colour, strong stalks, and digitate panicles, the spikelets of which are flat, and overlap each other. It grows nearly all the year round, but during the summer months yields a great amount of rich, succulent herbage, which is much relished by cattle. It is said that if cut when it first shows its flower stems, it can be made into excellent hay. A gentleman at Kempsey, forwarded a specimen of this grass to me for identification quite recently, with a note to the effect that it was a "very good grass for cattle, and that they ate it greedily." It is worth disseminating on moist lands in the coastal districts; and as it produces a great amount of seed if left undisturbed for a time, there would be very little trouble in collecting any quantity. Besides its value as a forage grass, it is useful for binding the banks of rivers, dams, and loose earth. Its tough fibrous roots penetrate deeply into the soil, and in time form a perfect mat, so that flood-waters would have little effect upon the land where it was firmly established. It will even undergo partial submerision for a few days without the slightest injury. The seeds usually ripen during the summer and autumn months.

Reference to plate.—A, Spike showing the arrangement of the spikelets on the rhachis. B, Spikelet. C, Floret showing the grain enclosed in the very loose and membranous, but persistent, pericarp. D, Grain, three different views. All variously magnified.



Eleusine indica, Gartn.
"Crowfoot," or "Crab Grass."



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Handwritten text at the bottom of the page, which is mirrored and difficult to decipher. It appears to contain a name and a date, possibly "A. L. ... 1912".



Eragrostis leptostachya, Steud.
A "Love Grass."



ERAGROSTIS, Beauv.

(From *eros*, love, and *agrostis*, grass, alluding to the pretty panicles.)

SPIKELETS several, usually many-flowered, pedicellate or sessile in a loose and spreading or narrow and clustered panicle, the rhachis of the spikelet usually glabrous and articulate under the flowering glumes, but often very tardily so and sometimes inarticulate. Outer empty glumes unequal and rather shorter than the flowering ones, keeled, without any or only faint lateral nerves. Flowering glumes obtuse or acute, unawned, three-nerved, the keel prominent, the lateral nerves in a few species very faint. Palea shorter than the glume, with two prominent nerves or keels, often persisting after the glume and grain have fallen away. Grain free, ovoid or oblong, not furrowed.

Eragrostis leptostachya, Steud. (Referring to the slender spikelets.) "Love Grass."—Stems slender, usually about 1 foot high. Leaves at the base narrow, convolute, or setaceous, glabrous. Panicle loosely pyramidal, 3 to 5 inches long, with slender divided spreading branches. Spikelets on capillary pedicles of 1 line to 3 lines, loosely spreading, about 2 lines long, narrow, but much broader than in *E. pilosa*, much smaller than in *E. brownii*, loosely six to ten flowered, usually dark-coloured. Glumes acute, more spreading than in *E. pilosa*, the lateral nerves faint and almost marginal. Palea nearly as long, glabrous. Grain ovoid, smooth.

A slender, perennial species, growing about 1½ feet high, although I have occasionally seen it 2 feet high. It is found in the coastal districts of New South Wales and Queensland, in the New England district, and also on the Blue Mountains of the former colony. In some situations it is fairly plentiful, and on good soil it yields a rich, succulent herbage, much sought after by all pasture animals. On the Hon. Dr. Norton's estate on the Blue Mountains it is growing very plentifully, and cattle eat it in preference to any other kind of grass. When I was there a short time since, I saw that this particular species was cropped very close down to the ground, although there were several other species of grasses growing there, and some of them rather tall, and affording a bulk of herbage. The grass under notice forms a large percentage in some of the pastures in the southern parts of New South Wales, and will grow on land where it is partially shaded with trees, and in such circumstances will afford a tender herbage during the winter and early spring months. It is much improved by cultivation, and if cut when the flower-stalks first appear it makes good hay. It produces an abundance of seed, which usually ripens in October and November, but in good seasons the seeds ripen all through the summer and autumn months.

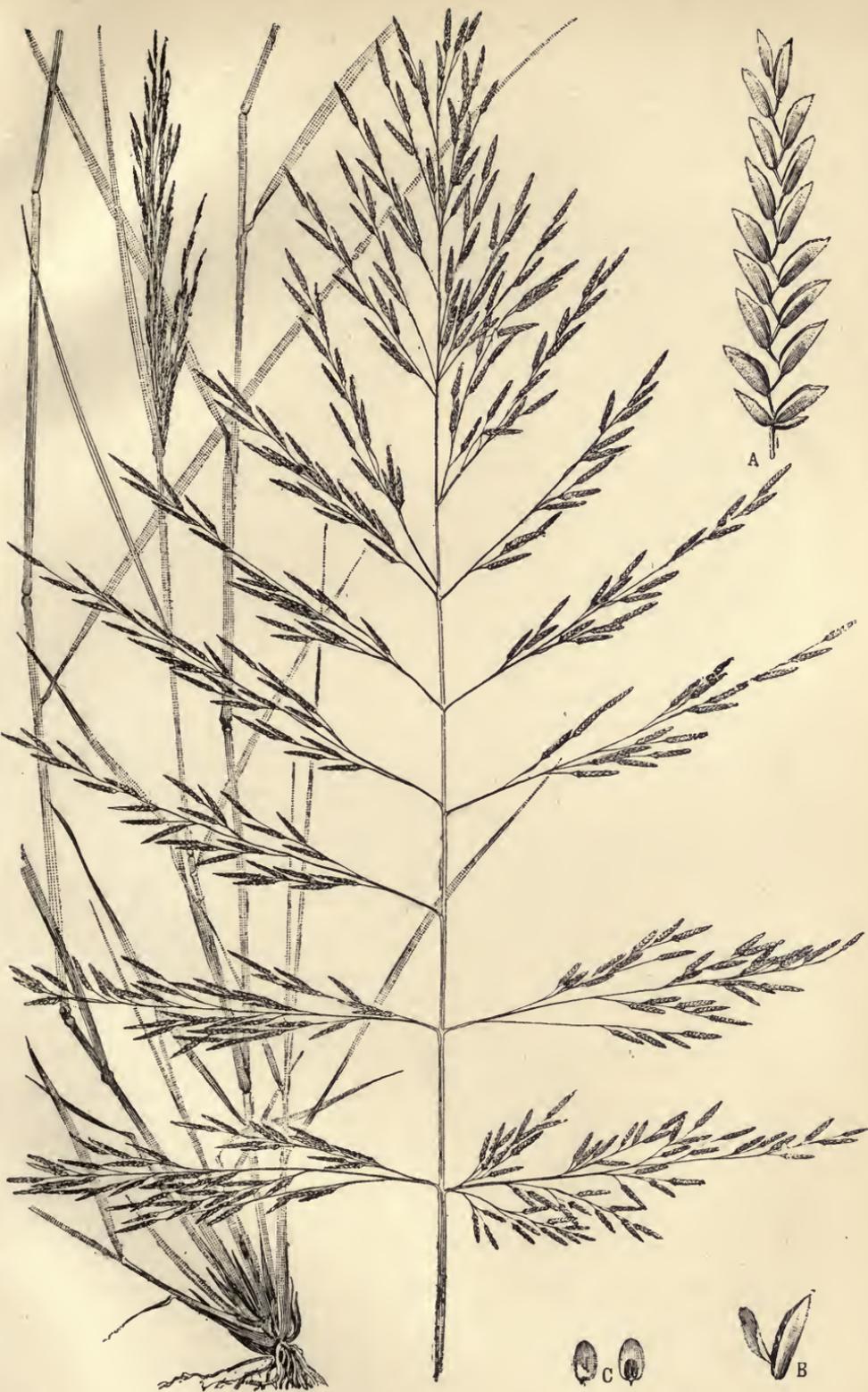
The Hon. Dr. Norton, M.L.C., says:—"After an experience of upwards of ten years at Euchora, Springwood, I feel justified in stating that the above-named grass is one of the most valuable of all the Australian grasses. Mixed with other native grasses, it grows freely on my land, and is greedily devoured by the cattle in preference to all other kinds. The milk produced by the cows which feed on these grasses is particularly rich, and makes excellent butter. The growth in places protected from the cattle is so great as to supply me in ordinary seasons with an abundance of hay for the winter, and both cows and horses seem almost more fond of this than of the grass in its green state."

Reference to plate.—A, Spikelet; B, Floret; C, Grain, back and front view. All variously magnified.

Eragrostis pilosa, Beauv. (From the hairs at the base of the branches of the panicle, which are not observable in the Australian grass. "Weeping Grass." "Love Grass.")—A tufted erect or ascending annual, 1 foot to near 2 feet high. Leaves narrow, usually flat. Panicle 6 inches to 1 foot long, narrow at first, spreading when in fruit, with numerous long capillary divided branches. Spikelets 2 to 4 lines long, narrow-linear, usually of a dark-leaden colour, but pale when old, loosely six to twenty flowered; the rhachis scarcely articulate. Glumes thin, distinctly keeled, the lateral nerves faint and short. Palea nearly as long, slightly ciliate on the keels, often persistent after the glumes have fallen away. Grain ovoid-oblong, smooth.

Mr. Bentham says, "This species is common in the warmer and some temperate regions of the northern hemisphere, chiefly in the old world. The hairs at the base of the branches of the panicle, which originally gave rise to the specific name, are not observable in any of the Australian specimens, and not constant in European ones." This annual grass is found in all the Australian colonies, both in the coastal districts and in the arid interior. On rich soils in a good season I have occasionally seen it 3 feet high. It generally starts into growth about the end of September, and if the season is a fairly moist one it will continue growing till March or April, when it gradually dies away. If, however, the season is a dry one, it may die out by the end of December, but will grow again from the ripened seed if rain should fall in January, and yield a fair amount of herbage during the late summer months. It is not particular as to soil or situation, as it may frequently be seen growing both on stony ridges and on rich meadow land. On good soils, however, it is a most prolific grass, and during the summer months affords a large amount of rich succulent herbage, which is much relished by stock of all kinds. On poor soils it takes very little root hold, and when being browsed upon is easily pulled up by the roots. I have had this grass under experimental cultivation, and it gave an enormous yield, and on being cut, when the flower stems first appeared, it made very good hay. I can recommend this grass to be grown for hay, for it not only gives a quick but, on good soils, a heavy return. There would be no difficulty in bringing it under systematic cultivation, for, under ordinary circumstances, it perfects a great amount of seed, which can be collected at almost any time during the summer and autumn months. An allied grass, the Teff of Abyssinia, is extensively cultivated for the sake of its grain, which furnishes food in the form of bread, to a great portion of the population of Abyssinia. On comparing the seeds of these two grasses I find that the Teff seeds are the larger, but the Australian grass would, no doubt, develop seeds quite as large after a few years of cultivation and selection, and as the grain separates very easily from the chaff I think I feel justified in classifying it with other Australian grasses, which I have already suggested, might be cultivated for the grain they yield.

Reference to plate.—A, Spikelet; B, Floret; C, Grain, front and side views. All variously magnified.



Eragrostis pilosa, Beauv.
"Weeping Grass," "Love Grass."







Eriochloa punctata, *Hamilt.*
"Early Spring Grass."

ERIOCHLOA, *Humb and Kunth.*(From two Greek words, *erion*, wool, and *chloa*, grass.)

SPIKELETS one-flowered, without protruding awns, with a callous annular or almost cuplike base; articulate on a short pedicel, in one or two rows along one side of the slender branches of a simple panicle. Glumes three, two outer ones empty, usually membranous, equal or nearly so; the third or flowering glume shorter, of a firm, coriaceous texture, obtuse, but tipped with a point or short awn not exceeding the outer glumes. Palea within the flowering glume coriaceous and involute. Styles distinct, rather long. Grain enclosed in the hardened palea and flowering glume, and free from them.

Eriochloa punctata, *Hamilt.* (Dotted.) "Early Spring Grass."—An erect grass, attaining 2 or 3 feet; glabrous, except the inflorescence, and sometimes a slight pubescence in the upper part. Leaves rather long, flat, or convolute when dry. Spikes or panicle-branches about 5 to 8, distant, erect, secund, the lowest often above 2 inches long, the others gradually shorter; the rachis, as well as the main axis, pubescent or hairy. Spikelets all pedicellate, but often rather close; the pedicels 1 line to 2 lines long, usually bearing a few long hairs; the spikelet ovoid, acute, or shortly acuminate, rather above $1\frac{1}{2}$ lines long, seated on a thick annular or almost cupular disk articulate on the pedicel. Empty glumes membranous, broad, and usually five-nerved, or the inner one rather narrower and sometimes only three-nerved, both more or less hairy outside, and sometimes rather densely covered with long hairs. Flowering glume much shorter, coriaceous, faintly three or five nerved, obtuse, but the midrib produced into a point or awn as long as the outer glumes.

This perennial grass is found in all the Australian Colonies from the coastal districts to the arid interior, and in many places it is fairly plentiful. It may be found growing on various soils, but the kind of land on which I have seen it growing best was a good rich loam. In the coastal districts, during its early growing period, it may be easily recognised amongst other herbage by the glaucous appearance of its stems and leaves. I have frequently identified the grass by this means alone. In sheltered situations in the coastal districts it will grow all the year round, but in the arid interior it generally grows during the summer months. On good soils its tough, fibrous roots penetrate the earth to a great depth, which enable the plant to withstand a very long spell of dry weather. In an ordinary season, both in the coastal district and in the far interior, it produces a great bulk of rich succulent herbage which all herbivora are remarkably fond of, and fatten on. I have seen this grass growing in cultivated places, and the herbage was superior to that which is usually seen in pastures. This led me to believe that it would well repay systematic cultivation by dairy-farmers and others. Its rich, succulent herbage should make excellent hay if cut before the flower-stems are too much developed. The grass is well worth disseminating in those parts of the country where it does not already exist, and as it produces an abundance of seed when it is allowed to grow undisturbed for a time there would be no difficulty in collecting any quantity by those desirous of so doing. In the interior the seeds usually ripen during November and December. In the coastal districts they are generally one month or two months later. In the interior the inflorescence of this grass is sometimes affected with a parasitic fungus—probably some species of *Ustilago*.

Reference to plate.—A, Spikelet opened out showing the three glumes and palea. B, Floret. C, Grain, back and front views. All variously magnified.

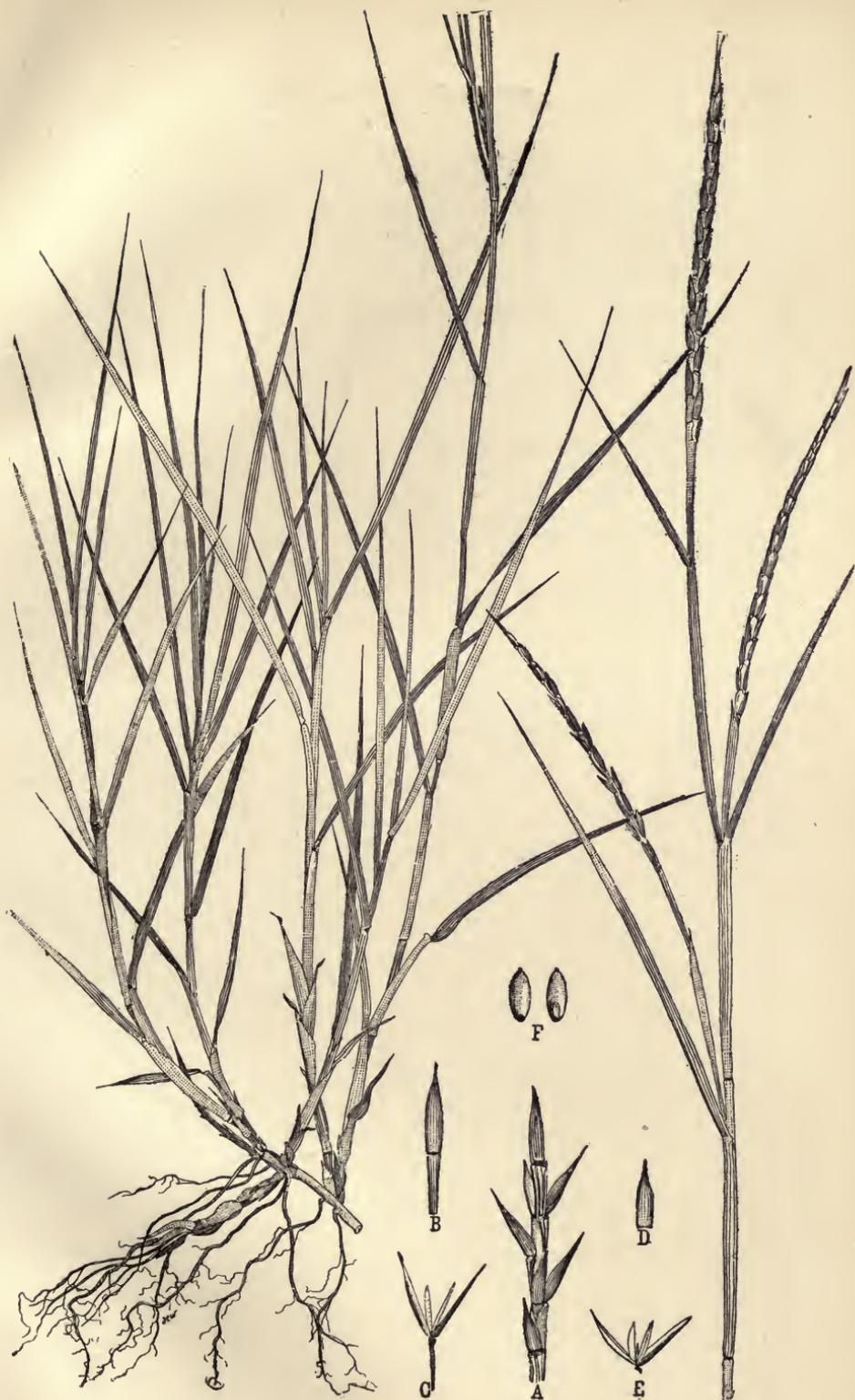
HEMARTHRIA, R. Br.

(Half-jointed ; referring to the spike.)

SPIKELETS in pairs, in the alternate notches of a simple spike, one sessile and half embedded in a cavity of the scarcely-articulate rhachis with one hermaphrodite flower, the other on a closely-appressed and often adnate pedicel reduced to two or three empty glumes, the spikes single on each peduncle above a sheathing bract and often flattened. Glumes in the sessile spikelet four, the outer one appressed and covering the cavity of the rhachis, the second thinner and concave or keeled, the third and fourth and the palea in the fourth thin and hyaline. Styles distinct. Grain enclosed in the glumes, but free from them.

Hemarthria compressa, R. Br. (Compressed spikes.) "Mat-grass."—Stems decumbent or creeping at the base, rather rigid, ascending to 1 foot or rather more, slightly branched. Leaves narrow, glabrous, or the lower ones sprinkled with a few long hairs. Spikes solitary on the branches or nearly so, more or less compressed, rigid, 3 to 5 inches long, often $1\frac{1}{2}$ lines broad. Spikelets all closely appressed, 3 to $3\frac{1}{2}$ lines long. Outer glume many-nerved, tapering into a very variable point, sometimes very short and straight, especially in the sessile spikelet, sometimes elongated and fine, or minutely hooked at the extremity; or in southern specimens, especially towards the end of the spike, terminating in a rather long inflexed rigid hook. In the pedicellate spikelet the point of the outer glume is often longer, finer, and straight, but occasionally that also is hooked, and more rarely the second glume ends in a small hook. Grain enclosed in the glumes of the sessile spikelet, but free from them. The hook at the end of the glumes, upon which Dr. Brown separated his *H. uncinata* from the *H. compressa* is exceedingly variable. In the southern specimens generally it is long and very rigid on some of the glumes, at least towards the upper end of the spike; most of the northern specimens have all the outer glumes fine-pointed without hooks.

This grass is found in all the Australian colonies, but principally in the coastal districts, and in some places it is very plentiful. It is generally found growing on the margins of swamps, on marsh lands, and on the banks of rivers or creeks, which its underground stems and roots assist in binding, and thus in a measure prevent injury from floods or heavy rains. It may also be found growing down near the brink of the ocean, above high-water mark on tidal rivers, and sometimes on what may be called saline land. Under some circumstances its stems lengthen out to 5 or 6 feet, and the branches often ascend to 2 or more feet. On wet undrained soils it forms a beautiful green sward during the summer months, and often when the surrounding vegetation



Hemarthria compressa, R. Br.
"Mat Grass."



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is languishing for want of rain it affords very good herbage. At the first glance this rather harsh, wiry-looking grass would not impress anyone as being a valuable forage-plant; nevertheless it is a fact that cattle eat it greedily, and it is said that horses will leave all other herbage to browse upon its stems and leaves. I received some specimens of this grass from Victoria a short time ago for identification, and it was stated that some Victorian pastoralists spoke highly of it, both as a good grass for stock and as a suitable one to encourage on moist lands. From long observation of the "mat-grass" I can recommend it for planting on moist undrained lands where it may not already be growing, and also on the banks of rivers or dams, where its strong underground roots would soon form a perfect mat which could not be easily dislodged by flood-waters or heavy rains. It will bear several degrees of frost and submersion for a few days without much injury. There would be no difficulty in bringing this grass under systematic cultivation, for not only does it produce plenty of seed, which germinates readily if sown in the spring of the year, but it can be easily propagated by division of its stems and roots in spring. The seeds of this grass usually ripen during the summer and autumn months.

Reference to plate.—A, Showing the arrangement of the spikelets on the rhachis, opened out. B, A pedicellate spikelet, dorsal view. C, A pedicellate spikelet, open, side view. D, Outer glume of a sessile spikelet, dorsal view. E, A sessile spikelet, open, side view. F, Grain, back and front views. All variously magnified.

IMPERATA, *Cyr.*

(Named in honor of Ferranti Imperati.)

SPIKELETS with one or rarely two flowers, usually in pairs, one sessile the other pedicellate, along the slender continuous rhachis of the short branches of a long cylindrical spike-like panicle, densely silky with the long hairs surrounding and seated on the spikelets. Glumes four, all thin hyaline and awnless, two outer empty ones usually hairy, the third empty or rarely enclosing a flower smaller and without hairs; terminal flowering glume still smaller. Palea usually truncate and jagged at the top. Stamens two, or one only in species not Australian. Styles distinct. Grain small, free, enclosed in the outer glumes.

Imperata arundinacea, *Cyr.* (Reed-like.) "Blady-grass."—A stiff, erect, perennial, 1 foot to 3 feet high, glabrous, except sometimes a tuft of hairs at the nodes, which, however, is not so common in Australian as in Indian specimens. Leaves erect, narrow, often longer than the stem. Spike-like panicle very dense, 3 to 8 inches long, regularly cylindrical, silvery white with the long silky hairs concealing the glumes, the dark-coloured stigmas and oblong-linear anthers alone protruding. Spikelets $1\frac{1}{2}$ to near 2 lines long; outer glume five or seven nerved, the second three or five nerved, the third usually empty; terminal flowering glume still smaller. Palea usually truncate and jagged at the top. Grain small, free, enclosed in the outer glumes.

This perennial grass is found all over Australia, and also in the temperate and tropical regions of the Old World. It is very common in the coastal districts of this country, but I have not observed it growing very far into the interior. It is generally found growing on low-lying, rich, moist land, though I have occasionally seen it growing on hillsides. In some instances it covers large areas of undrained land, and if the old stems and leaves are burnt off in October or November, the result will be a capital growth of succulent herbage during the greater part of the summer, which cattle eat with avidity. When the stems and leaves become old, however, they are very tough and harsh, and in that condition are seldom or never eaten if other herbage is obtainable. The "blady-grass" has sometimes proved a valuable standby for stock during prolonged droughts, especially after being burnt off in spring-time. I know of an instance where a number of sheep and cattle almost depended upon this species for forage for a time during a very dry period. It would be a good grass to plant for binding the littoral sands, as its underground stems form a perfect network, and are most difficult to eradicate. It can also be recommended for planting on railway embankments, the banks of rivers or dams, or on any loose earth, which it would bind and prevent injury from heavy rains or flood-waters. It should never be encouraged near cultivated land, however, for once it becomes established on good soil it would prove almost irrepressible; every small joint of its underground stems that is left in the ground is capable of producing a young plant. When the "blady-grass" is in flower it is easily recognised amongst other herbage by its silvery-white spike-like panicles. It produces a fair amount of seed, which usually ripens in the autumn months. It is easily propagated by division of its roots.

Reference to plate.—A, Showing the arrangement of the spikelets on the rhachis. B, A spikelet opened out showing the four glumes and palea. C, Grain, back and front view. All variously magnified.



Imperata arundinacea, Cyr.
"Blady Grass."







Isachne australis, R. Br.
"Swamp Millet."

ISACHNE, *R. Br.*

(From two Greek words signifying "equal" and a "glume.")

SPIKELETS two-flowered, both flowers hermaphrodite, or the upper female, or the lower male, small, in loose panicles; the rhachis of the spikelet articulate above the empty glumes, glabrous, and not produced above the flowering ones. Glumes unawned, convex, faintly nerved, two outer empty ones nearly equal; flowering ones of a firmer consistence, closely sessile, or the upper one slightly raised. Palea as long as the glume. Styles distinct. Grain enclosed in the hardened glume and palea, and free from them.

Isachne australis, R. Br. (Southern species.) "Swamp Millet."—Stems rather slender, decumbent, creeping, and rooting at the lower nodes, ascending to 1 foot or more. Leaves lanceolate, rough with a minute pubescence. Panicle loose, spreading, ovoid in circumscription, $1\frac{1}{2}$ to 3 inches long, with numerous filiform branches. Spikelets all pedicellate, nearly 1 line long. Outer glumes quite glabrous. Lower flower usually male, with a glabrous glume, the upper female, shortly stipitate, with the glume usually minutely and slightly pubescent; the rhachis slightly dilated and articulate immediately under the upper glume. Palea as long as the glume. Grain enclosed in the hardened glume and palea, but free from them.

This perennial grass is generally found growing by the sides of streams, and on swampy lands in the coastal districts of Queensland, New South Wales, and Victoria. Mr. Bentham says it is found also in tropical Asia from Ceylon and the Peninsula to the Malayan Archipelago and South China. In the settled districts in the Australian Colonies it is not nearly so abundant as it was a few years ago, especially in places where cattle have had easy access. When collecting botanical specimens a few days ago I had a striking proof of this. In a district where it used to grow abundantly not very long ago the only place that I observed it growing luxuriantly was protected on one side by a steep bank, and on the other side by a fence. Not only are horses and cattle remarkably fond of the "swamp millet," but pigs eat it with avidity. It is well worth conservation on wet lands in the coastal districts of all the Australian Colonies, and I can highly recommend it also for planting on the banks of rivers or dams to protect them from injury by heavy rains or floods. Its underground stems and roots form a perfect mat in a very short time, and when it becomes well established in the soil it is not easily dislodged. It will bear submersion for a few days without the slightest injury. When this grass is allowed to grow undisturbed for a time it produces plenty of seed, so that there would be no difficulty in collecting a quantity for dissemination in different parts of the country. It should be sown in the spring of the year. This grass will also propagate readily from pieces of the root if planted during the spring of the year. Its seeds usually ripen during November, December, and January.

Reference to plate.—A, Spikelet. B, Showing the sessile male and stipitate female floret with the outer glumes removed. C, Male floret. D, Female floret. E, Grain, back and front views. All variously magnified.

ISCHÆMUM, Linn.

(From *ischein*, to check; said to have derived the name from the woolly seeds of a species having been used to stop bleeding at the nose.)

SPIKELETS in pairs in the alternate notches of the articulate flexuose rachis of simple spikes, one sessile with one hermaphrodite terminal flower and a male one below it, the other pedicellate, and either similar or with only one hermaphrodite or one or two male flowers or reduced to empty glumes, the spikes either solitary or two or more, sessile or nearly so at the end of the common peduncle. Glumes in the sessile spikelet four, the outer one the largest, awnless, truncate or two-toothed at the top; second glume keeled, and sometimes produced into a short straight awn; third glume rather smaller, thin, enclosing a palea and three stamens; terminal glume a twisted and bent awn, attenuate or hyaline, and bifid at the base as in *Andropogon*. Palea small and thin, or none. Styles distinct. Grain enclosed in the glumes, but free from them.

Ischæmum laxum, R. Br. (Referring to the loose habit of the grass.) "Rat-tail Grass."—A rather slender grass of 2 to 3 feet, the Australian specimens quite glabrous. Leaves narrow, often subulate, the ligula short, ciliate. Spike single, dense, sometimes slightly curved, 2 to 4 or rarely 5 inches long; rachis and pedicels ciliate. Sessile spikelet narrow, scarcely flattened, 3 to 4 lines long; outer glume acutely acuminate, with two rather prominent nerves and obscure ones between them; second glume thin, produced into a long, fine, straight awn; third hyaline, enclosing a palea and a male flower; terminal glume hyaline, narrow, bifid, with a long bent awn. Pedicellate spikelet more conspicuous, much flattened as well as the pedicel. Glumes acutely acuminate, the outer one broadly lanceolate, with five very prominent nerves; the second thin, scarious, faintly three-nerved; two flowering glumes and paleas thin and hyaline, both with male flowers, or the third empty.

This perennial grass is found in New South Wales, Queensland, and North Australia, and, according to Bentham, it is found also in tropical Asia and Africa. It is abundant in many parts of Queensland, but, as far as I am aware, is not very plentiful in New South Wales. I was the first to record it for the latter colony, and that only quite recently.

The specimen from which the drawing was made was collected near Tamworth, in the northern part of New South Wales. The growth of this grass is much more slender in the last-named colony than in the adjoining one of Queensland. On rich alluvial soils in the latter colony it produces a great amount of herbage, which, though rather coarse, make tolerably good feed for cattle; for sheep it is not so highly spoken of. I have had this grass under experimental cultivation, and although it produced plenty of herbage which was superior to that generally seen when it is growing naturally in pastures, still I never looked upon it as a first-class forage grass. It will withstand a long spell of dry weather, and is valuable in this respect, because it can be depended upon when some other kinds of grasses fail. It is well worth conservation along with other grasses, but it is not one that I would recommend for cultivation in any portion of the continent. If the grass is allowed to grow unmolested for a time it produces a fair amount of seed, which usually ripens in November and December. But if the season should happen to be a wet one, the seeds may not mature until January or February.

Reference to plate.—A, Showing the arrangements of the spikelets (opened out) on the rachis. B, Sessile and pedicellate spikelet. C, Sessile spikelet showing the glumes, awn, and palea. D, Grain, back and front views. All variously magnified.



Ischaemum laxum, R. Br.
"Rat-tail Grass."





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Neurachne mitchelliana, Nees.
"Mulga Grass."

NEURACHNE, *R. Br.*

(From *neuron*, a nerve, and *achne*, a covering; in allusion to the hairs on the nerves of the glumes.)

SPIKELETS with one terminal hermaphrodite flower, and very rarely a second male one below it, sessile along the continuous rhachis of a simple ovoid or cylindrical spike. Glumes four, the second the largest, fringed on each side, at least in the lower half, with long spreading cilia on the intramarginal nerve; third glume smaller and thinner, usually with a small palea in its axil. Fruiting glume smaller, thin, and often hyaline. The palea also very thin, as long as or longer than the glume. Styles distinct. Grain enclosed in the thin palea and glume, but free from them.

Neurachne mitchelliana, *Nees*. (After Sir Thomas Mitchell.) "Mulga Grass."—Stems from a knotty woolly branching base erect, leafy to the inflorescence, or nearly so. Leaves flat, short, spreading, ciliate with a few long hairs, or the lower ones woolly-hairy. Spike narrow-cylindrical, 1 inch to nearly 2 inches long. Spikelets about 2 lines long, with a tuft of hairs at their base. Outer glume as long as the others, many-nerved, ciliate, marked in the centre on the back with a transverse callosity, bearing long rigid horizontally spreading hairs, with a broad cavity underneath it, very thin and almost hyaline, bordered by a prominent nerve on each side; second glume broad to above the middle, pubescent on the back, and densely fringed on each side by long spreading hairs, the upper part narrow, and glabrous, or nearly so; third glume shorter, thin, faintly nerved, and not ciliate, either empty or enclosing a small palea. Fruiting glume and palea thin and almost hyaline.

A perennial species, which rarely exceeds 1 foot in height. It is found in all the Australian Colonies, but is peculiar to the far interior. It was collected in Central Australia by the Elder Exploring Expedition, but is not reported to be very abundant anywhere. Its stems rise from a thick woolly rhizome, which probably acts as a storage reservoir to the plant in very dry weather, for it will withstand, and remain green throughout, a very severe drought even when growing on rather poor soil. It is generally found growing in what is termed "mulga country," that is, where the "mulga tree" (*Acacia aneura*) is the predominant vegetation, hence stockmen call it "mulga grass." It is a general favourite amongst pastoralists in the interior, and it can nearly always be depended upon to yield a fair amount of herbage during early springtime, of which sheep are very fond. It is well worth disseminating all over the arid interior where it does not already exist, and also on dry, sandy land. It might be conserved with advantage to supply feed during dry seasons. When allowed to grow undisturbed for a time the "mulga grass" produces a fair amount of seed, which usually ripens during October, November, and December, according to the season.

Reference to plate.—A, Open spikelet, showing the four glumes, and the very thin palea. B, Outer glume. C, Second glume. D, Back and front views of the grain. All variously magnified.

OPLISMENUS, Beauv.

(From *hoplismenos*, awned; referring to the awns on the spikelets.)

SPIKELETS with one terminal hermaphrodite flower, and a rudimentary one below it, awned, clustered along the second distant branches of a simple panicle. Glumes four, the lowest empty one not much shorter than the others and with a longer awn, the flowering glume awnless and hardened with the palea round the grain as in *Panicum*.

Oplismenus compositus, Beauv. (Composite.) "Awned Panic Grass."—Usually a weak grass, softly pubescent or villous, but sometimes nearly glabrous. Stems decumbent or creeping and rooting at the base, ascending sometimes to above 1 foot. Leaves from linear-lanceolate to ovate-lanceolate, 4 to 5 inches long in the larger specimens, but more frequently under 2 inches. Panicle slender, consisting of 4 to 8 or rarely more distant one-sided branches or spikes, of which the lowest slender ones are 2 inches long in the most luxuriant specimens, scarcely $\frac{1}{2}$ an inch long in others, the upper ones, or sometimes the greater number, reduced to short clusters. Spikelets glabrous pubescent or hirsute, rather above 1 line long, in distinct clusters of two or three each along the longer branches, crowded on the shorter ones. Glumes, three lower ones membranous, five-nerved, the lowest not much shorter than the others, tapering into a rather long smooth awn, the second with a small point or short awn, or only acuminate, the third rather larger, awnless, with a small hyaline palea or rudimentary flower in its axil; flowering glume nerveless, smooth, and hard, as well as the palea round the grain.

A slender, perennial, somewhat hairy grass, with decumbent or creeping stems, nearly always found growing under the dense shade of trees, and principally in scrubs in the coastal districts of New South Wales, Victoria, and Queensland, but also on the Blue Mountains in the former colony. This species is of very little value for forage purposes, as stock seldom or never touch it, but it is a most useful grass for planting under the dense shade of trees or buildings, where very little else would grow. If used for that purpose it would soon form a pleasing feature in what is often a great eyesore in shady places, as it makes a great amount of growth in a very short time. This grass is easily propagated by pieces of its stems or from seed. The best time to plant is in spring and autumn, and the best time to sow is in August, after rainfall if possible. In the coastal districts of this country I have seen acres of scrub-land covered with this grass, which formed a most beautiful carpet of green under the dense growing trees.

There are two other species (*Oplismenus setarius*, R. et S., and *Panicum pygmaeum*, R. Br.) of grasses indigenous to Australia, which grow under similar conditions to the one under notice, and I would particularly draw the attention of Australian foresters to the value of these grasses for planting in forests as preventives against bush-fires. If these grasses were established in young plantations of cedar, beech, cowrie, hoop-pine, and other coastal growing trees, they would prove a great safeguard to the plantations during the summer months, when bush-fires are sometimes prevalent. There is a beautiful variegated form of the *Oplismenus compositus* which is well worth cultivation in gardens. The typical form of this grass bears a fair amount of seed, which ripens during the late summer and autumn months, so that there would be little difficulty in collecting seed for dissemination in any portion of the continent where it may not already be growing.

Reference to plate.—A, Showing the arrangement of the spikelets on the rhachis. B, An open spikelet showing the four glumes and two paleas. C, Grain, back and front views. All variously magnified.



Oplismenus compositus, Beauv.

“Awned Panick Grass.”





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Panicum bicolor, R. Br.
"Two-coloured Panick Grass."

PANICUM, Linn.

(The old Latin name, derived by Pliny from *paniculum*, a panicle; alluding to the usual form of inflorescence.)

SPIKELETS with one terminal hermaphrodite flower, and occasionally a male or rudimentary flower below it, rarely awned, variously arranged along the branches of a simple or compound panicle rarely reduced to a simple spike, the partial rhachis very rarely produced beyond the last spikelet; barren awn-like branches none, or very rarely a single one. Glumes usually four, the outer one smaller than the others, not awned, often very small, deficient only in *P. gibbosum*, the second and third very variable in relative proportions, the third occasionally with a palea with or without three stamens in its axil; fourth or fruiting glume smaller or as long as the third, of a firmer consistence, enclosing a palea and hermaphrodite flower. Styles distinct or very shortly united at the base. Grain enclosed in the hardened fruiting glume and palea, but free from them.

Panicum bicolor, R. Br. (Two-coloured.) "Two-coloured Panick Grass."—Usually a small slender tufted grass, with much the habit of some species of *Aira* or *Agrostis*, but sometimes above 1 foot high, approaching in habit the *P. melananthum*. Leaves linear, usually very narrow, more or less hairy, especially at the orifice of the sheath, rarely quite glabrous; the ligula very short, ciliate. Panicle usually only 2 or 3 inches long, loose and slender, but rather narrow, but sometimes larger and spreading; the branches capillary and flexuose, not clustered, and not much divided. Spikelets all pedicellate, about 1 line long, glabrous. Outer glume acute, three-nerved, fully half as long as the spikelet; second and third glumes nearly equal, acute, about five-nerved; the third with a palea, but no stamens. Fruiting glume smooth and shining. Grain enclosed in the hardened fruiting glume and palea, but free from them.

A perennial grass found in the coastal districts of New South Wales and Queensland, and in some situations it is fairly abundant. It is found also in the New England and south-western portions of New South Wales, but not so plentifully as in the coastal districts. It is not particular as to soil or situation, for I have seen it growing as often on iron-stone ridges as on good pasture land; but, of course, in the latter situation it yields a larger amount of superior herbage. It is a capital sheep grass, but it is not bulky enough to make good pasture for cattle, although all herbivora are remarkably fond of it. In sheltered situations it will yield a fair amount of herbage during the winter and early spring months, so on this account it is well worth conservation. I have seen this grass growing plentifully in cultivated land, and the herbage was much superior to that which is usually seen under ordinary circumstances. This led me to believe that the grass could be much improved if brought under cultivation. It produces a fair amount of seed, which usually ripens in November and December.

This grass may be easily recognised, amongst other herbage, by its parti-coloured spikelets. They are mostly purple, pink, and light green.

Reference to plate.—A, Showing the arrangement of the spikelets on the panicle. B, Spikelet opened out, showing the four glumes and two paleas. C, Showing the relative size of the outer glume on the spikelet. D, Grain, back and front views. All variously magnified.

Panicum decompositum, *R. Br.* (Referring to the much-divided panicle.) "Australian Millet."—A semi-aquatic glabrous grass, often tall and stout. Leaves mostly long, flat, and rather broad, especially when growing in water, narrow in drier situations; ligula very short and broad, ciliate. Panicle 6 inches to 1 foot long, or even more, with numerous crowded filiform divided branches, the lower ones clustered, at first erect and enclosed at the base within the last leaf sheaf; at length sometimes very loose and spreading to the breadth of 1 foot. Spikelets all on slender pedicels, narrow, acute, $1\frac{1}{4}$ to $1\frac{1}{2}$ lines long; usually of a pale straw colour. Outer glume very short, broad and truncate, thin and nerveless; second and third glumes nearly equal, acute, thinly membranous, five or seven nerved, the third with a palea from a quarter to one-third its length, but no stamens. Fruiting glume very smooth and shining. Grain enclosed in the hardened fruiting glume and palea, but free from them.

This valuable grass is found all over Australia from the coastal districts to the far interior, and in some places it is very plentiful. It was collected by the Elder Exploring Expedition in Central Australia. In moist places and by the side of watercourses, I have seen this grass growing 4 feet high; on the plains, however, it rarely exceeds 2 feet in height. In all its varied forms it yields most valuable herbage which stock of all kinds are remarkably fond of, and fatten on. I have had the "Australian millet" under experimental cultivation for several years, and the amount of herbage it yielded in a few months was really astonishing. The hay that was made from it was equal to three tons per acre. I can highly recommend it for systematic cultivation either in the eastern or central portion of the continent. When allowed to grow undisturbed for a time it produces a great amount of seed, so that there would be no difficulty in collecting any quantity either for systematic cultivation or for re-dissemination in those parts of the country where it may have become scarce through overstocking. The seeds usually ripen during the summer and autumn months. At one time the aborigines used to collect the seeds in great quantities, grind them between stones, make them into cakes, and use them as an article of food. Sir Thomas Mitchell ("Three Expeditions," vol. I. pp. 237 and 290), alluding to this grass, says: "In the neighbourhood of our camp the grass had been pulled up to a very great extent and piled in hay-ricks, so that the aspect of the desert was softened into the agreeable semblance of a hay-field. The grass had evidently been thus laid up by the natives, but for what purpose we could not imagine. At first I thought the heaps were only the remains of encampments, as the aborigines sometimes sleep on a little dry grass; but when we found the ricks, or hay-cocks, extending for miles, we were quite at a loss to understand why they had been made. All the grass was of one kind, and not a spike of it was left in the soil over the whole ground. * * * We were still at a loss to know for what purpose the heaps of one particular kind of grass had been pulled, and so laid up hereabouts. Whether it was accumulated by the natives to allure birds, or by rats (as their holes were seen beneath), we were puzzled to determine. The grass was beautifully green beneath the heaps and full of seeds, and our cattle were very fond of this hay."

Reference to plate.—A, Showing the relative size of the outer glume to the spikelet. B, A spikelet opened out, showing the position of the four glumes and two paleas. C, Grain, back and front views. All variously magnified.



Panicum decompositum, R. Br.
"Australian Millet."







Panicum effusum, R. Br.
"Branched Panick Grass."

Panicum effusum, R. Br. (Referring to the numerous branches of the compound panicle.) "Branched Panick Grass."—An erect perennial, from 1 foot to 2 feet high. Leaves lanceolate or linear-lanceolate, scabrous and hairy as well as the sheaths, the nodes bearded with long spreading hairs; ligula very short and ciliate. Panicle much-branched, sessile within the last leaf, 3 to 4 inches long when first in flower, at length twice as long; the filiform divided branches very spreading and flexuose, the lower ones densely clustered but not verticillate, the upper ones scattered and distant. Spikelets all pedicellate, acute, about 1 line long, glabrous. Outer glume acute, one to three nerved, about half the length of the spikelet or rather more; second and third glumes nearly equal, five or seven nerved; a palea within the third about half its length. Fruiting glume smooth and shining. Grain enclosed in the hardened fruiting glume and palea, but free from them.

This perennial grass is found in all the Australian Colonies, both in the coastal districts and in the far interior, and in many places it is very plentiful. There are two distinct forms of this grass. The typical one is very hairy, and is peculiar to the coastal districts, and has, so far as I am aware, not been found at many stations very far inland. The variety *convallium* is much less hairy, and is more or less glaucous, and, as far as at present known, is found only in the interior. The typical form is not particular as to soil or situation, for it may as often be seen growing on ridges as on the more fertile low lands; but, of course, in the latter situation it yields a superior herbage. The inland form is generally found growing on rich, chocolate soils. Under ordinary circumstances both these grasses yield a fair amount of rich leafy herbage, of which cattle and sheep are very fond, the latter particularly so. I have seen the typical form of this grass growing 2 feet high in cultivated fields, and its herbage was much superior to that seen in ordinary pastures, which led me to believe that it could be much improved under cultivation. During ordinary seasons both these grasses grow and produce a quantity of leafy herbage for a considerable time before they develop their flower panicles, which is a decided advantage in any grass, and both are well worth conservation in those parts of the country where they may already be growing, and of dissemination in those parts of the country where they do not already exist. There would be no difficulty in bringing them under systematic cultivation, for, under ordinary circumstances, they yield an abundance of seed. The seed of the variety which is peculiar to the interior ripens in October, November, and December. The seed of the typical form, in the coastal districts, usually ripens one month or two months later. I have seen small areas, from which cattle had been excluded for a time, where any quantity of the seed of this grass might have been collected in a very short time. On two occasions I have had specimens sent to me for identification that were terribly smitten with fungi. These specimens came from Queanbeyan and near Braidwood, in New South Wales.

Reference to plate.—A, Spikelet opened out, showing the four glumes and two paleas. B, Showing the relative size of the outer glume on the spikelet. C, Grain, back and front views. All variously magnified.

Panicum gracile, R. Br. (Slender.) "Slender Panick Grass."—Erect, much branched towards the base, quite glabrous, usually slender, from under 1 foot to above $1\frac{1}{2}$ feet high, but exceedingly variable in stature and aspect. Leaves from very narrow to rather broad. Panicle usually long and slender, the branches or sessile spikes or clusters erect, distant, the lower ones 3 to 4 lines, or rarely $\frac{1}{2}$ to 1 inch long, the upper ones smaller, often reduced to short clusters or to single spikelets towards the end of the panicle, the rhachis of the branches often but not always produced beyond the last spikelet into a point sometimes as long as the spikelet. Spikelets singly sessile or in pairs, one pedicellate the other sessile along the rhachis, rarely more or less distinctly in two rows almost as in *P. flavidum*, ovoid, 1 line to $1\frac{1}{4}$ lines long, nearly straight, the outer glume ovate, acute, rather less or more than half as long as the spikelet, the second and third nearly equal, both empty, membranous, and about five-nerved. Fruiting glume as long or rather longer, minutely transversely rugose. Grain enclosed in the hardened fruiting glume and palea, but free from them.

A perennial grass, found in all the Australian Colonies from the coastal districts to the far interior, and is fairly plentiful in some situations. As might be supposed, a grass growing under such varied conditions of soil and climate as this one does is very variable as regards stature and appearance. Some forms of it might readily be mistaken for the variety *tenuior* of *P. flavidum*. In fact I have myself often been puzzled at first sight until I examined the spikelets, when its distinctive characters can at once be recognised. Mr. Bentham, writing about this grass, makes the following remarks:—"The variations of *P. gracile* are sometimes so great that it is difficult to reduce all the forms to one species without having seen the almost insensible gradations which unite them." In all its varied forms, however, it is an excellent pasture-grass, which stock of all descriptions are remarkably fond of, and fatten on. It does not seem particular as to soil or situation, for it may often be found growing on dry stony hillsides. On rich pasture-land, however, it yields a very superior herbage. On poor soils and in dry situations its leaves are very narrow, and in dry seasons its stems are somewhat harsh; still, when in this condition, cattle seem fond of it. On rich soils in the interior this grass will withstand a phenomenal amount of dry weather, and on this account it is well worth conservation in those parts where it is already growing, and also dissemination in those parts of the country where it may not already exist. When allowed to grow undisturbed for a time it produces a fair amount of seed, which, in the interior, will usually ripen during October and November, and in the coastal districts during December and January.

Reference to plate.—A, Showing the arrangement of the spikelets on the rhachis. B, A spikelet opened out, showing the four glumes and palea. C, Showing the relative size of the outer glume on the spikelet. D, Grain, back and front views. All variously magnified.



Panicum gracile, R. Br.
"Slender Panick Grass."







Panicum leucophœum, *H. B. et K.*
"Cotton Grass."

Panicum leucophœum, H. B. et K. (Referring to the silvery and purplish hairs on the spikelets.) "Cotton-grass."—Stems from a branching base 1 foot to 2 feet high. Leaves narrow, long or short, usually glabrous. Panicle of a few long, slender, and erect spikelike branches, very unequal, and sometimes reduced to two nearly equal ones, or to a single one, the longest 3 to 4 inches or in some very lax Queensland specimens 5 inches long; secondary branches short, slender, erect, the lower ones with four or five sessile or pedicellate spikelets, the upper ones with only one or two. Spikelets scarcely $1\frac{1}{2}$ lines long, rather acute, densely covered with long, silky, silvery, or purple hairs, often spreading when in fruit. Outer glume scarcely $\frac{1}{4}$ line long, obtuse; second and third glumes nearly equal and empty, both densely hairy; the second usually three-nerved; the third five-nerved. Fruiting glume shorter, smooth, rather acute, and often slightly gibbous at the base. Grain enclosed in the hardened fruiting glume and palea, but free from them.

This perennial grass is found all over Australia, from the coast to the far interior. It appears to be much more abundant, however, in the latter than in the former portion of the continent. According to Mr. Bentham this species is also found in tropical Africa and America. As might be supposed, a grass growing under such varied conditions of soil and climate has developed into many forms. It appears to be most variable in the degree of development of its inflorescence. I have received specimens for identification with the panicles composed of seven or eight spikelike branches, others with two branches only, and a few secondary short ones; others again with only a simple spike. The latter specimens belong to the variety *monostachyum*, and are found only, as far as I am aware, in the far interior. Both the typical form and the variety were collected in West Australia by the Elder Exploring Expedition. This grass is easily recognised in pastures when in flower by its spikelets being densely covered with long, silky, silvery, or purple hairs, which give it quite an ornamental appearance. It is generally found growing on rich, chocolate soils in the interior, and in such situations, in a good season, it will often attain a height of 3 feet. In all its varied forms it is a valuable pasture-grass, and during an ordinary season it will yield a quantity of rich herbage which is much relished by stock of all kinds. I can recommend it for general pasture, or to be grown and made into hay. I have had this species under experimental cultivation for several consecutive years, and it proved a very prolific grass. When cut as the flower-stalks first appeared it made excellent hay, of which horses were very fond. When the grass is allowed to grow undisturbed for a time it produces a great amount of seed, which usually ripens in November and December, but occasionally in the autumn months.

Reference to plate.—A, Showing the arrangement of the spikelets on the rhachis. B, Showing the relative size of the outer glume on the spikelet. C, A spikelet opened out, showing the four glumes and palea. D, Grain back and front views. All variously magnified.

Panicum melananthum, *F. v. M.* (Referring to the dark-coloured spikelets.) "Black-seeded Panick Grass."—A glabrous grass of 2 feet or more, decumbent at the base, and perhaps annual. Leaves flat and rather broad, the ligula exceedingly short, ciliate. Panicle sessile or nearly so within the last leaf, large and loose, with very numerous much-divided capillary branches scattered along the main rhachis, and very rarely clustered. Spikelets all pedicellate, about 1 line long, acute, glabrous, often dark-coloured. Outer glume ovate, acute, one or sometimes three nerved, nearly half the length of the spikelet; second and third glumes nearly equal, acute, rather broad, membranous, with usually five not prominent nerves, the third quite empty without any palea. Fruiting glume smooth and shining.

This grass is found in the coastal districts of New South Wales, Victoria, and Queensland, and also in New England, and on a few south-western stations in the first-named Colony, but nowhere is it reported to be very plentiful. It generally grows on moist lands, and in the warmer parts of Australia will attain a height of about 3 feet. During the summer months it yields a fair amount of succulent herbage which is much relished by stock. Although it is not adapted for cultivation in ordinary pastures, still it is worth dissemination on low moist lands in the warmer parts of the continent where it may not already be growing. On such lands it would yield good herbage during the most adverse seasons of drought, and might be the means of saving a number of stock from starvation during such periods. This grass would, no doubt, pay to cultivate on irrigated land, for like most other grasses it would improve in quality and yield under cultivation. I would not recommend it for growing on the banks of rivers or dams, with an idea of binding them, to prevent injury against the fury of flood-waters, because its roots generally do not take such a firm hold of the ground as do those of some other kinds of grasses which grow on moist land.

The species under notice is easily distinguished from other grasses by its large panicles of dark-coloured seeds. With this peculiarity, and with the aid of the engraving, no one, even those who have no pretensions to a knowledge of grasses, will have any difficulty in identifying it.

This grass produces a fair amount of seed, which usually ripens in December and January.

Reference to plate.—A, Showing the relative size of the other glume on the spikelet. B, An open spikelet, showing the arrangement of the four glumes and palea. C, Grain, back and front views. All variously magnified.



Panicum melananthum, *F. v. M.*
"Black-seeded Panick Grass."



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Panicum parviflorum, R. Br.
"Small-flowered Panick Grass."

Panicum parviflorum, *B. Br.* (Referring to the small flowers.) "Small-flowered Panick Grass."—A tall, but slender, usually glabrous grass. Leaves long and narrow; the ligula scarious, often long, jagged at the end. Panicle branches often numerous, spreading, simple, filiform, 2 to 4 inches, or in some specimens 5 to 6 inches long; the lower ones distant, the upper ones often crowded. Spikelets ovoid, glabrous, $\frac{1}{2}$ to $\frac{3}{4}$ lines long, mostly in pairs along the flexuose rhachis, one on a longer pedicel than the other; but in the lower part of the branch often clustered, the longer pedicel bearing two or three spikelets. Outer glume very small, ovate, usually one-nerved; second and third glumes nearly equal, both empty, membranous, obtuse; the second usually three-nerved, the third five-nerved. Fruiting glume as long, more acute, smooth.

A slender, glabrous, perennial grass, growing from 1 foot to 3 feet high, and found generally in the coastal districts of New South Wales and Queensland, and in some places it is fairly plentiful. It is generally one of the first native grasses to make its appearance after a clearing has been made in the scrub. It is not particular as to soil or situation, for I have seen it growing on dry stony ridges and on rich alluvial bottoms; but, of course, on rich soils it yields a far superior and a greater bulk of herbage. Its strong penetrating roots enable it to remain green during a long spell of dry weather. In sheltered situations it will grow nearly all the year round, and during an ordinary summer will yield a quantity of rich succulent herbage, which is greedily eaten by all herbivora. It is well worth conserving, and even cultivating, where dairy-cows are kept, and it should make good hay if cut when the flower-stems first appear. It might also be grown for ensilage. It produces an abundance of seed, which ripens during the summer and autumn months. There is a variety (*var. pilosa*) of this grass which is sometimes found in the coastal districts, but with the exception of being hairy it has nearly all the characteristics of the species.

Reference to plate.—A, Showing the arrangement of the spikelets on the flexuose rhachis. B, Showing the relative size of the outer glume on the spikelet. C, An open spikelet, showing the four glumes and palca. D, Grain, back and front views. All variously magnified.

Panicum prolatum, *F.v.M.* (Referring to the grass being found in wet places.) "Rigid Panick Grass."—Stems from a branching base erect, rigid, 1 foot to 2 feet high. Leaves rather rigid, the margins involute when dry, glabrous and glaucous; ligula very prominent, scarious, truncate or slightly jagged. Panicle 3 to 6 inches long, of numerous slender divided branches, the lower ones clustered, erect, and enclosed at the base by the last sheath, or at length exserted and spreading. Spikelets on filiform pedicels, ovoid, acute, glabrous, about $1\frac{1}{4}$ lines long. Empty glumes rather rigid, prominently nerved, the outer one obtuse, with scarious margins, more than half the length of the spikelet, three or five nerved, the second and third nearly equal, acute, five or seven nerved, no palea in the third. Fruiting glume smooth and shining.

This erect, rather rigid, perennial species is found growing principally in the interior of New South Wales, Victoria, Queensland, and South Australia, and in some situations it is moderately plentiful. It is generally found growing on good land that is liable to periodical inundations, and, as it makes most of its growth during the summer months, it is a valuable stand-by for stock when many other grasses are somewhat scarce. It is a valuable addition to other herbage, and, under ordinary circumstances, will retain its greenness far into the autumn months. It is not considered a good grass to make hay of, as its stems and leaves are too rigid when fully developed, but as a pasture-grass in the interior it is much valued. Before the aborigines tasted the sweets of civilisation they used to collect the seeds of this grass in large quantities, and use them as an article of food, after grinding them between two stones, which converted them into a kind of meal. The rigid panick grass is well worth conserving where it is already growing, and disseminating in suitable districts where it does not already exist. There would be no difficulty in collecting seeds of this grass, for under ordinary circumstances it produces an abundance, which ripen in the summer and autumn months. As much seed as would sow several acres could be collected in a few hours in a reserved area or within the railway enclosures.

Reference to plate.—A, Spikelet opened out, showing the four glumes and palea. B, Showing the relative size of the outer glume on the spikelet. C, Grain, back and front views. All variously magnified.



Panicum prolatum, F. v. M.
"Rigid Panick Grass."



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Panicum sanguinale, Linn.

"Summer Grass"

Panicum sanguinale, Linn. "Summer Grass."—Decumbent, and often shortly creeping and rooting at the base, ascending to 1 foot or rather more. Leaves flaccid, flat, usually pubescent, and sprinkled with long hairs especially on the sheaths, but sometimes nearly glabrous. Spikes or panicle-branches three to eight, crowded at the end of a long peduncle, all from nearly the same point or shortly distant, $1\frac{1}{2}$ to 3 inches, or, in some varieties, above 4 inches long; the rhachis slender but angular, flexuose, scabrous-ciliate. Spikelets in pairs, one nearly sessile, the other pedicillate, oblong, rather acute, and about $1\frac{1}{3}$ lines long. Outer glume minute, rarely above $\frac{1}{4}$ line long; the second glume lanceolate, three-nerved, from one-half to three-quarters the length of the spikelet; the third glume usually five-nerved, glabrous, or slightly ciliate, in the Australian specimens, empty. Fruiting glume shorter, smooth.

An annual species, which is common all over the eastern and northern portions of Australia, also in many districts in the interior. The "summer grass" is found also in Asia, Africa, and America. It is a creeping, quick-growing grass, and a great pest in cultivated land to farmers, orchardists, and gardeners. It will grow on almost any kind of soil and in any situation, provided that it is not too cold. This grass produces a great amount of forage in an incredibly short space of time, which, being of a succulent nature, is relished by all pasture animals. In America the "summer grass" is highly spoken of, and it is said that horses are so fond of the hay made from it that they leave all other fodder for it. This species produces an abundance of seed, which ripens in January, February, and March. It is said that Linnæus gave the specific name "sanguinale" to this grass, from a trick that the boys had in Germany of pricking one another's noses with the spikes until they bled.

In the *Hortus Gramineus Woburnensis* occurs the following passage with reference to this grass:—"It produces much seed, of which birds are very fond, and requires to be protected by nets, or otherwise, during the time of ripening. The smaller birds pick out the ripe seed, even when only a small quantity is formed among the blossoms. The common method of collecting it and preparing it in Germany is as follows: At sunrise the seed is gathered or beaten into a hair sieve from the dewy grass, spread on a sheet, and dried for a fortnight in the sun; it is then gently beaten with a wooden pestle in a wooden trough or mortar, with straw laid between the seeds and the pestle, till the chaff comes off; they are then winnowed. After this, they are again put into a trough or mortar in rows, with dried marigold flowers, apple and hazel leaves, and pounded till they appear bright; they are then winnowed again, and being made perfectly clean by this last process, are fit for use. The marigold flowers are added to give the seeds a fine colour. A bushel of seed with the chaff yields only about two quarts of clean seed. When boiled with milk and wine it forms an extremely palatable food, and is in general made use of whole in the manner of sago, to which it is in most instances preferred."

Reference to plate.—A, Showing the arrangement of the spikelets on the rhachis. B, An open spikelet, showing the three outer glumes, the fruiting glume, and palea. C, Showing the relative size of the outer glume on the spikelet. D, Grain, back and front views. All variously magnified.

PAPPOPHORUM, Schreb.

(The plumose awns on the flowering glumes resembling the *pappus* (hairy tufts) on some fruits of Composites.)

SPIKELETS with one hermaphrodite flower, and one or more male or rudimentary flowers or empty glumes above it, in a short dense and spike-like or narrow and loose panicle; the rachis of the spikelet articulate above the outer glumes, and hairy round the flowering glume. Outer glumes membranous, many-nerved, awnless, as long as the spikelet. Flowering glume broad, membranous, with nine, or in species not Australian, more nerves produced into more or less plumose awns. Palea two-nerved, as long as the glume, or longer. Styles distinct. Grain enclosed in the glume and palea, and free from them.

Pappophorum nigricans, R. Br. (Inflorescence often of a dark colour.) "Black Heads"—Stems from under 1 foot to $1\frac{1}{2}$ feet high. Leaves flat or convolute, usually narrow, sometimes quite setaceous, glabrous, pubescent, or villous; the nodes glabrous or bearded. Panicle dense and spike-like, varying from ovoid-oblong, and under half an inch long, to narrow cylindrical and 3 inches long, or broader, more branched, and 2 to 3 inches long, but always dense, pale or dark-coloured. Outer glumes varying from 1 line to rather above 2 lines long, obtuse or acute, striate with usually seven or nine nerves, but sometimes, especially on the lowest glume, reduced to five and two of those short. Flowering glume not above 1 line long, more or less hairy outside, especially at the base, with nine fine spreading plumose awns, varying from the length of the glume to twice as long. Above the flowering glume, and enclosed in it, is usually a similar smaller one, with a male or rudimentary flower, and one or two still smaller empty ones.

This perennial grass is found in all the Australian Colonies, from the coastal districts to the far interior, and in many pastures forms a good percentage of the herbage. As it grows under such varied conditions of soil and climate, it is not remarkable that there are many forms of it. Sometimes the inflorescence is perfectly black, which circumstance led to the specific name *nigricans* being given to it. At other times it is almost white, but this grass can never be mistaken under careful examination. In all its varied forms, however, it is a capital drought-resisting grass, and during the summer months, in an ordinary season, it yields a fair amount of good herbage, which stock eat with avidity, and fatten on. When the stems of this grass become old they often become very hard, and the foliage harsh, and in that state, if other herbage is plentiful, stock seldom eat it.

The "black heads" is well worth conservation in those parts of the country where it may already be growing, and disseminating in those parts where it may have been eaten out through overstocking. As it produces an abundance of seed when allowed to grow undisturbed for a time, there would be no difficulty in collecting any quantity from a reserved area for these purposes. The seeds usually ripen during October, November, and December. Some forms of this grass are very ornamental, and are worth the attention of horticulturists.

Reference to plate.—A, Spikelet. B, A spikelet with the outer glumes taken away, showing the flowering glume and a similar smaller one, with a male or rudimentary flower above that. C, Flowering glume and palea. D, Grain, back and front views. All variously magnified.



Pappophorum nigricans, R. Br.
"Black Heads."





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Paspalum distichum, Linn.
"Water Couch."

PASPALUM, *Linn.*(From *Paspalos*, one of the Greek names for Millet.)

SPIKELETS one-flowered, not awned, not callous at the base, in one or two rows along one side of slender spikes, either forming the branches of a simple panicle, or rarely solitary. Glumes three, two outer ones empty, usually membranous, and equal or nearly so, the third flowering of a firmer texture. Palea within the flowering glume smaller and more involute. Styles distinct, rather long. Grain enclosed in the hardened palea and flowering glume, and free from them.

Paspalum distichum, *Linn.* (Arranged in two rows.) "Water Couch."—Stems often creeping and rooting in the sands to a great extent, the ascending extremities varying from short, and entirely covered with the leaf-sheaths, to slender 1 foot long or more, with the leaves distant. Leaves either linear-lanceolate and flat or involute and almost subulate, glabrous, or with a few long hairs at the orifice of the sheath and base of the lamina. Spikes two, close together, or the lowest at a distance of 1 line to 2 lines, quite glabrous, the rachis not above $\frac{1}{2}$ line broad. Spikelets sessile, in two rows, oval-oblong, acute, or acuminate, flat, $1\frac{1}{2}$ to nearly 2 lines long. Outer empty glumes equal, and distinctly three-nerved. Fruiting glume hardened, and very faintly three-nerved, or the central nerve alone perceptible.

This creeping, rapid-growing, perennial grass is found in New South Wales, Queensland, and Western Australia, and generally in swampy places or on moist land, and sometimes in water, but always in the coastal districts; and sometimes close to the sea. It is particularly well adapted for covering waste moist lands, the banks of rivers and dams, which it binds very firmly once its underground stems get well established in the soil. Periodical inundations will not destroy it, but it is injured by severe frosts. This grass yields a great quantity of valuable herbage, which stock of all descriptions are remarkably fond of, and fatten on. It is highly spoken of by the dairymen in the coastal districts of this country. It is not a good grass, however, for making into hay, as it turns black in drying. It is said that butter made from the milk of cows fed exclusively on its herbage is quite white, but in no other way is it affected. Under ordinary circumstances this species remains beautifully green throughout the summer months, and some persons have been tempted to plant it on lawns, with rather serious consequences, however, for to keep it in anything like order during the summer months it requires cutting two or three times a week, and is as bad as ordinary couch to get out of cultivated land. It produces an abundance of seed, which ripens in January, February, and March. There is a variety (*var. littorale*) of this grass, which is found only in, or near, brackish swamps, and differs only from the one here described by its narrower leaves; with these exceptions, its qualities are much the same.

Baron von Mueller and L. Rummel give the following chemical analysis of *Paspalum distichum*, *Linn.*, made during the spring time of the year:—Albumen, 2.20; gluten, 7.71; starch, 1.56; gum, 1.64; sugar, 5.00 per cent.

Reference to plate.—A, A portion of the spike, showing the arrangement of the spikelets on the rachis. B, A spikelet, showing the outer glumes, fruiting glume, and palea. C, Grain, back and front views. All variously magnified.

PENTAPOGON, *R. Br.*

(Referring to the five lobes or awns at the end of the flowering glume.)

SPIKELETS one-flowered, numerous in a rather dense, much-branched panicle; the rhachis of the spikelet articulate above the two outer glumes, with a tuft of hairs surrounding the flowering glume, and not continued above it. Glumes three, two outer persistent, membranous, acute, or shortly pointed. Flowering glume narrow, rolled round the flower, divided at the end into five lobes or awns, the central one rigid, at length twisted, continuous with the keel and sometimes slightly dorsal, the lateral ones shorter and straight. Palea narrow, enclosed in the flowering glume. Lodicules two. Styles short, distinct. Grain enclosed in the glume, but free from it.

Pentapogon billardieri, *R. Br.* (After J. J. Labillardière.) "Five-awned Grass." An erect annual, from under 1 foot to above 2 feet high. Leaves narrow, hairy, pubescent, or rarely glabrous. Panicle narrow, erect or somewhat nodding, 2 to 6 inches long. Spikelets numerous, nearly sessile on the branches. Outer glumes narrow, varying from 3 to 6 lines long, almost hyaline, with a prominent, shortly ciliate keel, often produced into a short point. Flowering glume on a very short hairy stipes, the central awn terete, rigid, $\frac{1}{2}$ to 1 inch long; the lateral lobes two on each side, much shorter, erect, slightly flattened, and one-nerved. Grain enclosed in the glume, but free from it. There is a variety (var. *parviflorus*) with the outer glumes scarcely two lines long, the flowering glume and awns in proportion.

This grass is found in New South Wales, Victoria, South Australia, and Tasmania, but nowhere is it reported to be very plentiful. It is generally found in the coastal districts or on the mountain ranges throughout the southern portion of Australia. The specimen from which the drawing was made was collected on the Bodalla Estate, in the southern portion of New South Wales, where it is stated that cattle eat it greedily during the early summer months. It is essentially a spring and early summer-growing grass, and until November, December, or January, when its seeds begin to ripen, it produces a fair amount of herbage, which is eaten by all herbivora. After the flower-stems have developed, however, the herbage becomes harsh; then stock seldom or never touch it, if other grasses are plentiful. The "five-awned grass" may often be found growing on sandy soils, and if sheep are depastured in such places they sometimes pull the plant up when eating it, as its roots have such a slight hold upon the ground. It is not a grass that I would recommend for cultivation, although it is worthy of conservation with other pasture plants. It appears to hold its own in pastures that are not heavily stocked; but this may be accounted for by the fact that it produces, under ordinary circumstances, an abundance of seed which, when ripe, germinates readily during the autumn or spring months.

Reference to plate.—A, Spikelet. B, Floret. C, Flowering glume flattened out, showing the position of the five awns. D, Grain, back and front views. All variously magnified.



Pentapogon billardieri, R. Br.
"Five-awned Grass."





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Pollinia fulva, *Benth.*
"Sugar Grass."

POLLINIA, *Trin.*

(Named in honour of Cyrus Pollini.)

SPIKELETS one-flowered, in pairs in the alternate notches of the articulate rhachis of simple spikes, one sessile or shortly pedicellate, the other on a longer pedicel, but the two otherwise similar; the spikes sessile and clustered, or rarely solitary at the end of the common peduncle. Glumes four or three, outer one the largest, membranous, awnless, with a truncate toothed or ciliate tip; second usually thinner, keeled, acute, or produced into a fine straight awn, third thin and hyaline or deficient; terminal or fourth glume a twisted and bent awn, contracted and flexuose or hyaline, dilated, and two-lobed at the base as in *Andropogon*. Palea small and hyaline or none. Styles distinct. Grain enclosed in the outer glumes, and free from them.

Pollinia fulva, *Benth.* (Referring to the brown-coloured inflorescence.) "Sugar Grass."—Stems either slender and 1 foot to $1\frac{1}{2}$ feet high, or stouter, more branching at the base, and attaining 2 to 4 feet, the nodes glabrous, or shortly bearded. Leaves rather narrow tapering to fine points, the orifice of the sheaths and ligula usually ciliate, and sometimes the sheaths hairy. Spikes 2 or 3 sessile, and near together in a terminal cluster, but not quite digitate, $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long, covered with silky hairs of a rich brown. Spikelets mostly about 2 lines long, but variable in size, all similar, or the pedicellate ones rather narrower. Outer glume truncate or denticulate at the end, faintly nerved; second nearly as long, narrower, slightly keeled, truncate; third very minute, or more frequently entirely deficient. Awn or terminal glume slender, rarely $\frac{1}{2}$ inch long, contracted into a flexuose stipes or slightly dilated at the base, hyaline and bifid. Styles very shortly united.

A perennial grass which is found in all the Australian Colonies from the coastal districts to the far interior. It is much more common, however, in the latter than in the former portion of the continent. I have collected specimens within a few miles of Sydney. It is easily recognised, when in flower, amongst other grasses by its rich, brown, silky spikes. The "sugar grass" is generally found growing on the richest of soils, and often on deep alluvial flats bordering rivers and creeks. It is a superior pasture grass, and is much praised by stockowners, who have given it the name of "sugar grass," on account of the sweetness of its stems and foliage. During the summer months, in an ordinary season, it produces a great bulk of rich, succulent, sweet herbage, which is much relished by all herbivora. Under experimental cultivation this grass produced a great amount of herbage, much superior to that usually seen in pastures, and when cut just as the flower-stems appeared it made excellent hay. I can highly recommend the "sugar grass" for systematic conservation, and even cultivation, on good land, especially in districts suited for grazing cattle. From its great yield of herbage it ought to pay to make into ensilage, at any rate it is worth a trial. It is a good grass to encourage on the banks of rivers, creeks, and dams, as its strong penetrating roots would help to bind the soil and prevent it being washed away by the fury of flood-waters. When left unmolested for a time the "sugar grass" produces a fair amount of seed, which ripens in November and December.

Reference to plate.—A, Showing the arrangement of the spikelets on the rhachis. B, The sessile and pedicellate spikelet. C, Sessile spikelet, showing the arrangement of the glumes and terminal awn. D, Grain. All variously magnified.

SETARIA, Beauv.

(From *seta*, a bristle; alluding to the involucre of bristles surrounding the spikelets.)

SPIKELETS with one terminal hermaphrodite flower, and sometimes a second male one below it, crowded in a cylindrical dense, or rarely interrupted spike-like panicle not awned, but surrounded by numerous awn-like barren branches, persistent on the main rhachis; the spikelets sessile near the base of the branches, and falling away from them. Glumes four, the outer one small, the second usually shorter than the third. A palea, and sometimes three stamens in the axil of the third. Terminal or fruiting glume of a firmer consistence, with a perfect flower. Styles distinct. Grain enclosed in the hardened glume and palea, but free from them.

Setaria glauca, Beauv. (Referring to the pale bluish-green colour of the plant.) "Pigeon Grass."—An erect annual, of a pale green, 1 foot to 2 feet high. Leaves flat, with scabrous edges, and often ciliate with a few long hairs. Spike-like panicle simple, cylindrical, 1 inch to $1\frac{1}{2}$ inches long, the spikelets solitary at the base of numerous awn-like branches, many of which are barren and all scabrous with minute teeth directed upwards. Spikelets ovoid, about $1\frac{1}{2}$ lines long. Outer glume very small, the second not quite so long as the third. A palea, and very rarely stamens (in the northern and more vigorous growing specimens the stamens are generally present) in the third. Fruiting glume more or less gibbous, marked with prominent transverse wrinkles.

This annual grass is found growing over nearly the whole of Australia, but nowhere is it reported to be very plentiful. It is not endemic in this country, but is found growing in most of the warmer parts of the earth, but whether it is under cultivation anywhere I am unable to say. It may be found growing naturally on various soils in this country, but of course it yields a superior and larger amount of herbage on rich alluvial flats than on hillsides or on poorer land. On land that has been newly broken up it yields a rich, succulent herbage during the summer months, which is much relished by all kinds of stock. The "pigeon grass" is well worth systematic cultivation, either to be cut for green feed, or for making into hay. If grown for the latter it should be cut when the flower-stems first appear. I have had many specimens sent to me for identification from various parts of the country, and they were accompanied with notes to the effect that it was an excellent forage grass. Some of the specimens that had been collected in cultivated fields were 3 feet high. There would be no difficulty in bringing the grass under systematic cultivation, for if allowed to grow undisturbed for a time it produces a great amount of seed. Besides the value of the grass for forage purposes, the seeds are good feed for many domestic birds. The seed ripens during the summer and autumn months, and the best time to sow is in September or October, according to situation.

Reference to plate.—A, Spikelet partly surrounded by awn-like barren branches. B, Open spikelet, showing the four glumes and two paleas. C, Grain, back and front views. All variously magnified.



Setaria glauca, Beauv.
"Pigeon Grass."







Sorghum plumosum, Beauv.

SORGHUM, Pers.

(Said to be from *Sorgho*, the Indian name.)

FERTILE spikelet one-flowered, sessile between two pedicellate male or barren ones, at the end of the simple or divided branches of a terminal panicle, with one to five pairs or triplets of spikelets below the terminal three. Glumes on the fertile spikelets four, the outer one the largest, awnless, lanceolate or broad, hard and shining, obscurely nerved; second glume rather hard, keeled, and acute; third glume shorter, very thin and hyaline; fourth or terminal glume very thin, hyaline and two-lobed at the base, with an awn between the lobes, twisted in the lower half, bent above the middle, as in *Andropogon*. Palea very small or none. Styles distinct. Grain enclosed in the hard and shining outer glumes, free from them.

Sorghum plumosum, Beauv. (Referring to the feather-like panicle.) "Wild Sorghum."—Stems erect, varying from 4 to 5 feet; the nodes bearded with a dense tuft of hairs, and the leaves long and narrow. Panicle from 3 to 4 or more inches long, loose and branched; the smaller branches, pedicels, and spikelets more or less villous, with hairs usually rufous, besides the dense tuft at the base of the sessile spikelets. Spikelets varying from $2\frac{1}{2}$ to 4 lines long, lanceolate, but not very flat, and usually narrow. Outer glume at first several-nerved, at length rigid, shining, and apparently nerveless, except two ciliate nerves near the top, often turning almost black when ripe. Awn often short and capillary, but sometimes 2 inches long. Palea very small or none. Styles distinct. Ovary glabrous. Grain enclosed in the hard and shining outer glumes, but free from them. I am inclined to think that Sprengel's name, *Andropogon australis* (Syst. I, 287), is a more appropriate one for this grass than Beauvois' name, *Sorghum plumosum*. I have retained the latter, however, which is in keeping with the nomenclature used in the *Flora Australiensis*. The terminal fertile sessile spikelet between two pedicellate, male or barren ones (a characteristic of the genus *Sorghum*), is not constant. In fact, in many specimens that I have examined only one pedicellate spikelet, above the fertile sessile one, was present, which is a characteristic of the genus *Andropogon*.

This perennial grass is found in all the eastern colonies, and also in North Australia, and in some districts is very plentiful, especially on the coastal lands and in the colder parts of these colonies. In the New England district the "wild sorghum," when in flower, is quite a feature in the pastures, and is described as a valuable grass. Horses are said to eat the seeds with avidity, and to thrive on them. In the colder parts of Australia it is essentially a summer-growing species, for, generally speaking, it does not start into growth before September or October. In the warmer parts, however,

it grows more or less all the year round, and during an ordinary season will yield a bulk of valuable herbage which the larger herbivora eat with avidity. This grass grows too strong in the warmer parts of the continent to be classed as a valuable sheep-grass, although in the colder parts, where it does not grow so strong, sheep eat it readily enough and thrive on it. In those parts of the country where it may have been eaten out through over-stocking, it is well worth redissemination, and in places where it may not be growing in abundance it is worth conservation. There would be no difficulty in bringing this grass under systematic cultivation, for if allowed to grow undisturbed for a time it matures a great amount of seed, which ripens during the summer and autumn months. I should think, judging by the enormous amount of valuable herbage this grass will yield during an ordinary season, it would pay to cultivate for ensilage—at any rate, it is worth a trial.

Reference to plate.—A, The sessile fertile spikelet between two pedicellate, male or barren ones. B, A sessile fertile spikelet and a pedicellate, male or barren one. C, Fertile spikelet opened out, showing the three glumes and terminal awn. D, Grain, back and front views. All variously magnified.





Sporobolus diander, Beauv.
"Tussock Grass."

SPOROBOLUS, *R. Br.*

(From *sporos*, a seed, and *bolus*, a casting; the seeds are loose and easily scattered.)

SPIKELETS small, one-flowered, nearly sessile or pedicellate in a narrow spike-like or loose and pyramidal panicle, the rhachis of the spikelet very short, glabrous, scarcely articulate, not continued beyond the flower. Glumes three, persistent, or separately deciduous, unawned, slightly keeled or convex, and obscurely nerved, two outer empty ones usually unequal; flowering glume as long or longer. Palea about as long as the glume, with two nerves usually prominent and readily splitting between them. Styles very short. Grain free, readily falling away from the glume, the pericarp loosely enclosing the seed, or very thin and evanescent.

Sporobolus diander, *Beauv.* (Referring to its having but two stamens in the flower.) "Tussock Grass."—An erect glabrous grass of 1 foot to 2 or even 3 feet. Leaves chiefly at the base, narrow, the upper sheaths not covering the stem. Panicle narrow but loosely pyramidal, 6 inches to above 1 foot long, the branches scattered, at length spreading. Spikelets very shortly pedicellate or almost sessile, $\frac{2}{3}$ to 1 line long. Outer empty glumes very obtuse; hyaline, the upper one about $\frac{1}{2}$ line, the others shorter. Flowering glume longer, slightly keeled, obtuse, or almost acute. Palea broad, obtuse, faintly two-nerved, and not so readily splitting as in the other species. Grain broadly obovoid, the pericarp not readily separable.

This grass is found in the coastal districts of New South Wales and Queensland, and is also common in some parts of India. On rich, moist soils, and on land that is liable to periodical inundations, it forms good-sized tussocks of deep green herbage, and, whilst young, is greedily eaten by horses and cattle. When it becomes old, however, the herbage is very tough, and stock will then seldom or never touch it whilst other grasses are plentiful. If the old stems of this grass are burnt off in September or October it will, under some circumstances, continue to produce a fair amount of good feed for several months if kept well eaten down. After it has been allowed to grow undisturbed for some time its herbage becomes very tough and harsh, and consequently of little value for forage purposes. I can highly recommend this grass, however, for planting on the banks of rivers or dams, to prevent their being washed away by heavy rains or flood-waters. The strong, wiry roots form a perfect mat on almost any kind of moist land after it has been planted a very short time, and when once established it requires an unusual effort to eradicate. There would be no difficulty in bringing this grass under cultivation, for not only does it bear transplanting well, but under ordinary conditions it produces an abundance of seed which, when ripe, germinate readily if sown during the spring months. The seeds ripen during the summer and autumn months.

From the tough nature of the matured herbage of this grass it might also be recommended to paper manufacturers for a trial in making some kinds of paper. If it should prove useful for this purpose, there are thousands of acres of low-lying land in the coastal districts of this continent suitable for its cultivation, besides the large supplies that are now available in many districts.

Reference to plate.—A, Showing the arrangement of the spikelets on the panicle. B, A spikelet opened out, showing the three glumes and palea. C, Grain, two different views. All variously magnified.

Sporobolus indicus, R. Br. (Indian.) "Parramatta" or "Tussock Grass."—An erect tufted grass of 1 foot to 2 feet, glabrous except a few cilia at the base of the leaves. Leaves chiefly at the base of the stem, narrow, ending in fine points, the upper ones few with long sheaths. Spike-like panicle very narrow, 3 to 8 inches, or even longer, continuous throughout, or when long often much interrupted. Spikelets very numerous, crowded along the very short, erect, almost imbricate or distant branches. Outer glumes almost hyaline, obtuse, one-nerved, the lowest about $\frac{1}{2}$ a line, the second $\frac{3}{4}$ line long; flowering glume about 1 line, of a firmer consistence, broad, but almost tapering to a point, one-nerved (the whole spikelet rather smaller in some specimens). Palea nearly as long, faintly two-nerved. Grain broadly obovoid, the very thin pericarp sometimes appearing loose, though often evanescent or undistinguishable in the dried state.

An erect-growing, tussocky grass, sometimes attaining a height of $2\frac{1}{2}$ feet, and found in all the Australian Colonies from the coastal districts to the far interior, and in some situations very plentifully. In fact, in some places, where land has been broken up and sown with exotic grasses, this species is now master of the situation, much to the disgust of dairy farmers. Whilst in a young state it affords capital feed, but when old the herbage is very tough and harsh, so much so that it will loosen the teeth of horses and cows when kept too long in pastures where this grass predominates. Owing to the tough nature of the tussock grass, I have often recommended it for paper-making. If it should prove valuable for this purpose there is plenty of material in Australia to fall back upon. The *Sporobolus* is a prolific seed bearer, and the seeds are eaten by many small birds. They ripen at various times of the year, but principally in the summer and autumn months. There is a variety (*var. elongatus*) of this grass with narrower leaves, and a longer and looser panicle. With these exceptions, however, its qualities are much the same.

During certain seasons the inflorescence of both these grasses is badly affected with a black mould-like growth. This is a fungus known to botanists *Helminthosporium ravenelii*, curtis.

Reference to plate.—A, A portion of panicle, showing the arrangement of spikelets on the rachis. B, Spikelet—the caryopsis being ejected. C, Showing the relative size of the outer glume on the spikelet. D, Two different views of the grain. All variously magnified



Sporobolus indicus, R. Br.
"Parramatta," or "Tussock Grass."

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Sporobolus lindleyi, *Benth.*
"Pretty Sporobolus."

Sporobolus lindleyi, *Benth.* (After Dr. John Lindley.) "Pretty Sporobolus."—Stems tufted, 6 inches to 1 foot high, and nearly allied to *S. pulchellus*. Leaves narrow, not at all or only very shortly ciliate. Panicle very loose, broadly pyramidal, 3 to 5 inches long, and broad when fully out, the branches capillary, the lower ones elongated in a dense verticil, the upper ones more scattered. Spikelets $\frac{1}{2}$ to $\frac{3}{4}$ line long. Glumes very acute, the lowest outer one very small and narrow; the second also empty and the flowering glume nearly equal, usually dark coloured. Palea usually divided to the base into two, even at the time of flowering. Seed enclosed in a loose pericarp. With regard to this grass, Mr. Bentham remarks as follows:—"In general this species is very distinct from *S. pulchellus*, both in foliage and in spikelets, but some specimens of Bowman's seem almost to connect the two. They are, however, far advanced, and not perfect. Mitchell's are also far advanced, and not so characteristic as younger ones."

This exceedingly pretty grass is found in all the Australian Colonies, and principally on land in the interior liable to periodical inundation. It does not yield a great bulk of herbage; what there is, however, is sweet and succulent, and sheep are particularly fond of it. I have occasionally seen it eaten down to the roots, which is a proof that it is much sought after by herbivora. On some of the inland plains after a heavy rainfall had taken place succeeding a long spell of dry weather this grass might have been seen, some years ago, springing up like cultivated wheat in spring time, but since the general over-stocking of runs it has become scarce in many places where once it was growing plentifully. It is a grass that is well worth conservation along with many other valuable species which are peculiar to the inland plains of this country, and which has made them such valuable feeding grounds for stock. This grass quickly recuperates, for if left undisturbed for a time it produces a great amount of seed, which germinates readily during the spring of the year if there should happen to be any moisture in the soil. At one time the aborigines collected the seeds of this grass and used them as an article of food. The seeds usually ripen in October and November.

I can recommend this grass to be cultivated for decorative purposes. It is quite as pretty as many of the ornamental exotic grasses cultivated here for that purpose, the seeds of which our florists have to import from Europe or America.

Reference to plate.—A, Spikelet opened out, showing the three glumes, divided palea, and grain. B, Showing the relative size of the outer glume on the spikelet. C, Two different views of the grain. All variously magnified.

TRIRAPHIS, *R. Br.*

(Referring to the needle-like awns of the flowering glumes.)

SPIKELETS several-flowered, in a terminal panicle, the rhachis of the spikelet articulate above each glume, the terminal glume usually empty or with a male flower. Outer empty glumes unawned, entire or the second occasionally notched with a short point in the notch. Flowering glumes with three narrow lobes tapering into straight awns, the central occasionally with a short lobe or point on each side, or all three reduced to small teeth. Palea narrow. Styles distinct. Grain enclosed in the thin or coriaceous glume and palea, but free from them.

Triraphis mollis, *R. Br.* (From the soft appearance of the panicle.) "Purple Heads."—A glabrous rather slender erect grass attaining 2 feet, but sometimes much smaller. Leaves long and narrow, ending in fine points. Panicle narrow, dense, 6 to 10 inches long, with a soft look owing to the slender awns and hairs of the glumes. Spikelets crowded on the short erect branches, narrow, about $\frac{1}{2}$ inch long without the awns, with eight to ten, or even more, flowers. Glumes narrow, membranous, about $1\frac{1}{2}$ lines long, the two outer empty ones glabrous, entire, or the second with a short tooth on each side of the point. Flowering glumes sprinkled with a few long hairs, the central capillary awn 3 to 4 lines long, with a pointed lobe or short awn on each side, the lateral awns rather shorter. Palea narrow. Grain enclosed in the thin or coriaceous glume and palea, but free from them.

This perennial grass is found all over Australia, but principally in the arid interior. In the northern portion of the continent, however, it is found at a few stations near the coast, but so far as I am aware it is not very plentiful. In many parts of the interior it grows fairly abundantly, particularly on good soils. It is a capital drought-resisting species, and during the early summer months yields a fair amount of good herbage, of which sheep and other herbivora are very fond. After the flower panicles have developed, however, the stems become harsh and tough, then stock will seldom or never eat the grass whilst other herbage is plentiful. It is not a species that I would recommend for cultivation in pastures, though it is well worth conservation along with other grasses. When in flower this grass is easily recognised, as the panicles often assume a purplish colour, which gives the plant a very ornamental appearance. It might be introduced into gardens with good effect—in fact, there are many less ornamental grasses cultivated in gardens. It produces an abundance of seed, which usually ripens in November and December. There is a variety (var. *humilis*) of this grass which I have received on several occasions for identification; it rarely exceeds 6 inches in height, and has a flower panicle of only 2 or 3 inches in length. It is a somewhat uncommon grass, and generally found growing on sandy soils in the interior, but it is not of much value for forage. This delicate little grass might be introduced into gardens, where its charming purple panicles would be sure to be admired. The seeds of this variety usually ripen in October and November.

There is a grass which grows in the northern portion of the continent, and is known to botanists as *Ectrosia leporina*, *R. Br.*, that is often mistaken for *Triraphis mollis*, *R. Br.*, and *vice versa*. To the casual eye the purple panicles of both these grasses are similar. The dissectional details of the inflorescence, however, are totally distinct, as may be inferred from the names these grasses have received.

Reference to plate.—A, Spikelet. B, Floret. C, Flowering glume flattened out, showing the arrangement and relative size of the awns. D, Grain, back and front views. All variously magnified.



Triraphis mollis, R. Br.
"Purple Heads."



A Glossary of the Technical Terms used in the
Description of Australian Grasses.

Abnormal	...	Differing from the usual growth or structure.
Abortive	...	Imperfectly developed.
Acicular	...	Slender, but stiff and pointed at the end like a needle.
Acuminate	...	Gradually narrowing, and then more or less prolonged into a point.
Acute	...	Sharp pointed.
Adnate	...	Not easily separated.
Affinity	...	Plants, or their organs, that bear some striking resemblance to each other.
Alternate	...	Placed on the opposite side of a stem on a different level.
Amplexicaul	...	Stem-clasping.
Annual	...	Living but one year.
Anther	...	The terminal hollow of a stamen, the case which contains the pollen of a plant.
Apex	...	The opposite extremity of any organ to that by which it is attached.
Apiculate	...	With a little point.
Aristate	...	Having a fine point, like a hair.
Articulate	...	Having joints—places where spontaneous or easy separation takes place.
Awn	...	Bristle.
Axil	...	The angle formed between a stem and any organ that grows from it.
Axis	...	The stalk on which the flowers are disposed.
Barbate	...	Bearded.
Bifid	...	Split half-way down into two parts.
Blade	...	The expanded part of a leaf.
Bracteate	...	Having Bracts.
Bracts	...	The leaves immediately below a flower if they are at all altered from their usual form.
Bristles	...	Sharp stiff hairs.
Cæspitose	...	Growing in tufts or patches, as the common daisy.
Callous	...	Hardened and usually thickened.
Capillary	...	Having the form of a thread or hair.
Capitate	...	Growing in heads, or terminal close clusters.
Caryopsis	...	Seed or grain of grasses.
Ciliate	...	Bordered with thick hairs, or fine hair like teeth.
Compressed	...	Flattened lengthwise.
Contorted	...	Twisted.
Convolute	...	Rolled inwards.

- Cordate ... Heart shaped.
 Coriaceous ... Tough, leathery, firm.
 Crinite ... Covered with long weak hairs.
 Culm ... The stalk or stem of a grass.
 Cuneate ... Wedge shaped.
 Cuspidate ... Ending in a sharp, stiff point.
 Cylindrical ... Having a tubelike body of uniform diameter.
 Decomound ... Having various compound divisions.
 Decumbent ... Reclining upon the earth, and rising again from it.
 Denticulate ... Having very fine marginal teeth.
 Dichrous ... Two stamened.
 Dichotomous ... Having the divisions always in pairs.
 Diffuse ... Spreading widely.
 Digitate ... Having several distinct spikes radiating from the point of a stalk.
 Diœcious ... Having the sexes borne in different flowers by distinct individuals, as in *Spinifex*.
 Distichous ... Arranged in two rows.
 Divaricate ... Straggling, spreading abruptly.
 Dorsal ... Belonging to the back.
 Echinate ... Furnished with numerous rigid hairs, or straight prickles.
 Effuse ... Spreading widely.
 Emarginate ... Having a notch at the end, as if a piece had been taken out.
 Exserted ... Extended beyond—standing out.
 Falcate ... Curved like the blade of a reaper's sickle.
 Fertile ... Having the power of producing perfect seeds.
 Filament ... Any kind of thread-like body.
 Filiform ... Thread-like.
 Fimbriate ... Fringed.
 Flaccid ... Bending without elasticity.
 Flavescens ... A pure pale yellow.
 Flexuose ... Bending freely.
 Floret ... Sometimes used to designate the flowers of grasses.
 Fluitans ... Floating upon the surface of water.
 Frondose ... Bearing a number of leaves.
 Fulvous ... Dull yellow, with a mixture of gray and brown.
 Furrowed ... Marked by longitudinal channels.
 Geminate ... Growing in pairs.
 Geniculate ... Bent abruptly, like a knee.
 Gibbous ... More convex in one place than another.
 Glabrous ... Smooth, having no hairs.
 Glaucous ... Pale bluish green.
 Glomerate ... Clustered in roundish heads.
 Glumes ... The outer series of scales which constitute the flower of a grass.
 Hermaphrodite ... Containing both stamens and pistil.
 Hirsute ... Set with thick long hairs.
 Hispid ... Covered with stiff hairs.
 Hyaline ... Transparent, or nearly so.
 Imbricate ... Overlapping like the tiles of a roof.
 Inflorescence ... The arrangement of flowers.
 Inserted ... Growing out of.
 Internode ... The space which intervenes between the nodes.

Interrupted ...	Flowers in distinct clusters along a simple stem.
Involucre ...	Outer whorl.
Keel ...	A sharp projecting ridge.
Keeled ...	Having a sharp projecting ridge.
Laciniate ...	Having a deep, taper-pointed incision.
Lamina ...	The blade of a leaf.
Lanate... ..	Woolly.
Lanceolate ...	Compared to the head of a lance.
Lateral ...	Fixed near or upon the side.
Ligula ..	Scale-like projection at the base of leaf-blade.
Ligulate ...	Strap-shaped.
Line ...	The twelfth part of an inch.
Linear... ..	Narrow, line-like.
Lobe ...	Division of a glume.
Lodicule ...	A scale at the base of the ovary of grasses.
Membranous ...	Thin and semi-transparent.
Mollis ...	Soft.
Monœcious ...	Having the stamens and pistils in different flowers on the same plant.
Mucronate ...	Terminated abruptly by a hard, short point.
Nerve ...	The rib or principal vein of a leaf.
Neuter... ..	Having both stamens and pistil imperfect or wanting.
Node ...	That part of a stem from which the leaf arises.
Nut ...	A hard covering, usually containing only one seed.
Obovate ...	Opposite of ovate.
Obtuse... ..	Blunt ended.
Orbicular ...	Perfectly circular.
Ovary ...	That part of the pistil which contains the seed.
Ovate ...	Having the shape of the longitudinal section of an egg.
Ovoid ...	Egg-shaped, with the broad end downwards.
Ovule ...	The young seed.
Palea ...	Inner flower scale of grasses.
Panicle ...	Branched flower stalk.
Paniculate ...	Having a branched flower stalk.
Pectinate ...	Having the segments close and narrow, like the teeth of a comb.
Pedicel ...	A secondary flower stalk.
Pedicellate ...	On a pedicel.
Peduncle ...	The stalk of a flower.
Pedunculate ...	On a peduncle.
Penicillate ...	Consisting of, or covered with, hairs which are nearly parallel to each other.
Perennial ...	Lasting for several years, and yet flowering every year.
Pericarp ...	The rind of a fruit, or a thin skin covering a seed.
Persistent ...	Not falling off.
Pilose ...	Covered with hairs.
Pistil ...	The female organ of a fertile flower.
Plumose ...	Feathery.
Procumbent ...	Lying flat upon the ground.
Pubescent ...	Covered with soft hair or down.
Raceme ...	The arrangement of flowers singly on a distinct stalk along a common stem.
Reflexed ...	Bent backwards.
Refractus ...	Bent backwards suddenly.

Retuse	...	Terminating in a round end, the centre of which is depressed.
Revolvute	...	Rolled backwards.
Rhachis	...	The stem of an inflorescence.
Rhizome	...	A prostrate, rooting stem, progressively throwing up leaves.
Rudimentary	...	In an incomplete condition.
Rugose	...	Covered with wrinkled lines.
Scabrous	...	Slightly rough to the touch.
Scarious	...	Having a thin, dry, shrivelled appearance.
Scattered	...	Dispersed.
Secund	...	Having all the flowers turned to the same side.
Sericous	...	Covered with soft, silky hairs.
Sessile	...	Without any stalk.
Setaceous	...	Bristle like.
Sheath	...	That part which closes round a stem.
Spike	...	Flowers without any stalk, arranged along a simple stem.
Spikelet	...	The terminal collection of florets among grasses.
Stamen	...	That organ of a flower with which the anther is connected.
Stigma...	...	The surface to which the pollen adheres before it fertilises the ovules.
Stipes	...	Stalk.
Style	...	The part of the pistil which bears the stigma.
Subulate	...	Awl-shaped.
Sulcate	...	Furrowed.
Terete	...	Free from angles.
Tomentose	...	Covered with dense, rather rigid short hairs.
Transverse	...	Crossing.
Truncate	...	Terminating very abruptly, as if a piece had been cut off.
Verticil	...	A ring of organs on the same plane.
Verticillate	...	Growing out from the same node at regular intervals along a stem.
Villous...	...	Covered with long weak hairs.
Virgate	...	Twiggy.
Viscid	...	Glutinous, clammy.
Whorl	...	The same as verticil.
Woolly	...	Clothed with long and matted hairs.

Opinions of the Press on the "Indigenous Forage-Plants of Australia" (non-grasses).

BY THE SAME AUTHOR.

"THE work contains no less than ninety-one engravings with descriptive letter-press of the most valuable forage-plants in Australia, including all the famous salinous plants of the country. . . . To pastoralists and landowners generally this work must be of immense value, as by its aid the more valuable of our indigenous forage-plants can be readily identified by any resident in the country. Both the Latin and common name of each plant are given, so that the ordinary reader may not be mystified by high-sounding Latin terms, to the exclusion of the more simple English names. Mr. Turner is to be congratulated on the excellence of this work. . . . Mr. Turner has a great work before him in collecting and describing the various economic and ornamental plants of this country. The accuracy of detail and industry shown in collecting and describing the forage-plants of Australia is an assurance that his future work will be practical, valuable, and accurate. . . . We have much pleasure in recommending Mr. Turner's able volume to the consideration of the landowners of Australia, fully believing that they will receive much valuable information from its perusal."—*Town and Country Journal*.

"A very useful work, by F. Turner, F.L.S., which has just been published under the auspices of the Department of Agriculture, affords another proof of that gentleman's labours in the direction of forage-plants indigenous in Australia. It is a subject which has engaged the attention of the writer for the last fifteen years, and his various papers and pamphlets in connection with it (especially the paper read before the Australasian Association for the Advancement of Science, 1890, and his 'Census of the Grasses of New South Wales,' 1890) prove that he has studied the vegetation of Australia to good effect. . . . Mr. Turner's book may be regarded as a valuable contribution to the study of our forage-plants; and being got up in a popular manner it seems to meet the requirements of those who have not the leisure to follow the technicalities of systematic botany. His introduction is worthy of attentive perusal, as it clearly shows the value of native pastures, the necessity of preserving them, and the intimate connection there is between the forage-plants of Australia and some of our most important exports, such, for instance, as high-class wool, frozen meat, &c. The author also, in his enumeration of the native grasses, points out the various purposes for which the species may be utilised and the localities for which they are best adapted, thereby indicating a very practical knowledge of the subject."—*Sydney Mail*.

"The subject is one of considerable economic and commercial interest, and it is time that something was done to direct attention in some systematic way to the value of these plants. . . . The numerous illustrations, many of them representing plants that have never before been so reproduced, lend a special value to the book, which has been issued with the special approval of the late Minister for Agriculture."—*Sydney Morning Herald*.

"Pastoralists and farmers have good cause to thank Mr. Fred. Turner, the botanist, for the large amount of excellent information he has compressed within the covers. Close upon 100 of the chief fodder-plants and shrubs of Australia are described, and the description in each case is accompanied by a carefully-drawn engraving of the specimen. . . . The printed matter is thoroughly readable; it is more than that, it is interesting. All the facts necessary for a competent understanding of the subject under discussion are plainly and concisely set down. The book bristles with information regarding the uses, habits, and habitats of the forage-plants of the continent. The introductory pages, in which the subject of fodder and fodder-plants are dealt with in a general manner, form a valuable feature of the book."—*Sydney Daily Telegraph*.

"Mr. F. Turner's book contains ninety descriptions of plants (not grasses) which are regarded as being useful fodder-plants, each of which is illustrated by a capably-executed portrait in black and white. The descriptive matter is written in plain English. . . . Pastoralists and graziers will find in this work a great deal of most important information, and doubtless many of them will be as anxious to conserve and multiply the native forage-plants as foreign inquirers are eager to procure seeds of the same for propagation in their own countries."—*Adelaide Observer*.

"We are very pleased to see that Mr. Turner advocates the preservation from total extinction of the best of the native fodder plants and grasses by a proper system of conservation, and even cultivation. This is a subject which has received far too little attention, and we are glad to see the author of this work calling attention to the danger of the complete destruction of some of them. Most disappointing and unfortunate have been the consequences of the injudicious introduction of plants supposed to possess economic value. Many of these are not merely useless weeds, but they are covering the country in some places to the serious detriment of the native pastures. . . . Attempts to introduce exotic plants, even when successful, have not been attended with such excellent results as had been expected. . . . Salsolaceous plants, which are so good for sheep, are disappearing from the plains of the interior, because they are so closely fed down the seed cannot get time for maturing. . . . The letter-press descriptions of the forage-plants mentioned in the volume are clear and precise. They are accompanied with excellent full-page illustrations. These have been carefully prepared and reproduced with great nicety."—*Rockhampton Bulletin*.

"When grass fails both sheep and cattle suffer, and then owners have to fall back upon native plants of drought-resisting capabilities. It is desirable, therefore, they should know plants which may safely be fed to stock. Such knowledge in times of dearth cannot fail to prove valuable. It cannot, however, be easily or accurately acquired, except by a botanist of practical experience. Even he must spend much time and be at great pains before he can with confidence impart his information to others. Mr. F. Turner, F.L.S., is in this happy position. He has been paying particular attention to the forage-plants of Australia, and after writing at considerable length on the subject in the columns of the Agricultural Press, he has revised the articles and made them up into a handsome volume of nearly a hundred large pages."—*Capricornian*.

"This book is full of the most valuable information for pastoralists and farmers. Nearly 100 of the chief fodder-plants and shrubs of Australia are described, and the description in each case is accompanied by an excellent engraving of the specimen. The book from beginning to end is interesting in the extreme. The introductory pages, in which the subject of fodder and fodder-plants is dealt with in a general manner, form a very valuable feature of the book. . . . Mr. Turner is a botanist of high standing, and fifteen years' careful study of the subject has fitted him to speak with authority. Those engaged in pastoral pursuits should possess this book."—*Australasian Pastoralists' Review*.

"We have received a useful work on the 'Forage-Plants of Australia,' by Mr. F. Turner, F.L.S. The book contains upwards of 100 illustrations, and very full descriptions of various native fodder-plants and their comparative merits and values, forming a very useful work of reference."—*The Australasian*.

"The 'Forage-Plants of Australia' is a valuable work. . . . The book is copiously illustrated, and the author has admirably succeeded in producing a work which will do much to popularise the native economic products."—*Brisbane Courier*.

"The study of our indigenous herbage, except in a casual way, has hitherto been almost entirely neglected by graziers and others who are interested in the pastoral industry of Queensland. The importance of the subject was some time ago recognised in New South Wales, and the result is an illustrated volume entitled, 'The Forage-Plants of Australia,' by Mr. F. Turner. Almost every known plant of economic value indigenous to this country is described in plain everyday language, scientific expressions being avoided wherever possible, and every plant described is also illustrated. The aim of the author, to render the work so simple that 'anyone knowing the alphabet might be able to take up the book and glean instruction from it,' has been well carried out."—*Queenslander*.

"The 'Forage-Plants of Australia' should be of especial value to those pastoralists the grass on whose runs from overstocking shows signs of giving out. The book is neatly got up, and the engravings are clean and well drawn."—*The Western Advocate*.

"The work contains a complete description of fodder-plants peculiar to Australia, together with well-executed illustrations. The object of the work is to induce pastoralists and agriculturists to take a more active interest in the cultivation of these products for

the benefit of themselves. We trust that those interested in that direction here will make use of the work, and endeavour to improve this important industry by carrying out the latest improvements and discoveries which have been made by considerable pains by our scientific men."—*The Clarence River Advocate*.

"The book contains a full account of our indigenous fodders, with illustrations of same, and is well worth the attention of farmers and dairymen. In the introduction matters are mentioned in connection with native-grasses which have been too long lost sight of, and cannot be too carefully considered by the farmers of this district. . . . After fifteen years' experience, Mr. Turner has come to the conclusion that in most cases the native grasses are the best fodder-plants; and he warns pastoralists and agriculturists to be careful lest the want of proper attention in conserving these leads to the extinction of most valuable grasses. It would be worth any farmer's while to read the introduction to the book, as a further perusal would almost be certain."—*Clarence and Richmond Examiner*.

"Nearly a hundred different forage-plants are treated of, both by letter-press and illustration, in an admirable manner, and the information conveyed ought to lead to increased attention being directed to the cultivation of indigenous pasturage plants. What enhances the value of the volume is that the author did not confine his attention to the plants of his own colony, but has caused it to embrace the whole of Australia, thereby rendering it a work of great utility to the agriculturist, pastoralist, and stockowner in all parts of the continent."—*The West Australian*.

"There are various practical remarks on the conservation of native grasses and salsolaceous plants. Then follow descriptions of a large number of forage-plants, with accompanying engravings. As far as possible technicalities have been avoided, and the illustrations are excellent. Such a publication must be of great utility in itself, and also as possibly providing an incentive for further effort on the part of other workers."—*Adelaide Advertiser*.

"Mr. F. Turner, F. L. S., has become so impressed with the value of the natural grasses of Australia that he has fairly bubbled over, and in a neat volume of ninety-four pages gives us a mine of most valuable information. Accurately estimating the busy life of those for whom the book is specially intended, the subject matter is presented in the most attractive way, there being no less than ninety-one full-page illustrations, with descriptive letter-press on the opposite page. Having compared the engravings with some of the plants with which we are most familiar, we can speak with pleasure of their faithfulness to nature. In fact the work requires to be seen to be appreciated, and it should be on the table of every woolgrower and farmer in the Colony. We are not aware whether it is the intention of the Department of Public Instruction to make it a class-book, but we certainly think that every Australian child should be made familiar with the contents. With a view to promote a love for the study, it is our intention to give a prize for the child attending any of the schools in this district who shall make the best collection of forage-plants to be classified and properly named, according to this book, to be exhibited at the next Gunnedah Show."—*Gunnedah Advertiser*.

"A useful work, and very conscientiously has the task been performed. It will probably be news to a good many colonists to learn that in grasses alone no less than 360 species have been classified, all indigenous to Australia. Not all of these are suited for fodder, and it has been part of the author's task to indicate which are the more valuable. The same information is afforded with regard to the various edible plants and shrubs growing in different parts of the country, showing which kinds are the most worthy of being conserved. The description of every plant given is clear and concise, rendering identification easy to any person of ordinary capacity, but in order to make it absolutely certain in the case of many species, well-executed engravings accompany the letter-press. The book is of interest to all, and should be of much practical value to landowners."—*The Albury Banner*.

"Some idea of the scope of Mr. Turner's work may be gleaned from the fact that it contains full descriptions of no less than ninety-one plants, with a clearly-executed engraving of each. . . . With the aid of these any ordinarily intelligent person should have no difficulty whatever in the identification of plants. In addition to a description of each plant, given in language as little scientific as possible, and an account of its properties as food, there will be found much valuable information as to the most suitable mode of propagation, the districts best adapted for its growth, and directions for its cultivation and conservation. Further, as in the case of some of the gums and acacias, when a plant possesses economic value besides that of fodder pure and simple its uses and commercial value are discussed. A large portion of the book is devoted to the plants of the order *Chenopodiaceae*, commonly known as salt-bush, for

these Mr. Turner considers of the first importance on account of their drought-resisting properties. The native grasses are briefly alluded to in the introduction. A work on these, treated in the same as the one under review, would be a valuable companion handbook, and we trust will be forthcoming at no very distant date. . . . The book should have an extensive circulation, not only in Australia, but in the pastoral provinces of the other continents."—*The Bathurst Daily Times*.

"A very useful handbook on the forage-plants of Australia. . . . The illustrations certainly make such works very much more useful to the ordinary student. The book will be interesting to all who take an interest in the subject it treats of, which, we may add, is one of great importance to the country."—*The Northern Star*.

"A most valuable publication on the forage-plants of Australia by F. Turner, F.L.S. . . . It contains a full and perfect account of ninety-one forage-plants. The publication should engage the most earnest attention of all pastoralists, stockowners, and agriculturists, and should result in increased attention being given to our valuable indigenous fodder-plants."—*St. Mary's Gazette*.

"The climate of many parts of Australia is of a character which renders the cultivation of recognised foreign plants impossible, and too much attention cannot therefore be paid to the preservation and propagation of such forms of natural herbage as have proved, in addition to their drought-resisting properties, to be of great nutritive value. It is with the object of bringing the most important of such native plants before the notice of interested people that the well-written volume of over ninety-one pages has been prepared. It is illustrated by some ninety-one lithographic plates."—*Garden and Field*.

"This volume contains well-executed lithographic illustrations of some ninety plants which serve as fodder to stock. The orders to which they belong are far more varied than would occur to any botanist who has not given much attention to the matter. Much information is given that is interesting from the point of view of the stockowner, as well as of the botanist."—*The Chemist and Druggist of Australasia*.



Opinions of the Press on "A Census of the Grasses of New South Wales, together with a popular description of each Species."

BY THE SAME AUTHOR.

"THIS very useful work, published by the Government under the auspices of the Department of Agriculture, may be regarded as a valuable instalment towards the botany of New South Wales. . . . The author is not a novice in these matters, for many years ago he compiled a list of Australian grasses, and acquired some reputation in Queensland by his experiments in cultivating useful species. . . . Mr. Turner informs us there are 197 species of grass found in New South Wales. Of these he gives a popular account arranged alphabetically. To settlers and pastoralists the descriptions of our grasses are likely to prove serviceable for the determination and preservation of such species as are most nutritious for sheep and cattle. Hitherto little attention has been paid to this subject, and so great has been the destruction of forage-plants, owing sometimes to the prevalence of droughts and sometimes to the overstocking of runs, that Mr. Turner justly remarks :—'It is generally admitted by all observant persons that something in the way of cultivation or conservation must be undertaken ere long to save some of our most valuable grasses from extinction.' . . . Mr. Turner has given a figure of the 'Mitchell Grass,' and he states that the Minister for Mines and Agriculture has made arrangements for the preparation of an illustrated monograph of the grasses of New South Wales. This will be a great assistance to those who cannot appreciate written descriptions for the identification of species, whilst the promised work on supposed poisonous plants is still a great desideratum for New South Wales. The Department of Agriculture has done much service by the publication of Mr. Turner's book, whilst the writer has shown himself fully capable of advancing the interests of the Colony by making known in popular language the plants best adapted for forage, their nutritious or other properties, the range of their distribution, and the time of their seeding."—*Sydney Mail*.

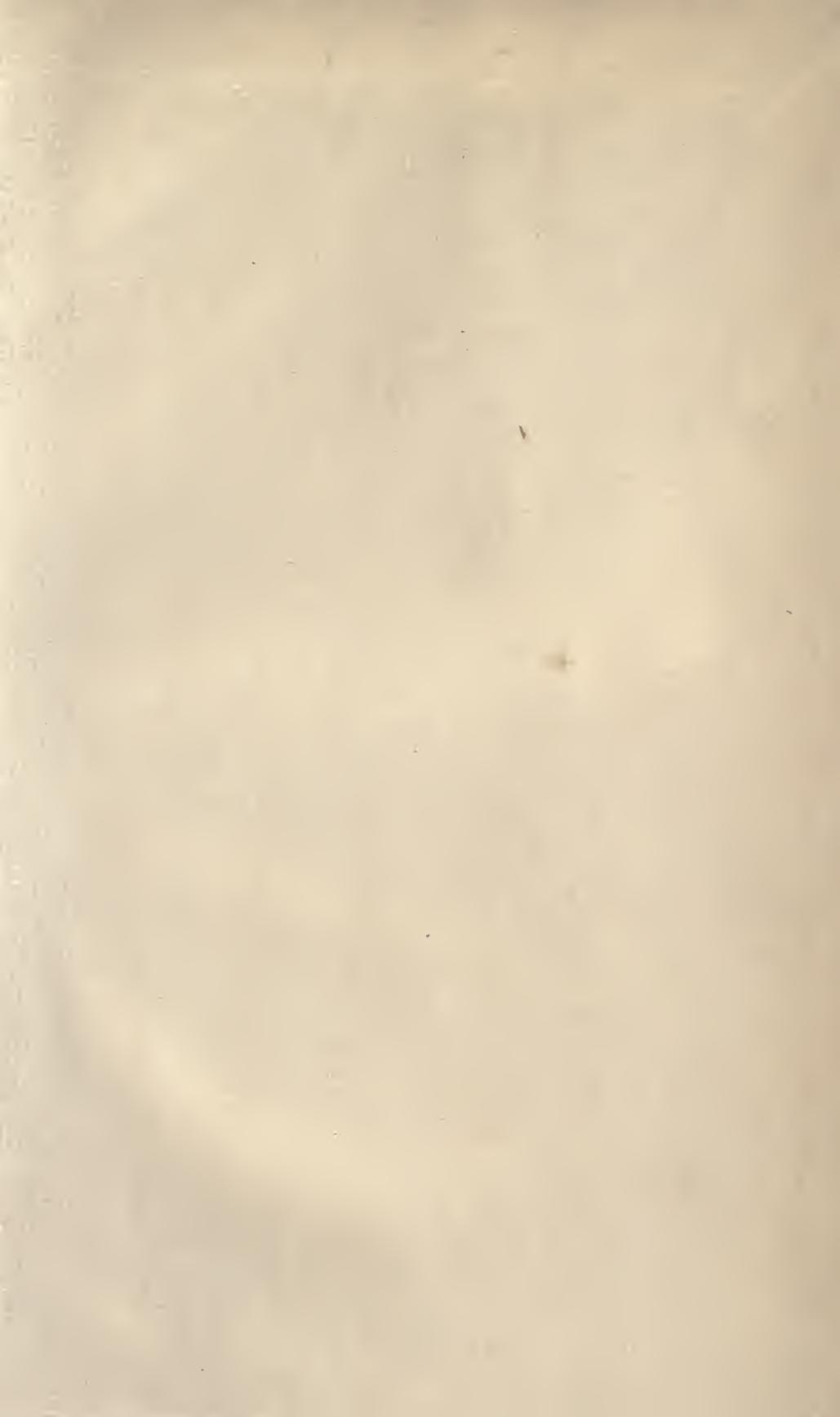
This valuable work ought to be in the hands of every agriculturist and pastoralist in the Colony. . . . So large a part of New South Wales being peculiarly a grazing country, all information in regard to its natural resources in the way of food for stock is of general interest. We therefore hail this publication of the Agricultural Department as a matter of national importance, and deem it a fortunate circumstance that a man of so much practical knowledge and so capable of putting what he has to say into clear and popular shape as Mr. Turner was available for the work. All that is known about our grasses he has brought together in the "Census" in a form to be "understood of the people." The study of Australian grasses is a very interesting one to the botanist, as well as to the agriculturist. . . . We ought to have in our local museum actual specimens of all the native grasses which flourish in the district. . . . As a supplement to this work on our grasses it is proposed to publish at an early date a list of all the introduced weeds, with instructions to farmers as to the best means of extirpating them. This will be followed by a descriptive list of all the supposed poisonous plants which grow in New South Wales."—*The National Advocate, Bathurst*.

Sydney : Charles Potter, Government Printer.—1895.









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