which are circular at the bottom and have beaters in them. They are entirely open at the top, but require to have a lid during the time of churning to prevent splashing. The same objection applies to these as to all beater churns, but they are convenient and easily kept clean. Much fault is often found with churns when the fault ought to be put on the person using them. They are blamed for not churning quickly enough, or not being regular in their action, but the fault is that the cream is not regular either as regards ripeness or temperature. It may be taken as a rule that fresh cream requires longer to churn than ripe cream, and in fresh cream there is nearly always a considerable loss of butter-fat in the butter-milk. If the temperature of the cream is too high or too low the churning may be prolonged for hours. Sometimes the cream swells to an extraordinary extent after starting churning, so as to fill the churn, in this case the only remedy is to take a quantity of it out. When starting churning the speed should be kept slower than towards the end.

For ordinary concussion churns a good average speed is 45 revolutions to the minute. With other churns a great deal depends upon the construction and kind of churn.

After churns have been used they should be thoroughly washed and scalded, and never closed, but left open so that the fresh air can get at them.

There are a great number and variety of churns made in America and the United Kingdom, none of which have been described here, but as they are not used much in these colonies I have not given any description of them.

The ones particularly mentioned have been those found most suitable for these climates. A good churn, well looked after, will last a life time, but if neglected will soon spoil. In purchasing a churn, get a reliable one, even if it costs more it will be cheaper in the end.

EAST KIMBERLEY.

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By Richard Helms.

Biologist, Bureau of Agriculture.

On the Journey.

Viewed from the sea, as one is sailing northward from Fremantle, the coast of Western Australia along the greater part of over a thousand miles is monotonous in the extreme. The vegetation, never luxuriant, is scattered and stunted, and whether passing by limestone cliffs, strips of sandy beaches, acherous coloured slates or other formations, the same desolate landscape greets the eye.

Far inland the country is often seen extending flat, unvarying and uninteresting; here and there squat hills appear, and occasionally the headland of some bay rises moderately; but nowhere is the scene relieved by any prominent geographical features, and an arid aspect hangs over the whole.

Even within the tropics the scene remains unchanged, and the expected luxuriant verdure does not appear to relieve the barren prospect still lying before the observer. A weird gray haze at times is cast over the landscape, which is apt to produce a feeling of uncertainty in the beholder; the melancholy loneliness of the interior seems to creep, as it were, upon one's mind.

"A land where all things always seemed the same!" There is nothing about the whole of the north-western and northern coast of Western Australia that is tropical except the heat.

To the north of Sharks Bay the sea is calm during the greater part of the year, and the further north one travels the calmer it becomes. With the exception of some tidal rushes in the gulfs and bays, scarcely a ripple ruffles the face of the ocean in the tropics. Navigators may therefore, without much risk, keep close into the coast and pass without danger by reefs and shoals and rocky islets. This, to some extent, relieves the monotonous sameness of the trip, particularly after entering among the islands of the Buccaneer Archipelago and, more still further north between the Institute Islands till the northernmost point of Western Australia is passed, the fairway winds between islands of different dimensions and treacherous coral reefs. In places fleets of small crafts are met with in these seas, following the lucrative calling of pearl-shell fishing.

The sea and its adjacent scenery presents a considerable amount of life and variation in these parts during the day, and at night the balmy air compensates for the heat of the perfectly cloudless day. In these latitudes, moreover, the twinkling stars become doubly interesting, because both northern and southern constellations may be watched to dip below the horizon. The voyage from Onslow to Wyndham is extremely pleasant, and in many parts very interesting. This would be much enhanced if the aspect of the back country did not convey an impression of barrenness. Along the north-west coast occasionally ranges come into view. These do not rise to any great height, and in most instances are table-topped, which is apparently due to a stratum of sedimentary rock forming their uppermost part. Their flanks from a distance present loose rubble, and do not show aborescent vegetation.

Steaming up Cambridge Gulf the ever-turbid water of this long inlet washes shores which differ in nothing from the other parts of the coast. No palms or tree ferns dip their fronds into the brine, nor are there colossal trees whose crowns are tied with networks of lianas or, hanging from them, festoons display gorgeously coloured flowers to scent the air. The scenery is disappointing and inhospitable, merely changing between barren looking hilly shores, with stunted vegetation sparcely distributed over them, mangrove flats and, at its upper end, tidal marshes without a trace of vegetation. Cambridge Gulf, with the exception of King Sound, extends further inland than any of the many similar features found along the northern coast. Its full length is over fifty-five miles. Situated in the centre of its mouth is Lacrosse Island, affording good anchorage in a sandy bay, which is known as a resort of large turtles, and 20 miles up the sound its eastern branch is faced by Adolphus Island. The western branch continues almost in a straight line in a due southerly direction to its head, some eight miles below which the township of Wyndham is situated on its eastern side. The navigation of the Gulf meets with no difficulties, and the largest vessels may on the flood tide proceed almost to its head. The rise and fall of the tide, as in all the northern inlets, is very high, from 22 feet, at ordinary, to 26 ft. at spring tides. At half tide the current runs always very swift, and cannot be stemmed; steamers therefore never go in or out against the tide. During low water the vessels lie aground at Wyndham, resting on a bed of soft mud of great depth. The level salt marshes constitute a characteristic feature of the upper parts of the Gulf. Those flats, which are regularly covered by every tide, are very muddy, but large tracts only get occasionally covered during high spring tides, and on these the fine sediment dries as hard as a brick under the tropical sun, and gets covered with a reticulation of cracks. Immense perfectly level stretches of this formation become available for vehicular traffic, as well as for riders.

From both sides a number of rivers debouch into the Gulf which are for a considerable distance affected by the tidal flow. The largest of them is the Ord, which enters the head of the eastern branch. For more than three hundred miles it flows in a sinuous course from south to north and drains with its tributaries the eastern portion of the Kimberley District. It is not navigable for more than

about thirty miles on account of a rocky bar at this distance from its mouth. This lower part may as justly be called a branch of the Gulf, because the tide affects the river past the rock-bar and makes it salty for a number of miles higher up. In its upper course it passes everywhere through rich and well grassed tracts, which, by the permanency of its water as well as that of many tributaries, becomes the foremost grazing country of Western Australia. A description of the present state of this fertile valley and its prospects of future development is attempted in this sketch.

Geology and Topography.

The inquiry into geological features and their study is undoubtedly of foremost importance to the miner, but to a considerable extent it also interests the agriculturist and the grazier. The soils, as a rule, are greatly made up, or much influenced, by the formations of the environment, and as upon the productiveness of the land depends the welfare of its occupier, an acquaintance with their nature is deserving his attention. It is not my intention to particularise every rock found in the district, which, in fact, it would be impossible for me to do, as I had not the time for extensive and minute examinations; all I propose doing is to make passing comments upon the principal formations and their influence upon the fertility of the alluviums.

The predominating rocks in the northern part of the district are slates of different character. Many are indurated with quartz veins, which, in places, expand to dykes and reefs. Granitic reefs protrude only in few localities, and are not always appearing massive. In many places the slates are displaced by quartzites, more particularly in localities to the south. Basaltic rock, like the granite, is also of rather local occurrence. Limestone is widely distributed, especially to the east. It overlies the other rocks where it occurs, and has been one of the principal materials to form the fertile alluviums of many of the extensive plains. Other rocks have no doubt largely contributed towards the composition of the soil and its fertility, as no simple soil is ever very productive and generally adapted to special vegetation only, but the lime appears to be a great stimulating agent, as is becoming obvious from the superior vegetation near this formation.

Indications of metalliferous rocks are noticeable in several directions. Gold is found in many places along the bed of the Ord, although much scattered, and rarely in workable quantities. Towards the head of the river the famous Kimberley rush took place in 1882, and at present both quartz reefs and alluvial ground are still worked there. Nowhere, however, have I observed coal exposed in the natural sections of mountain ravines, nor did I meet with indications of this mineral in any of the watercourses. If coal is to be found, which would prove a more important factor than any other mineral to raise and secure the permanent and general prosperity of the district, it will probably be at a considerable depth below the surface.

In several places salt springs occur. A noted one is found close to the Ord (in fact in the bed of this river during the greater part of the wet season), a few miles above the junction of the Negri. The water of this spring is besides, warm, and must be heavily charged with salt, as considerable quantities are deposited on the adjoining rocks. The settlers collect the salt, and use it for pickling, for which purpose it is well adapted, although it gives the meat a dark colour, which may be due to a small quantity of gypsum found mixed with it. The land, however, seems to be tolerably free from salt, except near salt springs, the regular rains having leached the mineral fairly well from the soil. Owing no doubt mainly to the salt water entering the river, the shallow parts in the Ord become brackish at the height of the dry season. At the head of Flying Fox Creek, a tributary flowing from a westerly direction into the Ord, two hot springs occur. They issue from the base of a precipitous range, mainly composed of quartzite, and are strong and permanent. The temperature of the water must be over 100° F., as I could not bear my hand in it for many seconds.

The topography of East Kimberley is highly interesting and diversified, differing in this respect from the greater part of Western Australia. Mountain ranges ramify through the district, descending from a main axis, which has an almost northerly and southerly trend. Its average height is probably not much more than 2000 feet above sea level, only few points rising to upwards of 4000 feet. The gorges and gaps found in the ranges are frequently narrow, and in places rugged, with steep escarpments and precipitous declivities. On the whole, however, the mountains do not present many imposing aspects, and possess nothing of the stupendous massiveness of an Alpine character.

A number of low mountains and ranges, disconnected from the main series, are table-topped. These are almost invariably capped with a layer of (carboniferous?) limestone, generally varying between 6 to 10 feet in thickness. From the isolated position of many of these table-tops (noticeable also for great distances near the north-western coast), it may be inferred that they once formed the level of the country during a former geological period, when a general rise elevated them. The eruption of the main ranges and the concomitant depressions in other parts left these table-tops, as it were, like islands. The somewhat limited thickness of this limestone, together with its wide distribution (it extends far into the Northern Territory of S.A.) attaches much scientific interest to this formation. It is evidently the one longest exposed in the district (not the oldest necessarily), and totally different from the common coraline limestone of the south. Is is scantily macro-fossiliferous throughout.

To the north of the lower Negri for some thirty miles a complex of rugged ranges occur which, although very irregular in their ramifications have a general easterly and westerly trend. They are composed of quartzites and basaltic rock; the latter forming a distinct feature of the country. The culminating points of the basalt are the high spurs to be seen about five miles south of Wild Dog Spring. The formation reappears to the west at several places in the bed of the Ord, being overlaid for a distance of twenty miles by recent alluvium, and to the west it extends into the Northern Territory of S.A., the situation of the high spur being close to the boundary.

The valleys in the leading ranges mostly form level flats, whence the mountains enclosing them frequently rise suddenly. Away from the ranges broad plains expand often beyond the reach of the eye. Although not high nor clothed with a luxuriant vegetation that would check a rapid rush of water and assist absorption, the ranges nevertheless send forth a number of springs to permanently feed rivulets and rivers. The country is indeed well dissected by watercourses and rivers, most of which run during the greater part of the year, or hold water permanently in their many depressions. The abundance of water in the greater part of the district is one of the most pleasing features to be encountered by the traveller. As previously stated, the Ord is the main artery which drains the district of East Kimberley. From the south-east, proceeding southward, the Behn, Negri, Forrest, Lencker, and Nicholson rivers form the principal tributaries, whilst from the south-west enter the Denham, Bow, Osmond and others. The Elvire, properly speaking, should be the Ord, but this river, as far as the name goes, begins at the confluence of the Johnston

with the former. Besides these larger waters mentioned a number of less extensive but still important rivulets enter the main river from both sides. Water is also met with in a number of swamps and lagoons scattered over the country. Although these are subject to much shrinkage during the long dry season, with few exceptions they never dry up entirely. The heavy and regularly occurring thundershowers during the summer months fill every depression and for some time flood the rivers. Many washaways and the width of the river-beds bear witness of the great violence of the water on these occasions.

The Soil and Climate.

Very few spots are found on the face of the earth where a fertile soil under a salubrious climate guarantees the maximum results from the pursuit of agriculture and its adjuncts. As a rule one or the other of these leading factors lacks much of perfection, and man must exert his ingenuity and energy to combat such disadvantages. Neither the soil nor the climate of East Kimberley possesses the highest potentialities desirable, still they compare favourably not only with other parts of Western Australia, but with many other portions of the continent and the outside world as well.

With the exception of a few sandy parts most of the soil is very fertile, and in places remarkably so. Leaving the mountain ridges and adjacent stretches out of question, the greater part of the extensive plains is covered with a deep crust of heavy soil, variously colored and differently composed. Decomposed quartzites, basalts, granites, slates and limestone have contributed towards forming the alluviums, which therefore enclose elements suitable for every species of vegetation. Perhaps a good deal of the soil is not sufficently permeable by water, which is due to the fine sedimentary nature of it; in consequence of which it is sticky when wet and liable to bake and crack when it becomes dry. This to some extent detracts from its fertility under existing climatic conditions.

The rainfall is from 25 to 30 inches per annum; but this is distributed to the greater part over less than three months, and during eight months of the year it may be said no rain whatever falls, for only exceptionally drizzling rain occurs once in a while during winter. The summer rains can however be relied on, and during November, December and January heavy thunderstorms are of almost daily occurence. It is then that under the tropical sun vegetation developes visibly and enough food and water is accumulated to last through the whole of the dry season. Sometimes the storms are accompanied by cyclones, the so-called "whirley, whirley." These always cause considerable damage when they strike habitations, as almost nothing can resist their terrible force. As a precaution every roof is fastened down by having wires stretched across them and the ends fastened to the ground, which will protect them, unless struck by the full force of the whirlwind. Destructive as these phenomenal meteorological disturbances may prove, they are nevertheless not so disadvantageous to the perfect welfare of the country as the total cessation of rain for over eight months.

The temperature rises in summer at times to upwards of 120° F. in the shade, and the heat is strongly felt after the thunder-showers, when the sun comes out with full force. Still the average summer temperature does not exceed 95°. The winter maximum temperature averages about 80°, which is more than summer heat in the southern parts of the colony. But the nights during midwinter get very cool, still not to such an extent as to affect the tenderest vegetation. The dry winter season may almost be called delightful; a pleasant light breeze, as a rule, springing up about 10 o'clock and lasting till sunset, makes the climate during the day tolerable.

The Natural Vegetation.

The most important vegetable feature, from an economic standpoint, comprises the excellent native grasses which everywhere cover the fertile plains. Foremost among them are the Mitchell grasses and the Flinders grass. The nutritious grasses, although not occupying the land entirely, have a wide distribution and form the principal fattening pasture for cattle. Their wiry and penetrating roots make them well adapted to the soil and enable them to withstand the dry season better than any other forage plant. Although as a rule these grasses do not grow as high as many other species, and possess a somewhat straggling habit, I have seen them in East Kimberley grow to 3 feet high in places, with erect stems, and closely covering the ground. Many other valuable grasses occur besides these mentioned, but also a number of coarse and less valuable ones. The nature of the soil necessitates that plants should be deep-rooting in order to withstand the prolonged dry weather of the tropical winter of this district; still the number of different fodder plants is considerable. Towards the end of the dry season the pasture is beginning to look parched, but no sooner does the wet season set in, than everything, replete with the suppressed spring impulse, bursts out with great luxuriance, and at a rate only possible in a tropical climate. The *Arundos*, indifferently called "reed" or "sugar" grasses, outgrow probably every other species of vegetation, they shoot up 12 to 14 feet in less than a couple of months. Many plants not visible before, spring from apparently dead roots or from seeds, in marvellous profusion. Everything is verdant now and flowers appear in abundance. Many of the fine forage plants remain green for a considerable time after the rainfalls have ceased; but the rapid progress of herbaceous vegetation is followed by a similar decline of many plants. First the annuals disappear, followed by many perennials, dying down to the roots again. Still a great number of grasses and herbs retain their nutritious qualities to a wonderful extent, although apparently dead by ripening. Some plants less conspicuous than the dominating grasses, but especially adapted to the climate, retain their full vitality in spite of the heat and dryness, and flourish more particularly on stony ground, where they are less subjected to being smothered by a heavy growth of grasses. Even several species of wild melons yield numerous succulent fruits the size of a duck-egg towards the end of the dry season. The advantages of such pasturage can scarcely be too highly appreciated; and, therefore, it is no exaggeration to place East Kimberley amongst the best grazing districts in Australia.

Having thus far cast a cursory glance at that part of the vegetation which on account of the leading pursuit of the district, the grazing interest, merits prominent consideration, a few other characteristic features of the flora deserve mentioning.

A very curiously shaped tree, the "Boabab" tree (*Adansonia Gregorii*) attracts every new-comer's attention. Sometimes it is also called "bottle" tree, but inappropriately, because it is not shaped like a bottle, but more like a "ninepin" as its trunk frequently expands in circumference at the crown. Moreover it is distinct from the "bottle-tree" of Queensland, which is *Sterculia rupestris*. The curious shape, as well as the great dimensions of the trunk, makes the tree strikingly conspicuous. It sometimes reaches a diameter of 15 feet, whilst the trunk rarely grows higher than from 20 to 25 feet. The bark is several inches thick and the wood somewhat pulpy when green. It is one of the few deciduous trees of Australia, and when bare of foliage its 3 to 5 inch long gourd-like fruits hang exposed at the tips of the branches. Within the hard shell of the fruit a number of seeds of the size of a small acorn lie embedded in a white pulp, which dries to a finely granulated powder, having a pleasant acidulated taste.

Both seeds and their flour-like pabulum are used as food by the natives.

Another very attractive tree is the "Screw-Pine" *(Pandanus aquaticus ?)* It is found on the banks of every creek and river in situations not liable to be cut away by currents, and on the edges of swamps or other damp localities.

The broad-leafed "Leichardt Pine" occurs sparsely near permanent waters. It is valued on account of its being immune from attack by white ants, and therefore used for inside fittings of buildings.

Palms occur in a few isolated spots, and several species of fig trees are found overhanging the river banks in many places.

A small tree, yielding a silky cotton from its fruit capsules, grows in many places on stony ground. It is probably *Gossypium flaviflorum*. The cotton might be worth collecting if the tree were growing more abundantly.

Eucalypts occur and occasionally may be found in patches of limited extent ; and some ten or twelve species of *Acacia* are scattered over the district. On the whole the *Leguminosæ* are more abundantly represented than the species of all other orders. Several trees of considerable size, a number of shrubs and some climbers bearing large pods, are found in many places. Of the *Protaceæ Hakeas* and *Grevilleas* are represented by several species each, but *Banksias* I did not notice. By the sides of all rivers and swampy ground the "Paper Bark Titree," interesting on account of the many uses the blacks have for the bark, is common. Plant life is very varied and in many respects peculiar ; it is, however, noticeable that individuals of different species occur often very isolated.

The Absence of Forests.

One of the puzzles met with in the district is the total absence of compact forests. Considering the fertility of the soil, together with the regularly recurring, and by no means inconsiderable, rainfall, it must strike anyone, particularly when for the first time passing through the country, as extremely remarkable. Moreover, when making careful observations, traces of former forests are discovered in many places. In a number of localities huge mounds built by termites are met with, which are now deserted by the insect, and may have been for several hundred years.* At any rate, the inhabitants of these "ant hills" emigrated long ago, or died of starvation, as it cannot be doubted that the places of these mounds, sometimes as much as 10 feet in diameter, and as high, once were occupied by large trees. Now, as it is a well-known fact that termites only attack dead, dying or damaged trees, the destruction of the forests cannot be caused by these insects ; a primary cause preceded their aggression, which merely finished what was left undone. Moreover, young trees, in the ordinary course of nature, would have taken the place of the old and decayed, and in this manner have left the forest, as such, practically intact. Were it not so the termites would have worked their own destruction, which is against the law of nature, and other forests would ultimately have sprung up and not now be molested by these insects.

The fact that the former large forests are destroyed to their last vestige in many places, and in others remain merely as stunted remnants, together with what is palpably observable and still practised, is in itself a clue to the problem. It cannot be doubted that man has ruined the forests.

The persistent firing of the country by the aborigines, continued for several thousand years, and perhaps begun before historical times, has completely altered the natural conditions here as well as elsewhere in Australia. If anyone is not satisfied to agree with me from what becomes strikingly apparent in East Kimberley, then I am further able to mention a convincing analogy bearing upon the subject. But let us first examine the present state of arborescent vegetation of the district in question. Look where you like, on the ranges, hills or plains, and everywhere the traces of fire present themselves at almost every tree. Trunks are seen half burnt or exposing a decaying centre, limbs charred and dead, or pipes running down to the trunk from where the burnt limb broke off ; trees dead to the ground and surrounded by suckers, illustrating the struggle for renovation from the still living roots. Such and other indications of fire become visible in every direction the eye is cast. Still, the most of these mutilated trees yet bear seed, and reproduce themselves by a succession of their kind. These offspring, however, in the course of time are exposed to similar aggressions by fire. Moreover, the seeds of these trees, as well as the seedlings, are swept away by the flames, and in this manner the greater number of places have been denuded of forests, and only in a few protected localities trees now attain maturity without being crippled. Can it be surprising that under the continued repetitions, extending over probably more than fifty centuries, the ranges have been almost bared of tree and shrub growth.

A single fire does comparatively little harm, because, although it may destroy a forest completely, another will spring up in its stead. But a succession of fires will ultimately destroy everything, young trees, seedlings, seeds and even the soil are burnt by every fire that passes over the ground, and at every repetition the chance the flora has to renew itself is lessened with increasing progression. Thus, slowly but surely, all trees disappear, and were it not for the wonderful fact that every being produces numberless offspring far in excess of what could possibly be sustained within the limits of its habitat, all trees would long ago have disappeared from Australia.

The analogy referred to above is found in the state of the highlands of Otago, in New Zealand. At present scarcely a shrub occurs in these regions, and yet not long since, meaning within traditional times, the whole country must have been covered with forests. In many gullies may be found wood just below the surface. It has been washed together in these localities, has been covered over, and now is dug up to serve as fuel. From the comparative soundness of the timber one would scarcely judge that an extraordinary length of time could have elapsed since these remnants of former forests were buried. Although the Maories now living have not known the Moa, the tradition still exists how their ancestors killed the bird. They burned the forest down, and in this manner drove these giant birds from their lairs. For generations this method was pursued till the birds became extinct, but also many forests. For it is a significant fact that the districts in which the remains of the different, now extinct, wingless birds are most frequently met with, are denuded of forests, namely, the eastern highlands of Otago and the Canterbury Plains.

Giving further attention to the present condition of timber trees in East Kimberley the existence of a considerably luxuriant growth along the water-courses must be noted. In these localities as also in some low-lying places the trees have been better able to resist the fires, and their seeds were protected from entire destruction, owing to the

*How long these nests may resist the destroying influence of wind and weather has never been observed or calculated. They are, however, almost as indestructible as rock ; their fine particles being so closely agglutinated that neither water nor air can find many points of aggression. That they outlast many generations of man cannot be doubted, and when I suggest that they may last for several hundred years, I merely wish to be well within the margin, as it is quite possible that a thousand years or more will not obliterate them in a warm and predominatingly dry country where frost does not manifest its powerful aid in their decomposition, as would be the case in colder climates.

moisture of the ground. This illustrates strikingly that trees will grow where fires become not too aggressive. Admitting that many trees found in river-beds are such as would always be met with in similar situations only, nevertheless a number of species occur in these localities which would thrive almost anywhere if guarded against fire.

The scarcity of timber is a great drawback to East Kimberley. Suitable timber for fencing purposes and for stockyard buildings is difficult to obtain in several localities, and it will become still more so when with increasing settlement of the country the demand for it arises. Even near some of the homesteads a sufficient quantity requisite for fuel can only be obtained with difficulty and has to be drawn for miles.

When the time arrives that it will be more profitable to export preserved meats than live stock the absence of an abundant supply of fuel will be severely felt. From what I have seen of the country it appears to me very doubtful that coal exists there ; consequently the supply of fuel necessary for preserving works will have to be derived from locally grown timber, or must be imported. This prospective subject will be touched upon later on.

(To be continued.)

CHEESE INSECTS.

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By Arthur M. Lea,

Enomologist to the Bureau of Agriculture.

A number of insects are known to attack cheese and to render it unfit for consumption, though many people prefer cheese when it is "mitey," or full of "jumpers." How people can knowingly swallow and enjoy thousands of minute living animals must remain a mystery to those whose tastes are more fastidious, and more especially to those who have seen the mite (a truly hideous creature) under the microscope.

The Cheese Mite.

(Tyroglyphus siro.)

This is a very minute eight-legged animal, of a pale watery-white colour, which in affected cheese swarms in countless thousands ; cheese that has been attacked becomes crumbly and covered with a sort of greasy dust, consisting of fragments of cheese, cast skins and excrement of the mites. The powers of reproduction of mites are wonderful. I recently received a tin of beetles from Queensland ; these were collected last summer, still, on opening the tin it was found to be swarming with millions of specimens of a species allied to the cheese mite and known as *T. entomophagus* ; this mite had in about four months reduced the beetles (large *Anoplognathi*, etc.) almost to dust. In cheese the mites are wonderfully fertile, and once attacked it is extremely difficult to get rid of them ; in cut cheese it is hopeless to attempt anything, but when uncut, strong brine will prevent the cheese from being attacked. This mite also attacks wheat (a sample recently received by the Bureau from Geraldton was so affected) and flour, besides other substances. In wheat they may be readily destroyed by the fumes of bi-sulphide of carbon, but I know of no substance that will destroy them in flour without tainting it. If, however, the flour is kept clean and dry the mite will seldom attack it.

The Cheese Maggot or Jumper.

(Piophila casei.)

This is the larva of a small blackish fly which may often be seen on cheese and which is now almost cosmopolitan. The fly has a long ovipositor which it thrusts (with the aid of its extensible abdomen) into cracks of cheese to deposit its maggots. The maggot (known as "jumper") is small, thin, of a pale yellowish colour, and with a black head ; when disturbed it has a habit of doubling itself into a hoop and then suddenly releasing itself springs for a considerable distance. Thousands may often be found in affected cheese ; the place where the maggots are present is marked by a watery spot and the outer portion of the cheese gets dry and hard and is very liable to split. The cheese when whole may be protected from attacks by washing it with strong brine, or if cut, with fine mosquito net or muslin. The fly also occasionally attacks bread, and rancid fat is frequently attacked.

THE DAIRY.

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EFFECT OF FOOD ON MILK.

(From a Paper by Mr. John Speir, read before the Glasgow Dairyman's Association).

Mr. Speir said that the quantity of milk was very materially influenced by the food used, some foods having a more marked effect in this respect than others. It was a common opinion that draff (brewers' grains) had that effect, and he had found in all his tests that that was the case. With the exception of fresh grass, none of the other foods with which he had experimented appeared to have that power in any marked degree. In his experiments eight cows were used, and different foods were given at intervals of five weeks, the quantity and quality being meanwhile carefully noted. During the first five weeks they were fed on grass, bran, and potatoes, which increased the milk 9·3 per cent. He would explain that in all the experiments the cows received as much as they could eat of the different foods, as the object was not to ascertain what was the proper quantity to feed, but the effect of each class of food on the milk. The cows were next fed on pasture, and the milk supply rose 17·8 per cent during the five weeks ; decorticated cotton-cake was next fed, and resulted in a decrease of 13 per cent. ; the others were—flesh meat, which decreased the supply 5·6 per cent. ; cummins* (an excessively rich food) brought it down 6·6 per cent., and it might be noted that 15lb. of cummins per day were fed to each cow. He did not intend using them in that quantity, but he thought that perhaps, as the milk was still decreasing, the cows were not getting enough. Paisley meal, when fed, began to show an increase, and when gray peas were fed the increase was also very marked. A food of a similar kind to the latter, and composed principally of beans, decreased the supply very materially. How that came about he could not say, unless it was, as in the case of the cotton-cake and cummins, used in the extreme. Coming now to the question of the quality of the milk, few people but believed they could alter the quality of the milk at will by the use of certain foods. His experience, however, did not altogether warrant him in believing that it was possible to alter the quality of milk permanently in that way. There was no doubt that when the food was changed the quality might be improved by the use of certain foods, but it did not last. To get permanent results, they would require to start with a cow that would give them rich milk, and breed similar animals. The way in which he ascertained the quality of the milk was as follows :—When the milk was drawn from the cows a wineglassful was taken from each cow's milk, and these samples were at the end of the week tested for butter fat. In this way a fairly reliable average result was obtained of what the milk during the week was bound to be. The average variation over fifteen periods of five weeks each was found to be very

*Cummin, a fennel-like umbelliferous plant, *Cuminum Cyminum*. An annual, found wild in Egypt and Syria, and cultivated for the sake of its fruit.

administer to a horse, which, as is known and has become proverbial, can stand very strong doses. Professor Law * is very strong on this point :—"We cannot certainly kill the bots in the stomach, as they will resist the strongest acids and alkalies, the most irrespirable and poisonous gases, the most potent narcotics and mineral poisons, empyreumatic oils, etc. Oil of turpentine, bryony, ether, and benzine have been relied on by different practitioners, but none of them are quite satisfactory. It seems probable that these, like other vermifuges, will act best in autumn or early winter, before the larvæ have acquired their hard, horny coat of mail, and at this time accordingly they may be given with more confidence. The azedarch (pride of China) grown round stables in the South [England, R. H.] to protect from bots, probably acts in this way, if at all, being cropped and swallowed by the animals while the bots are still white, soft, and permeable to liquids."

Other authorities are also strong in their expressions as regards the resisting faculties of bots.

The only time promising an effective removal of the larvæ is when these are young and still covered with a less impervious vestment than is the case after several months. A powerful drench administered soon after the horse has been infested may prove of great service. It is, however, not here the place to give formulas of recipes which ought to be administered only on the advice of a veterinary surgeon, after diagnosis of the disease.

Preventives are the only safeguard against the ill-effects produced by bots.

Horses which are constantly handled are easily protected. Mere cleanliness—washing and grooming—will prevent the larvæ reaching the stomach of the horse. The long hairs below the jaw and at the base of the neck, between the legs, etc., should be cut away to prevent the fly settling with ease and depositing her eggs. Washing the shoulders, flanks, and other favourite parts visited by the fly with soap and water will effectively remove the eggs. *A systematic washing and thorough grooming, particularly during the early summer, which is the time the fly deposits her eggs, should not be neglected.*

Horses running in paddocks should occasionally be caught, washed and groomed, and their shoulders, base of neck, forelegs, in fact as far as the horse can lick itself about the forequarters, smeared over with oil or some other fatty substance. As long as the fat lasts the fly will not settle on the horse. A little carbolic, *the crude strong smelling*, might be added with advantage. The removal of the long hairs, as mentioned above, is important.

The horses to be sent out for a period to graze in the bush during spring or summer should be clipped before being turned out. I would strongly recommend this to be done, because I feel certain that a clipped horse will be left unmolested by the fly where long-haired horses are present. The absence of long hairs will frustrate the successful ovipositing, and were all horses clipped *in spring* the danger from bots would be reduced to a minimum.

In speaking of the removal of long hairs, I wish not to be misunderstood by those who are too fond of trimming the mane and the tail of the horse, as arguing in favour of such a fad. I consider it a downright cruelty to the noble animal to reduce its tail and mane in a country pestered like none other with many kinds of flies and to which now another dangerous one is added by introduction. A fig for fashion ; give me the horse with a long tail and mane. It feeds with more comfort, thrives, and consequently does its work with less distress than a bob-tail would under even conditions.

The Arab who seeks his equal for being proud of his mare, allows her tail to grow full length, because he really loves the brute and studies her comfort.

* loc. cit.

EAST KIMBERLEY.

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By Richard Helms.
Biologist, Bureau of Agriculture.

(Continued from page 1287).

The Grazing Interest.

The principal pursuit the inhabitants of East Kimberley are at present engaged in is rearing cattle, and for many years to come beef will remain the staple production of this district, bringing wealth to the holders of the land. It is scarcely more than ten years since the first settlers drove herds overland from Southern Queensland, undertakings which required much courage and perseverance. Moreover, great risks were involved in them and losses of considerable magnitude were incurred during the journey, which lasted about eighteen months. But the fair pasture rewarded the pioneers for all hardships and risks and soon recuperated their losses. For the hundreds they at first introduced into the country they may almost count thousands now.

Although the increase has been enormous, the present holdings are not stocked to the tenth of their carrying capacities. Besides, large tracts of land are still entirely unoccupied. There is consequently room for a number more intending squatters.

In round numbers the area of East Kimberley may be computed to cover 20,000 square miles. More than one half, and probably two-thirds, of this vast tract of country is adapted for carrying cattle, if not altogether fattening country.

At present only about 65,000 cattle of all ages roam over the holdings ; but as these numbers are fast increasing they will soon double and treble, unless epidemic diseases should come among them.

The fine grasses and herbage, together with the abundance of water found in the country, make it naturally adapted to grazing, a subject which need be no further dilated upon, as it is well known and has been repeatedly alluded to in this essay.

Diseases of Stock and Parasites.

Like everywhere else "tuberculosis" is the most frequently met with disease amongst cattle. On one of the larger runs I found a considerable number affected with it, which may be attributed to the indifferent management the place has received for a period. For years the diseased animals have been allowed to run among the herds, and only such are now shot, when mustering, which are so bad that they would probably not see the next mustering time.

"Actinomycosis," vulgarly known as "lumpy-jaw," is also prevalent, but it appears to be diminishing. One of the early settlers informed me that it became so serious during the first few years that he was greatly alarmed and almost feared that he would have to abandon the place. However, the disease occurred to a much lesser extent after a few years and is at present reduced to a narrow percentage on his run. He attributes the early prevalence of the disease to certain grass seeds which do not now develop in the pasture mostly frequented by the cattle. This seems to me a very feasible theory, as no doubt a frequent irritation of the mouth, larynx, and throat would prepare the ground for the disease. I have no doubt that in many instances the disease is the after result of rough handling which the calves are subjected to when being branded. Particularly yearlings who had escaped the previous year's musterings, and which as a rule are very obstreperous, receive generally bad treatment.

On the run previously mentioned were also found a considerable number suffering from what is commonly called "cancer." This is an open suppurating wound which gradually expands; from time to time a thick scurfy crust is formed over the surface, which is frequently rubbed off or drops off by itself. These blemishes invariably start from the brand, and are probably caused in the first instance by too severe branding, more particularly when done with uneven and corroded irons, which in places will burn through the hide. All indications point to it being a microbic disease and that infection is caused by flies. The total destruction by fire of every beast shot on account of this disease would much militate against its spread. Instead of doing this, such and other "wasters" are left to rot at the "cutting-out" camps where they were shot. The newly branded calves frequent the neighbourhood of these camps and must often be infected through the flies coming from the carcases, and also from other animals still running about with the disease.

With several calves I noticed what is locally called "scab". This is a rough crust of dried matter, frequently covering the greater part of the back, sometimes over ¼ inch thick. Below it a yellow watery secretion is found. I felt inclined to attribute the disease to a *Sarcoptes*, but on examination of some material brought with me I failed to discover parasites. It may, therefore, be a fungus disease. The assertion that the calves grow out of it appears to me very doubtful.

The "parasites" found on the cattle were three; two species of lice, and a tick. The more prevalent of the first is the "Large Cattle Louse" (*Haematopinus eurysternus*) which I saw on several beasts. On one young steer it occurred in phenomenal numbers, covering particularly the parts between the hind legs with a thick crust of the insect in all its stages, from the egg to the full-sized mature louse. The "Small Cattle Louse" (*Trichodectes scalaris*) I met only once, on a bullock that had been killed. These parasites are irritating, but not otherwise dangerous; but when found attacking an animal in such numbers as with the steer just mentioned, I consider it impossible for a beast to thrive.

The true "Cattle Tick"—*Ixodes* (*Boophilus*) *bovis*—was found by me on the Negri and on the Lenncker rivers, which come from the east and flow into the Ord.

As the great danger to cattle from this parasite has been so frequently discussed during the last two years, it becomes unnecessary to further comment upon this subject.

Amongst horses a disease known as "Swamp Cancer" occurs. It is an open suppurating wound, accompanied by swelling, and is generally located under the belly. It was only once brought under my notice, but I am informed that it is by no means uncommon. Not having been able to pay special attention to this disease, I merely mention its occurrence; but from what I could learn it is generally considered infectious and incurable.

A small tick once found on a horse on the Negri, in my opinion, was the true cattle tick.

Agriculture and Horticulture.

Agriculture has up to the present received but little attention. With the exception of the cultivation of a little maize in a few places, nothing further has been done. As far as these trials went they proved a great success. No doubt, therefore, exists that this corn can be successfully cultivated, and, if a demand for it existed, could be grown with good profit. For local consumption it is little in demand. The excellent pasture makes it needless to feed horses on corn, and fowls also find almost enough food about the homesteads and slaughteryards.

Horticulture, wherever attempted, has been eminently successful with the help of irrigation. All culinary vegetables grow well if watered daily, which, of course, may be omitted during the wet season. Without watering regularly it is impossible to grow them, but the trouble is compensated by the quality of the production which, as a rule, is very good, as the plants grow rapidly.

The following is a list of culinary plants, including those I have seen cultivated in one or the other place:—Cabbage, turnips, swedes, radish, China cabbage, carrots, parsnips, peas, French beans, broad-beans, potatoes, beet, spinach, onions, eschalots, chillies, cucumbers, pumpkins, water-melons, rock-melons, sweet potatoes (*Ipomoea batatas*). All grow well, and as the greater number naturally prefer a cool climate I have enumerated them specifically to show that with care and attention almost anything may be grown in the district. The curcubiteous plants grew almost without any trouble; in fact, I was told that self-sown watermelons grow abundantly after floods in the bed of the Ord, and yield tons of fruit.

Of introduced fruit trees, I found the following growing:—Orange, mandarin, lemon, custard apple, mulberry, and pomegranate. The pomegranate happened to be double-flowering; but its growth left no doubt that fruiting trees would also prosper well.

The Indigenous Fauna.

To a lover of nature the fauna met with in a district not previously visited is always particularly attractive. My limited stay in East Kimberley, I am sorry to say, prevented me from making an exhaustive study of this branch of natural science. In most cases the higher animals were only observed from a distance, often when on horseback, and no time was available to secure specimens for examination. Owing to this fact it is impossible to attempt a scientific specialisation of the different kinds observed; all I shall endeavor will be to enumerate superficially, and as briefly as possible, the more prominent features of animal life found in the district.

The *Mammalia* are well represented. Dingos are numerous; sometimes they are tamed by the blacks, who are besides very fond of their flesh. On one occasion I saw five half-grown roasted dogs in the possession of some gins. Two species of kangaroo were seen, as well as two species of scrub-wallabi and the rock-wallabi. Other large marsupials undoubtedly occur, but it seems that the blacks keep these animals fairly well in check, as not many of any kind were observed. Bandicootes are very abundant, and are often met with, although they are constantly pursued by the blacks. The black women at one of the stations daily brought home a number of them. Ringtailed opossums are found in many localities; but the larger species I did not see, although I was informed that it occurred. A non-marsupial rat, larger than the common introduced species, is in places plentiful, living in burrows, and a large mouse living in the ground and under fallen timber was observed. Flying-foxes occur in enormous numbers over the greater part of the district. They are slightly smaller than those found in the eastern colonies. At the head of a creek I saw one of their permanent "camps," which exceeded anything I have ever seen in New South Wales, where, particularly on the northern rivers, they are frequent. Several species of other bats were noticed flying in the twilight.

The *Avifauna* is very rich in species, and highly attractive, especially the waterfowl, which are met with in great variety and extraordinary numbers in certain localities. Some of the swamps and lagoons literally swarm with them during the dry season. In the large swamps, situated about twenty miles to the south-east from Wyndham, I saw certain species of birds in numbers such as I have never had an opportunity to observe before. Several species of ducks, but more particularly the "whistling" duck, were there by thousands. When they rose it might

be said they formed clouds. I am almost afraid to arouse suspicion among my readers that I am telling "travellers' yarns" were I to attempt to give numbers; moreover, it could only be an approximation of them, and therefore I will merely say that they were enormous and wonderful to behold. Hundreds and hundreds of white cranes waded near the margins of the swamps, and the stately "native companion" stilted in uncountable flocks by their side. Ibis and geese rose in large flocks when disturbed, and the less conspicuous blue crane and the spur-winged plover became more prominently visible on such occasions. The different species of birds, as a rule, keep together, both on the ground, as well as in the air, but when disturbed their cries of alarm mingle in a babel of confusion, which is enhanced by their numbers. Large groups of the common pelican swam leisurely about in the deep water, and smaller numbers of the rarer white species now and again were seen. Many rarer birds, such as the gigantic white crane and the white spoonbill, the nankin crane, and a number of smaller species, among which the pretty "Burdekin" duck deserves mentioning, even congregate here. It would lead too far were I to attempt a further enumeration of the many other species I found assembled in these swamps at the time. In every water-hole of considerable size throughout the district numbers of birds can always be seen, and I will only add that on several occasions I had the pleasure of seeing the rarest feathery denizen of Australia, the tall large-beaked "Jabbirru," stalking along the bed of the Ord.

The land birds are not less interesting than the water-fowl, although with few exceptions they do not congregate in large numbers. When landing at Wyndham, the kites flying about the place in a considerable number arrest one's attention. These birds are good scavengers and in this capacity become very useful. Further inland they are assisted in this work by the crows. On the slopes of the low ranges near the port large flocks, including many hundreds each, of a small white cockatoo, could always be met with feeding among the rocks on the burnt ground. Their plumage had been much soiled by the charred grass, making them appear like dirty cage birds. Black cockatoos were also very numerous; these birds used to fly regularly inland to their roosting places. One evening I counted over 300 in one flock. The large white yellow-crested cockatoo occurs further inland and throughout the country several very handsome parroquets are found. On the plains the emu is frequently seen, as well as the bustard, and the curlew makes itself heard at night. The wedge-tailed eagle is not often seen, but several other hawks, besides the common kite, are frequently met with, and the call of some owls I have heard after dark. During the greater part of the day one may hear the cooing of several kinds of pigeons, and one species of dove is nearly always sounding a loud note audible at a long distance. The large bronze-winged pigeon, generally met with in pairs, is probably the handsomest of this well represented group of birds; but a ground-pigeon, known as the "spinifex pigeon" is the prettiest; this bird is not shy and may occasionally be seen to run quickly over the ground and then stop and look at the passer-by. It is almost uniformly drab grey, with lighter spangling, and has a ring of blue feathers round the eye, and a red, almost scarlet, patch underneath it. These colours and a long pointed topnot gives this plump bird a merry appearance and make it very attractive. Quails frequently rise under the horses' feet, and several kinds of honey-eaters may be seen sucking food from bright flowers, the most of which secrete nectar profusely. Several species akin to the "Java Sparrow" occur in large numbers, and these may become a nuisance in future times when grain cultivation receives attention. Many other kinds deserve being noticed, but I will merely mention the interesting bower-bird, the playground of which I met on several occasions. One of these may be seen near the road not far from "Golden Gate," a narrow rocky gap in a low range which has to be crossed on the road to the upper Ord. This bower has been known for many years and several times has been damaged and almost completely destroyed through travelling bullocks trampling on it, but the birds have always restored it again.

Reptilia are represented from the active little *Lygosoma*, which darts over walls of buildings after flies, to the man-eating alligator. The latter inhabits the Gulf and the lower portion of the Ord for more than 60 miles. The upper Ord and other rivers swarm with crocodiles wherever there is deep water. They are, however, harmless to man and much sought after for food by the blacks. Several species of what colloquially are called "Iguanas," are numerous, as well as frilled and other lizards, including geckos and lygosomas. Snakes of different sizes, including a number of species, are abundant in certain places, whilst tortoises and frogs inhabit the waters.

Many of the deep waterholes of the Ord and its tributaries are plentifully stocked with fishes. Opportunity to eat some was only afforded on a few occasions, I myself not having time to indulge in the sport of angling. The different species have not come under my observation, but more than a dozen occur, according to report, exclusive of those found within the tidal flow. The strangest fresh water fish is certainly the "Burramundi," supposed to be common in certain localities; and in the Gulf the most remarkable species is the "Mud Fish." This extraordinary half fish and half frog-like animal may be seen in numbers on the soft mud when the tide is out, propelling itself in a jerky manner by the help of its fins and tail, and disappearing with marvellous rapidity under the ground when pursued.

In every streamlet, swamp, or lagoon "fresh-water shells" abound; both univalves and bivalves. The larger species of the latter are extensively eaten by the blacks, and the others, together with water insects, furnish the principal food for the many water-fowl.

The "insects," although certain species are very abundant, on the whole are not represented to that extent one would expect to find in a tropical country. The continuous burning of the vegetation by successive generations must have diminished the number of species enormously. Judging from the results of my researches (and, considering that I devoted nearly all my spare time specially to this branch of natural history, I think I am able to form an opinion), the insect fauna is not as rich as that of England. Nevertheless, I managed to collect about 250 species of beetles and about 100 species of the other orders. Even admitting that I visited the district during the most unfavourable season, as regards insect life, the result of my collection is very poor. No doubt during and immediately after the wet season these numbers might easily have been more than quadrupled. Although not specially divergent from the typical Australian fauna, several peculiarities are noteworthy, and others would no doubt be observed if the district were carefully examined during the more promising season. One notable peculiarity worth mentioning is that among my limited collection I obtained five species of *Apion*, a genus nowhere very numerously represented.

To dilate upon every interesting point would lead beyond my intention of giving a general survey of the fauna, I therefore merely mention that ants are not as numerous as one might expect; and that in many piped branches a small bee builds her nest and collects a delicious honey.

From an economic standpoint, entomology is one of the most important pursuits of natural sciences. My mission to East Kimberley came practically within the scope of economic entomology, although it was specialised in one direction. Nevertheless, other features did not escape my observation, some, in fact, were forcibly brought under my notice. I was, for instance, struck in finding three well-known East Australian beetles in numbers attacking the pumkins and melons, as in the other colonies. They are *Epilachna 28-punctata*, *Aulocophora hilaris*, and *Aulocophora Wilsoni*. Finding two indigenous species of curcubiteous plants very abundant explained the presence of these beetles on the cultivated plants. Their occurrence proves these beetles to be the most widely distributed species of the order in Australia.

Perhaps the most dangerous insects are the numerous grasshoppers. At present their voraciousness is not much felt, because the pasture is everywhere more than abundant; but at a future period it may appear different, and when agriculture becomes subsidiary to the grazing pursuit they may at times cause formidable damage to cultivated crops. If, however, the native avifauna is not ruthlessly exterminated a salutary check will always be kept upon these insects. The bustard and curlew, and to a large extent the emu also, live largely upon grasshoppers and many other insects; and still more beneficial are the crows, the various hawks and the owls, for these prey besides upon mice and other small mammals. Hawks are often much maligned, but unjustly so. In a report issued by the Agriculture Department of America it was shown that repeated dissections of over seventy species of hawks and owls proved their stomachs invariably filled with grasshoppers and mice. The damage done by some of these birds is unfortunately always prominently noticed and often exaggerated, whilst their benefit to man is never considered by the unthinking multitude. Their utter selfishness prevents them seeing anything beyond their immediate environments; they cannot therefore conceive the danger that lies hidden in disturbing the balance of the economy of nature. One reason why introduced pests—let them be insects or other animals or plants—become so noxious is that they, as a rule, may propagate their kind to the fullest extent of their fecundity without being checked by natural enemies.

Other very destructive insects are the *Termites*, or "white ants," probably represented by several species and found in all situations. Every stick of dead timber, and even the drying droppings of cattle and horses are invariably attacked by them. Very objectionable insects also are the common flies and congeneric species, which are found there as numerously as in most other parts of Western Australia. Several species of mosquitoes are always abundant near water even in the dry season, and a universal nuisance during and some time after the wet.

A threatening danger lurks in the possible spread of the "cattle tick," which, unfortunately, has reached the southern part of the district. It would be a calamity of a very serious nature were these parasites to spread over this fertile tract. The whole of the grazing industry stands in danger of being greatly affected by this pest. In pointing out that it may cause the ruin of some of the settlers, I cannot be charged with being an alarmist, in the face of the destruction it has already caused in the eastern colonies. As the danger is now well known and the settlers are made aware of its existence in their approximate neighbourhood, it is to be hoped that, for their own safety, they will not take the matter in a light mood, but carefully watch and, as much as possible, prevent the spread of the pest.

Reforesting the Country.

An undertaking of the greatest importance to the district will be the reforesting of the country. The perspective advantage of successful endeavours in that direction will, I am afraid, not be appreciated by the ordinary reader; yet I feel satisfied that it is one of the most momentuous questions governing the future prosperity of this favoured land. When less time than the space of another generation has passed away, the utilitarian demand for plenty of fuel will have become of vital importance, especially when the question has to be solved how to dispose to the best advantage of the surplus beef, which cannot then be exported in the shape of living bullocks, and will meet besides with keener competition from other parts of Australia and that of the outer world. This point is easily understandable and may be grasped by those who can not (or will not) look beyond a twelve-month ahead; but from my standpoint the question has a bearing of far greater magnitude.

It is an established axiom that, within temperate and warm regions, the greater the rainfall, the more prolific the vegetation; but universally also it is verified that the more extensive the arborescence the greater and the more regular, as a rule, will be the rainfall. To go into the details of all phases which rule the reciprocal interactions between rainfall and forests, would appear too didactic on my part; still, I cannot pass the subject by without making some explanatory remarks.

Those who have given only the most superficial attention to the meteorological conditions that rule the descent of ærial moisture know that the precipitation of rain mainly depends upon the reduction of the temperature of the atmosphere (other factors also play important parts, but these need not enter into this argument). Wherever, therefore, the sun strikes barren ranges, exposed rocky mountains or open plains, a considerable amount of heat is absorbed, which later is given off again or eradiated. It is this eradiation of heat which prevents the precipitation of moisture, because it will not permit the atmosphere to cool sufficiently to allow the gaseous state the water was converted into by evaporation to be changed back again into its fluid state. Taking the atmosphere as a whole it must be looked upon as a vast ocean surrounding the earth, which practically is of an equal consistency. It is, however, constantly charged with moisture in a gaseous state, which, at certain points, it yields again as water. Now these points may exist at any portion of the globe; the reaction of such depending merely upon a reduction of temperature to a greater or lesser degree.

Wherever forests exist the evaporation is never so rapid or so complete as in the open country, because the solar rays do not strike the ground; and this retention of moisture is in proportion to the density of the forest. The evaporated water does not get attenuated to such an extent as where the sun can strike constantly directly upon the ground, consequently a cooler air is maintained in forest-covered regions. The cool air when coming in contact with the warmer strata condenses the gaseous water of these, and in this manner becomes charged with more moisture than it is able to hold in suspension. The result of such condensation manifests itself during each night in the shape of dew, and under more favorable circumstances as fog or rain. It must be borne in mind that the atmosphere is everywhere charged with moisture to an almost equal extent, and that it is not water that is driven before the wind from great distances during rains, but that the wind, which means moving air, is meeting a cool stratum, which continues to condense the moisture of every successive cubic metre as it reaches its sphere. There is no need for going further into the complicated subject; all that was tried to explain in brief is the connection of forest growth with temperature and its effect upon the precipitation of moisture. It merely requires to be noted that the higher the forests are situated the greater is their influence upon meterological phenomena.

If the mountain ranges once more become covered with a vigorous arborescent vegetation, their changed character will produce a material influence upon the climate. It is safe to predict a greater rainfall in summer, and that winter rains will become more frequent. And, besides, another important consequence will be the obstruction offered by the trees against the too sudden rush of water towards the valleys, as is now the case. More water will be retained by the soil, through the increased possibilities for absorption, as well as on account of a smaller loss by evaporation later on. This will increase the number of springs, and strengthen the existing ones, thus adding to the supply of flowing water, as well as making it more permanent.

It is not my intention to lay down a systematic plan for this undertaking, nor discuss the nature of the most suitable trees for planting or sowing. This is in the hands of another Department, which will no doubt move in the matter as soon as the people of East Kimberley urge the necessity of it.

A serious difficulty operating against the successful rehablitation of forests arises from the firing of the ranges and the country generally by natives and Europeans. The latter are guilty of the greater part of it at present, although the blame is invariably put upon the natives. To remedy this, there should, in my opinion, be two effective measures adopted. The natives should be removed from the country; and against the Europeans the law prohibiting the firing of the country should be enforced, and a few examples be made by heavy fines or incarceration.

I do not mean to argue here upon the practicability of removing the natives, and the method to be adopted for this purpose, knowing that it will meet with many objections; but I am bold enough to state that it is an easy task. And I will further add that I consider such a process an act of humanity, providing always that the indigines receive a sufficiently large area allotted to them that they can live upon it according to their natural habits. The treatment which the natives have received formerly, and still are receiving in many quarters, is a disgrace to civilisation. To deal with this subject in detail comes not within the scope of this essay, and only on account of the connection existing between the blacks and the firing of the country, which is detrimental to the necessary reforesting of it, has the subject been touched upon.

In spite of the perpetual destruction of vegetation by fire there still exist many patches of shrubby growth and occasionally some good-sized trees on the ranges; and everywhere solitary specimens are struggling for an existance. If, therefore, the firing were to cease for only 20 years, a considerable difference would be noticeable in the growth of all manner of vegetation springing up without artificial help. Unfortunately the insane burning of grass lands is practised by many settlers, who imagine that they can improve the pasture in this manner. Apparently through burning off coarse and valueless grasses the pasturage is improved, because the stock eats the young shoots of the coarsest grasses; but such improvement is only a delusion, because the coarse grasses later on will be all the more dominating, as these not being heavily eaten down, are the only ones to form deep-rooted and many stalked stools and also have frequently produced ripe seeds. On the other hand, the softer and more succulent grasses, being constantly fed down with avidity and having a hard struggle against the coarse tussocks, rarely get a chance to produce seed and lose continuously more ground at every burning, till ultimately they become exterminated.

(To be continued.)

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RAINFALL FOR MAY, 1897.

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IN POINTS (100 POINTS ONE INCH).

STATION.	Points.
Wyndham	Nil.
Condon	Nil.
Boodarie	Nil.
Talga Talga	2
Marble Bar	Nil
Pilbarra	Nil.
Roebourne	Nil.
Cossack	Nil.
Fortescue	Nil.
Onslow	Nil.
Carnarvon	10
Freshwater Camp	38
Hamelin Pool	13
Northampton	167
Geraldton	112
Greenough	87
Dongara	78
Mingenew	81
Carnamah	36
Berkshire Valley	120
New Norcia	173
Gingin	512
Mullewa	42
Yalgoo	67
Mount Magnet	26
Daydawn	20
Cue	50
Nannine	10
Newcastle	238
Northam	180
York	263
Beverley	270
Kellerberrin	111
Southern Cross	29
Boorabbin	4
Coolgardie	9
Norseman	29
Dundas	47
Kalgoorlie	10
Kanowna	10
Kurnalpi	21
Bulong	25
Goongarrie	17
Menzies	6
Niagara	10
Yerilla	16
Rottnest	327
Guildford	316
Perth Observatory	304
Perth Botanical Gardens	312
Jarrahdale	513
Harvey	411
Mandurah	491
Pinjarrah	451
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Busselton	368
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Bridgetown	351
Quindalup	437
Karridale	337
Cape Leeuwin	255
Pingelly	249
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Wagin	196
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Broomehill	223
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Williams	215
Arthur River	283
Kojonup	256
Mt. Barker	160
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Breaksea Island	138
Bremer Bay	188
Esperance Bay	80
Israelite Bay	37
Balladonia	8
Eyre	64
Eucla	27

On the Undesirability of Growing Olives and Oleanders Without Careful Supervision.

In various parts of the colony olives are grown as breakwinds, hedges, or as ornamental plants, and when once planted no trouble is afterwards taken with them. This is a dangerous practice, as the olive is especially subject to the attacks of the black scale (*Lecanium oleæ*), and requires constant treatment to be kept clean. I do not think I have seen one olive tree that was not more or less densely covered with this scale. When it is grown in the vicinity of orchards it becomes very dangerous, as the scales can easily migrate to the surrounding trees, so that no matter how carefully the fruit trees (and especially oranges) may be sprayed, unless the olives are also treated, they will be just as badly affected again in a short period. The olive is attacked by other scales, but to a less extent. The following species are known to attack it—*Lecanium hemisphæricum*, *Aspidiotus aurantii*, *A. rapax and A. Rossi*. The oleander is attacked even more heavily than the olive, and branches may frequently be seen that have been killed by the black scale, and leaves where it would be impossible to touch any part with the head of a pin without touching a specimen of *Aspidiotus Rossi*.

In this connection it may be advisable to point out that a noxious weed, *Solanum Sodomæum* (Devil's apple, poison apple, or apple of Sodom), may often be seen to be densely infested with the black scale.

The Silver Eye.

This bird is, unfortunately, only too well known in Australia on account of its fruit eating habits. It has often been noticed to feed on the Wooly Aphis and various small destructive grubs, and if it confined its attention to those insects it would to that extent be useful; but it does not. On opening the stomachs of a number of Silver Eyes I have often found the remains of *Leis conformis*, *Coccinella transversalis*, *Chilomenes expustulatus*, and other useful ladybirds; and I am inclined to think that when feeding on the Wooly Aphis, if there are any insects eating that pest, the bird eats them also, at once cancelling the small service it renders to man. I do not believe in the indiscriminate destruction of small birds, even when such have been proved to be partially grain or fruit-eaters; but from every direction we look at the silver eye it is seen to be a noxious bird. It eats fruit, it distributes the seeds of noxious weeds, and lastly, it destroys large numbers of useful insects.

EAST KIMBERLEY.

—:o:—

By Richard Helms.

Biologist, Bureau of Agriculture.

(Continued from page 1303).

The Prospects of East Kimberley.

For many years to come the leading industry in this magnificent country will be cattle rearing, as it is now. The holdings are very large at present, but they are not stocked to nearly a tenth of their carrying capacity. A considerable increase is annually adding to the wealth of the present owners, who hold a well grassed and well watered country which can be worked at very low expense, and with a remarkably small risk. No drought ever endangers the stock; all the loss from ungovernable incidents to be contended against is what the blacks spear from time to time. But, annoying as such losses are at times, when, for instance, the natives kill an imported bull or other stud animal, it does not reach the loss occasioned through mismanagement or carelessness.

Under existing conditions the present holders have a monopoly of the country, for they not only occupy the choicest portions of the land on long leases, but besides the still unoccupied land is remaining so owing to the impossibility of stocking it at a reasonable expense. The scare of introducing the tick fever into East Kimberley has induced the Stock Department to exclude all cattle coming from the northern territory of South Australia. As only from this country can breeding cattle be introduced at a payable rate, the present holders need have no fear of further competition. Through the natural increase these will have to employ a few more hands in the course of time to better manage their extending herds, still such increase in the population could not be compared to what it would be in the same time if a possibility existed and encouragement were given to stock the still unoccupied land.

The country evidently suits cattle best; but it is also admirably adapted to breeding horses. Those found in East Kimberley are by no means an inferior stamp of animals, and for the work required of them, probably very suitable. Still, I think that a much superior race and a very marketable stamp might just as easily be reared. Very few horses are met with that would suit for cavalry or artillery service. Throughout Australia this stamp of horse has become gradually scarcer during the last fifteen years, although prior to that time they were common enough. General Hutton drew attention to this in an article written for the *Agricultural Gazette* of N.S.W. which was accompanied by figures and photographs taken from characteristic horses of the permanent military contingent, pointing out the stamp of horses profitable to rear.* Probably no district in Australia is better adapted for rearing remounts and artillery horses for the Indian army than the northern part of Western Australia. The climate being tropical would be an important consideration, as horses bred there would be more suitable for the Indian service than those from cooler parts. Breeding horses specially for the military service of India would, undoubtedly, prove a remunerative enterprise.

Sheep have hitherto not been introduced into East Kimberley. Certain hilly lands and a few other localities may probably suit them, but the greater portion of the pasturage is too coarse; the climate may also prove too hot for the production of a good staple. As no trial has been made this opinion may not be borne out by facts; still it appears that a concensus of opinion exists that the result of a trial would be doubtful, otherwise if sheep rearing were likely to prove profitable an attempt at it would have been made before now. It would, however, be deserving of a practical trial, as then, if successful, much of the unoccupied land might be utilised.

Goats do very well. Several of the squatters keep small flocks about the homestead for killing purposes. Judging from this, I have no doubt that Angora goats would thrive, and probably might prove very profitable.

East Kimberley, like many other districts in Western Australia, is in need of a larger population to better develop its resources. It possesses a climate free from the drawbacks of other tropical countries, as it is perfectly healthy, so far as malarial fevers are concerned. A European population, therefore, is able to work the soil without endangering their health. The land possesses the potentialities of supporting a large population by tropical agriculture, the establishment of which waits to be taken in land. Under existing conditions, however, there appears little prospect of the introduction of its lucrative branches.

* "Horsebreeding for Military Remounts."—*Agricultural Gazette of N.S.W.*, vol. v., p. 715.

For the present it would be an important step forward to largely increase the stock in the district, and for this purpose allow breeding cattle to be introduced overland. It is the best means to utilise the land in its primitive state and will yield probably the quickest return, whilst the opportunities for disposing of large quantities of meat within Western Australia last. The occupation, and heavier stocking of occupied lands, would naturally lead to water conservation, for which the best facilities exist in almost every watercourse. All rivers and creeks possess now reaches and waterholes, which, though they never become dry, might easily be much enlarged by judicious damming; and smaller ones might be made permanent in this manner, while new ones could be created in hundreds of places, as depressions with rock bottoms are found numerously in every watercourse. In comparision with other parts of Australia East Kimberley possesses extraordinary advantages for the conservation of water, which cannot be too highly estimated.

By the time the present leases terminate considerable progress could be accomplished if the inhabitants will only work with a progressive spirit and make the best of their advantages. When the land becomes open for re-letting, a number of the blocks will, no doubt, be keenly competed for, as by that time the value of the land is certain to be better known than now. Some of the larger holdings will become reduced by this natural process of competition. But this can only be an advantage to the colony in general, for unless the settlers increase the land will never be utilised to its best advantage.

In the meantime, it is to be hoped that the firing of the country will be effectively suppressed, so that crops of cereals may be grown over large areas. The fertility of the soil warrants agriculture being a remunerative enterprise within reasonable distance from the ports. Wheat, rice and millet will always find a ready market; the first within the colony, and the others in India or Europe. A single crop of these cereals could easily be grown annually, if sown during the wet season, and with the help of irrigation a double crop would be obtainable.

But the greatest prosperity of the country will begin when the cultivation of specially tropical products is taken up in earnest. It will then be that the country becomes populated, for a couple of hundred acres well tilled and planted with suitable crops, enables a man to acquire an independency. The country possesses not only the rare advantage of being perfectly healthy, but the land best suited for the growth of tropical products is free from timber. It, therefore, requires no coloured labour to produce cotton, sugar, cocoa, tobacco, rubber, or fibre, and other profitable articles of commerce; Europeans can do the work, and no great capital is required to prepare the land, the grubbing of trees in a tropical forest being always a great expense. Moreover, irrigation can be carried out at a minimum of expense. In a number of places it will be found that water can be conserved in such a way as to enable large areas to be watered by gravitation; but where that method is impracticable, windmills may effectively be employed, as a steady breeze generally blows throughout the day.

Probably the present generation will not witness much more than the beginning of this desirable state of high cultivation, unless some enterprising mind forestalls the ordinary course of events. Still, I am convinced that the most favoured portion of Western Australia will be ultimately destined to tropical agriculture, employing a large European population.

Forecasting the future of East Kimberley the sequence of progress will be as follows:—Great increase of stock; increase in the number of holdings and a moderate increase of population; export: live stock, mainly. Further increase of stock; cultivation of cereals, with a proportionate increase of population; exports: live stock, preserved meats (frozen meat?) and cereals. Stock reaching its limit of increase, greater production of cereals, and the production of tropical products; population increasing considerably; exports, as previously, at an increasing rate, and tropical products. The same, with a greater proportion of tropical products; a steadily increasing population; exports, increasing, mainly in tropical products.

Amongst the future exports horses will probably furnish a considerable item, and wool—sheep and angora—may possibly also augment them.

List of Trees and Other Plants Deserving to be Introduced into the Tropical Latitudes of Western Australia, with Hints to their Propagation and Culture.

The Cocoa-Nut Palm (*Cocoa nucifara*).—This "prince of palms," as the noble tree is deservedly called, ought to grace the shores of Cambridge Gulf and other inlets. The great value of its nut, as a wholesome diet, as well as an oil and fibre producer, is too well known to require further comment. It is my opinion that it would require but little care at the beginning to successfully establish it on the marshes of the northern gulfs and near the estuaries of rivers entering them. After the first year the plants will take care of themselves, and in a few years more begin to bear, and then spread by natural increase. From Dr. Nicholl's "Text-Book of Tropical Agriculture" I take the following:—"The low alluvial flats, near the mouth of rivers, more especially lands subject to occasional inundations, are the best situations for the cultivation of the cocoa-nut, for in these places the alluvial loam is usually rich and deep." This palm would also thrive well on some of the rich loamy banks of rivers.

Propagation by unshelled perfectly ripe nuts, which it is best to allow to germinate in a nursery before setting out. (The natives of New Guinea spike the coir with a pointed stick, which is driven into the ground. In this manner the nuts are suspended about 3 feet from the ground and allowed to germinate. They are planted when their shoot is about 18 inches long.)

The Date Palm (*Phœnix dactilifera*).—This exquisite palm should be planted in numbers all over the country. In order to secure the production of fruit the trees require to be planted in groups, because the plant is *diœcious*, which means that the male and female flowers are developed on separate trees. Unless, therefore, a male tree is present the female flowers cannot be fertilised, and do not set fruit, or the fruit drops without ripening. This valuable palm will thrive in almost any soil, and withstands the greatest drought. The fruit has ripened inland in the latitude of Perth.

Propagation is readily secured from seeds.

The "Sugar Palm" of India (*Phœnix Silvestris*).—Although this palm would not probably do as well as the date palm in the almost rainless interior of Australia, it is, nevertheless, adapted for dry regions. The climate of East Kimberley would suit the tree admirably. In Bengal annually about 50,000 tons of sugar are produced from this tree by evaporating its juice. The sap is withdrawn from incisions made at the upper part of the trunk. Each tree yields annually sufficient sap to produce 8 lbs. of sugar, and sometimes more. The tree is not destroyed by this process, but may be utilised in this manner for upwards of fifty years. The fruits resemble dates, but are not as large, though very palatable.

Propagation by Seed.

Bananas (*Musa spp.*).—The different varieties of this palm are very easily cultivated. They will thrive on almost any soil, except in such as is wholly composed of sand and lime only. They flourish best in a loam which allows of the ready permeation of moisture. Along the banks of the rivers in Kimberley a number of eminently favourable spots can easily be found. As the plants to a certain degree are also fond of salt, I think they may probably thrive well along the shores of Cambridge Gulf. *Musa Cavendishi*, known in Australia as the "Fiji Banana," would probably be the best suited for this situation.

No other plant produces the same amount of nutriment per acre as the banana.

Propagation by Suckers.

Fig Trees (*Ficus spp.*).—These trees do well on almost any soil, and are easier cultivated than any other fruit-growing species. Once established the trees require no attention.

Mango (*Mangifera Indica*).—This delicious fruit might be grown in certain positions to perfection. The tree prefers a humid atmosphere, and therefore would prosper best near permanent water-holes in the semi-shade of other trees. On account of the abundance of delicious fruit the tree produces it is deserving of trouble to establish it.

Propagation by seed, which, however, must not be allowed to get dry before they are planted to ensure germination. The best plan would be to import ripe fruit, and if the flesh should have become unfit for use divide the fruit, and plant the seeds with the flesh on them. There are generally two seeds found in each fruit. Can also be propagated by layering.

Rose Apples (*Eugenia spp*).—The fruit of these trees possess a rose flavour and are very palatable. Would grow well on river banks and even swampy soil. The best variety is probably *Eugenia Mallaccensis*, on account of its fine fruit, and because it bears when still a shrub, although it grows to a tall tree. Others are *E. jambos*—grows to a medium-sized tree, and is a prolific bearer, and the species most frequently cultivated—*E. macrocarpa*, *E. Javanica*, *E. aquea*, *E. amplexicaulis*. All species produce an umbrageous foliage.

Propagation from Seeds.

Clove (*Eugenia caryophyllata.*)—This tree, as will be seen, belongs to the same genus as the rose-apple. It should grow well in sheltered situations without heavy shade, which the tree dislikes. The aromatic spice known as cloves is the dried flower-bud of this plant.

Propagation from Seeds or Layering.

Pine Apple (*Ananas sativa.*)—This delicious fruit deserves to be cultivated near every homestead. It prospers best in a rich loam, and when once established, except being freed from weeds, requires no attention. The plant lasts for years and produces a number of suckers annually, which should be reduced in order to avoid the development of too many fruits of small size.

Propagation by Suckers or the top of the Fruit.

Coffee (*Coffea arabica* and *C. liberia.*)—Every householder ought to cultivate a number of trees of either of these species, it does not matter which, as both are good, in order to produce sufficient beans for his own use. Pure coffee is a much more wholesome drink than most of the tea imported into Australia, and which is so extensively consumed. Coffee would, under any circumstances, form an agreeable change.

The tree requires a deep soil, because it produces a deep tap root. It also requires a moderate shade to thrive well, and, therefore, would do best near river banks where such conditions can always be obtained.

Propagation from seed. Young plants are best reared in a nursery bed, which must be of loose soil and requires to be well shaded till the plants get sturdy. *C. Liberia* is supposed to be non-subject, or considerably less than *C. Arabica*, to the pestilential fungus, *Hemileia vastatrix* which destroyed the plantations of Ceylon.

Passion Fruit.—If planted on banks of rivers all the different varieties of this climber will thrive well and rapidly produce fruits. Birds will help to disseminate these plants. It should, moreover, be borne in mind that they are admirably adapted for shading verandahs or forming arbours.

Propagation from Seeds or Suckers.

Guava (*Psidium Guayava*) —the yellow guava—and other species. These shrubs, bearing a delightful fruit, could easily be grown in almost any position. Birds and cattle will disseminate these shrubs when once they begin to bear.

Propagation by Seeds, Suckers and Cuttings.

Loquat (*Photinia eriobotrya.*)— This tree prefers a slightly damp soil, but will grow rapidly when once it has made a start.

Propagation easily from seed.

Custard Apples (*Anona spp*).—It has already been mentioned that the common custard apple (*Anona reticulata*) thrives well in East Kimberley. Several others besides this species yield splendid fruit and fragrant blossoms. They are all natives of the West Indies, and, therefore, truly tropical fruits. Propagation easily from seeds.

The Ochro (*Hibiscus esculentus*).—"Tropical Africa. A tall herb. The unripe mucilageous seed capsules are known as Ochro, Okra, Bandakai, or Gumbo, and used as a culinary vegetable. The Ochro can be preserved by being dried either in the sun or by artificial heat after previous slicing." (Baron von Mueller). Propagation from seeds.

The Avacado Pear (*Persea gratissima*).—"From Mexico. The fruit attains sometimes a weight of two pounds, and is generally sliced for salad, and of delicious taste and flavour. A noble evergreen tree. Adverse to drought; likes humid soil." (Baron von Mueller).

The Argan Tree (*Argania syderoxylon*).—The fruit serves as food for cattle in Morocco; an oil can be pressed from the kernels. "Its growth is generally slow, but it is a long-lived tree. Though comparatively low in stature, its foliage occasionally spreads to a circumference of 220 feet. It sends out suckers from the roots. Commences to bear fruit when about six years old, and thence bears regularly and has more or less fruits on it throughout the year." (Baron von Mueller).

The Camphor Tree (*Cinnamomum Camphora*).—China and Japan. A moderately sized tree, the timber of which is valuable because resisting insects. From it camphor is obtained by distillation. The demand for this resin is increasing, since it is extensively used in the manufacture of smokeless powders and of celluloid. It would grow well in some of the sandy patches and near rivers, as it likes a light damp soil.

The Cashaw, Mesquite, or Algaroba Tree (*Prosopis dulcis*).—Texas to La Plata States.—A thorny shrub, growing finally to a tree 60 feet high. May send its roots to great depth in order to reach underground water. This is one of the species yielding the sweetish Algaroba-pods for cattle fodder, and utilised even in some instances for human food. Argentina Algaroba-pods contain, according to Sievert, 25 to 28 per cent. of grape sugar, 11 to 17 per cent. starch, 7 to 11 per cent. pretein, 14 to 24 per cent. of organic acids, pectin, and other non-nitrogenous nutritive substances. They are comparatively rich in potash and phosphoric acid. A sparkling drink called Aloja is made of the fruit. This and some allied species yield the Algarobylla-bark for tanning; the leaves contain, according to Sievert, 21 per cent. tannin. (Baron von Mueller).

The Breadfruit Tree *(Artocarpus communis)*.—This excellent tree would grow well in the deep alluviums of East Kimberley. Its highly nutritious fruit can be gathered throughout the greater part of the year, as the trees generally flower in irregular succession.

The Jack Tree *(Artocarpus integrifolia)*.—Native of India. Has been grown for a number of years in Queensland. "A large tree in full bearing is one of the grandest objects in the whole vegetation of the world. The fruit attains exceptionally a weight of 80 lbs; it is eaten raw, or variously prepared; the seeds, when roasted, are not inferior to chestnuts. In East Australia, just outside the tropics, the tree still produces fruits in enormous quantity up to a weight of 23 lb." (F.v.M.)

The Mahwa *(Illippe latifolia)*.—"Central India. A tree 50 feet high, content with dry, stony ground. The succulent corolla affords a never-failing crop of saccharine food to the rural inhabitants. Each tree supplies 2 to 3 cwt.; each hundredweight yields on distillation about 3 gallons of spirits; essential oil is also obtained from the corolla. The flowers are also used for feeding cattle; they will keep for a long time. The seeds yield oil of thick consistence." (F.v.M.)

The Papaw Tree (*Carica Papaya*).—"West Indies, Mexico and Peru. A small, often branchless tree, of short vitality. Bears enormously in eastern sub-tropical Australia, producing fruits occasionally of 4 lb. weight near Keppel Bay. Fruit generally of the size of a small lemon; eaten boiled or preserved in sugar or pickled in vinegar. Fruits ripen successively. Fresh seeds germinate readily." (F.v.M.)

Brazil Nut Tree (*Bertholletia excelsa*).—"A large tree. Fruit about a foot in diameter; the seeds known as Brazil nuts." (F.v.M.)

Texan Date Plum *(Diospyros Texana)*.—Indigenous to Texas and Mexico, and, therefore, well suited to the North Australian climate. The fruit is luscious, according to travellers, and the wood valuable as a substitute for boxwood used for engravers' work.

The Giant Arum (*Monstrea deliciosa*.)—A native of Mexico and Guatemala. A climbing Arum with long-stalked imposing foliage, and bearing a fruit flavoured like pine-apple.

Propagation by layers and suckers; also from seeds, which, however, is rather slow in comparison to the other methods.

Apricot (*Prunus Armeniaca*).—The apricot tree may thrive and probably bear fruit in tropical Australia. It would be worth a trial.

Almond (*Prunus Amygdalus*).—The almond tree may also deserve a trial.

Date Plum; Persimon (*Diospyros Kaki*).—There are a number of varieties known of this delicious fruit, many of which would do well at East Kimberley. Originally cultivated in Japan, China, Assam and Burma.

Propagation from seeds. The plants are later grafted if typical varieties are desired.

Cape Gooseberry (*Physalis Peruviana*).—This well known plant, with its doubly incorrect name, being neither a native of the Cape nor resembling a gooseberry, is easily cultivated. "The dried fruit acts as a substitute for yeast," says Baron von Mueller in *Select Extra-Tropical Plants*.

Propagation by suckers or seed.

Blackberries (*Rubus Spp.*)—Several species of this bramble, I am of opinion, would do well if planted on the margin of watercourses.

Propagation by suckers and seed.

Rubber Tree (*Ficus elastica*).—The Indian rubber-tree is probably still the one producing the greatest quantity of the important article for which there is no substitute. Several other plants, besides certain species of figs, also yield rubber, but, in many cases, not to the same extent. The rubber tree and other caoutchoue plants deserve being cultivated more than any tree of special commercial value. Rubber has been steadily increasing in value for the last fifteen years, and is doing so now at a greater ratio. Since the pneumatic tires have been attached to bicycles the demand for rubber has been so keen that it is feared the supply will become exhausted. The tree can only be tapped every third year without hurting it, when a mature specimen yields 40 lbs. caoutchoue. Through tapping the trees oftener great numbers are constantly destroyed. Even without the unexpected and extraordinarily large demand created for cycle tires, and the steadily increasing consumption for belting, hose, valves, washers, buffers, medical instruments, etc., it would have been a good investment if anyone had planted a thousand trees 25 years ago. It takes 20 to 25 years before the trees are fit to be tapped, but they will live for 100 years more if properly treated, *i.e.*, not bled to death by too frequent tapping. Planting rubber trees is not an enterprise giving quick returns, but it is a splendid legacy for anyone's progeny.

Propagation, easy from seeds; the young trees like shade. Would grow in East Kimberley best along watercourses, as the tree likes a humid atmosphere; but it will endure great drought, particularly when growing on rocky substratum.

From the late Baron von Mueller's great work, "Select Extra-Tropical Plants," I learn that the United Kingdom imported in 1883 unworked rubber to the value of £3,500,000; and in 1884, £2,266,000 worth. The United States of America imported in 1883 30,000 tons, worth about £6,000,000. There were in that year 120 india-rubber factories in America, employing 15,000 people. [This is before the cycle era; I cannot find the statistics giving the millions' worth imported now.—R.H.] "*F. laccifera*, from Silbet, is also a caoutchoue-tree." "Several other species of tropical figs, American as well as Asiatic, are known to produce caoutchoue."—"*Ficus Vogelii* yields in Liberia and Lagos a kind of rubber." "The Columbian Rubber-tree is *Sapium biglandulasum*." "*Hevea Guianensis*. Guiana and nearest countries. A tree, rising finally to about 60 feet. . . . In East Australia the plant thrives fairly well, at least as far as south of the tropic of Capricorn." "*Castilloe elastica*. Central America, but hardy and fruiting in Florida."

The two last-mentioned trees yield caoutchoue which is regarded superior to that obtained from *Ficus elastica*.

Other caoutchoue-yielding plants are the *Vaheas*, large climbers occurring in tropical East and West Africa. These plants yield a superior article and lately have received much attention. Not only is their native habitat being explored in search of the valuable product, but some of the species are now cultivated in India. They also produce the highly appreciated *Aboh-fruit*. The following is found in the Baron's great book: "Dr. Welwitsch describes the Aboh-fruit of this species (*Vahea Comorensis*) as sweet and acidulous, but was not less gratified with the beauty and marvellous abundance of its snow-white and jasmin-scented flowers."

The Ceara Rubber Tree (*Manihot Glaziou*).—A native of the Ceara coast of Brazil, in latitude 4°, possessing a climate arid for a considerable portion of the year. It produces the Ceara-rubber. Its cultivation is not difficult. Mr. Holtze, of Port Darwin, had a grand success with this plant in Australia; his plants attained a height of 12 feet in little more than a year. In Ceylon it thrives well up to 3000 feet elevation, content with poor dry soil. Easily reared from seeds or propagated from cuttings; the germinating is expedited by filing the shell of the seeds and

placing them in coir; when sprouting they should be put into the soil with the germ downward. The plants should be placed 10 feet apart. It is best to wait with tapping till the trees are five years old. (Baron von Mueller.)

Of a somewhat similar substance to rubber, the supply of gutter-percha is beginning to fall short of the demand. For this important article, as with rubber and cork, no substitute exists for many industrial purposes, which with the rapidly increasing population and the marvellous progress of modern times are rising in proportion.

Palaquium Gutta, with other cogeneric species, yields the greater quantities of gutta-percha; but the article is also obtainable from other trees of the sapotaceous order. In certain localities of the Sunda Islands, P. Gutta has been almost annihilated through excessive depletion. Unfortunately the tree does not produce much milk till it is about 30 years old, but that is all the more reason that this and other gutta-percha yielding trees should receive immediate attention and be extensively planted. The Baron in his work gives a list of trees known to yield gutta-percha; this book, and those of other writers, must be refered to for further particulars. He says about *Achras sapota*—a native of the West Indies and Central America, producing the "Sapodilla Plum"—"a fine evergreen tree, producing delicious fruit"—"yields also gutta-percha. The bark possesses tonic properties." Being the producer of a splendid fruit among the gutta-percha trees, I make special mention of this plant.

Rosella (*Hibiscus Sabdariffa*).—This annual plant, which, however, sometimes lasts longer than one year, I found doing well. This is the best known of several of the genus furnishing pleasant material for jams and jellies. Its swollen calyces are of an agreeable acidulous taste. It should be more extensively cultivated, as besides its culinary value it yields also a good fibre, and, although it cannot endure frost, will grow in almost any part of Australia.

Castor Oil Plant (*Ricinus communis*).—This shrub I also found growing well in the same place. In time, no doubt, it will become useful, and the oil produced from it form an article of commerce.

The Artichoke (*Cynara Scolymus*).—I believe I have seen this growing in East Kimberley. This excellent vegetable would deserve extensive cultivation there, and as the plant is perennial it requires less attention than many others.

The Pomegranate, Mulberry, and Citrus trees have previously been mentioned as promisingly established.

The foregoing enumeration includes the most useful fruit-bearing and profitable plants which promise a prosperous growth; but the list may still be considerably extended.

Other very beneficial plants, and deserving the attention of the settlers, are the following:—

Salt Bushes.—Among the most valuable fodder plants must be classed the Australian salt bushes. For fattening stock, and keeping them in good health, when fed together with good grasses, no other plant will probably surpass them. On this account they cannot be too highly recommended. Moreover, they will grow well in East Kimberley, as has been proved by Messrs. Durack Bros., at Argyle Downs, where I saw the plants of *Atriplex nummularium*—the "Old Man" Saltbush—and *A. leptocarpum* grow marvellously well.

It will be somewhat difficult to protect the plants sufficiently long enough to have them well established and growing in quantities. If allowed to be fed upon, when still young, they would soon be exterminated, because all stock eat them with avidity. But they are well worth all the necessary trouble.

I do not doubt that the different salt bushes will grow luxuriantly on every soil in East Kimberley, but it is possible that they would do best on some of the limestone country, and flourish exceptionally well near the salt springs, and on the land in their more immediate neighbourhood.

The late Baron von Mueller considers the four following species as the most valuable:—*

Atriplex leptocarpum, *A. semibaccatum*, *A. nummularium*, and *A. halimoides*. On account of its robust growth I should especially recommend *A. nummularium*—the "Old Man" Saltbush—to be cultivated on cattle runs. It is equal to the best as regards its feeding qualities, and would easier hold its own against the heavy browsing of the stock than any other kind.

Teosinte (*Euchlæna Mexicana*).—This excellent grass, as the name indicates, is a native of Mexico, and, therefore, would thrive well in East Kimberley. Although this district possesses already a large number of unsurpassable indigenous grasses, the Teosinte would be deserving of introduction in different places, as it makes a good change of diet for cattle. It is very sweet when young, and produces a great deal of seed when ripe, which would come in as grand feed for horses during the dry season.

Wonder Grass; Coapim (*Panicum spectabile*).—A native of West Africa. This grass is considered to be one of the most succulent, as well as nutritious, forage plants. It would deserve introduction into East Kimberley, like the foregoing. Baron von Mueller was instrumental in introducing it into Australia, where it at present is widely distributed. It has been reported as doing well wherever introduced. Queensland, Port Darwin (Holtze), Upper Murchison River (Tyson), Geographe Bay (Pries), etc., etc. Would be best suited in localities where cattle thickly congregate, as near their watering places, to keep it well fed down. It should be kept away from lands intended for cultivation, on account of its running roots. Propagation from seed, but easiest by pieces of its runners.

Sainfoin; Esparsette (*Onobrychis viciifolia*).—This perennial deep-rooting plant would do particularly well on limestone soil. It lasts for more than five years. As a fodder plant it is superior to clover or lucerne, and can stand dry weather much better.

Spekboom (*Portulacaria Afra*).—"South Africa. A shrub rising to 12 feet. Affords locally the principal food for elephants; excellent also for sheep pasture, according to Professor M. C. Owen; hence this succulent shrub may deserve naturalisation on stony ridges and in sandy desert land, not readily otherwise utilised. Mr. T. R. Sim states that all kinds of pasture animals eat it readily, and when grass is scarce nearly live on it. Grows on hot rocky slopes. Easily struck from cuttings and even solitary leaves. Displays an extraordinary recuperative power when broken by browsing animals, or when injured from other causes." (F.v.M.)

Chocho or Chayota (*Sechium edule*).—This is one of the easiest cultivated and most thankful culinary plants. It is a climber, growing rapidly, and may easily be trained to produce shade. The large tuber formed at its root is very floury and tasty; but it also yields a great number of fruits like a vegetable marrow, weighing about a pound each. Either boiled or roasted these fruits are a splendid dish. I cannot think of a more easily cultivated plant and one more prolific. It begins to bear when about six months old, and is perennial, shooting up afresh from the old tuber. Progagation by planting the whole fruit, which will sometimes germinate whilst still hanging to the vines.

* See JOURNAL, Bureau of Agriculture, 30th June, 1896.

Sunflower-Artichoke ; Jerusalem Artichoke (*Helianthus tuberosus*).—A tuber-bearing sunflower indigenous in Brazil. The tubers make a splendid culinary vegetable. Also a good milk producing fodder. The foliage is also eaten by cattle. Propagation from tubers. Easily cultivated. The small tubers left in the ground produce new plants. It likes a soil rich in potash.

Victoria Regia.—This noble water lily, the most gigantic of the kind, would be deserving of introduction. Not only would its magnificent foliage and immense white flowers be a charming sight on lagoons and other sheets of water, but it would also be valuable as a means of checking the evaporation of water. Its round leaves not uncommonly measure six feet through, and often considerably more. The aborigines of its natural habitat, the northern parts of South America, use the seeds for food, and water fowl also live largely upon it.

Gigantic Aloe (*Agave Americana*).—This plant being a native of Mexico and Central America, would thrive well in the district. It is not a very fast grower at first, but in a few years will make an impenetrable fence if properly planted, which possesses the further advantage of barring fires. It cannot, therefore, be too highly recommended for this purpose and should be extensively acclimatised in the northern districts, where fencing is very expensive and the lands are in frequent danger of being swept by fires. If planted in a double row three feet apart, with a distance of six feet between the plants and these placed quincunx-like, the plants will have sufficient room to expand and thus form a perfect hedge in time.—Propogation by suckers or seeds.

New Zealand Flax (*Phormium tenax*.)—The long and wide blades of this lily need but be divided in strips to make the strongest tying material imaginable. The fibre is valuable and extensvely used for ropes and similar fabrics. It can also be prepared to make the finest textile goods. Near any swamp or lagoon or riverside it will flourish, and when once established may endure extremes of climate. Its growth is rapid and profuse. Propagation by suckers or seed.

For shade trees, so much needed round homesteads in the tropical climate, the following trees would be very suitable :—

The Pepper Tree (*Schinus molle*).—This remarkable tree is probably, without exception, one that flourishes under the most diverse climates. Native of America, it occurs from Mexico to Chili. In the latter country it ascends the Andes to over 12,000 feet, and yet it is doing well in the arid regions of Central Australia. Every kind of soil seems to agree with it. After rain it emits an aromatic odour, and its spicy berries may be used as condiment. Its growth is moderately fast, and in time its dark-green pendulous foliage forms capital shade. Readily propagated from seeds.

Ailantus (*Ailantus glandulosa*).—A native of India, of rapid growth, deciduous, but bearing its large foliage during the greater part of the year. A handsome tree, the foliage of which feeds the large Indian silkworm. Probably no other animal touches these, for even goats will not eat them. The bark can be utilised as a vermifuge.

Propagation from seeds.

Bamboo (*Bambusa spp.*)—Several of the Indian species of this gigantic grass would undoubtedly grow well in North Australia. The surprisingly rapid growth of some species—*Bambusa Vulgaris* is known to shoot up between 30 and 40 feet in one season—makes them specially adapted for procuring shade, as they soon form groups of numerous stems.

Propagation from suckers or seeds. Seeds require to be fully ripened and fresh, as they are liable to lose their germinating power.

Kurrijong (*Brachychiton spp.*)—Some species of this Australian genus make unequalled shade and avenue trees, and deserve attention for these purposes.

Brachychiton populneus grows to a large tree with a large crown of dense foliage. I have seen it do well at Bourke, one of the driest and hottest places in Australia.

Brachychiton Gregorii is another species with densely umbrageous crown. It occurs sparingly throughout the arid interior of Australia, where I found it generally in heavy and also on rocky soil. The camels are fond of the leaves, and the aborigines derive nutriment from the roots and seeds.

Brachychiton acerifolious is the Flame-tree of Eastern Australia. It makes a tall shade tree, producing large clusters of bright crimson blossoms, hence its vernacular name.

NOXIOUS WEEDS.

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By Richard Helms,

Biologist, Bureau of Agriculture.

STINKWORT,

Inula Gradeolens.

During the past two years attention has repeatedly been drawn to this objectionable weed. Probably before 1894 it was not known in Western Australia, or only in a few isolated places. Since then, however, it has spread at a considerable ratio, and now is beginning to cause alarm in rural districts. Whilst I do not desire to frighten those most interested in this matter, I must strongly warn against taking the subject lightly. Practically speaking, the weed is entirely useless, and a terrible nuisance in every way. It ultimately crowds out all pasturage and smothers the cultivated crop. Owing to its offensive odour none of the domesticated animals will eat it except when under great stress.

Among the notoriously prolific plants of the order, the *Compositae*, most of which have a tuft—*pappus*—attached to their seed for wind distribution, the stinkwort ranks among the foremost.

From a plant nearly 18 inches high, I took 10 seed-heads, which contained the following numbers of seeds :—

34
34
31
30
32
35
31
24
31
26
308

or an average of 30 in a round figure. The plant had developed 1,222 seed-heads, which makes a total of 36,660 seeds. The plant, it must be borne in mind, was only small or medium sized, as some reach the height of three feet, and would probably bear triple the amount of seeds. The figures speak for themselves as regards the enormous reproductiveness of this noxious plant, and are deserving of attention on account of the danger arising from a single example that may crop up in a new place.