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REPORT

—ON—

NATAL BOTANIC GARDENS,

—AND—

Colonial Herbarium,

FOR THE

YEAR 1898,

—BY—

J. MEDLEY WOOD A.L.S.,

*Corresponding Member of the Pharmaceutical Society
of Great Britain.*

CURATOR.

DURBAN :

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1899.



Durban Botanic Society.

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J. MEDLEY WOOD, A.L.S.

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NATAL BOTANIC GARDENS.

BYE-LAWS.

1. The Gardens are open to the public every weekday from sunrise to sunset; on Sundays from 2 o'clock p.m. until sunset.
2. The only public entrance is opposite to Botanic Gardens Road, and persons are prohibited from entering or leaving by any other way.
3. Children under ten years of age, unless accompanied by a competent protector, cannot be admitted.
4. Persons accompanied by a dog or dogs cannot be admitted.
5. No vehicle shall be allowed entrance, nor persons upon bicycles, but upon application to the Curator, invalids in wheeled chairs may be admitted.
6. Admission may be granted to pic-nic parties, if permission be first obtained from the Curator.
7. Visitors are requested to keep to the paths.
8. Touching or handling plants, fruit, or flowers, is strictly prohibited.
9. All games, climbing of trees, shooting with guns or catapults, throwing of stones or fruit, disorderly or indecent behaviour, are strictly prohibited.
10. Any persons abstracting, destroying or damaging any property of the Society shall be liable to be prosecuted.
11. The Curator is hereby authorised to prosecute offenders under the foregoing Bye-Laws whenever found to be necessary.

The Jubilee Conservatory is open to the public as under:—

Week days from 9 a.m. to 6 p.m. in summer; from 9 a.m. to sunset in winter; Sundays, from 2.30 p.m. to 5.30 p.m. in summer; from 2.30 p.m. to sunset in winter.

NATAL BOLIVIA

REPORT.

NATAL BOTANIC GARDENS,

BEREA, DURBAN, JANUARY, 1899.

TO THE PRESIDENT AND COMMITTEE,

DURBAN BOTANIC SOCIETY.

GENTLEMEN,

In presenting my seventeenth Annual Report, I have again much pleasure in being able to say that we have had in all respects a most successful season, the rainfall for the year as will be seen from the Abstract of Meteorological Observations kindly supplied by the Government Astronomer has been 42.48 inches which is 8.09 more than the fall for 1897, which was also a good year. We have not suffered damage from drought, flood, or gales of wind, and though the locusts have visited us on several occasions, they stayed but a short time, and did no material damage.

The year has been again an exceedingly busy one, and improvements, other than the erection of the new Jubilee Palm House could not be undertaken. The attempt to provide a Palm House and Conservatory which should be worthy of the Gardens and the town was commenced in 1897, and a sub-committee consisting of Mr. T. W. Edmonds and Mr. M. S. Evans, M.L.A., was appointed to obtain subscriptions for this purpose from the public, and as will be seen by the statement of accounts submitted herewith their efforts were met with very distinct success, especially when it is considered that all the subscriptions were obtained from Durban residents, and none were asked for, from either the Government or the Corporation. As soon as it was found that sufficient funds would be obtained, tenders were called for at Home, several designs were sent, and that of Messrs. Jas. Boyd & Son, of Glasgow, was finally selected as being the most suitable, tenders were then invited for the brick work, &c., &c., and for erecting the superstructure on its arrival.

The brick work was commenced in March, and in the early part of May the woodwork for the superstructure arrived and Mr. Lansdell who had the superintendence of its erection, commenced work at once, the building was completed in October, but the internal arrangements took some time to complete, and it was finally opened to the public by His Excellency, Sir Walter-Hely Hutchinson, K.C.M.G., Governor of the Colony, on the 8th December, and a reproduction of a photo taken during the opening ceremony will be found at the end of this Report. Though there were not a large number of people present, many have visited the Gardens since, and all express their complete satisfaction with the building and its internal arrangements. We find that many plants, such as Caladiums, Ferns, &c., have made very rapid progress since they were transferred to the new House, and we hope to be able to grow in it plants which in spite of our so-called semi-tropical climate will not succeed out of doors, but to stock the House with such plants will necessarily take some time to accomplish, I have, however, several promises of assistance from various correspondents, and some plants have already arrived, but are as yet too small to make much show.

The old gate at the main entrance to the Garden has been now removed, and a new wrought iron pair of gates with about 30 yards of fencing to match has been erected in its place, an improvement which has long been urgently required. From the gate of the Curator's residence to the corner of the Observatory ground a fence of plain and barded wire with iron posts has been erected, this having become absolutely necessary in consequence of trespass by natives and Indians. The material is on hand for continuing this fence below the main entrance, to the southern corner of the Garden ground, and this fence will be completed in the early part of the present year. The fence along the Sydenham Road is at present not effectual, and it is hoped that a substantial wire fence will take its place during the year.

On several occasions it has been suggested by Borough Councillors and others that it would be a convenience to the public to continue the Botanic Gardens Road through the Gardens and connect it with the Cowey Road on the other side, and I am given to understand that both the present Mayor and the Borough Engineer are in favour of this being done, I may, however, take this opportunity of saying that if such a plan were carried out it would almost ruin the Gardens, a public road, along which traffic would pass, and which would cut our small area of ground into two almost equal portions, and having as is contemplated a tram line along it, would, so far as

we are concerned, be a calamity, and it is sincerely to be hoped that no more will be heard of such a proposition. As an alternative I would suggest that if the Umbilo Road were extended along Lancers Road, then close alongside the foot of the Gardens, along Avondale to Florida Road, then Umbilo and Stamford Hill will would be connected by a direct Road, along which a tram might be run with advantage, since it would connect both the existing lines, pass close to the Race Course, Polo Ground, and Golf Ground, and run for several hundred yards alongside the lower fence of the Botanic Gardens. It will be remembered by some of the older colonists that the original entrance to the Gardens was in the centre of this lower line, and the direct road made by the Corporation into the town still exists, but is never used, if, however, this suggested road were made, the original entrance could be again used and the Gardens would then be accessible from any part of the borough.

The Mango crop has been an almost total failure, for though the trees promised well in the early part of the season, later on the fruit was so severely attacked by insects that scarcely a sound fruit was to be got, of the large green variety I have not seen a single ripe and sound fruit in the Gardens this season. It is somewhat remarkable that it has been reported that the "White Peach" has ripened its fruit near Maritzburg without being severely attacked by insects, and it is thought that this is due to the last winter having been so cold as to destroy many of the insects which do so much damage to fruit, but near Durban we have not found any diminution of these pests, but the cold does not appear to be so severe here as it is in Maritzburg.

The best method of combating this evil appears to be by "gassing" the trees, that is covering them with a specially prepared tent, and then filling it with the poisonous hydrocyanic gas, this, however, necessitates some considerable expense in material and apparatus, and as the gas is highly dangerous to human life the utmost care must be taken in its use. It is satisfactory to know that the Agricultural Department have undertaken to do this work at a reasonable charge, and have already provided the necessary apparatus.

In the early part of the year, Mr. Wylie went for a collecting trip with a wagon and oxen to the Karkloof district, and succeeded in obtaining a number of plants for exchange, and of dried specimens for the Colonial Herbarium, most of which have since been classified and distributed to correspondents.

The Bye-Laws drawn up by a sub-committee were assented to by His Excellency the Governor, and will be found at the commencement of this Report.

There has been an attempt made to enlist the sympathies of some of the up-country towns in favour of the establishment of a Botanic Garden in the upper districts, but it appears to me that at present there is but little chance of success, at least in the direction indicated, what is wanted is not so much a Botanic Garden as an Experiment Station, where different plants could be tried, and reported upon on a fuller scale than is possible in a Botanic Garden, whose province it is to introduce plants and to report from time to time as to their suitability or otherwise for the locality in which the Garden is situated, an Experiment Station would go farther than this, cultivate the plants in larger quantities, report on their growth, cost of cultivation, yield of crop, most suitable manures, and any other matters which might be of use to the farmers and others.

In the year 1891 a Commission was appointed to report on the Botanic Gardens of the Colony, the late Sir Theophilus Shepstone was the Chairman, and I was requested to accompany him and Colonel Bowker to the upper districts and report provisionally on the most suitable district for an Experiment Station, and the locality upon which we decided was in the vicinity of Mooi River, if a suitable site could be obtained. The report of that Commission was, I believe, drawn up but not signed, and was burned in the fire which destroyed the Maritzburg Town Hall. It is to be hoped, in the interests of the Colony, that one or more of such Stations will be established in the near future, but at present I can scarcely think that a so-called Botanic Garden in the vicinity of an up-country town, and controlled by its Local Board is quite the thing that is wanted. The Botanic Gardens and Experiment Stations of the Colony should, in my opinion, be under the direct control of the Minister of Agriculture, and wholly supported by the Government, I may be wrong, but I think that to place them under the control of the Forest Department would be a serious mistake, and would probably result in preventing the Gardens from being as much use to the Colony as they otherwise would be.

PUBLICATIONS RECEIVED.

Name.	From.
Report Botanical Department, Jamaica...	W. Fawcett, Director
„ Secretary for Agriculture, Nova Scotia	Author
„ Royal Botanic Gardens, Trinidad	Director
„ „ „ Jamaica	„
„ Botanic Gardens, Missouri „ ...	„

Report Botanic Gardens, Sydney ...	Director
" " " Hamburg ...	"
" " " Mysore... ...	"
" " " Hong Kong ...	"
" " " Badulla ...	"
" " " Saharunpur ...	"
" " " Zurich ...	"
on new remedies by E. Merck ...	Author
on "Spotted Gum" for wood paving, by J. H. Maiden ...	"
on Tea Culture in Assam ...	Kew
on Flax culture, by C. R. Dodge	U.S. Government
on Agriculture Experiment Stations of California... ...	Director
on Department of Agriculture, Canada	Kew
on U.S. of America National Museum	U.S. Government
on Albany Museum, Grahamstown	Director
Bulletin Botanical Department, Jamaica	"
" " Trinidad	"
" University of California ...	"
" Experimental cultivation in the Shan States	"
" Cultivation of Tea in India ...	(?)
Notes from Botanic Gardens, Sydney ...	Director
Gartenflora, No. 36 ...	Directors Botanic Gardens, Berlin
Observations on the Eucalypts of New South Wales, by F. Deane, F.L.S., and J. H. Maiden, F.L.S.	Authors
Some native Australian fodder plants, by J. H. Maiden, F.L.S.	"
Anniversary address, Royal Society of Tasmania, by the President, J. H. Maiden, F.L.S.	"
American Ginseng, by G. V. Nash ...	U.S. Government
Additional Notes on Seed testing by G. H. Hicks and Southron Key ...	"
Proceedings, Royal Society of Tasmania, 1894-5-6-7	J. H. Maiden, F.L.S.
Insects injurious to stored Paddy	Director Botanic Gardens, Ceylon
Collecting and sending insects for report	"
Principal poisonous plants of U.S. America	U.S. Government
Hybrids and their utilisation in plant breeding	"

Edible and poisonous fungi, by Dr. W. G. Farlow	U.S. Government
Notes on Rubber plants, by E. Cowley...	Author
The Olive Knot, by F. Broletti	"
Proceedings of the Indiana Academy of Science for 1894; 1895; 1896	Secretary
Acta Horti Petropolitani, Vol. XIV., Part 2	Director
Growing and separation of fibre, by E. Cowley	Author
American Naturalist	W. Trelease
The Fruit Industry, by W. A. Taylor ...	U.S. Government
Narrative of the famine in the Hyderabad district, 1896-7	Kew
Government Crop Report, Nova Scotia	Sec. for Agriculture, Nova Scotia
Experiment Station Record, U.S. America, Current Nos.	U S. Government
Journal Agri-Horticultural Society of India	Secretary
Year Book, U.S. Department of Agriculture	U.S. Government
Zanzibar Agricultural Journal	Zanzibar Government
Resistant Vines	U.S. Government
Report of Viticultural work in California " " , Smithsonian Institute, 3 bound Volumes	"
Cacao Canker, Circulars 1, 2, 3...	Director Botanic Garden, Ceylon
On Rubber and Rice culture, by E. Cowley	Author
On Divi-Divi culture	"
Archives Italiennes de Biologie, by Professor A. Mosso	"
Boletin de la Real Academia de Ciencias Y Artes de Barcelona	Director
Rate of growth of indigenous trees, by J. H. Maiden	Author
Stapfia, A new genus of grasses, by J. Burt Davy	"
Journal of Botany, Current Nos. ...	J. Britten, F.L.S.
Selected Papers from the Kew Bulletin, Fibres	Kew

PURCHASED.

Gardener's Chronicle, Current Nos.; Tropical Agriculturist, Current Nos.; Natal Agricultural Journal, Current Nos.

Seeds were received during the year as under :—

			PACKETS.
Royal Botanic Gardens, Calcutta...	...	...	1
" " " Kew	...	...	19
Botanic Gardens, Bangalore	...	...	5
" " Brisbane	...	...	27
" " Baroda	...	...	34
" " Kong-Kong	...	...	1
" " Grenada	...	...	1
" " Saharunpur	...	...	1
" " Paris	...	...	8
" " Madras	...	...	2
" " Sydney	...	...	141
" " Mysore	...	...	2
" " Mauritius	...	...	12
Messrs. Damman & Co., Naples	...	...	13
Mr. Scott-Elliott, Scotland...	...	...	25
Mr. Max Leichtlin, Baden-Baden	...	...	8
Mr. L. Cripps, Central Africa	...	...	1
Mr. M. Buysman, Holland	...	...	117
Mr. O. E. Menzel, Australia	...	...	30
Mr. J. B. Blandy, Madeira...	...	...	1
Mr. C. Gross, Warsaw	...	...	11
Town Gardens, Ballarat	...	...	5
University of California	...	...	123
Acclimatisation Society, California	...	...	63
Messrs. Reasoner Bros. "	...	...	1
Hon. R. Jameson, Durban	...	...	28
Mr. F. Button "	...	...	1
Mr. J. Beningfield "	...	...	2
Mr. F. C. Smith "	...	...	1
Mrs. Schultz "	...	...	9
Mrs. Burrill "	...	...	1
Mr. A. Wilkinson, Ottawa...	...	...	1
Mr. M. S. Evans, M.L.A., Durban...	...	...	1
Mr. H. V. Ellis, Hilton	...	...	1
Mr. A. Marshall, New Zealand	...	...	2
Mrs. English, Johannesburg	...	...	1
Mrs. Crompton, Pinetown	...	...	10
			—
			710

The following plants were received :—

From Royal Gardens, Kew, 24 Tubers of *Oxalis crenata*; 5 *Dioscorea*, sp (White Yam).

From Botanic Gardens, Melbourne, Australia, 3 Tubers of a sweet potato.

From Royal Botanic Gardens, Calcutta, 25 Bamboos of 10 species ; 25 Palms of 7 species.

From Mr. C. Jameson, 8 Orchids of different species.

From Mr. R. Adlam, Johannesburg, 2 bulbs of 1 species.

From Mr. Veith, Madagascar, 1 case of Orchids, all dead on arrival.

From Mr. Jas. Beningfield, Durban, 5 bulbs, different species.

The following were purchased :—

From Moulmein	...	...	113	Orchids	33 species
From Calcutta	...	...	20	,,	of different species

In all 610 packets of seeds, and 231 plants, which will be reported on next year,

During the year 1897, we received 165 plants, and 834 packets of seeds, which gave results as under :—

PLANTS.

Dead on arrival	...	...	...	11
Died afterwards	...	...	...	6
Planted in Gardens	...	...	...	16
Still in pots	...	...	...	112
Previously in stock	...	...	...	20
				165

SEEDS.

Failed to germinate	...	...	...	140
Germinated but died afterwards	...	...	...	104
Distributed	...	...	...	50
Previously in stock	...	...	...	218
Still in pots	...	...	...	92
Annuals and grasses	...	...	...	230
				834

During the year we sent away 666 packets of seeds to the following correspondents :—

Botanic Gardens, Ceylon	...	...	39
" " Melbourne	...	...	39
" " Sydney	...	...	39
" " Adelaide	...	...	40
" " Brisbane	...	...	39
" " Port Darwin	...	...	39
" " Ballarat	...	...	39
" " Hobart...	...	...	39
" " Georgetown	...	...	39

Botanic Gardens, Calcutta	...	...	39
" " Saharunpur	...	...	39
" " Baroda	...	...	39
" " Grenada	...	...	39
" " Jamaica	...	...	39
" " Mauritius	...	...	41
" " Buenos Ayres	...	...	35
Agri-Horticultural Society, Calcutta	...	...	39
Damman & Co., Naples	...	...	2
T. Christy & Co., London	...	...	1
E. Hutchins, Capetown	...	...	1

I note, however, that the seeds sent to Jamaica were at once destroyed for fear of the Coffee Leaf disease being introduced to the Island, our exchanges with that Island, and probably with the whole of the West India Islands will, therefore, have to be discontinued.

The following numbers of plants and bulbs were sent away in exchange during the year:—

Agri-Horticultural Society, Calcutta	...	253
Royal Botanic Gardens, Kew	...	22
" " " Glasgow	...	22
" " " Edinburgh	...	22
" " " Mauritius	...	22
" " " Jamaica	...	22
Botanic Gardens, Najpur	...	40
" " Bangalore	...	22
" " Saharunpur	...	22
" " Madras	...	22
" " Trinidad	...	22
" " Guiana...	...	22
" " Brisbane	...	22
" " Melbourne	...	22
" " Adelaide	...	22
" " Sydney	...	234
" " Port Darwin	...	22
" " Tasmania	...	22
Dr. Thompson, Gazaland	...	32
Reasoner Bros., Florida	...	22
Dr. Franceschi, California	...	22
H. Dixon, Sydney	...	26
H. Buysman, Holland	...	22
Jas. O'Brien, London	...	444
J. B. Blandy, Madeira	...	3
Total	...	1,428

Plants have been supplied free during the year as under :—

Colonial Engineer's office, Maritzburg	...	£3	0	0
Presbyterian Church, Berea	... ..	1	0	0
Young Ladies' College, Durban	... ..	1	16	0
Zulu Mission, Umzumbe	... ..	2	16	6
Government House, Maritzburg	... ..	5	0	0
Umlazi Mission	... ..	5	1	6
Railway Station, Van Reenen	... ..	2	8	0
St. Aidan's Dispensary	... ..	3	3	0
Durban Home	... ..	1	15	0
Wesleyan Chapel, Stamford Hill	... ..	5	5	0
Indian Hospital, Verulam	... ..	1	9	6

£32 14 6

The following were put out in the Garden during the year :—

<i>Amaryllis belladonna</i>	... ..	Purchased
<i>Areca oleracea</i>	... ..	Botanic Gardens, Madras
„ <i>sapida</i>	... ..	„ „ Mauritius
<i>Arenga saccharifera</i>	... ..	{ Agri-Horticultural Soc. Calcutta
<i>Bauhinia, sp</i> (White)	... ..	Mr. Buring, Umtali
<i>Chamaerops excelsa</i>	... ..	Dammman & Co., Naples
<i>Dioscorea, sp</i> (White Yam of Trinidad)	... ..	Royal Gardens, Kew
<i>Jubaea spectabilis</i> , "Coquito Palm"	... ..	„ „ „
<i>Kentia Canterburyana</i>	... ..	Purchased
„ <i>Forsteriana</i>	... ..	„ „ „
<i>Oxalis crenata</i>	... ..	Royal Gardens, Kew
<i>Philodendron, sp</i>	... ..	Purchased
<i>Seaforthia elegans</i>	... ..	„ „ „
<i>Tectona grandis</i> , "Teak"	... ..	Own Seed
<i>Washingtonia filifera</i>	... ..	Reasoner Bros.

The following have flowered for the first time in the Garden :—

<i>Anthurium hybridum</i>	... ..	Sander & Co.
<i>Carludovica latifolia</i>	... ..	„ „
<i>Dendrobium aggregatum</i>	... ..	Purchased
„ <i>cretacavum</i>	... ..	„ „
„ <i>formosum giganteum</i>	... ..	„ „
„ <i>Farmeri</i> (type)	... ..	„ „
„ <i>undulatum</i>	... ..	„ „
„ <i>Pierardii</i>	... ..	„ „
<i>Kaempferia, sp nov</i>	... ..	Mr. J. Benningfield
<i>Richardia Adlami</i>	... ..	Mr. R. Adlam
<i>Salmia Lucheana</i>	... ..	Sander & Co.
<i>Strobilanthus Dyerianus</i>	... ..	„ „
<i>Strophanthus hispidis</i>	... ..	Royal Gardens, Kew

The following plants, some of which are enumerated above, seem to call for a little further notice :—

Areca oleracea.—“The Cabbage Palm” of the West Indies. This is a tall growing palm, and the young buds at the apex of the stem are removed and used as a vegetable, but it is rather an expensive one as their removal prevents further growth and kills the tree. The stems are afterwards bored by a beetle which deposits its eggs, and the grubs are eagerly sought for, and esteemed a great delicacy by the negroes, and are, I think, occasionally eaten by Europeans.

Arenga saccharifera.—This Palm attains a height of 40 feet. The black fibres of the leaf stalks are adapted for cables and ropes, intended to resist wet very long. The juice convertible into toddy or sugar; the young kernels made with syrup into preserves. This Palm dies off as soon as it has produced its fruit; the stem then becomes hollow, and can be used for spouts and troughs of great durability. The pith supplies sago, about 150lbs. from a tree, according to Roxburgh. (Baron von Mueller).

Jubaea spectabilis.—The “Coquito Palm,” A kind of treacle is obtained from the sap of this Palm. A good tree will give 90 gallons of mellaginous sap. The small kernels are edible. (Baron von Mueller).

Tectona grandis.—The well known Teak tree. One tree of this species has been in the Gardens for many years but was overshadowed by a large Australian Acacia, since the removal of that tree, however, it has borne seed and plants have been put out, and so far promise to do well. I need scarcely say that the wood is most valuable, but it is a tree of slow growth.

Strophanthus hispidus.—This is one of the plants whose seeds are used medicinally, it is the “Arrow poison” of the East Coast of Africa. Our plant has flowered abundantly and promises to do well.

Oxalis crenata.—“Oka” of the Peruvians. In February I received from the Director of Kew Gardens some small tubers of this plant, which were at once planted, and at the close of the season were found to have increased, but not sufficiently so to allow of their being distributed, they have, therefore, been again planted, and so far appear to be doing well, so that I hope to have a few to distribute in the early spring. The Director says of it: “I am sending you a few tubes of *Oxalis crenata*, the “Oka” of Peru, which is worth a trial as a vegetable for the table. The tubers should be planted 3 feet apart in sandy soil, and treated like the potato. New tubers are formed at the

end of the season and under favourable conditions they are 3 inches long, and weigh 2 ounces. When lifted they should be exposed to sunlight for two or three days. To cook them, boil for 20 minutes in water containing a pinch of carbonate of soda; they change to a bright amber colour, and if eaten with pepper and salt they are palatable and of pleasant flavour." I have since heard that the leaves and young stems of the plant are used with salads.

Euchlaena, sp.—Amongst the numerous species of grass seeds that have been received, one only appears to have done well down here, and specimens of it have been sent to Professor Hackel for determination, but I have not been able to ascertain its specific name. It is a tall growing plant, and when once in the ground would, I think, be difficult to eradicate, the roots are stout, and penetrate the ground to a considerable depth, it would seem to be a plant well suited for fixing sand or sandy banks in favourable situation, and might perhaps be useful on railway banks. It belongs to the same genus as the "Teosinte" which is so highly extolled as a fodder plant, and it has the advantage of being perennial, while the "Teosinte" in Natal at any rate is annual only. Horses eat it readily, and it will spread itself without the slightest attention.

Cola acuminata.—The Cola Nut of commerce. In my last Report I stated that these plants would be put out in the Garden and further reported on. This was done, but I am sorry to have to say that they show little if any signs of growth, and I fear that the plant is not suited to our climate. It is my intention to send a plant or two to the Botanic Gardens in Maritzburg for trial there.

Dipteryx odorata.—"Tonga" or "Tonquin Bean." These plants were put out in the Gardens, and show very fair growth being now from 3 to 4 feet in height, so there seems to be a fair prospect of success with them, but as I previously stated it is a tree of slow growth, and the demand for the beans is but very limited.

Swietenia macrophylla.—In my last Report I stated that the common mahogany (*S. mahogani*) was doing fairly well, and and the plants continue to grow slowly, and since that time plants of *S. macrophylla* a closely allied species have been put out, and so far appear to grow better than the first named species, they are now about 2 feet high and looking quite healthy, their further growth will be reported on from time to time.

Pistachia vera.—"Pistachia Nut." From all the seed of this plant which I obtained, 3 plants only were reared, they have

been planted out in the Garden, and if one at least of them should happen to be a female we shall be able to graft for distribution as we have the stocks, and can rear as many more as we shall require, I shall try to obtain more seed if possible.

Jadoo Fibre.—Wishing to give a fair trial to this method of plant growing, I obtained from the Jadoo Company in England a ton of the fibre, and asked Mr. Wylie to give it his close attention and report on it in due course. As our experience with it did not promise very well, I omitted mention of it in my last Annual Report, and determined to give it a longer trial. During the year the local agent of the company visited the Gardens in company with a member of the Home firm, and saw the plants which were then under trial, and I asked them to look at the fibre and see whether it was in good condition, which they did and appeared to be satisfied that it was all right. The liquid we have not tried. The following is Mr. Wylie's report upon the fibre:—

EXPERIMENTS WITH JADOO FIBRE.

In June, 1897, we received a ton of Jadoo fibre, and in the following October potted two each of the undermentioned species in it:—

Anthurium Andreanum; *crystallinum*; *leuconeurum*; *magnificum*; *regale*.

Cannas; 12 varieties.

Dieffenbachia Baussei; *magnifica*; *Memoria Cortii*; *Ver-shaffeltii*.

Maranta Makoyana; *Massangeanum*; *Veitchii*; *Zebrina*.

Pandanus javanicus variegatus; *Veitchii*.

Panax Victorice; *Stenoglottis longifolia*.

Adiantum Collisii; *cuneatum*; *Fergusoni*; *fissum*; *gracillimum*; *intermedium*; *Lathomi*; *Le grande*; *peruvianum*; *tenerum*; *trapeziforme*; *villosum*; *trapeziforme, var Sancta Catherineæ*.

Davallia hirta cristata; *polypodioides*; *tenuifolia*.

Nephrolepis davallioides var furcans; *rufescens var tripinnatifida*.

Selaginella erythropus; *filicina*; *viticulosa*; *Wallichii*.

All the above grew well in Jadoo with the exception of *Adiantum Fergusoni*; *gracillimum*; *Le grande*; *fissum*; and *peruvianum*, which had to be turned out of the Jadoo and repotted in soil, when they soon made vigorous growth. The *Cannas* did not grow so robust nor flower so freely as those grown in soil, none of the plants or Ferns showed any better results than those grown in our ordinary potting soil.

LEMON STOCKS.—Three rows containing about 400 plants were planted with Jadoo, the growth, either in root, fibres, or stems, was no better than those planted without it.

CUTTINGS.—Crotons. Two pots of each 30 varieties were planted along with a similar batch in soil, those in soil were, in three weeks, well rooted, and being potted off, while those in Jadoo were only just beginning to show roots.

Dracaenas.—Results the same as with Crotons.

Ficus elastica.—Those in Jadoo were a complete failure, a small percentage of those in soil rooted well.

Mognolia fuscata.—All in Jadoo failed to root, fifty per cent. of those in soil rooted.

Pandanus javanicus variegatus ; *Veitchii*.—Two dozen cuttings of each species were put into small pots with Jadoo, and the same number into small pots with soil. those in Jadoo stood for three months without showing any sign of roots, while those in soil rooted well, and had been shifted into larger pots.

In using the Jadoo for potting and for cuttings we followed the instructions given in Colonel Halford Thompson's pamphlet, "How to grow plants in Jadoo."

Furcraea Lindeni.—These plants were noted in my last Annual Report, and I have now only to add, that in the early part of the year each of them sent up a flowering shoot from the centre, and having produced a large number of seeds then died. Mr. Watt, of the Umgeni Fibre Works, tested some of the leaves, and found that the fibre was excellent, but unfortunately no account was taken of the yield. A few of the plants have been reared here, and a large number were given to Mr. Watt for trial at Umzimkulu.

Boehmeria nivea.—"Rheea" or "China Grass." Seeds of this plant were received from Government and a number of plants were reared, but as we had no ground on which to plant them, the plants were offered to Mr. W. R. Hindson, of Stanger, but as yet I have no report as to their success or otherwise, a few plants were also sent to Mr. J. Landers, of Umzinto, who says: "The Rheea plants you sent me are doing remarkably well, I have taken several shoots from the roots of the plants, and transplanted them, and in most cases they have grown." That this plant will grow well in the colony appears to be certain, but whether it will yield a sufficient number of cuttings in the season to make the industry a profitable one has yet, in my opinion, to be proved.

The European staff at the Gardens remains unchanged, and the thanks of the Society are, I think, due to all of them, for their services cheerfully rendered during an exceptionally trying season. To Mr. Wylie, the head gardener, who has full charge of the outdoor work, my thanks are especially due, since he has relieved me of much work which would have made it impossible for me otherwise to continue the botanical work which absorbs so large a portion of my time.

I wish also to thank the Committee for their valuable assistance, and co-operation without which my work could not have been carried out so pleasantly as it has been.

I have the honour to be,

Gentlemen,

Your obedient servant,

J. MEDLEY WOOD.

DURBAN BOTANIC SOCIETY.

STATEMENT OF RECEIPTS AND EXPENDITURE FOR YEAR ENDING 31ST DECEMBER, 1898.

EXPENDITURE.				RECEIPTS.			
	£	s.	d.		£	s.	d.
To Labour	1,428	12	0	By Balance Natal Bank at	576	0	6
" Maintenance	467	12	7	31st December, 1897...	1,882	6	0
" To Rations	74	7	0	Produce sold	700	0	0
" Interest	37	19	6	Government Grant	200	0	0
" Colonial Herbarium	90	11	1	Col. Herbarium Grant...	231	0	6
" Commission	7	5	4	" General Subscriptions...	3,589	7	0
" Bonus	95	10	0				
" Advance to New Conservatory ...	528	12	11				
" Contribution to publication, "Natal							
Plants"	71	10	0				
" Band	12	12	0				
" Balance in the Natal Bank ...	2,814	12	5				
	774	14	7				
	<u>£3,589</u>	<u>7</u>	<u>0</u>		<u>£3,589</u>	<u>7</u>	<u>0</u>

Examined and found correct,
 Durban 25th February, 1899,
 W. MURRAY-SMITH, F.S.A.A. (Eng.)
 Auditor.

MAURICE S. EVANS,
 Hon. Treasurer.

ABSTRACT OF METEOROLOGICAL OBSERVATIONS FOR THE YEAR 1898,

TAKEN AT THE NATAL OBSERVATORY, DURBAN. READINGS, 9 A.M. AND 3 P.M.

Reading of Barometer reduced to sea level and 32° Fahrenheit. A light wind has a mean force of 1·00. A fresh wind a mean force of 2·00. 10 corresponds to an overcast sky. Zero to a clear sky.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Barometer—Highest	In. 30·280	In. 30·422	In. 30·372	In. 30·402	In. 30·530	In. 30·548	In. 30·632	In. 30·789	In. 30·451	In. 30·479	In. 30·243	In. 30·238	
Lowest	.. 29·614	.. 29·800	.. 29·650	.. 29·794	.. 29·660	.. 29·763	.. 29·802	.. 29·950	.. 29·771	.. 29·712	.. 29·650	.. 29·590	
Mean, 9 a.m.	.. 29·946	.. 30·101	.. 30·037	.. 30·161	.. 30·179	.. 30·293	.. 30·268	.. 30·362	.. 30·169	.. 30·088	.. 30·988	.. 30·022	30·135
Thermometer in shade—	Deg. 98·8	Deg. 91·2	Deg. 90·7	Deg. 86·7	Deg. 84·6	Deg. 81·9	Deg. 85·5	Deg. 82·2	Deg. 94·5	Deg. 93·9	Deg. 97·4	Deg. 94·1	Year. 98·8
Highest	.. 58·9	.. 59·2	.. 63·9	.. 55·3	.. 50·8	.. 45·9	.. 41·8	.. 45·6	.. 49·7	.. 51·7	.. 56·9	.. 59·1	Year. 41·8
Lowest	.. 78·3	.. 77·4	.. 76·1	.. 70·4	.. 64·8	.. 60·4	.. 60·0	.. 61·7	.. 67·6	.. 68·7	.. 75·8	.. 75·5	Mean. 69·7
Mean, 9 a.m.	.. 85·9	.. 85·0	.. 84·6	.. 80·5	.. 76·0	.. 73·5	.. 73·4	.. 73·2	.. 77·0	.. 76·8	.. 83·0	.. 82·1	Year. 79·3
Maximum Thermometer	.. 69·8	.. 67·1	.. 68·3	.. 62·1	.. 57·8	.. 51·6	.. 51·2	.. 53·6	.. 56·4	.. 59·3	.. 65·4	.. 65·3	Year. 60·7
Minimum	In. 4·49	In. 5·62	In. 2·76	In. 4·79	In. 2·75	In. 0·47	In. 0·24	In. 2·09	In. 2·00	In. 6·02	In. 5·55	In. 5·70	Year. 42·48
Rainfall	No. 22	No. 11	No. 18	No. 12	No. 9	No. 5	No. 7	No. 9	No. 11	No. 20	No. 20	No. 21	Total 165
Days on which rain fell ..	1·08	1·13	0·76	0·98	0·79	0·70	0·77	0·75	1·08	1·16	1·09	1·03	Year. 0·94
Wind—Mean force of ..	6·94	4·02	4·81	3·03	2·58	1·17	1·71	2·81	3·85	5·62	6·09	6·32	4·08
Cloud—Mean amount of ..													

THE PRINCIPAL DISEASES OF CITRUS FRUITS IN FLORIDA.



(BY WALTER T. SWINGLE AND HERBERT J. WEBBER.)

REPRINTED FROM BULLETIN NO. 8, OF U.S. DEPARTMENT
OF AGRICULTURE DIVISION OF VEGETABLE,
PHYSIOLOGY, AND PATHOLOGY.

INTRODUCTION.

IT is the purpose of this bulletin, to give in as brief and concise a manner as possible, an account of some of the principal diseases of citrus fruits, especially those occurring in Florida. The following are the diseases which we will endeavour to describe:—Blight, die-back or axanthema, scab or verrucosis, sooty mould, foot rot or mal-di-gomma, and melanose.

The diseases of citrus fruits have received more or less attention from the Department, through the division of Vegetable Physiology and Pathology, since the year 1886. In 1891, Professor L. M. Underwood was sent to Florida to make a preliminary study of this subject. Later the same year one of the writers, with Dr. Erwin F. Smith, was sent to Florida to carry on further studies, especially on blight, and the following spring the former returned to continue the work. In the fall of 1892 a slightly increased appropriation enabled the Department to station both writers regularly in Florida. A laboratory especially erected for the purpose was donated by the citizens of Eustis, Fla., and this point was made our headquarters. Since the completion of the building both laboratory

and field investigations have been carried on continuously, with highly gratifying results. Melanose, an entirely new disease, has been studied and remedies for it discovered. Satisfactory remedies or preventives have also been found for all the other diseases mentioned above, foot rot being the only one which could be said to be under control when the work was commenced. Much information has been collected in relation to the causes of the various diseases and their effects on the plants attacked.

BLIGHT.

This disease, also called wilt and leaf curl, is found only in Florida, and so far as known at present is incurable. Nearly all citrus fruits are liable to it, but in different degrees. Trees grown on light hammock soil are most susceptible, but no locality in the State is entirely exempt. The malady has been known for at least twenty and possibly twenty-five years. The first reliable account of it, however, was published in 1891 (1) by Professor L. M. Underwood.

Blight never attacks trees until they have attained considerable size and have begun to bear fruit. In any given grove usually only a small per cent. of new cases occur in each year, but the fact that the disease is apparently incurable and that it attacks the oldest and most vigorous and fruitful trees in the grove renders it one of the most destructive maladies known. It is widely distributed over the State occurring, in the oldest and best groves and on the land best suited for profitable orange culture. The affected trees do not die at once, but apparently revive when the rainy season commences. In this way false hopes are aroused and the owner waits for years before he finally removes the blighted trees and replaces them with healthy one. Much time and money have been wasted on supposed cures, the worthlessness of which does not become apparent until after several years' trial. In some localities from 1 to 10 per cent. of the trees blight annually. The annual loss resulting from this disease in Florida is from one to two hundred thousand dollars. Within the last ten years it has caused losses probably amounting to several million dollars.

SYMPTOMS.—Blight usually appears very suddenly and on trees that have previously seemed perfectly healthy. The first symptom is a wilting of the foliage, as if the tree was suffering from drought. At first the wilting is slight and can be plainly seen only on hot dry days; but it soon becomes very pronounced, and often continues so during the wet season in summer, when rains are almost a daily occurrence. Most cases of blight

(1) *Journal of Mycology*, Vol. VII., p.p. 32—34.

appear in early spring, from February to April, which is usually a dry season. Sometimes, however, cases occur in midsummer, when the ground is thoroughly wetted every few days. After the wilting becomes severe the foliage begins to drop, and in a few weeks to a few months, according to the severity of the case, the affected branches shed nearly all their leaves. In many cases the whole top of the tree is attacked at one time, but very often only a single branch shows the disease at first. In such cases, however, the entire tree soon becomes affected.

As soon as the rainy season begins, the trunk of the larger branches puts forth numerous water sprouts, which grow rapidly and at first seem to be perfectly healthy. Eventually, however, these sicken and gradually die back. The branches which first show the blight usually retain for a year or more some foliage, which is abnormally small and of a dingy green colour. New growth is very sparse and does not produce normal sized leaves. Such branches often show green twig all over, even when nearly leafless. In the spring following the first wilting (unless it occurs late in winter, when it is not until the second spring following) these branches, though often nearly leafless, flower very profusely and continue blooming for ten days to three weeks after the normal period of flowering has passed. Unlike the lemon, the flowering season of the orange is very definite, and usually is not longer than two weeks. This profuse and late bloom consists of small flowers which almost never set fruit. In fact, very little fruit is produced by a tree after it is attacked by blight. Trees bearing a full crop may sometimes be attacked late in summer and mature their fruit, but it is only in case of late attacks that any considerable amount of fruit can be seen on diseased trees. Fruit borne by blighted trees is usually undersized, but otherwise is apparently normal.

The contrast in the amount of fruit produced by trees attacked by blight, and those affected with mal-di-gomma is very striking, trees suffering from the latter disease often bearing an unusually heavy crop.

In very severe cases of blight the trees succumb so suddenly that the leaves do not fall, but simply wither and turn brown on the twigs. This is also frequently the case with a single branch. In such cases the trees usually die outright in a few weeks and never put out any new growth from the trunk. Again, a single branch may wither as suddenly. In the great majority of cases, however, a vigorous new growth pushes out from the trunk at the beginning of the rainy season, and at first it would seem as though the tree would recover. Sometimes such sprouts continue growing vigorously two years or

more, but sooner or later they show small and usually yellowish leaves, and begin to decline. Often, too, such shoots wilt and shew all the symptoms of a fresh case of blight. Ordinarily the tree continues to decline gradually and is finally removed before it dies, to make place for a new tree. Again, cases may linger ten years or more, making a slow sickly growth, and even bearing a little fruit. Cases of real recovery from genuine blight are, however, almost entirely unknown, although hundreds of growers have been deceived by the vigorous growth of water sprouts sent out by blighted trees after the first wilting.

A most remarkable fact is that the roots of blighted trees invariably seem to be entirely healthy. The vigorous growth of water sprouts they support shows that they are capable of considerable functional activity.

No anatomical features which are characteristic of blight have yet been found. Under the highest powers of the microscope the tissue of every organ of blighted trees appears to be normal, which is in striking contrast to foot-rot and die-back. The physiological activity of the leaves and branches, however, is very much deranged, as has been proved by experiments on the loss of water from blighted twigs.

VARIETIES OF TREES ATTACKED.—Almost all citrus fruits are attacked by blight, although some sorts are nearly exempt. Common oranges (*Citrus Aurantium*), tangerines and mandarins (*Citrus nobilis*) and grape fruit (*Citrus decumana*), in about the order named, are the most susceptible. Lemons blight less than any of the fruits mentioned, while limes and sour oranges, especially the latter, are almost exempt from this disease. Certainly not more than one sour orange tree in a thousand is blighted even in regions most liable to the malady. Curiously enough the sort of stock used appears to have no influence in increasing or diminishing the susceptibility of trees to the disease. Common oranges budded on sour orange roots are apparently as liable to blight as are sweet seedling trees.

SITUATIONS MOST LIABLE TO THE DISEASE.—Although blight attacks citrus fruits growing on all kinds of soil, it is most common on trees growing on very light, sandy hammock (1). Such soils are usually composed almost wholly of sand with an admixture of decaying vegetable matter; sometimes, however, they are underlaid at a depth of from 4 to 12 feet with clay or hardpan (sandstone). Trees growing on clayey hammock or

(1) Hammock land is that which was originally covered with hard woods, especially live oak, magnolia, hickory, &c.

high pine land (2) are almost exempt from the disease. On flatwood land (3) the trees are less susceptible than those on light hammock, but more susceptible than those on high pine lands.

As the blight is more prevalent on best orange lands, with the exception of clayey hammock, which is rare, it is obviously impracticable to prevent the disease by planting on lands least subject to it.

CAUSE.—So far the most diligent search, both in the field and in the laboratory, has failed to reveal the cause of blight. Judging from what is known of the disease, it is not improbable that it is caused by some minute parasitic organism—but the character of the soil to a large extent governs the entrance and spread of the organism. In many respects blight strongly resembles peach yellows, the exact cause of which is also unknown. Certain it is that blight cannot be attributed directly to cold, drought, wet weather, close proximity of hardpan, or improper fertilisers, as it is often erroneously believed.

IS BLIGHT CONTAGIOUS?—As before stated, this malady in many respects resembles peach yellows, which latter disease is contagious by budding as has been proved by experiments. Numerous experiments are under way to determine whether blight can be introduced by buds on the roots or tops of trees, but so far no conclusive results have been obtained. The disease attacks trees in groups, as is obvious in groves where it exists. A year or two after a tree is blighted it is a common thing to see the adjacent trees shew the blight on the limbs next to the diseased tree. All these circumstances strengthen the belief that the disease is of a contagious nature.

PREVENTIVE MEASURES.—Experience has taught that it is not only useless but dangerous to attempt to cure blighted trees, since it is probable that the disease is contagious, and that a diseased tree left in the grove may infect surrounding healthy trees. It is by all means the safest, and at the same time the most profitable plan to dig up and burn all blighted trees as soon as they appear, and plant new trees in their places. In many instances it would seem that prompt destruction of trees

(2) Land covered with scattering *Pinus Palustris* and a few trees of *Quercus cinerea* and *Q. Catesbaei*, all growing so far apart as to allow grass to grow so thick that it burned off annually, thus preventing the growth of underbush.

(3) Much like high pine land, but low and flat, with a subsoil near the surface and more undergrowth, composed largely of shrub palmetto, (*Serenoa serrulata*) and *Ericaceæ*.

as soon as attacked has decidedly reduced the number of new cases as compared with adjoining groves similar in all respects, but where the diseased trees were allowed to remain. In peach yellows the prompt extirpation of cases as they appear is the only known way of preventing the spread of the disease.

In replanting, goodsized trees are preferable to small trees, as the latter are liable to be overshadowed and starved out by the large trees surrounding them. The diseased trees when dug out can be either hauled away and burned, or better cut up and burned on the spot, thus avoiding any possibility of spreading the disease through the grove. It has been abundantly proved that trees planted where blighted ones have stood, are not more likely to contract the malady than any other in the vicinity, and in no case are they liable to blight before they begin to bear.

The practice here recommended of extirpating all cases as they appear is now largely followed by those who have had the most experience with blight and who know the uselessness of supposed remedial treatments. In all badly infected regions concerted action is highly desirable, but even if this cannot be secured the grower should not be deterred from eradicating the diseased trees from his own grove. Aside from the fact that such a course probably lessens the spread of the malady, it is the cheapest and best policy.

DIE-BACK OR EXANTHEMA (4).

The disease of the orange and other citrus fruits, commonly known as die-back, is widely distributed throughout the orange region of Florida, but is not known to occur in any other part of the world.* The name "die-back" originated from the behaviour of trees affected, a few inches of the vigorous new growth die back in early spring. The disease is not much feared by growers, because it is apparently not contagious; but while the damage it causes in a single grove may be slight, the total loss, on account of its very wide spread occurrence, is nearly as great as that resulting from any other disease affecting the orange. The malady is well known to most orange growers, but is generally poorly understood. It was first accurately described by J. H. Fowler (5) in 1875. When and

(4) From the Greek, meaning an eruption or pustule.

(5) Fowler, J. H. On the Die-back in Orange Trees (Proceedings of the Florida Fruit Growers' Association, Annual Meeting, January, 1875; reprinted; Florida, its Scenery, Climate, and History, Sidney Lanier, 1876, J. B. Lippincott & Co., Phil., Appendix, p.p. 281—290.

where it first appeared has not yet been determined. Growers have known of its occurrence for years, presumably ever since orange culture became common in the State.

The damage caused by die-back is much greater than is usually estimated. Many growers have suffered for years from slight attacks of the disease, the damage being caused mainly by the excessive dropping of the fruit, and by the coarseness and staining of that which remains on the trees. In some severe cases due to improper fertilisation and cultivation, groves have been badly injured and almost the entire crop of fruit lost. Frequently much loss is incurred by planting trees on improper soils and continuing to cultivate and fertilise them for years after they contract the disease. Almost every grove in the State has a few cases of this disease. Trees growing in the vicinity of stables, chicken houses, privies, etc., are the ones generally affected, and also those growing on the margins of lakes, or on low wet, poorly drained soils.

The diminished productiveness of trees badly affected with die-back, together with the splitting and falling of much of the fruit and the disfigurement and coarseness of that which does develop, makes such trees almost worthless. The malady causes great loss of fruit, renders more of poor quality, frequently permanently stunts the tree and eventually kills it. The annual loss resulting from die-back in Florida may be conservatively estimated at about \$100,000.

SYMPTOMS.—Die-back has probably more characteristic symptoms than any known plant disease, principally among which are the following:—

1. The ends of the very rapid growing shoots turn yellowish before maturing, and finally become stained reddish brown in patches or throughout. This appearance is caused by a deposit in the outer cells of a reddish brown resin like substance. The yellowing and staining of the twigs, which is very general on the new growth all over the tree, is followed by the dying back of the affected twigs for a short distance usually 3 to 6 inches. The reddish stain may occur on the twigs back of the point to which they die, and indeed may spread in irregular patches more or less over the entire new growth.

2. On the new growth (most frequently at the nodes, but sometimes the inter-nodes) there occur comparatively large swellings, caused by gum pockets formed in the wood. These pockets frequently become quite marked.

3. Eruptions caused by the bursting of the bark, very commonly occur on old and new twigs. In such cases the tissue swells up, protrudes from the rupture, and becomes stained by

the reddish-brown, resin-like exudation, which is so characteristic of the disease. These eruptions are very numerous, and in badly affected trees many limbs, from an inch in diameter down to the smallest, become thickly studded with them. This character almost invariably accompanies the disease and is present at all seasons of the year, so that it may probably be regarded as the principal symptom. Trees may be slightly affected, however, and not shew this symptom.

4. In diseased trees rapidly grown young shoots often droop in a characteristic manner. After starting to push, the twigs gradually bend downwards and the ends turn up a little, giving the twigs a slightly S shaped curved. This, however, is not always a symptom of die-back, being occasionally seen in perfectly healthy trees.

5. Young twigs frequently develop an abnormal number of buds in the axils of the leaves, where, under normal conditions, only one or two are formed. This over production of buds is often followed by a gummy exudation at these points. Several of these buds from one node may develop into branches, which in connection with the short inter-nodes, frequently give the new growth a somewhat fascicled appearance. This causes a dense foliage and after the new growth which produces this fascicled appearance has died back, the tree takes on a very regular appearance, as if it were clipped. This is very characteristic of cases in the middle stage of the disease. In a latter stage large limbs die-back, leaving around the trunk a dense growth of small water sprouts with large leaves. These shoots in turn become stained with the characteristic reddish brown exudations and eruptions and finally die back. In this stage of the disease, which is one of the last, the tree presents a very ragged appearance, many of the large limbs being dead.

6. The leaves on trees affected with die-back are rather larger and generally longer and more pointed than those on healthy trees. This symptom, however, is not very noticeable.

7. The foliage of diseased trees is always a very dark green ; indeed this colour, so much desired by some growers, indicates that the grove is on the verge of shewing the disease.

8. Frenching or spotting of the leaves with white and green frequently occurs in the more advanced stages of the trouble, but can hardly be considered a symptom.

9. Slightly swollen, stained spots often occur on leaves of trees in a medium stage of the disease. Any slight mechanical injury or injury due to the attacks of the six-spotted mite (red spider) which works in definite spots, is liable to be followed by a swelling of the leaves at the points injured, accompanied

by the characteristic stains, this forming brown swollen spots. These spots are evidently formed only in places where the leaves are injured.

10. The fruits of diseased trees early assume a pale sickly green colour, which is quite different from the dark green colour of normal fruits. Some fruits split and fall while in this condition, but by no means as many as fall in the next stage of the disease.

11. When the fruits reach a size of from 1 to $1\frac{1}{2}$ inches in diameter they gradually change colour, turning light lemon yellow and commonly shewing a slight brown exudation in places on the rind. At this stage many fruits fall; this usually occurs after the appearance of the brown stains, but sometimes before. On trees slightly affected many of the fruits fall early, while on trees badly affected it is seldom that any fruits remain on the tree until they reach full size. The fruits usually split before dropping. At first a slight crack appears around the eye end or apex of the orange, accompanied by a slight gummy exudation. Finally a large split opens across the fruit, exposing the segments and causing the orange to rot and fall.

12. Both the fruits which fall early and those which come to full maturity are usually more or less disfigured by irregular brown stains, similar to those occurring on the twigs. These stains frequently cover a large portion of the fruit, rendering it unsaleable.

13. Slight swellings are sometimes found on the rind, particularly in the sour orange. These swellings are caused by gum pockets formed within the tissue of the rind. Very frequently a formation of gum also occurs in the segments immediately around the axis, generally near the seeds.

14. The fruit of trees affected with die-back usually ripens considerably earlier than that of adjoining healthy trees of the same variety. As a rule, however, it is large, very coarse, thick skinned, and disfigured with brown stains, and in consequence often unsaleable.

15. The roots of trees affected with the disease usually have a healthy appearance, but in severe cases on improper soils, they frequently become ulcerated and die back for some distance, the dead ends rotting away. Roots which have died back frequently have large and somewhat swollen ends from which later on a number of small roots frequently arise.

The order in which the symptoms appear and their severity vary greatly, but generally are as follows:—The first sign of

the disease is the usually dark green colour of the foliage, rank growth and large thick skinned fruit. These symptoms are soon followed by the staining and dying back of a few twigs, and by brown stains formed on some of the fruits. The fruits developed are very prone to split and drop prematurely. In the first stage of the disease either the stained fruit or the stained dying twigs must be present to determine with certainty the presence of the malady. Trees affected with the disease may grow for years and shew only one of these characters; in other cases all the symptoms may be present, but to a very slight extent, so that very careful search must be made to find them. As the disease progresses, the brown staining of the fruit and twigs becomes more abundant and the dying back of the twigs occurs all over the tree; eruptions form on the young and old twigs; nodal swellings, due to the gum pockets, become very abundant; and the tree assumes the dense foliage and regular outline described above. In this stage of the disease many fruits set, but they usually turn yellow, become stained, split and fall before maturity, only a few, if any, reaching full size. Soon the gum eruptions extend to the old limbs and these die back. The rank new growth becomes limited to the centre of the tree; here branches grow luxuriantly for a time, only to become stained and die back later. The tree then assumes the ragged appearance described above. In this stage no fruits set, and indeed, the tree has become so sick that no flowers are formed. This disease is not accompanied by profuse blooming, as is the case in blight; on the contrary, the tendency is to produce very little bloom. If the disease is allowed to continue unchecked the trees will ultimately cease to grow and finally die.

CAUSE.—The cause of the die-back is not yet thoroughly understood. For several years experiments have been under way to determine whether various fertilisers may not produce the malady. Experiments have also been conducted in the laboratory with water cultures. In these experiments various forms of pure chemical manures were employed, the amounts used being under absolute control. From the results of these experiments and from extensive field observations in many parts of the State, it seems highly probable that the disease is caused by malnutrition. In most cases it is probably induced by excessive use of organic nitrogenous fertilisers. As before stated, trees near stables, chicken houses, privies, &c., are very commonly affected by the disease. Heavy applications of cotton seed meal, dried blood, or other highly nitrogenous organic fertilisers are frequently followed by the appearance of the trouble. Groves fertilised continuously with organic fertilisers rich in nitrogen are usually more or less affected

with the malady, depending upon the quantity of fertiliser used. Whether the chemical manures, such as nitrate of soda or sulphate of ammonia, when used in excessive quantities, will finally produce the disease, is yet questionable, but all evidence indicates that they will not. In several experiments the excessive quantities of chemical manures used killed the trees outright, although no signs of the disease appeared.

A form of the disease known as soil die-back is very common and is very evidently independent of the action of any fertiliser. Certain fields of limited area, which are low and poorly drained or underlaid with "hardpan" (a ferruginous sandstone), seem predisposed to produce the disease. Trees set out on such soil never develop normally, but contract die-back in its worst form. These frequently remain for years in a stunted condition, each year's growth as formed dying back. Such trees finally die if allowed to remain untreated. Often considerable loss is incurred by planting and fertilising groves on the die-back soils. The symptoms of die-back are the same whether due to excessive fertilisation or to improper soil conditions, and it is probable that the real cause will be found to be the same in both cases. Both forms of the disease appear to be greatly aggravated by excessive cultivation, which apparently destroys the surface roots and forces the tree to feed lower down.

TREATMENT.—When the die-back is due to the excessive use of highly nitrogenous, organic fertilisers, an effective remedy consists in simply ceasing to cultivate and allowing all weeds to grow. In fertilising omit entirely all highly nitrogenous organic manures, but use about the normal quantity of potash and phosphoric acid. As the tree recovers, a small amount of nitrogen should be given preferably in the form of nitrate of soda or sulphate of ammonia until the tree is brought up to its normal condition. If the disease is produced by the close proximity of privies, chicken houses, barns, &c., removing these will usually result in the recovery of the affected trees. In the case of barns which cannot be removed it has been found effective in some cases to dig trenches between the trees and the barn to prevent the feeding roots from running under the former. Of course the caution in regard to the use of organic nitrogenous fertilisers given above is applicable in this case also. When the malady is caused by planting on die-back lands, treatments vary according to the character of the soil. If the grove is on low wet soil, through drainage will usually be found an effective remedy without other treatment. If the soil is underlaid with hardpan, mulching the trees with pine straw, oak leaves, or something of this nature, and stopping cultivation will allow the feeding roots to develop near the

surface and usually bring about a cure. The latter has been found an effective treatment in many instances. Good drainage is also beneficial in such cases.

SCAB OR VERRUCOSIS OF THE LEMON AND OTHER CITRUS FRUITS.

The introduction of this disease into the United States is comparatively recent. It first appeared in Florida about the year 1884, and spread rapidly over the State and to Louisiana. Although many thousands of trees affected with scab have been sent to California, it seems that the disease is unable to exist there permanently. The reason for this will appear later. The malady also occurs in Australia and Japan, from which latter country it was undoubtedly introduced into America. So far it is not known to occur in Europe or Africa. The first account of the disease was published by F. Lamson-Scribner in October, 1886, (Bulletin of the Torrey Botanical Club, New York, Vol. XIII., No. 10, p.p. 181—183), at which time Professor Scribner was chief of the section of Vegetable Pathology of the Department of Agriculture. A fuller account, with a coloured plate, was published in the Annual Report of the Commissioner of Agriculture for 1886, p.p. 120, 121. A disease undoubtedly the same was reported from Australia on orange and lemon leaves by Henry Tyron (1).

The principal loss from scab occurs in Florida, where it often renders lemon groves so unprofitable that they are cut off and budded to other citrus fruits. In many cases a very large percentage of the fruit is rendered unsaleable, sometimes one-third or even one-half being unfit for market. It also causes some injury to sour orange trees (before they are budded) when grown for nursery stock.

Scab, or a disease closely allied to it, occurs on very young fruit of the lime (*Citrus limetta*), and in some localities is often so severe as to entirely destroy the crop. For example, a grove in tropical Florida, capable of yielding 500 boxes of fruit annually, when attacked by this disease produced for several years only a few hundred fruits, and the majority of these fell off while still very young. In Louisiana it is said to have attacked Satsuma oranges; in Japan it causes considerable damage to orange groves situated on low moist land; in Australia it is reported as causing orange and lemon trees to lose their leaves and to yield poor crops, badly affected trees often not setting a single fruit. Probably the annual loss from scab in the United States is not far from \$50,000, most of the damage being done to the lemon in Florida.

(1) Report on Insect and Fungus Pests, No. 1, Queensland, 1889, p.p. 144, 145.

SYMPTOMS.—The leaves and fruit of trees affected with this disease show small wart like excrescences. These excrescences are of various sizes, the diameter ranging from $\frac{1}{2}$ mm. to 1 cm. (one fiftieth to two fifths of an inch), but usually being from 1 to 1 mm. They sometimes run together and cover a large portion of the leaf or fruit. In case the fruit is attacked while still very young the tissues below the wart grow more rapidly than normally. This causes the fruit to become covered with bumps, of irregular pyramidal shape. These grow proportionately with the fruit and on the mature fruit may sometimes be 1 to 2 cm. across and project out nearly the same distance. At first the warts look like small semi-translucent pimples, of a slightly lighter shade of green than the surrounding healthy tissue. In a few days if the weather be favourable, the warts become prominent, assume a conspicuously light green colour, and look watery. After this they become covered with a delicate fungus, which is at first grey, then dusky, and at last black. Finally the infected tissue covering the tips of the warts is cut off from the healthy tissue below by a formation of cork, and ultimately the cork formation becomes so abundant as to give a dingy white colour to the old warts. The appearance and development of the warts are much the same on the leaves as on the fruits. There is no formation of a lump below the wart. When the leaves are attacked while still very young much the same effect is produced as in the case of the fruit, the leaf surface bulging abruptly outward and causing the warts to appear seated on hollow conical protuberances. The leaf is often considerably thickened where the wart is situated, and the persistence of the leaves for at least a year in most cases, enables the cork formation to proceed further than is usually the case on the fruit.

VARIETIES OF TREES ATTACKED.—Scab attacks only certain species of citrus fruits, the sour orange (*Citrus bigaradia*) being particularly subject to its ravages. It was first noticed in the United States on this host. Both leaves and fruits of affected trees are often severely injured. The greatest loss, however, is caused by its disfiguring the lemon. It attacks the fruits far more frequently than the leaves, and by causing the lemons to become bumpy and warty renders them valueless or nearly so. On the foliage it is never abundant enough to do serious harm. After the sour orange and lemon, the Satsuma orange is most frequently attacked. This variety, probably a form of *Citrus nobilis*, came from Japan. On this host scab rarely causes serious damage to the crop, and is seldom seen in the foliage. In all probability the disease was introduced from Japan into the United States on this orange. In several localities in Florida the first appearance of scab on the sour

orange and lemon was shortly after the introduction of Satsuma orange trees. The fact of its being usually inconspicuous on this host explains why it was not noticed at first on this species.

Scab, or a disease closely allied to it, occurs on very young fruit of the lime (*Citrus limetta*) causing the fruits to fall while still very small. It has not been found on the older fruits or leaves of this species. It also occurs on the Otaheite orange, a variety of unknown origin, but apparently having some lemon ancestry.

All the common sweet oranges (*Citrus Aurantium*), the Kumquat (*C. Japonica*), tangerine, mandarin, and king oranges (*C. nobilis*), grape fruit and shaddock (*C. decumana*) seem to be nearly if not quite exempt. Certainly no appreciable damage is ever caused to these sorts by scab. In Florida, however, it is said to occur occasionally on the tangerine and mandarin oranges. In Japan it appears to affect the ordinary cultivated oranges, which are largely varieties of *Citrus nobilis*. In Australia the disease is reported on orange leaves, but no information has been furnished as to whether or not any other sorts are exempt.

CAUSE.—Scab is caused by a minute parasitic fungus (*Cladosporium* sp.). So far as known this fungus is found only on the varieties of citrus plants subject to the disease in question. It is a very minute species and usually forms a delicate dusky coating, only a few hundredths of an inch thick, on the surface of the wart. The colourless mycelial threads of the parasite creep about in the superficial layers of the warts and give rise to tufts of erect, brown, branched, and multicellular fruiting branches or hyphae, which often show numerous scars where spores have been detached. The spores are usually one-celled, but occasionally are two, and very rarely even three-celled. They are very minute, being only about $\frac{1}{3000}$ inch long and $\frac{1}{8000}$ inch wide. The spores germinate by pushing out a slender thread from the side.

CONDITIONS GOVERNING THE INFECTION OF THE HOST PLANT BY THE PARASITE.

It has been found that this fungus is remarkably sensitive to weather conditions and can fruit abundantly and spread rapidly only where the air is moist. In Florida the disease often makes no perceptible progress for weeks during the dry spring, but if a few days of damp weather come on, it suddenly spreads and develops very rapidly. Groves in low moist situations are more subject to scab than those on high and dry lands. The fact that the fungus depends so closely on moist weather for its proper development and spread, doubtless

explains its almost total absence from California, where the atmosphere is much drier during the growing season than it is in Florida.

Another important condition governing infection, is that the tissue must still be growing to be subject to the invasion of the parasite. The period of greatest danger to both leaves and fruits is when they are young and tender, and growing rapidly. This explains why old lemon and sour orange fruits are not badly deformed when attacked by the fungus after the moist weather of summer sets in.

TREATMENT.—During the spring and summer of 1894 extensive experiments were carried on by one of the writers to discover if possible, means of preventing scab on the lemon. Owing to the irregular blooming of the lemon, the prevention of the disease was found to be a difficult undertaking. However it was demonstrated that Bordeaux mixture and ammoniacal solution of copper carbonate, if properly applied, are efficient. The former is very effective against the fungus, but is more or less injurious to the fruit and foliage of the lemon, while the latter is almost an absolute preventive of the disease and causes very little if any injury to the tree.

It was found highly important that all infected fruits be removed from the tree, and from the ground beneath before blooming begins. This measure is absolutely necessary to insure the success of any treatment, and is of itself a great aid in checking the disease. All sour orange trees or sprouts from the sour stocks should also be removed from the vicinity of lemon trees, since they are even more subject to scab than the lemon, and because not only the fruit but also the leaves can support a luxuriant growth of the fungus.

The disease can be prevented to some extent, by planting the trees on dry soil and in localities having little rainfall during and immediately after the blooming season. Directions for treating the disease are briefly as follows:—

1. Carefully remove, and burn or bury all diseased lemon fruits, however small, either on the trees or on the ground. Cut down and destroy all sour orange trees or sprouts from sour stock in the vicinity of the lemon trees.

2. Prepare ammoniacal solution of copper carbonate as follows:—Take 5 ounces of copper carbonate and stir up with about a pint of water to a thick paste; then dilute with one and a half gallons of water in a wooden pail. Stir vigorously, and at the same time add slowly 2 pints of strong ammonia (1)

(1) Aqua ammoniæ fortior (28 per cent.) of druggists

or 5 and a half pints weaker ammonia water (2). Stir until all is dissolved, or at least all but a few granules, and then dilute with water to 50 gallons.

3. Apply the ammoniacal solution with a pump giving a good pressure and furnished with a Vermorel nozzle. The initial spraying should be made when the first young fruits are exposed by the falling of the flowers. The second spraying usually after two or three weeks, a third two or three weeks later on when blooming is nearly or quite over, and a fourth when the fruits are of a size ranging from that of a pea to that of an olive. If necessary a fifth and even a sixth spraying should be made after particularly wet weather. In most cases four and often five sprayings are absolutely necessary. By carefully watching for the appearance of warts on the fruit, particularly during moist weather, the grower can determine when to spray and whether any spraying is necessary after the third application.

4. Direct the spray so as to coat all the young fruits evenly, but thinly. It is not necessary to spray the leaves but it will not be possible to avoid wetting them when spraying the fruit.

5. Watch for scale insects, and if they appear in great numbers use resin wash, kerosene emulsion, or other insecticide. This caution is necessary because in some cases where trees are spread with Bordeaux mixture the fungus parasites of the scale are killed, and consequently the scale insects multiply very fast. As yet no such effect has been observed when ammoniacal copper carbonate was used, but the possible danger from this source should be borne in mind.

6. If preferred, Bordeaux mixture can be used in place of the ammoniacal solution of copper carbonate. In preparing the Bordeaux mixture, take 6 lbs. of copper sulphate, and 3 lbs. of lime, add 26 gallons of water to each, then mix and add 6 lbs. of dissolved soap to the mixture. This spray must be applied with care, giving the trees only a thin coating, otherwise the youngest foliage may be injured or scale insects induced.

SOOTY MOULD (1).

Sooty mould of the orange, or smut (2), as it is sometimes

(2) Aqua ammoniac (10 per cent.) of druggists.

(1) Sooty mould of the orange is probably produced by several different species of the genus *Meliola*. The forms known as *Meliola penzigi* and *Meliola camiliae* appear to be the most common in Florida. In publications in this country the fungus has usually been referred to *Capnolium citri* and *Fumago salicina*. The disease is known in Italy under the names *fummaggine*, *morfea*, *nero*, etc., and in Germany as *Russtanan*.

(2) Smut is the name very generally applied to diseases produced by the true smut fungi (*Ustilagineae*).

erroneously called, is a malady which frequently causes serious damage. The fungus producing it is of saprophytic habit, deriving its nourishment from the sweet fluids (honeydew) secreted by certain insects, the attacks of which it invariably follows. As the honeydew falls it strikes principally on the upper surfaces of the leaves and exposed branches and upper portions of the fruit (the stem end, as the fruit are pendulous), and it is on these portions that the sooty mould grows. It develops also to some extent on the lower surfaces of the leaves, but is not so abundant here. In Florida sooty mould follows principally the attacks of the mealy wing or white fly (*Aleyrodes citri*, R. & H.) wax scale (*Ceroplastes floridensis*), mealy bug (*Dactylopius citri*) orange plant louse or aphid (*Aphis gossipii*, Glover), &c., and spreads as these insect pests spread. It is only where it follows the mealy wing, however, that it becomes serious. In this State it is estimated that the loss it causes is not far short of \$50,000 annually.

Besides occurring on all varieties of citrus fruits, sooty mould is frequently found on a number of wild plants in Florida. It is particularly abundant on a gall berry (*Ilex glabra*) red bay, (*Persea carolinensis*), which also infests the orange.

Sooty mould is probably common in all orange countries of the world. In California it causes much damage and is considered a serious malady. There it follows chiefly the black scale (*Lecanium oleae*) and the cottony cushion scale (*Icerya purchasi*). In Louisiana it is very common on the orange, following chiefly as in Florida the mealy wing and wax scale. It is also quite common in Spain, Italy, and many other orange-growing countries (3).

SYMPTOMS —Sooty mould may be readily recognised by the dense sooty black membrane which it forms over the fruit and upper surfaces of the leaves. This membrane is made up of the densely interwoven branched mycelial filaments (threads) of the fungus, the individual filaments of which can in some cases be distinguished with a hand lens. When isolated the filaments are seen to vary in colour from olive green to dark brown. They are at first loosely interwoven, but gradually become very numerous and crowded. Finally they become cemented together, forming a dense compact membrane. The fungus as nearly as can be determined, is entirely superficial. Small projections occur on the filaments, but no proof has been found that these penetrate the tissue of the leaf. Apparently

(3) In Jamaica it is common on the Rose Apple, *Eugenia Jambos*, Linn.

they are merely organs of attachment. Large disks (hypophodia) are also frequently developed which evidently serve as organs for attaching the mould to the leaf. Reproductive bodies of several forms are developed in great abundance, and these are easily carried from tree to tree or from grove to grove through the agency of the wind, insects, birds, or animals.

This disease injures the plant by interrupting the process of assimilation. This is brought about by the cutting off of light and by hindering the passage of necessary gases in and out of the plant. The accompanying insects further injure the plant by sucking the nutritious juices from the cells of the leaves. The growth of the tree is usually greatly retarded, and in serious cases is frequently entirely checked until some relief is found. The blooming and fruiting are commonly light, and in very bad cases are wholly suppressed. In slight droughts the leaves wither quickly and curl up, resembling those on blighted trees. The young fruit becomes covered with the sooty mould and is retarded in its development, frequently never reaching complete maturity. It is usually smaller and less juicy than that normally developed, and remains very insipid. It does not change to the normal bright orange colour of mature fruit until very late, and if the membrane of the sooty mould covering it is quite thick the rind remains somewhat green, apparently for an indefinite period, rendering the fruit unsaleable. The black coating formed by the sooty mould renders the fruit unsightly and unsaleable until it is thoroughly washed, which necessitates a considerable expenditure of time and labour. Even when carefully washed, a process which injures the keeping quality of the fruit, much of it being still small and green is unfit for market.

TREATMENT.—Where sooty mould followed the attacks of the orange mealy wing, spraying with resin wash or fumigation with hydrocyanic acid gas was found to be very effective. When resin wash (4) is used, the best time for treatment is in

(4) The following is the formula for resin wash: Resin, 20 lbs.; caustic soda (98 per cent.) $4\frac{1}{2}$ lbs.; fish oil (crude) 3 pints; water to make 15 gallons. Place the resin, caustic soda, and fish oil in a large kettle. Pour over them 13 gallons of water and boil till the resin is thoroughly dissolved, which requires from three to ten minutes after the materials begin to boil. While hot add enough water to make just 15 gallons. This may be most readily accomplished by taking a tight keg or other tall receptacle and measuring into it 15 gallons of water. Then plainly and permanently mark the height to which the 15 gallons reach. After boiling the hot solution may be poured directly into this measuring keg and sufficient water added to bring it up to the 15 gallon mark. This serves as a stock preparation.

When this stock preparation cools, a fine yellowish precipitate forms and settles to the bottom of the vessel. The preparation must, there-

winter, between December and the 1st of March. During this period the mealy wing cannot fly away to escape the spray, being in the mature larval or pupal stage and fixed immovably to the lower surface of the leaf. Furthermore to be thoroughly effective, the resin wash must remain on the trees at least one or two days, and as this is usually a dry season it is not likely to be washed off soon. If thoroughly done three or four sprayings during the period mentioned, at intervals of one or two weeks, will be found an efficient treatment. It is probably best to delay the sprayings until the fruit has been removed. Should it be found necessary, treatments may also be made during May and the first half of June and again during the latter part of August and first of September.

In spraying it is important to wet thoroughly the under surface of every leaf. In treating this disease it has been found a good practice to trim the trees within, about the trunk and main limbs, thus leaving the greater part of the foliage near the outer parts of the tree. This greatly facilitates spraying, which must be done largely from under the tree, the spray being directly outward in order to wet the lower surfaces of the leaves. Where trees are trimmed out in this way an abundance of water sprouts usually spring up on the main limbs. The mealy wing generally lay its eggs on these in great numbers, and after a brood of mature winged insects have disappeared, it is a good practice to prune off these water sprouts and burn them. In this way great numbers of these insects may be destroyed at slight expense.

Fumigation with hydrocyanic gas, in the way it is generally used, is also a very effective remedy. One treatment during the year, if properly made should be sufficient. In the case of

fore, be thoroughly stirred each time before measuring out to dilute so as to uniformly mix this precipitate with the clear dark amber brown liquid which forms by far the larger part of the stock preparation. An instrument like a churn dasher without perforations greatly facilitates rapid and thorough mixing. When desired for use take one part of the stock preparation to nine parts of water. If the wash be desired for immediate use, the materials after boiling and while still hot, may be poured directly into the spray tank and diluted with cold water up to 150 gallons. This requires the addition of about 135 gallons of water.

If a fluid stock solution is preferred the wash may be prepared as follows: Place the same proportions of resin, caustic soda, and fish oil in the kettle and pour over them from 15 to 17 gallons of water. Boil until the resin is thoroughly dissolved and then dilute with cold water while the solution is still very hot, to exactly 21 gallons. To get this exact amount the barrel may be prepared and marked in the manner already described. This will form a clear dark amber brown solution which at ordinary Florida temperatures will remain perfectly fluid. For use dilute the whole formula to 150 gallons or use in the proportion of 1 part of the stock solution to 6 parts of water.

fumigation the treatment should be made some time between December and the first of March. During this period the temperature is usually much lower than at any other time, and this is a feature of importance. In treating this disease, it has been found more effective, to allow the gas to act for a slightly longer period than usual, say about forty minutes.

A parasitic fungus (*Aschersonia tahitensis*), has been found which attacks and destroys the larvae and pupae of the mealy wing, and bids fair to be of great aid in combating this pest. It forms small wart-like conical pustules, from 2, to 3 mm. in diameter. At first these are white or orange yellow throughout, but in the mature stage the spore masses become orange red. This fungus is frequently found in groves affected with sooty mould. It dots the under surface of the leaves, and may occasion alarm if its nature is not understood. Unless examined in an early stage of development, no trace of the mealy wing scale can be discovered without microscopic study.

When sooty mould follows attacks of the wax scale, mealy bug, or orange aphid, thorough spraying with the resin wash or standard kerosene emulsion will be found effective. The time when the treatment should be made is not important in these cases, but if the resin wash is used, a dry season should be selected when the work will not be rendered uncertain by the liability of rainfall.

FOOT-ROT MAL-DI-GOMMA (5).

Foot-rot or mal-di-gomma is a disease chiefly of the orange and lemon, and is probably more widespread than any other citrus malady. It is known to occur in almost all countries where the orange is cultivated, but so far as known appeared first in the Azores Islands, where it was very severe. According to the statement of Fouque (6), it was first noticed in this group in 1834, on the island of San Miguel, where it seems to have originated. From that time till 1840, he estimates that fully one fourth of the trees were destroyed. It reached its greatest severity on the island in 1840; in 1842, it had begun to decrease, and in 1873 it had ceased to be very serious. F. Alphonso says (7) that according to general report the malady

(5) An account of this disease prepared by B. T. Galloway was published in Part II, of Bulletin No. 8 of the Division of Botany, U.S. Department of Agriculture.

(6) *Voyages géologiques aux Açores, III., Les Cultures de S. Miguel* (Revue des Deux Mondes, Paris, Apr. 15, 1873, p. 837).

(7) Alphonso, F., *La coltivazione degli aranci nelle Azzorre*, (Annali di agricoltura Siciliana, Vol. V., 1873, p. 311).

appeared in Portugal in 1845, in Hyeres in 1851 (8), in Lago di Garda in 1855, and in Messina in 1863. According to Briosi (9), the disease first appeared in Sicily in 1862, and afterwards spread to Naples, Liguria, and Lago di Gardo, everywhere destroying orange and lemon trees by thousands. Professor Wohler mentioned in Briosi's monograph referred to in foot-note, found the malady very destructive on the Balearic Islands in 1871. Statements differ in regard to the first appearance of the disease in Florida, but it seems to have been noted here some eighteen or twenty years ago. Dr. A. H. Curtis (10) says: "It appeared about nineteen years ago, though few people remember to have observed it earlier than 1880." The disease is widely distributed in Florida and has by no means run out, but on the contrary, seems to be gradually spreading. It has also appeared in Louisiana and California, where, in places, it is said to be very destructive.

The damage caused by foot-rot is very great, and without question much more than that caused by any other orange disease. The first season after the trees are attacked they may bear an unusually large crop of fruit, but this is generally the last full crop produced. By the next season the tree is either killed or else so reduced that it cannot support much fruit. Sometimes trees are nearly girdled in the space of a few months. Whole groves have been entirely destroyed in the course of a few years. Briosi describes its effects in Italy and Sicily as being most serious; he estimates the damage done in Italy from 1862 to 1878 at more than \$2,000,000. In Florida many fine bearing groves have been almost totally destroyed in the course of a few years, but the malady does not appear to be so severe here as in some foreign countries. The annual damage it causes in Florida is estimated at about \$100,000.

SYMPTOMS.—The first symptom of foot-rot is an abundant exudation of drops of gum on the trunk of the tree near the base. This occurs over a limited portion of the bark in the first stages of the disease, and may appear in one or several distinct patches. In this stage the bark will be found to be discoloured, having become brownish, and to contain numerous

(8) Rendu, M. V., Notes sur la maladie des oranges d'Hieres, Extrait, (Commissionaires Jussieu, Gaudichaud, Decaisne), Compt. Rend. t 33, 1851, p.p. 681-683.

(9) Briosi Giovanni, Intorno al mal di gomma degli agrumi (Fusisporium limoni Briosi), Atti della R., Acad. dei Lincei, Roma, ser. 3a, Vol. II.; Memoria della classe di scienze fisiche ecc, meeting of May 5, 1878, p.p. 485-496.

(10) Curtis, A. H., sore shin or gum disease (Fla. Expt. Sta. Bull. No. 2, June, 1888, p.p. 29-35.

cavities filled with gum. The inner bark becomes watery and more or less rotten, and has a very disagreeable, fetid odour. As the malady develops, the demarcation between the healthy bark and the diseased patches becomes very apparent. The plant endeavours to throw off the disease and a separative layer is formed between the healthy and diseased portions. The patch of diseased bark thus delimited, dries up, the edges break away where the separative layer is formed and gradually curve up in drying. Finally the patches of diseased bark are thrown off. The death and decay of the tissues caused by the disease extend through the bark and apparently for some distance into the wood. The cambium layer, the most vital part of the tree, situated between the bark and the wood, is destroyed, and when the bark is thrown off there is no possibility of new bark growing over that portion. The patches of bark which first become diseased, are irregular in shape and vary greatly in size, but are usually from one to four inches in diameter. The exudation of gum occurs principally in the spring or in early autumn, after the rainy season, while delimitation and detachment of the bark usually take place during the summer or winter.

As the disease progresses, gum exudes on other portions of the bark which are in turn thrown off. It is quite common for a circle of bark surrounding an old diseased spot to become affected and be thrown off, thus enlarging the spot. The malady gradually spreads in all directions, but principally down on the main crown roots and around the trunk in a lateral direction. Year after year other portions of bark become affected, until the tree is entirely girdled and thereby killed. In malignant cases the disease runs its course and kills the tree in two years or less, while in mild cases the growth of the tree is scarcely affected, and in a few years the wounds are often completely covered with the new growth from the sides. The destruction of the bark on the trunk does not usually extend over one or one and a half feet above the ground, but occurs on the roots for some distance below the surface.

Trees affected with foot-rot appear at first as if they were suffering from lack of nourishment. The foliage becomes light yellow and scanty, the leaves developed being smaller than usual; the tree bears considerable fruit, apparently of normal size and good quality. This abundant fruiting is in marked contrast with blight where a profuse bloom is formed, but very little fruit set. In trees suffering from this disease the small limbs die first, but as the malady progresses large limbs succumb, thus giving the tree a ragged appearance. Again in marked contrast with blight and with severe cases of die-back,

no water sprouts develop from the interior of the tree top or from the trunk. In Florida trees are not usually attacked until they are quite old and have been bearing fruit for a number of years. In other regions, however, young trees are said to contract the disease.

Psorosis, a disease (11) known in Florida as "tears" or "gum disease" is often confounded with the foot-rot, but is unquestionably quite distinct. In appearance, it is similar to foot-rot, but with it the diseased spots occur on the limbs and occasionally on the trunk, but never on the roots so far as known. Psorosis does not kill the bark entirely, but extends only to the middle layer, the inner bark and cambium layer remaining healthy.

VARIETIES OF TREES ATTACKED.—Probably all species of citrus trees may contract mal-di-gomma, but some are very much more subject to it than others. Sweet seedling orange trees (*Citrus Aurantium*) are particularly susceptible, and it is in old groves of these that the most damage is done. Sweet orange used as a stock for budding is also liable to the disease. This malady is very destructive to the lemon (*C. limonum*), occurring quite commonly on all varieties. Grape fruit (*C. decumana*) is frequently affected, but is much more resistant to attacks than the sweet orange or lemon. Indeed, it is seldom that this fruit is seriously damaged. Tangerine and mandarin oranges (*C. nobilis*) are occasionally affected, but the damage is not usually very great. The sour orange (*C. bigaradia*) is apparently almost wholly free from mal-di-gomma. The writers carried on a careful search for the disease on this species, but succeeded in finding only two unquestionable cases. The sour orange used a stock for budding, remains free from attacks, and in Florida its use for this purpose is almost a sure preventive of the disease. It is probable that the disease occurs on the lime (*C. limetta*) and citron (*C. medica*) also, but no cases have as yet been observed in Florida.

CAUSE.—Mal-di-gomma has been studied extensively by many investigators, but as yet the cause of the disease is not surely known. It is thought by many to result from the attacks of some parasitic organism, and Professor Briosi (Briosi, loc. cit., 495) describes and names a fungus (*Fusisporium limoni*) which he finds always accompanying this disease. He is inclined to consider the fungus the cause of the trouble, but is in doubt as to whether it is the primary cause. He says, however: "I do not believe there can be any doubt

(11) From the Greek, meaning an ulcer.

that its presence accelerates the disorganisation of the tissues and aids in extending the disease."

The manner in which the disease spreads, appearing at different dates first in one country and then in another, and extending gradually from grove to grove, strongly indicates that it is contagious, being caused or at least greatly aggravated by some parasitic organism. Some investigators also think that the disease is due to physiological derangements, for instance, imperfect aeration of the roots. The most effective treatment known is based largely on this supposition.

Observation has shown that the disease is most common where any of the following conditions exists: Improper drainage; planting the trees so close together that the ground is continually shaded and kept moist; continuous use of organic fertilisers; excessive cultivation; continuous excessive irrigation, which keeps the soil water soaked; and deep planting.

Trees badly effected with the disease frequently recover if transplanted to some other location, on apparently similar soil, and given plenty of room. A remarkable instance of this was seen by the writers in a case where 40 acres were planted out some five years ago with large trees affected with foot-rot. After three years every tree of the several thousand transplanted to this grove seemed to have fully recovered.

TREATMENT.—Very many attempts have been made, both in Europe and in the United States, to find remedies for this malady. One of the most important discoveries is that it can be prevented by using immune or resistant stocks. It was early noticed that the sour orange and trees of sour orange stocks were almost absolutely exempt from the malady. By using this stock in setting out young groves the disease can be effectually prevented. On high, dry, soils, not suited to the sour orange, grape fruit stock can be used, as it is also quite resistant.

Many curative treatments prove more or less beneficial, and this has led to conflicting claims as to which is the best. In many cases it has been found sufficient to simply dig away the earth and expose the roots. This probably explains why so many different applications made to the roots seem to benefit the tree. The very act of opening the soil and exposing the roots to the air of itself tends to effect a cure. As the disease is probably caused by a parasite, it is important that no wounds be made on healthy roots in removing the soil. It is desirable to cut away all infected bark and wash the scars with some anti-septic solution, such as sulphurous acid, carbolic acid, or sulphur wash. Where trees are closely planted it is

usually necessary to remove and transplant a part of them to give light and air free access to the roots and trunk. The use of highly organic nitrogenous fertilisers should be avoided, and also excessive or deep cultivation.

The following is a summary of the treatment recommended for foot-rot:—

1. Remove the earth from about the roots for 2 to 3 feet from the trunk, being careful not to wound the healthy roots. When the groves are furnished with irrigation plant of the kind commonly used in Florida, which are capable of delivering a stream of water under considerable pressure, the earth should be washed away rather than dug away from the roots. A good way to do this is to first dig a hole some three feet in diameter and 2 to 3 feet deep about 6 feet from the tree; then stand on the opposite side of the tree and wash the soil from under the tree, driving it into the hole previously dug. If no hole is dug before washing out is attempted, the soil is likely to bank up around the tree and make it difficult to expose the roots sufficiently. In all cases the roots should be left exposed till recovery takes place, except possibly during a portion of the winter when severe freezes are likely to occur.

2. Cut away all diseased spots in the bark or the roots or trunk and cover the wounds with one of the following anti-septic solutions:—(1) Sulphurous (not sulphuric) acid, 15 parts to 85 parts of water. This may be sprayed on the roots. (2) Carbonic acid, 1 part of crude acid to 1 part of water. When diluted 1 to 5 this may be sprayed over the roots. (3) Sulphur wash made by putting 30 lbs. of flowers of sulphur in an iron or wooden vessel and mixing enough water, about 12 quarts, with it to make a stiff paste. To this add 20 lbs. of finely pulverised 98 per cent. caustic soda and stir vigorously. In a few moments the mass becomes hot, turns brown and then boils up and becomes liquid. As soon as the violent boiling has ceased, add enough water to bring up to 20 gallons and strain into a barrel that can be kept tightly corked. For covering cut places use 1 part of this stock preparation to 1 part of water (12). The roots may be sprayed with one part of stock solution to 10 part of water. (Two quarts of the stock solution to 10 gallons of water makes a very effective remedy for rust mite, and 1 gallon to 50 gallons of water for the six-spotted mite) All these solutions should be kept in wooden or glass vessels and should not be allowed to come in

(12) Two quarts of the stock solution to 50 gallons of water makes a very effective remedy for rust mite, and 1 to 50 gallons of water for the six spotted mite.

contact with metals. It is possible that any of these applications will prove of benefit even if the diseased spots are not cut out. In this latter case, however, care should be taken to saturate the bark of all diseased spots with the solution.

3. When the diseased trees are old and closely set, so that the ground is much shaded, every other tree should be removed and replanted in a new grove.

4. Avoid highly nitrogenous organic fertilisers in diseased groves, using preferably nitrate of soda or sulphate of ammonia as a source of nitrogen.

5. All tools used in infected groves should be cleaned and washed with crude carbolic acid before they are used in healthy groves.

6. In setting new groves dead trees should be replaced with trees budded on sour orange stock. (Sour stock does better than sweet on low wet hammock lands, and as well on flatwood land. For high, dry lands grape fruit stock may be used, since sour stock does not do well and grape fruit is almost exempt from foot-rot.)

7. Avoid excessive and deep cultivation in diseased groves. Injuries to the roots, such as are often caused by deep ploughing, seem to greatly favour the spread of the disease.

MELANOSE.

Melanose (from the Greek, black and disease), which in some groves is causing considerable damage, was first brought to the attention of the writers in November, 1892, by Mr. J. A. Barnes, who sent specimens to us from Citra. It apparently attacks all citrus fruits, but develops somewhat more freely on the grape fruit than on the other varieties. It is known to affect the grape fruit, common sweet orange, sour orange, lemon, mandarin, and Satsuma. The disease develops most freely on young rapidly growing vigorous shoots. It resembles to some extent the injury produced by the rust mite, and was for a time confounded with this disease. Its refusal to yield to the treatment for rust mite, however, led to the discovery that it is distinct from rust (a brown discolouration of the fruit, caused by the attack of a surface feeding mite, *Phytoptus*).

The disease is undoubtedly of very recent origin or introduction. It has spread rapidly in the region about Citra, and many of the groves there are badly affected. The malady has also been found to occur to some extent at Ocala, Stanton, and Sandford, and is apparently spreading rapidly.

The foliage of trees attacked by this disease is greatly injured, and consequently the general vigour and productiveness

of the tree much reduced. The growth of young trees is retarded, and they are apparently permanently stunted if the disease is allowed to continue. The fruit produced is mostly disfigured, some of it so badly as to be unsaleable. This is particularly the case with lemons, they, unlike russet oranges being almost wholly unsaleable. At Stanton where the malady occurs in lemon groves to some extent, from 3 to 4 per cent. of the fruit was affected in 1894, and about 2 per cent. rendered unsaleable. The total damage produced by this malady is as yet slight, being about \$5,000 annually. It appears to be spreading rapidly, however, and may ere long become one of the most common and most injurious diseases. Great care should be taken to prevent the introduction of this malady into California and other orange growing countries where it is not yet known to occur.

SYMPTOMS.—The most conspicuous symptom of melanose is the occurrence of small dark brown spots on the leaves, young stems and fruits. On the leaves and fruits the individual spots, when distinct, are nearly round and are slightly elevated above the surrounding surface. On the stems the spots are usually roundish, but are frequently somewhat elliptical or oblong and elevated, as on the leaves. Only the elevated spot is discoloured, the surrounding tissue being of normal colour. The spots are at first very minute and yellowish. They gradually increase, however, and swell up, changing to dark brown or nearly black. Many of the spots finally burst near the centre and show a small irregular fissure. Very commonly the underside of the leaves shows minute depressions, corresponding to the spots located on the upper surface. On young and partially grown leaves this latter character is usually very evident, each brown spot occurring on a slight elevation of the leaf. The spots vary considerably in size, ranging usually from $\frac{1}{4}$ to 1 mm. ($\frac{1}{100}$ to $\frac{1}{25}$ inch) in diameter. On the common sweet orange and sour orange they range in size from $\frac{1}{4}$ to $\frac{1}{2}$ mm. ($\frac{1}{100}$ to $\frac{1}{50}$ inch) in diameter. On the grape fruit they are from $\frac{1}{2}$ to 1 mm. ($\frac{1}{50}$ to $\frac{1}{25}$ inch) in diameter, the individual spots being usually much larger and more conspicuous than on common orange or sour orange. On the common orange 388 spots were counted on a square centimetre of a badly infected leaf, and 44 spots on a square centimetre of one slightly infected. In the grape fruit only 130 spots to the square centimetre were found on a badly infected leaf; these were partly confluent, forming an almost continuous blotch. Where the spots are very abundant, they frequently run together, forming large irregular dark brown blotches. This frequently occurs on all species of citrus trees affected with the disease, and is found on stems, leaves, and fruits. On the

fruits in particular this is of frequent occurrence. As the fruit ripens the blotches, which are hard and brittle, sometimes become considerably chequered and fissured similar to the cracking of mud in drying.

The spots, are to some extent formed on both surfaces of the leaf, but are much more abundant on the upper surface. This character is more particularly noticeable in the grape fruit than in other species of citrus. On grape fruit the spots are almost wholly limited to the upper surface. In the common sweet orange and sour orange they occur abundantly on the lower surface, but are still more numerous on the upper surface. On the different portions of the fruit and young stems the spots are apparently uniformly abundant. This malady is most severe on the lower portions of the tree, but the characteristic spots are also found on the leaves and twigs in the tops of large trees, nearly 30 feet from the ground.

The infection, it appears, usually takes place at an early stage in the development of the leaves and stems, and if the disease becomes severe the infected organs are considerably modified in appearance. The leaves becomes greatly distorted and wrinkled and remain much smaller and more pointed than normally. Many of the leaves fall before reaching maturity, only a scanty foliage remaining on badly affected branches. The branches are also considerably contorted and stunted in severe attacks.

CAUSE.—From studies that have been made of this disease it seems very probable that it is caused by some vegetable parasite, although the microscopic studies which have thus far been carried on have failed to reveal the presence of any such organism. The disease is apparently contagious, spreading from definite centres. In some groves infected areas are plainly seen. In the centres of these areas, where the disease first started, the trees will be found to be very badly affected, but towards the margins the malady becomes gradually less apparent.

Melanose appears to be of an entirely local nature. In its growth and development each spot is entirely independent on any other spot, probably being caused by a separate infection. The tissue between the diseased spots is evidently perfectly healthy outside of the general debility which results from the infection of such a large portion of the leaf. The strict localisation of the disease, so similar to what occurs in scab, again strongly suggests that the disease is caused by some vegetable parasite. Infection can take place apparently only when the tissues are quite young. If the leaves and stems escape the

disease until they are nearly full grown the danger of infection is past. This is the case also with the fruits, and therefore spraying to prevent the disease must be done early while the fruits are small. After they reach an inch in diameter they appear to be safe from infection and spraying may then be discontinued.

PREVENTIVE MEASURES.—In the summer of 1894 experiments with various fungicides were carried on at Stanton and Citra, with a view to find a preventive of the disease. The copper fungicides, *i.e.*, Bordeaux mixture and ammoniacal solution of copper carbonate, were found to almost wholly prevent the disease if properly applied. In two plats of lemon trees at Stanton, sprayed with Bordeaux mixtures (6 pounds of copper sulphate and three and a half pounds of lime to 50 gallons of water), melanose was absolutely prevented, the most careful search failing to disclose a single fruit showing the characteristic spots. The sprayings were made once a week and twice a week respectively, for a term of ten weeks, beginning February 3rd. On an orange tree sprayed at the same time with the lemons the treatment was equally effective. However both the lemon trees and orange trees were somewhat injured by the Bordeaux mixture, probably largely because of the numerous sprayings given. On adjoining unsprayed lemon trees from 2 to 4 per cent. of the fruits and a larger per cent. of the foliage were considerably spotted with the disease. Perhaps half the spotted fruits were so badly disfigured as to be unsaleable. In a plat of lemon trees sprayed weekly with ammoniacal solution of copper carbonate (5 ounces to 50 gallons), beginning February 24 and continuing eight consecutive weeks, no melanose could be found on any of the sprayed trees. However, very little developed on the unsprayed trees adjoining this plat.

In another series of experiments at Citra, several plants of very badly infected orange trees were sprayed with Bordeaux mixture (6 lbs. of copper sulphate and 3 1/2 pounds of lime to 80 gallons of water.) In one of these plats sprayed twice, April 19 (shortly after flowering) and May 16, melanose was almost wholly prevented. Only two slightly spotted fruits were found on the entire plats of twenty-five large trees. Certainly not one-tenth of 1 per cent. of the fruit showed even a trace of the disease. On the adjoining unsprayed trees fully 90 per cent. of the fruit was diseased, some 50 per cent. of it being very badly disfigured. In these experiments the trees also were injured to some extent, probably largely because of the abundance of scale insects on sprayed trees. As melanose was absolutely prevented by Bordeaux mixture of the strength

above, it is highly probable that weaker sprays would be equally effective. It is likely that more sprayings will be necessary in treating melanose on the lemon than on the orange because of the more extended flowering period of the former. Although the experiments were mostly with Bordeaux mixture, which has proved fully effective in preventing the malady, it is likely that ammoniacal solution of copper carbonate will be the most practical remedy, because it is not so apt to injure the trees and will probably prove as effective as Bordeaux mixture.

The following is a summary of practical directions for keeping melanose in check. In treating the lemon for melanose spray with Bordeaux mixture (13) or ammoniacal solution of copper carbonate. Spray first about a month after the beginning of the spring blooming, or when the oldest of the young fruits are about the size of an olive. Spray again about a month after the first application, after flowering has ceased and the youngest fruits are the size of a pea. A third spraying may be made a month later if it is found necessary, but two sprayings will probably be sufficient.

In treating the orange and grape fruit for this disease, use Bordeaux mixture or ammoniacal solution of copper carbonate, prepared as indicated above. Two sprayings should be made, the first about two weeks after the flowers have fallen and the second about a month later. A Vermorel nozzle and a pump giving a good spray should be used. The spray must be applied to the fruits in the form of a fine mist, covering them thinly and evenly. In this way the leaves will be sufficiently coated without any special effort being made to wet them.

(13) Take 6 lbs. of copper sulphate and 3 lbs. of good lime to 80 gallons of water. Slack the lime carefully and dissolve the copper sulphate; then dilute each constituent with water to 25 gallons and mix. Add 6 lbs. of soap, dissolved in as many gallons of hot water, and finally add enough water to bring the mixture up to 80 gallons. A resin soap suitable for adding to fungicides can be prepared very easily as follows: Take 40 lbs. resin, 20 lbs. sal soda (crystalline) and water to make 25 gallons. Place the resin and sal soda in a comparatively large kettle with 5 quarts of water. Boil, meanwhile stirring briskly, until the resin and sal soda are thoroughly mixed together and form a frothy mixture without lumps. Now add 20 gallons of cold water, pouring it rather slowly and with short intervals between, and avoid chilling the mixture too suddenly. When all of the water is added bring to a boil; then pour out the hot solution, straining through a coarse cloth, and add sufficient water to make 25 gallons of the solution. This if correctly made forms a thick dark brown, translucent, syrupy solution, which may be preserved as a stock preparation. About 2 lbs. of soap are contained to the gallon and the cost is only about $1\frac{1}{2}$ to $2\frac{1}{2}$ cents per gallon, while ordinary good hard soap costs five to twelve times as much.

SUMMARY.

1. **BLIGHT** attacks trees only when over 5 years old and which are in bearing. It is first manifested by a sudden wilting of the leaves, which soon becomes so bad as to continue even in wet weather. At the beginning of the rainy season following the wilting, vigorously growing sprouts start from the trunk and larger branches. These often continue growing several years, but finally sicken and gradually decline. The spring following the wilting of the top, the branches which have now become nearly leafless, bloom profusely. These flowers continue to appear for two or three weeks after normal blooming is over. They are small, however, and almost never set fruit. Very little fruit is produced by blighted trees. After flowering, the branches usually die, often leaving only the sprouts from the trunk alive and growing. The whole top may be attacked at once or only a single branch, but in any case the entire top ultimately becomes blighted. The affected trees usually linger for many years and rarely die outright, though they may be finally reduced to mere stumps. The roots for the first year at least seem perfectly normal. The annual loss from this disease in Florida is about \$150,000. The cause is unknown but it is probably a contagious malady, and so far as known, is incurable. Affected trees should be dug up and burned as soon as they show this disease, and healthy ones set out in their places.

2. **DIE-BACK OR EXANTHEMA** is apparently caused by malnutrition, accompanied by improper drainage, improper cultivation, &c. The disease may be recognised by the very large dark pointed leaves, and the reddish brown stains on certain of the new growth twigs, which latter die-back for a considerable distance. Brown eruptions occur very abundantly on young and old twigs, all of which finally die back. Swellings produced by gum pockets in the wood occur very abundantly on the young twigs. Multiple buds form in the axis of the leaves. Diseased trees bear little fruit, and that formed soon assumes a pale green colour, then a light lemon yellow, becoming coloured prematurely. The fruits are very commonly more or less disfigured by the characteristic reddish brown stain. A very large percentage split open and drop before ripening. The loss from this malady is about \$100,000 annually in Florida. Withholding all organic nitrogenous manures, ceasing to cultivate and mulching the soil have been found beneficial treatments. In cases where the disease has been produced by wet soils good drainage will frequently be found an effective remedy.

3. **SCAB OR VERRUCOSIS** attacks principally sour oranges and

lemons, the common sweet orange being exempt. It occurs in the United States, Australia, and Japan, from which latter country it was probably introduced into America. It causes small excrescences to appear on the young leaves and fruit. These excrescences are at first of a pale, watery green colour, but soon become coated with a dusky fungous growth composed of a species of *Cladosporium* (the parasite which causes the disease). The tissues of the warts infested by the fungus are cut off from those below by a formation of cork which ultimately becomes so abundant as to give the excrescence a grey colour. The full grown warts are $\frac{1}{25}$ th to $\frac{1}{4}$ th of an inch in diameter and are often confluent. When attacked while still very young the leaves and fruits are greatly distorted by the disease. In the fruit especially, the warts cause the tissues below to grow too fast and to form large bumps. These with the grey excrescences so disfigure the fruit as to render it nearly valueless. The fungous parasite causing scab is able to spread and infect new spots only during moist weather. For this reason very dry regions are nearly exempt from the malady. The loss from this disease results principally from its action in disfiguring lemons. It does most harm in Florida, where it causes an annual loss of not far from \$50,000. The disease can be prevented on lemons by spraying the young fruits from three to five times with ammoniacal solution of copper carbonate.

4. **SOOTY MOULD** is a black fungus, which follows the attacks of certain honey-dew secreting insects. It may be recognised by the sooty black membrane which it forms principally over the upper surfaces of the leaves, fruits, and stems. The disease greatly reduces the productivity of the trees, and the oranges formed are so badly disfigured by the covering of sooty mould as to be rendered unsaleable. The annual loss in Florida is not far from \$50,000. Thorough spraying with resin wash has been found very effective. Between December and March of each year three sprayings should be made. Fumigation with hydro-cyanic gas has also been found an effective remedy. The applications should be made during the winter. A parasitic fungus has been found which promises to be a very great aid in combating this malady.

5. **FOOT ROT OR MAL-DI-GOMMA** is the most wide spread of all orange disease. The total damage which it causes is greater than that resulting from any other one malady, in Florida alone, amounting to nearly \$100,000 annually. It may be recognised by the exudations of gum from definite patches of the tree near the base. A separative layer is formed by the tree delimiting the diseased bark; the edges of the bark

thus freed, curve up away from the tree, dry out and finally fall off. These patches are enlarged by the disease spreading to the adjoining bark. Other patches also form on fresh bark. The malady spreads down the roots and latterly around the trunk. It extends through the bark and cambium layer into the wood, killing all the tissues as far as it extends. In many cases the tree is finally girdled, which, of course, results in its death. The accompanying or premonitory symptoms are sparse foliage, small yellow leaves, and the dying of small limbs over the tree. The disease is apparently contagious, probably being caused by some minute parasitic organism. It is also thought that improper æration of the roots induces the disease. Sweet seedling orange trees and lemons are particularly subject to the malady, while grape fruit is but slightly subject to it, and sour orange is almost wholly exempt. The malady may be prevented by using sour orange stocks on lowland and flat woods, and grape fruit stocks on high and dry pine lands. Removing the soil from around the crown roots is the most effective treatment. This can be best done by using a stream of water under considerable pressure. This washes the soil away without injuring the roots, cutting away the diseased portions of bark and wood and washing and painting the wounds with a solution of sulphurous acid, carbolic acid, or sulphur wash is recommended as beneficial. Avoid the excessive use of nitrogenous organic manures, excessive cultivation, and immoderate irrigation. Give good drainage in all cases and if the trees are planted too thick so that the ground is shaded, thin them out.

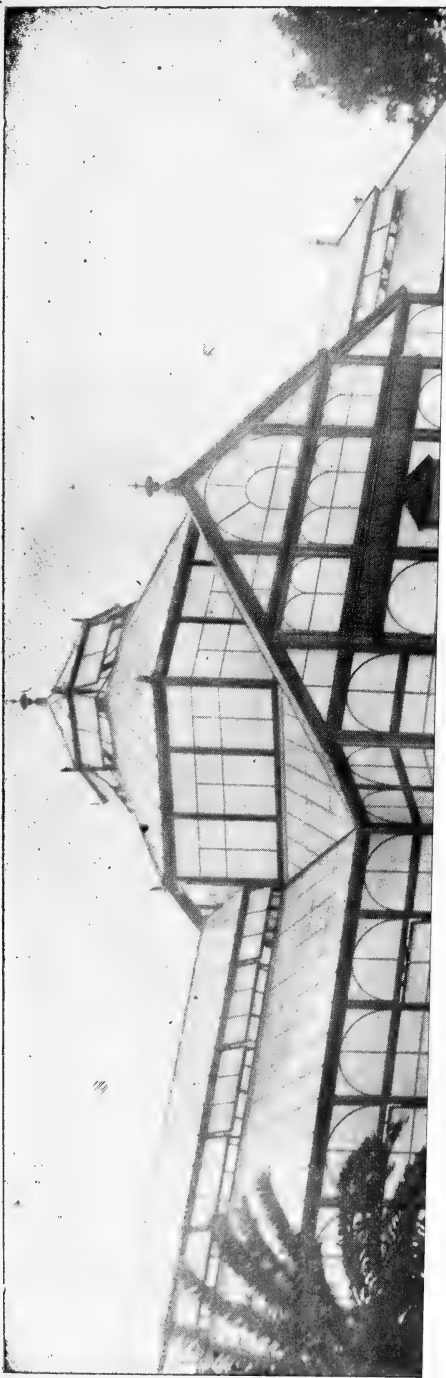
6. MELANOSE which attacks all citrus fruits is a new disease. It is as yet known only from a few points in Florida and does not cause much damage, probably only about \$5,000 in 1894. However, it seems to be spreading and is capable of causing great losses should it become widely distributed. It forms minute brown spots on the leaves, twigs and fruits. These brown spots appear when the fruit and leaves are still young and do not form an old tissue. They reach a size of from 1/100th to 1/25th of an inch in diameter and are often very numerous sometimes running together over large areas, greatly staining and disfiguring the fruit. In bad cases the trees are much injured by the malady, but ordinarily most of the damage results from the discolouring of the fruit. Lemons particularly, are unsaleable if attacked by melanose to any considerable extent. The cause of this disease is not certainly known, but it is very probably some minute vegetable parasite. Bordeaux mixture or ammoniacal solution of copper carbonate are very effective remedies if applied two or three times to the young fruits.

LIST OF SUBSCRIBERS TO JUBILEE CONSERVATORY.

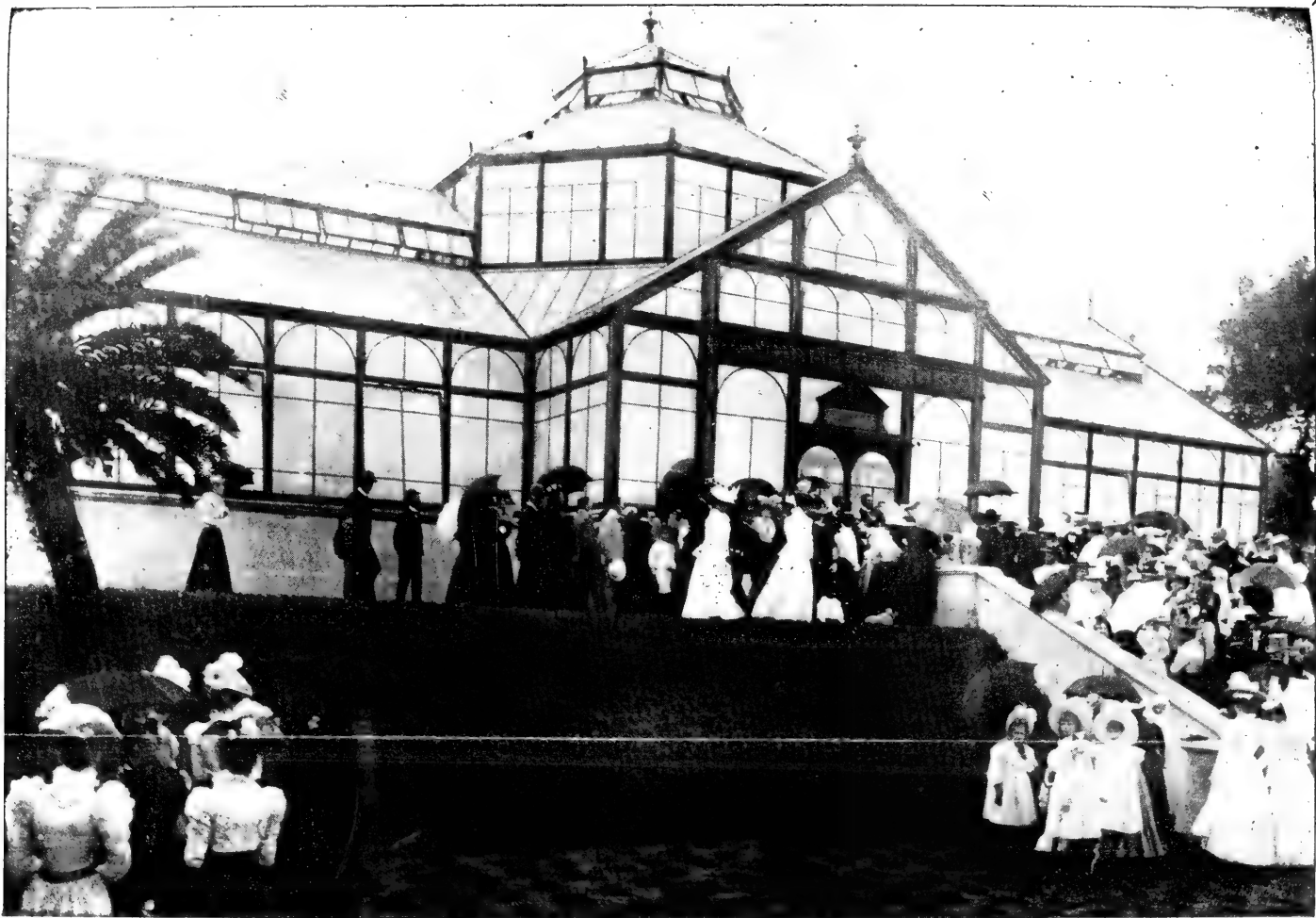
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Randles Bro. & Hudson	100	0	0	Jno. Lysaght, Ltd. ..	5	5	0
Geo. Payne ..	100	0	0	W. Keidel & Co. ..	5	5	0
Parker, Wood & Co. ..	100	0	0	Jas. Pulleyn ..	5	5	0
S. Butcher & Sons ..	50	0	0	Geo. Blaine ..	5	5	0
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Hunt, Leuchars & Hepburn	50	0	0	F. M. Dudley ..	5	5	0
A. Findlay & Co. ..	50	0	0	Oldbury & Smith Bros.	5	5	0
John Nichol ..	25	0	0	Pollok & Button ..	5	5	0
John T. Rennie & Son ..	50	0	0	Clark & Thiselton ..	5	5	0
S. Butcher, Senr. ..	50	0	0	Milne Bros. & Co. ..	5	5	0
A. A. Smith ..	50	0	0	De Waal & Co. ..	5	5	0
T. W. Edmonds ..	25	0	0	James Forbes ..	5	5	0
Maurice S. Evans ..	25	0	0	W. H. Kinsman ..	2	2	0
R. H. Tatham ..	25	0	0	C. A. Holwell ..	2	2	0
Fowlie Boden & Co. ..	25	0	0	H. Abrey ..	2	2	0
Frank Stevens ..	25	0	0	Thos. Poynton ..	2	2	0
Okell & Evans ..	25	0	0	F. H. Tunmer & Co. ..	2	2	0
W. E. Robarts ..	25	0	0	Kershaw, Son & Co. ..	2	2	0
Jas. F. Ferguson ..	25	0	0	C. Henwood ..	2	0	0
Ernest S. Acutt ..	25	0	0	A. H. Smith ..	2	2	0
M. Campbell ..	25	0	0	H. J. Henochsberg ..	2	2	0
David Don ..	25	0	0	F. F. Churchill ..	3	3	0
Steel Murray & Co. ..	30	0	0	A. E. Loram ..	2	2	0
King & Sons ..	25	0	0	H. T. Davies ..	2	2	0
Reid & Acutt ..	25	0	0	H. E. Stainbank, M.L.C.	2	2	0
Sidney A. Green ..	10	0	0	Thos. Drew ..	2	2	0
Dickinson & Fisher ..	20	0	0	John Arnold ..	2	2	0
P. Henwood, Son Soutter & Co. ..	20	0	0	Wm. Clark ..	2	2	0
E. W. Evans ..	25	0	0	Jos. Trimborn ..	2	2	0
J. Chiazari ..	25	0	0	Sparks Bros. ..	2	2	0
Union S.S. Co., Ltd. ..	25	0	0	T. B. Robinson ..	2	2	0
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R. N. Acutt ..	25	0	0	K/Anval Aime ..	2	2	0
African Boating Co., Ltd.	25	0	0	James Brown ..	2	2	0
D. McDonald ..	10	10	0	L. J. Wilson ..	1	1	0
Ebell & Co. ..	10	10	0	Wm. Rogerson ..	2	2	0
Atkinson & Murray ..	10	10	0	G. & J. P. Landsdell ..	2	2	0
Shepstone, Wylie & Binns	10	10	0	A. D. Millar ..	2	2	0
A. Murchie ..	10	10	0	Wm. Storm ..	2	2	0
Munder & Auerswald ..	10	0	0	Sparks & Young ..	2	2	0
Natal Advertiser ..	10	10	0	J. Hansford ..	1	1	0
Buchanan Forsyth & Co.	10	10	0	David Green ..	1	1	0
Dr. McKenzie ..	10	0	0	J. T. Jacob, Jnr. ..	1	1	0
J. G. Thomas ..	10	10	0	A. Henderson ..	1	1	0
Mason & Watkinson ..	5	5	0	J. H. E. Wall ..	1	1	0
Albert Andrews ..	5	5	0	Geo. A. Riches ..	0	10	0
Walter Greenacre ..	5	0	0	H. W. Currie ..	1	1	0
W. F. Johnstone ..	5	5	0	F. A. Franks ..	1	1	0
E. R. Robinson & Co. ..	5	5	0	Jas. Watson ..	0	10	6
				H. H. Puntan ..	2	0	6
				Jenkins & Co. ..	5	5	0

	£	s.	d.			£	s.	d.
Richard Harwin ..	5	5	0	Dr. Campbell	5	5	0
Adams & Co. ..	5	5	0	Mercury	5	5	0
H. J. Brereton ..	5	5	0	Colonist	1	1	0
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E. Munder ..	5	0	0	Jas. Ramsay	1	1	0
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Corbishley, White & Co. ..	5	5	0	T. W. Turner	1	1	0
J. F. King ..	5	5	0	T. J. Garland	1	1	0
J. Ellis Brown ..	5	5	0	G. J. Gatland	1	1	0
Stranack & Williams ..	5	5	0	R. Raw ..	..	1	1	0
Jameson & Co. ..	5	5	0	W. H. Dyer ..	..	1	1	0
E. Pickering & Sons ..	5	5	0	W. Cooley ..	..	1	1	0
John Millar & Co. ..	5	5	0	E. A. Hamp ..	..	1	1	0
Russell & Marriott ..	5	5	0	Emperor of Austria Ju-				
H. & T. McCubbin ..	5	5	0	bilee fund (per Consul				
C. J. Povall ..	5	5	0	Munder) ..	..	5	5	0
Gumpelson & Lipinski..	5	5	0					
Mrs. Harry Chambers ..	5	5	0					
Robt. W. Evans..	5	5	0					
						£1,798	1	0









JUBILEE CONSERVATORY AND PALM HOUSE, OPENED BY HIS EXCELLENCY, SIR WALTER
HELY-HUTCHINSON, K.C.M.G., DEC. 8TH, 1898.



Colonial Herbarium.

REPORT

FOR THE

—✻— YEAR 1898, —✻—

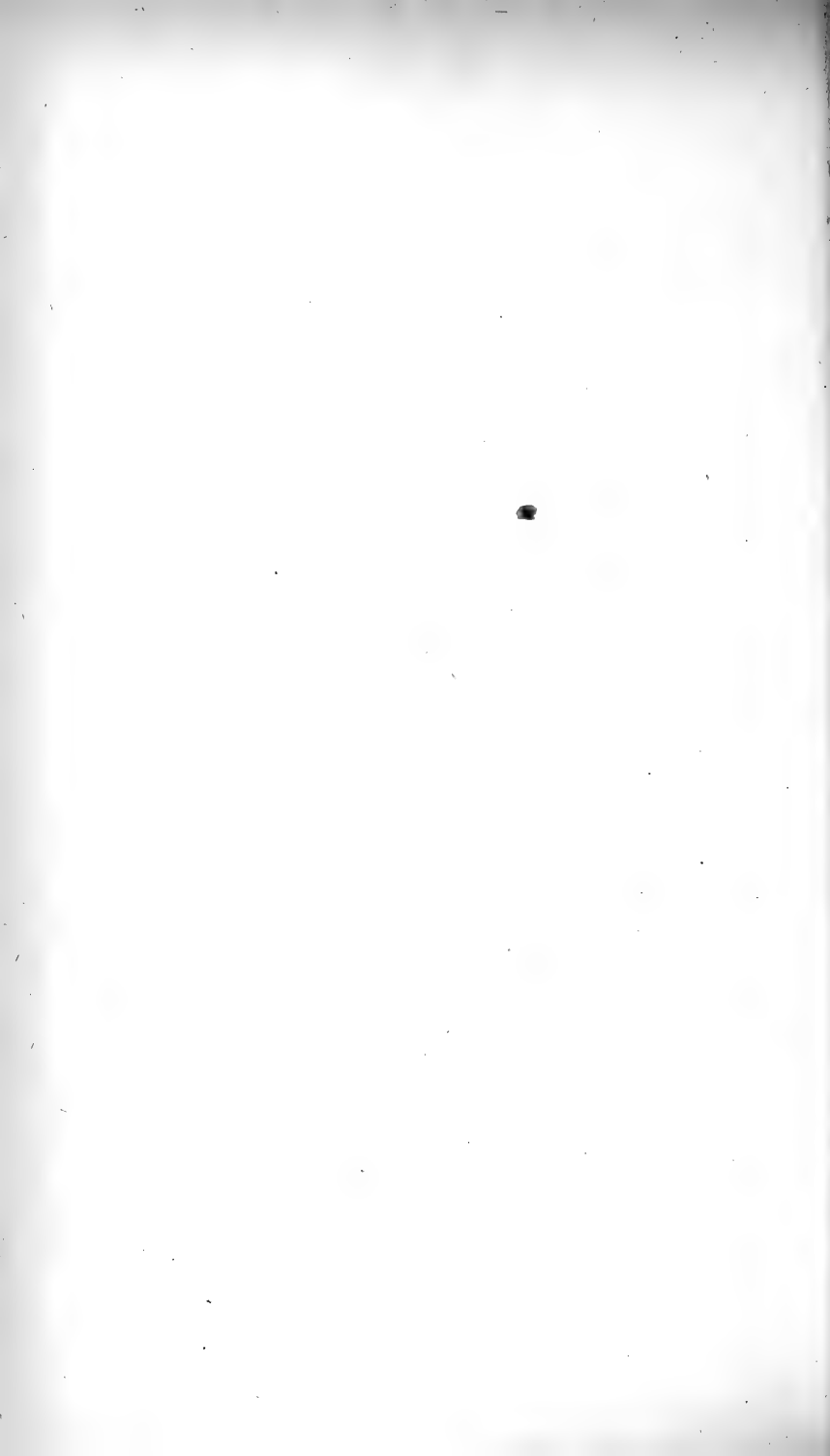
—BY—

J. MEDLEY WOOD, A.L.S.,

*Corresponding Member of the Pharmaceutical
Society of Great Britain.*

CURATOR OF BOTANIC GARDENS,

DURBAN.



COLONIAL HERBARIUM.



REPORT FOR THE YEAR 1898.



The year just ended has been one of considerable activity in the Herbarium, for though no very large number of specimens have been added to the collection, work of other kinds has kept both my assistant and myself very fully occupied.

The first part of "Natal Plants" was published in June, and to that part my assistant, Miss Lauth, contributed 16 of the plates, of the second part 30 plates are now finished, and of these 17 were drawn by Miss Lauth in the Herbarium, the remainder by Mr. Haygarth who will complete the volume. The whole of the descriptions were done in the Herbarium by Mr. Evans and myself, and we hope to have the second part of the volume completed and ready for publication about the middle of the present year. The third decade of "New Natal Plants" has not yet been published, but Mr. Evans and I hope to send it for publication early in the year. The work of collation, mounting, and cataloguing the specimens which I receive in exchange takes up a great deal of time, some at any rate of which might be much better employed, and I have at the latter part of the year found that an educated Indian can do a large portion of this work, and also the poisoning fairly well, and thus my assistant is relieved of a considerable amount of merely manual labour; the comparison of the specimens, entering and ticket writing, however, an Indian cannot be trusted to do. A number of specimens of indigenous plants have been sent for identification, and if persons would only remember that fairly complete specimens are required, the names of the plant sent, could, in nearly all cases, be supplied to the sender, but to expect that a plant shall be identified by a single leaf, a piece of bark, or a flower or two, not properly dried, and usually spoiled in transit, is expecting rather too much; if persons will only take care to send good representative specimens, dry them

properly, and forward them to me in good order, I shall always be glad to do my best to supply the names of the plants, and give any information about them which may be required, and in my power to give.

The Central African plants presented to the Herbarium by the late Mr. John Buchanan, C.M.G., were sent to Berlin in the early part of the year, duplicates being, of course, retained here, they have been examined and compared at the Imperial Herbarium at Berlin, where I understand a large number of Central African plants are deposited, and some weeks ago I received by the kindness of Mr. Rudolf Schlechter, a list of the names of 147 species, amongst which are several interesting plants which were new to science, and my very hearty thanks are due to Mr. Schlechter, for the trouble that he has taken in this matter.

The specimens of grasses which were sent to Professor Hackel, through Professor Dr. Hans Schinz have been examined and a list of the names has been received, this list includes 76 species, several of which are new have been described by Professor Hackel, and their names will be found in the additions to the Preliminary Catalogue of Natal Plants, which I give below.

It is my intention as soon as time will allow, to commence the second volume of "Natal Plants" and to confine it to the grasses and sedges of the colony, and with this end in view I have asked for contributions of dried grasses and sedges from persons in a position to collect them, and already I have offers of assistance from several persons, and one parcel of 28 species has already come to hand, having been collected near Maritzburg by Mr. T. J. St. George, it includes one species which is new to our collection, and I think to the colony also, it has been sent along with some others to Kew for identification. I may add that directions for drying and sending the specimens will be sent on application, and that all parcels of dried specimens will pass free through the post within the colony, if addressed, O.H.M.S. Curator Colonial Herbarium Botanic Gardens, Musgrave Road, Durban.

I have made several short collecting trips during the year, securing on each occasion a number of specimens to add to our collection, and a larger number for exchange with correspondents, and there are still a large number on hand which will be sent away as occasion offers, and for which a fair equivalent of plants of other countries is expected. I have received during the year parcels of specimens as under:—

G. V. Aznavour, Constantinople ...	...	...	350
Dr. Agner, Stockholm ...	...	...	285
Royal Botanic Gardens, Calcutta ...	...	...	450
J. Wagner, Hungary ...	...	...	216

J. Fowler, Canada ..	...	...	260
Biltmore Herbarium, U.S. America	...	...	584
Botanic Gardens, Saharunpur	...	...	121
Mr. M. Buysman, Holland	...	...	33
Dr. De Degen, Budapest	...	...	167
Mr. H. D. Flanagan, Cape Colony	...	...	81
State Herbarium, U.S. America ..	...	...	207
Herbarium Boissier, Geneva	...	...	170
			2,924

Many of these are very good specimens, and new to our collection, but as must always happen, a large number of them were already in the Herbarium, and these duplicates are, therefore, reserved for further exchange when possible.

Parcels of dried and named specimens of our indigenous plants have been sent away as under:—

G. V. Aznavour, Constantinople...	...	...	198
Dr. Hjalmer Agner, Stockholm	...	...	221
State Herbarium, U.S. America...	...	...	173
Professor Urban, Berlin	...	...	181
Royal Botanic Gardens, Edinburgh	...	...	170
British Museum, London	...	...	96
Royal Botanic Gardens, Calcutta	...	...	150
Professor J. Wagner, Hungary	...	...	178
O. E. Menzel, Australia	...	...	180
Biltmore Herbarium, U.S. America	...	...	234
Herbarium Boissier, Geneva	...	...	175
Dr. Palacky, Prague	...	...	140
			2,096

Some of these are in payment for specimens already received, and for the remainder we expect receive an equivalent during the season.

The number of specimens in stock has increased from 19,919, as stated in my last report to 22,657, of which 7,773 are South African, and 14,884 from other countries, an increase of 2,728 sheets. At the commencement of the year our 26 Cabinets were already fairly well filled, and when the new specimens arrived and were mounted, accommodation had to be found for them, 4 new Cabinets were therefore purchased, and these are now nearly filled, more Cabinets will be required during the present year; and unfortunately the room will only hold 4 more, leaving room for the ordinary work to be carried on, so that it will very soon be necessary to provide additional space, or the additions to the Herbarium will perforce have to cease, but it is to be hoped that means will be found to overcome this difficulty.

In my last annual report I noted amongst the publications received, the sixth volume of the Flora Capensis, but in the hurry of preparing that report at the busiest season of the year, I unfortunately omitted any further mention of the continuation of a work, which has been at a standstill for 33 years. The continuance of this work is of the very utmost assistance to every botanist in South Africa, and as it and the 7th volume which is in the course of publication includes a large number of the most attractive plants of our flora, it is to be hoped that its publication will induce some at any rate of our colonists to pay more attention to the science of botany than they have hitherto done. It will be noticed that in the list of contributions of books, that during the year the first and second parts of the 7th volume have been received from Kew, and the third part is, I understand, in active preparation. The Herbarium department is very greatly indebted to the Director of Kew Gardens, and to the various botanists associated with him in the preparation of this work.

We are also indebted to various correspondents for the donations of books, as specified in the subjoined list, more especially perhaps, to the Director of Kew Gardens for the Flora of British India in 7 volumes now complete, the different parts having been received from time to time as published, also for the Flora of Tropical Africa so far as issued, for the Kew Bulletin which is regularly received, and is most useful, and I again take this opportunity of saying that this work deserves a very much larger circulation than it appears to receive. To the Bentham Trustees through the Director of Kew Gardens we are indebted for the magnificent donation of a set of the Icones Plantarum, which will be of great use to us; to the National Herbarium of the United States of America we are indebted for several useful publications, and also to other Institutions as detailed in the attached list.

I now give a further addition to the list of the indigenous plants of the colony, the list given in my report for 1897 contained 86 names and 5 corrections or alterations, the one now given contains 96 additions and 24 corrections, so that it would perhaps be premature to publish an amended list at present, more especially so, as the attention being given to the Gramineæ, and Cyperaceæ will probably result in the addition of many new species, as these orders have, up to the present time been so far as Natal is concerned much neglected.

FIFTH ADDITION TO THE "PRELIMINARY CATALOGUE OF PLANTS."

<i>Andropogon halepensis</i> , Sibt	Gramineæ
" <i>punctatus</i> , Roxb	"
<i>Aristida junciformis</i> , Trin	"
<i>Bromus speciosus</i> , Nees	"

<i>Buddleia auriculata</i> , Bth.	Loganiaceae
<i>Bulbostylis humilis</i> , Kth.	Cyperaceae
<i>Carex Bolusii</i> , C. B. Clarke	"
„ <i>condensata</i> , Nees	"
„ <i>drakensbergensis</i> , C. B. Clarke	"
<i>Commelina Krebsiana</i> , Kunth	Commelinaceae
„ <i>nudiflora</i> , L. „	"
<i>Crassula inandensis</i> , Schönland	Crassulaceae
„ <i>latispathulata</i> „	"
<i>Cyperus compressus</i> , L.	Cyperaceae
„ <i>corymbosus</i> , Rottb.	"
„ <i>fastigiatus</i> , „	"
„ <i>hæmatocephalus</i> , C. B. Clarke	"
„ <i>tenellus</i> , L.	"
<i>Dactyloctenium ægyptiacum</i> , W.	Gramineae
<i>Desmonema caffra</i> , Miers	Menispermaceae
<i>Dichilus strictus</i> , E. Meyer	Leguminosae
<i>Diplachne fusca</i> , Beauv.	Gramineae
<i>Eragrostis Brownei</i> , Nees	"
„ <i>filiformis</i> , „	"
„ <i>natalensis</i> , Hack	"
„ <i>parviflora</i> , Trin.	"
„ <i>pilosa</i> , Beauv.	"
„ <i>plana</i> , Nees	"
<i>Eriocaulon abyssinicum</i> , Hochst	Eriocaulaceae
„ <i>Woodii</i> , N. E. Brown	"
<i>Ficinia gracilis</i> , Schrad	Cyperaceae
„ <i>stolonifera</i> , Bæck	"
<i>Gomphocarpus fragrans</i> , Schlechter	Asclepiadeae
<i>Indigofera oxytropis</i> , Benth	Leguminosae
<i>Ipomæa congesta</i> , R. Br.	Convolvulaceae
<i>Juncus brevistylis</i> , Buchan	Juncaceae
„ <i>oxycarpus</i> , E. Meyer	"
„ <i>rostratus</i> , Buchanan	"
<i>Kniphofia parviflora</i> , Kth.	Liliaceae
<i>Kyllinga Lehmanni</i> , (P)	Cyperaceae
<i>Luzula africana</i> , Drege	Juncaceae
<i>Mariscus nossibeensis</i> , Steud	Cyperaceae
<i>Oligomeris Dregeana</i> , Presl.	Resedaceae
<i>Ornithogalum virens</i> , Lindl.	Liliaceae
<i>Orthosiphon natalensis</i> , Gurcke	Labiatae
„ <i>Woodii</i> , „	"
<i>Osteospermum sonchifolium</i> , D. C.	Compositae
<i>Panicum colonum</i> , L.	Gramineae
„ <i>didactylon</i> , Kth.	"
„ <i>Eckloni</i> , Nees	"
„ <i>geminatum</i> , Forst	"
„ <i>glabrescens</i> , Steud	"

<i>Panicum hirsutissimum</i> , Steud	Gramineae
„ <i>laticomum</i> , Nees	„
„ <i>Schimperianum</i> , Hochst	„
„ <i>Woodii</i> , Hack	„
<i>Paspalum distichum</i> , L.	„
<i>Pennisetum Schimperi</i> , Hackel	„
<i>Polygala affinis</i> (?)	Polygaleae
„ <i>chloroptera</i> , Chod	„
„ <i>durbanensis</i> , Chod	„
„ <i>Galpini</i> , Hook	„
„ <i>Gerrardi</i> , Chod	„
„ <i>lysimachiaefolia</i> , Chod	„
„ <i>natalensis</i> , Chod	„
„ <i>ophiura</i> , Chod	„
„ <i>rigens</i> , D. C.	„
„ <i>ukambica</i> , Chod	„
<i>Potamogeton americanus</i> , Cham.	Naiadaceae
„ <i>Friesii</i> , Ruprecht	„
<i>Pycreus chrysanthus</i> , C. B. Clarke	Cyperaceae
„ <i>ferrugineus</i> , „	„
„ <i>flavescens</i> , Reichb	„
„ <i>macranthus</i> , C. B. Clarke	„
„ <i>oakfortensis</i> , „	„
„ <i>Rehmannianus</i> , C. B. Clarke	„
<i>Ranunculus Baurii</i> , MacOwan	Ranunculaceae
<i>Restio sejunctus</i> , Mast	Restiaceae
<i>Scilla Tysoni</i> , Baker	Liliaceae
<i>Scirpus frutans</i> , L.	Cyperaceae
„ <i>macer</i> , Bœck	„
„ <i>subprolifer</i> , Bœck	„
<i>Scleria Dregeana</i> , Kth.	„
<i>Sebœa longicaulis</i> , Schinz	Gentianeae
„ <i>sedoides</i> , Gilg	„
„ <i>stricta</i> , „	„
„ <i>Thodeana</i> , Gilg	„
„ <i>Woodii</i> , Gilg	„
<i>Senecio thyrsoides</i> , D. C.	Compositae
<i>Setaria aurea</i> , Hochst	Gramineae
„ <i>Woodii</i> , Hack	„
<i>Stachys sessilis</i> , (P)	Labiatae
<i>Stictocardia Woodii</i> , Hattier, f	Convolvulaceae
<i>Trichopteryx stipoides</i> , var <i>natalensis</i> , Hack	Gramineae
<i>Wahlenbergia rivularis</i> , Diels	Campanulaceae
<i>Xyris anceps</i> , Lam.	Xyrideae

CORRECTIONS AND ALTERATIONS.

<i>Cladium jamaicense</i> , Crantz	is <i>Cladium mariscus</i> , R. Br.
<i>Cyperus ingratus</i> , Kth.	is <i>Cyperus pulcher</i> , Thb

<i>Cyperus obtusiflorus</i> , Vahl	is	<i>Cyperus compactus</i> , Lam
„ <i>retusus</i> , Nees	is	„ <i>esculentus</i> , Linn
„ <i>lævigatus</i> , L.	is	<i>Juncellus lævigatus</i> , C. B. Clarke
„ <i>congestus</i> , Vahl	is	<i>Mariscus congestus</i> , C. B. Clarke
„ <i>cylindrostachys</i> , Bæck	is	„ <i>Sieberianus</i> , Nees
„ <i>elephantinus</i> , C. B. Clarke	is	„ <i>elephantinus</i> , C. B. Clarke
„ <i>vestitus</i> , Hochst	is	„ <i>vestitus</i> , C. B. Clarke
„ <i>abyssinicus</i> , Steud	is	<i>Pycrus flavescens</i> , Reichb
„ <i>atronitens</i> , Hochst	is	„ <i>elegantulus</i> , C. B. Clarke
„ <i>lanceus</i> , Thb	is	„ <i>umbrosus</i> , Nees
„ <i>micans</i> , Kth	is	„ <i>ferrugineus</i> , C. B. Clarke
„ <i>Mundtii</i> , Kth	is	„ <i>Mundtii</i> , Nees
„ <i>polystachyus</i> , R. Br.	is	„ <i>polystachyus</i> , Beauv
<i>Ipomœa Woodii</i> , N. E. B.	is	<i>Stictocardia Woodii</i> , Hattier, f
<i>Kyllinga alata</i> , Nees	is	<i>Kyllinga alba</i> , Nees
<i>Mariscus Bolusi</i> , C. B. Clarke	is	<i>Mariscus umbilensis</i> , C. B. Clarke
<i>Orthosiphon</i> (Wood No. 3107)	is	<i>Orthosiphon stenophyllus</i> , Gúrcke
„ (Wood No. 3573)	is	„ <i>macranthus</i> , Gúrcke
<i>Schœnoxiphium Buchanani</i> , C. B. Clarke	is	<i>Carex Buchanani</i> , C. B. Clarke
<i>Scirpus pterolepis</i> , Kunth	is	<i>Scirpus littoralis</i> , Schrad
<i>Scleria melanocephala</i> (?)	is	<i>Scleria melanomcephala</i> , Kunth
<i>Sebæa crassulæfolia</i> , var <i>lan-</i>	is	<i>Sebæa Woodii</i> , Gilg
<i>ceolata</i> , Schinz		
<i>Typha</i> (Wood No. 1378)	is	<i>Typha capensis</i> , Rohrb

No separate list of the Fungi of Natal has to my knowledge ever been published, I therefore give an enumeration of those which have been collected by myself in the Colony, by far the larger portion of them were collected before I took charge of the Botanic Gardens, and the type specimens have been presented by me to the Herbarium, it is as well, however, to state that they are mostly in paper capsules, which are firmly glued to stout paper, the specimens themselves being loose in the capsules, but this is not as it should be, since unless the greatest care is exercised when the different species are being examined, they are pretty certain to get mixed, and therefore their value as type specimens will be destroyed, I cannot therefore until they are properly mounted, allow any person to examine them but myself, and at present at any rate, I see no

prospect of time being spared to mount them as they should be mounted. In the list as given below, it will be seen that the names of genera and species are given alphabetically, no sort of classification being attempted further than keeping those which are usually parasitical on living plants from the others, and relegating the Mosses to a separate list. It will also be noticed that in the earlier collections the name of the host plant is not always given, as I was not then able to recognise it, in the later collections this omission occurs but seldom.

NATAL FUNGI.

PARASITIC ON LIVING PLANTS.

		Wood No.
<i>Aecidium acanthacearum</i> , Cke	on <i>Justicia</i> , sp ...	603
„ <i>abilabrum</i> , K.	on <i>Kraussia floribunda</i> , Harv... ..	21
„ <i>aroidium</i> , Cke	on <i>Stylochiton natalense</i> , Schott	114
„ <i>asperifolium</i> , L.K.	on <i>Cynoglossum micran-</i> <i>thum</i> , Desf	643
„ <i>bicolor</i> , Sacc	on <i>Maba natalensis</i> , Harv	6460
„ <i>cardiospermi</i> , Cke	on <i>Cardiospermum micro-</i> <i>carpum</i> (?)	537
„ <i>compositarum</i> , D.C.	on <i>Conyza incisa</i> , Ait ...	18
„ <i>crini</i> , K. & C.	on <i>Crinum longifolium</i> , Thb	68
„ <i>crypticum</i> , K. & C.	on <i>Gerbera</i> , sp	66
„ <i>cussoniae</i> , K. & C.	on <i>Cussonia</i> , sp	88
„ <i>dissotidis</i> , Cke	on <i>Dissotis eximia</i> , Harv	470
„ <i>dolichi</i> , Cke	on <i>Dolichos axillaris</i> (?)...	640
„ <i>flustra</i> , Bernh	on <i>Aster asper</i> , Less ...	648
„ <i>hibisci</i> , Cke	on <i>Hibiscus cannabinus</i> , L.	3495
„ <i>ipomœae</i> , Schw	on <i>Batatas paniculata</i> ...	3921
„ <i>loranthi</i> , Cke	on <i>Loranthus</i> , sp... ..	830
„ <i>Macowanianum</i> , Thum	on <i>Conyza pinnatilobata</i> , D.C.	456
„ <i>menthae</i> , L.K.	on <i>Ocimum obovatum</i> , E.M.	568
„ <i>ocimi</i> , P. Henn	on „ „ „ „	46
„ <i>ornamentale</i> , K.	on <i>Acacia</i> , sp	682A
„ <i>phaseolorum</i> , D.C.	on <i>Desmodium scalpe</i> , D.C.	613
„ <i>plectranthi</i> , Cke	on <i>Plectranthus</i> , sp ...	505
„ <i>plectroniae</i> , Cke	on <i>Plectronia Gueinzii</i> , Sond... ..	577
„ <i>rhynchosiae</i> , Cke	on <i>Rhynchosia</i> , sp ...	557
„ <i>royenae</i> , C. & M.	on <i>Royena pallens</i> , Thb...	4078
„ <i>scrophulariae</i> , D.C.	on <i>Chænostoma floribun-</i> <i>dum</i> , Bth	562

<i>Aecidium senecionis</i> , Desv	on Senecio, sp	116
„ <i>stobæa</i> , K. & C.	on Berkheya, sp	651
„ <i>tabernaemontanae</i> , Cke	on Tabernaemontana ven- triosa, Hochst	469
„ <i>Thunbergiae</i> , Cke	on Thunbergia natalensis, Hook	468
„ <i>tragiae</i> , Cke	on Tragia, sp	628
„ <i>tylophorae</i> , Cke	on Jasminium multipartit- um, Hochst... ..	694
„ <i>valerianae</i> , D.C.	on Valeriana, capensis, Thb	443
„ <i>vangueriae</i> , Cke	on Vangueria infausta, Burch	527
„ <i>vignae</i> , Cke	on Vigna marginata	407
<i>Antennaria Robinsonii</i> , B & M.	on leaves	636
„ „ „	on „ of Araucarias	695
<i>Arcyria punicea</i> , Pers	on Ricinus communis, L.	322
<i>Asterina diplocarpa</i> , Cke	on Sida rhombifolia, L. ...	601
„ <i>ditricha</i> (?)	on Celastrus, sp ..	3
„ <i>fimbriatus</i> , K. & Cke	on Hypoestes aristata, R. Br	608
„ <i>grewiae</i> , Cke	on Grewia lasiocarpa, E.M.	639
„ <i>Macowaniana</i> , K. & Cke	on Celastrus buxifolius, L.	6453
„ <i>myriadae</i> , Cke	on leaves	641
„ <i>phaeostroma</i> , Cke	on Kraussia lanceolata, Sond	652
„ <i>similis</i> , Cke	on Sida rhombifolia, L....	544
„ <i>stylospora</i> , Cke	on Sponia guineensis, Schm	564
„ <i>tenuis</i> , Wint	on Kraussia coriacea, Sond	6452
„ <i>toruligena</i> , Cke	on leaves	559-635
<i>Calonectria leucorroäina</i> (Mont), Speg	on Eugenia, sp	(?)
<i>Cephaleuros virescens</i> , Kze	on Ficus sp	3492
<i>Ceratostoma</i> , sp	on leaves	558
<i>Cercospora haemanthi</i> , Kalch	on Hæmanthus puniceus, Linn	(?)
<i>Chaetomella, artemisiae</i> , Cke	on Artemisia afra, Jacq.	572
<i>Cœoma ricini</i> (?)	on Ricinus communis, Linn	33
<i>Coleosporium hedyotidis</i>	on Hedyotis amatymbica	60
„ <i>ochraceum</i> , Fell	on Agrimonia Eupatoria, Linn	432
<i>Cystopus candidus</i> , Lev	on Brassica napi	459
„ <i>cubicus</i> , Sw	on Hewittea bicolor, W. & A.	467
<i>Darluca filum</i>	on Phaseolus	89
<i>Dimosporum acokantherae</i> , O. Henn	on Acokanthera spectabi- lis, Bth	6450
<i>Di-Orchidium Woodii</i> , K. & Cke	on Millettia caffra, Meisn	70
<i>Dothidea circinata</i> , K. & Cke	on (?)	49
„ <i>graminis</i> , P.	on Grass	569

<i>Dothidea perisporoides</i> , B.	on <i>Desmodium setigerum</i>	541
" " "	on <i>Vigna marginata</i> , Bth	115
" " "	on <i>Eriosema salignum</i> , E. M.	471
" " "	on " <i>cordatum</i> , "	664
" " "	on <i>Indigofera</i> , sp	684
" <i>puncta</i> , Cke	on <i>Dalbergia armata</i> , E. M.	605
" <i>repens</i> , Corda	on leaves	228
" <i>scabies</i> , K. & Cke	on "	48
" <i>strelitziae</i> (?)	on <i>Strelitzia augusta</i> , Thb	580
" <i>viventes</i> , Cke	on <i>Albizia fastigiata</i> , Oliv	583
<i>Epichloe cinerea</i> , B.	on Grass	3959
<i>Epochnium phyllogenum</i> , K. & Cke	on leaves	39
<i>Eurotium herbariorum</i> (?)	on Dried leaves of <i>Cephalanthus</i>	3920
<i>Fusicladium fuliginosum</i> , K. & Cke	on <i>Greyia Sutherlandi</i> , H. & H.	9
<i>Graphiola phœnicis</i> , Poir	on <i>Phoenix reclinata</i> , Jacq	554
<i>Hamaspora longissima</i> , Kan	on <i>Rhynchosia</i> , sp	24
<i>Hemileia vastatrix</i> , Berk	on <i>Coffea arabica</i>	(?)
" <i>Woodii</i> , K. & Cke	on <i>Vangueria infausta</i> , Burch	28
<i>Leptosphaerella helichrysi</i> , Cke	on <i>Helichrysum</i> , sp	683
<i>Melampsora hypericorum</i> , Schr	on <i>Hypericum Lalandü</i> , Choisy	610
" <i>stratosa</i> , Cke	on <i>Croton sylvaticus</i> , Hochst	466
<i>Meliola amphitricha</i> , Fr	on <i>Plectranthus ciliatus</i> , E. M.	604
" <i>bifida</i> , Cke	on <i>Osyridocarpus natalensis</i> , Juss	(?)
" <i>inermis</i> , K. & Cke	on <i>Buddleia</i> , sp	570
" <i>Mitchellae</i> , Cke	on <i>Acridocarpus natalitius</i> , Juss	575
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In quoting these numbers the letter A must be prefixed to all those below 1,000.

MOSSES.

<i>Atrichum polyphyllum</i> , Rehm	<i>Fissidens glaucescens</i> , C. M.
<i>Brachymenium pulchrum</i> , Hook	„ <i>natalensis</i> , Rehm
<i>Brachythecium Dicksoni</i> , Rehm	„ <i>Rehmanni</i> , C. M.
„ <i>erythropycis</i> , Rehm	<i>Funaria hygrometica</i> , L. var
<i>Bryum argutideus</i> , (?)	<i>Grimmia apocarpa</i> , L.
„ <i>integrifolium</i> , Rehm	<i>Hedwiggia Macowanii</i> , C. M.
„ <i>leucothrix</i> , C. M.	<i>Hookeria macropyxis</i> , Rehm
<i>Calicostella tristis</i> , Rehm	„ <i>Woodii</i> , Rehm
„ „ var <i>atrovirens</i>	<i>Hypnum argenteum</i> , Rehm
<i>Campylopus chlorotrichus</i> , C. M.	„ <i>brevifolium</i> , Rehm
„ <i>Inandae</i> , Rehm	„ <i>cygnicollum</i> , Rehm
„ <i>Woodii</i> , Rehm	„ <i>gracillimum</i> , Rehm
<i>Dicranella Bergiana</i> , (?)	„ <i>malii</i> , Rehm
„ <i>graciliramea</i> , Rehm	<i>Hypnum mucronatum</i> , Rehm
<i>Entodon Dregeana</i> , (?)	„ <i>natalense</i> , Rehm
„ <i>enervis</i> , Rehm	„ <i>Woodii</i> , Rehm
<i>Entosthodon marginatus</i> , C. M.	<i>Leptotrichum capense</i> , C. M.
<i>Eurhynchium brevirostre</i> , (?)	<i>Leucoloma Woodii</i> , C. M.
„ <i>cavifolium</i> , Rehm	<i>Neckera capensis</i> , C. M.
„ <i>Shawii</i> , Rehm	„ <i>pteropus</i> , C. M.
<i>Fabronia Rehmanni</i> , (?)	<i>Octoblepharium album</i> , (?)

<i>Octodicerus capensis</i> , C. M.	<i>Rhynchothegium sphaeropyxis</i> , Rehm
<i>Papillaria africana</i> , C. M.	
" " " var	<i>Rhizogonum spiniforme</i> , Rehm
" natalensis, Rehm	<i>Schlotheimia Grevilleana</i> , Nutt
<i>Philonotis africana</i> , Rehm	<i>Schlotheimia rufo-aeruginosae</i> , Rehm
" Woodii, Rehm	
<i>Plagiothecium membranosolum</i> , C. M.	<i>Sphagnum oligodon</i> , Rehm
	<i>Splachnum natalense</i> , Rehm
<i>Pogonatum</i> , sp	<i>Syrrhopodon uncifolius</i> , C. M.
<i>Politrichum Buchanani</i> , Rehm	<i>Trematodon lingulatus</i> , Rehm
" sp	" <i>tortilis</i> , Rehm
<i>Porotrichum pennaeforme</i> , Rehm	<i>Trichostomum Bainesii</i> , Rehm
<i>Rhynchothegium sphaerotheca</i> , Rehm	" <i>riparium</i> , Rehm

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J. MEDLEY WOOD.

