On the Zonal Distribution of South Atlantic and Antarctic Vegetation
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brushing through the grass. On the following day the steamer stuck near the junction of the Atem and Mading with the Awai, but, proceeding in the launch, the party went down the Mading as far as Gurung's "Meshra." All three rivers swarm with hippopotamus. Afterwards the Awai was explored below the spill into the main river, and was found to lead to a series of lakes reached by Colonel Peake from Shambe during the sudd-cutting operations, the steamer then turning back. Subsequently inquiries were made at Bor as to the channel by which the Dervishers had made their way to Twi, but no such channel could be found. Returning, therefore, to the point of junction of the Awai, Atem, and Mading, the last-named was traced till it became very small, a mile before its final disappearance. Up-stream, on the Atem, firm ground with forest containing fine trees approached close to the east bank, which remains good as far as Tu, the southernmost village of Fakeir, itself the southern district of Twi. The river was said to be blocked by sudd some 10 miles further on. It varies considerably in width and depth, but the least depth found, in the best channel, was 4 feet. The Mading is at first a fine river 80 yards wide, but most of the water soon spills away into the marsh. The Awai is, as a rule, a deep river (9 to 12 feet), but there are shallower parts, and its width varies very much. All along the Awai and Atem there are innumerable "mayas" and spills in and out of the rivers.

The accompanying map is a reduction of Captain Liddell's sketch, which was based on—

(1) A compass sketch from Taufikia to Twi, with halting-places fixed astronomically.

(2) Captain Lyons' survey of the Bahr-el-Jebel.

(3) A compass sketch of the channels between Twi and Shambe adjusted to Captain Lyons' survey.

ON THE ZONAL DISTRIBUTION OF SOUTH ATLANTIC AND ANTARCTIC VEGETATION.*

PRELIMINARY REPORT.

By C. SKOTTSBERG, Botanist of the Swedish Antarctic Expedition, 1901—1903.

ONE of the most important objects for the Swedish Antarctic Expedition was to investigate all biological, and especially zoo- and phyto-geographical, conditions in the southern lands and around their coasts. Fortunately, I had good opportunities of studying the nature of different countries; those in which I have been able to make botanical observations are the Falkland islands, South Georgia, Tierra del Fuego, the Isla de los Estados, the South Shetland islands, and Graham Land, with a number of islets near its coasts.

Here I can only make a preliminary communication as to the phytogeographical results obtained, leaving all details for another paper.

* Map, p. 657.

I. The Land Vegetation.

Which vegetation has the right to be regarded as Antarctic?

Before we had any knowledge that a real vegetable life exists in Antarctic lands, one used to comprehend the floras of the Tierra del Fuego, South Georgia, the Falkland islands, Kerguelen Land, the Auckland group, etc., together with the faint traces of a plant life found in the neighbourhood of Graham Land, under the name of *Flora antarctica*.* But if we have regard to the present geographical definition of the Antarctic zone, we find at once that a great section of the above-mentioned floras cannot with any right claim to be designated Antarctic. The geographical principle, which takes the normal northern extension of drift sea-ice (not icebergs) as the northern limit of the Antarctic region, seems to me rather natural; and Graham Land, with its islands, the South Shetlands, the South Orkneys, and South Georgia, with the South Sandwich islands, though within the Atlantic, have thus to be considered as Antarctic. From my study of the vegetation in some of these regions, I am of opinion that it is not in all cases truly Antarctic, still less so in the case of the Falkland islands or Tierra del Fuego.

It seems to me appropriate, for the lands south of 40–50° S, to propose the following phytogeographical zones: the *Austral* zone, including Tierra del Fuego, with the Isla de los Estados, the Falkland islands, South Georgia, and no doubt also the South Sandwich islands; and the *Antarctic* zone, including South Orkney and South Shetland islands, and Graham Land, with its surrounding groups of islands. The Austral zone is characterized by a climate which permits the existence of forests or grassland; the Antarctic climate giving origin to a cold desert.†

If we survey the vegetation of the Austral regions, we shall find, going from the west to the east, the luxuriant forests of West Fuegia gradually change into the South Georgian grassland, which exists under very hard conditions, and therefore is very poor.

Tierra del Fuego.—Brought by the predominating westerly and south-westerly winds, a very great quantity of rain and snow drenches the south and west Fuegian islands. The following table ‡ speaks in the main for itself. As to the great mass of

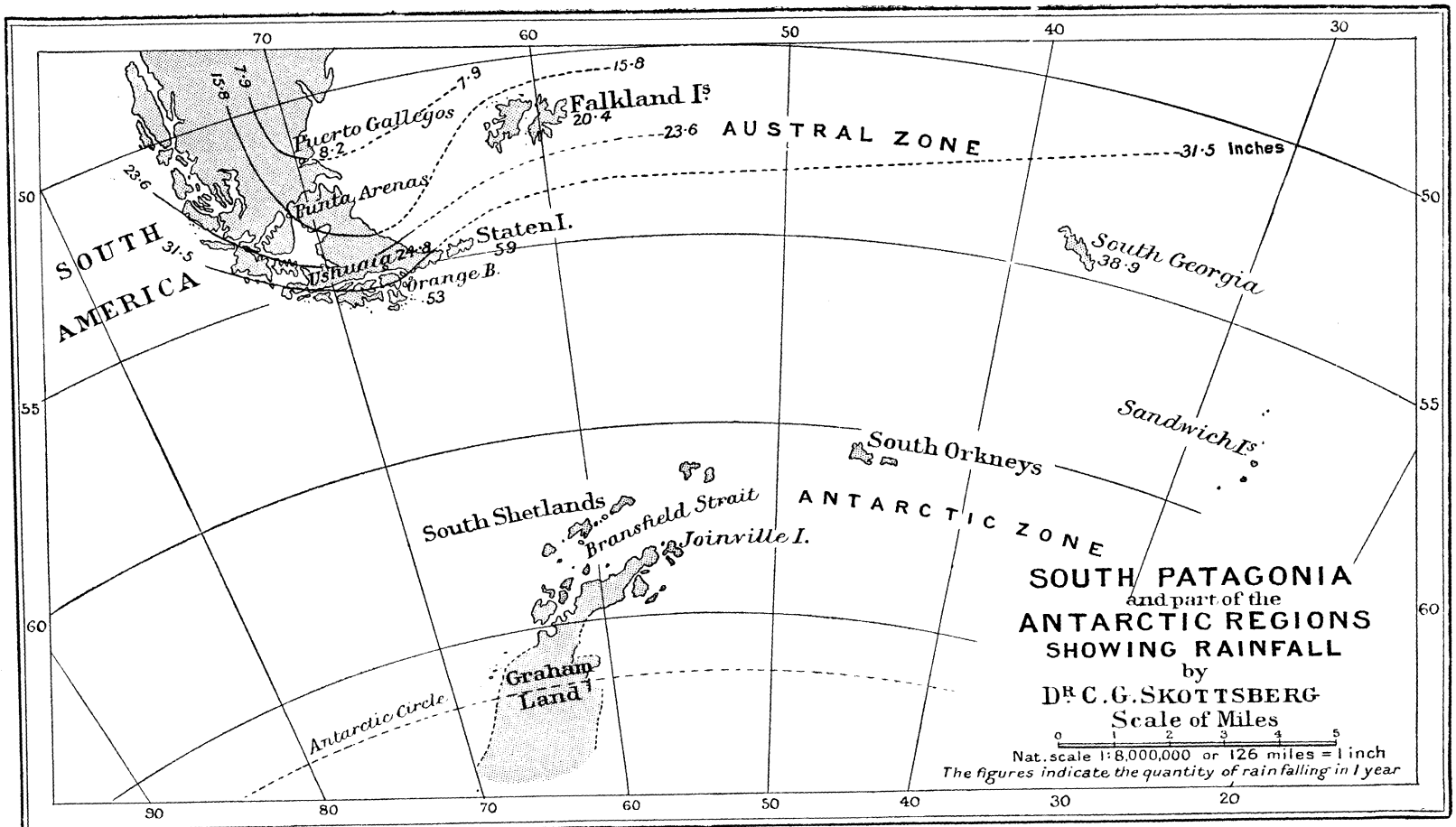
Tierra del Fuego, Orange Bay. Lat. 55° 31′ S., Long. 68° 5′ W. 1882–83.

Month.	Mean temperature. Fahr.	Means of max. temperature. Fahr.	Means of min. temperature. Fahr.	Mean humidity of air. Per cent.	Mean strength of wind. Ft. per sec.	Days with rain or snow.	Days with snow.	Rain and snow. Inches.
	°	°	°					
October ...	42·40	51·42	34·66	83·3	18·0	26	6	3·2
November ...	44·29	53·20	36·59	82·4	24·5	28	3	5·0
December ...	46·22	55·45	38·32	83·0	24·7	29	2	5·9
January ...	46·00	51·35	38·82	83·1	30·1	28	7	6·4
February ...	48·05	60·33	39·79	80·6	25·5	27	2	3·4
March	42·62	51·26	36·91	79·5	21·6	26	4	6·0
April	40·89	46·87	35·17	83·9	19·3	26	4	7·0
May	39·91	44·98	34·88	83·2	19·5	25	9	4·5
June	36·19	40·30	31·37	88·1	18·2	23	9	4·8
July	37·76	42·78	35·54	82·0	19·8	21	11	1·5
August ...	37·45	43·70	32·09	76·1	19·3	25	13	5·4
Year (eleven months)	41·98	49·24	35·83	82·3	21·9	284	70	53·1

* For instance, Drude, 'Atlas der Pflazenverbeitung.' Gotha: 1887.

† Schimper, 'Pflanzengeographie,' p. 177. Jena: 1898.

‡ My information on the Fuegian climate is from 'Mission Scientifique du Cap Horn, 1882–83,' t. ii. Paris: 1885.



rain and snow, I find it rather remarkable that the number of snowy days is so great. But a glance at the more detailed table shows that the snow very often appears mixed with rain; and that falls of pure snow even at a lower temperature are rare. Thus, it is easy to understand that the snow never lies many hours in the forest, being half melted when falling. The direction of the wind is mostly west-south-west, and the strength very great. The sky is very cloudy, and the humidity of the air great.

These climatological conditions have nourished a typical rain-forest. It consists mainly of a kind of beech, the *Nothofagus betuloides* (Mirb.), Blume, a low tree with small leathery leaves. This, as well as two other trees rather common amongst the beech, *Drimys Winteri* (Forst.) and *Maytenus magellanica* (Lam.), Hook. fil., is evergreen. The *Nothofagus antarctica* (Forst.), Blume, which is deciduous, plays a part only above the limits of the evergreens, the climatological factors allowing it to climb the mountains much higher up than this. The ground vegetation in the forests is very remarkable. It consists of carpets of exceedingly luxuriant *hepaticæ*, of many types and species, while the phanerogamic are rather sparely represented. As a characteristic species, climbing the trunks of the trees, I only mention the *Lebetanthus myrsinites* (Lam.), Endl.

As the map shows, the rainy region makes a curve towards the north-east, including the Isla de los Estados. Here we find the largest quantity of annual rain observed in the regions treated in this paper—not less than 1500 mm.* The main character of the forest is quite the same as in other parts of the rainy zone. Towards the north and east this zone presently passes into a region with much less rain; here Ushuaia, the Fuegian capital, is a station for meteorological observations. I refer to the publications by the 'Mission scientifique du Cap Horn,' and the paper by Dr. Chavanne. Unfortunately, this paper only shows the average temperature and rainfall for the four seasons, and not for the months, nor the specially important averages of the extreme temperatures †; as to the quantity of snow there is no information.

TIERRA DEL FUEGO, USHUAIA. LAT. 54° 49′ 30″ S., LONG. 68° 18′ 8″ W. 1882-3.

Months.	Mean temperature. Fahr.	Means of max. temperature. Fahr.	Means of min. temperature. Fahr.	Mean humidity of air. Per cent.	Mean strength of wind. Ft. per sec.	Days with rain or snow.	Days with snow.	Rain and snow. Inches.
	°	°	°					
December ...	49·57	59·67	38·91	73·4	7·5	14	0	2·5
January ...	49·55	58·87	39·72	75·8	7·5	19	1	2·3
February ...	52·02	64·54	38·57	75·4	8·8	12	1	1·8
March	45·80	58·33	36·55	79·8	6·9	18	0	3·1
April	42·46	50·45	33·10	75·1	6·9	15	5	2·0
May	39·61	48·36	32·57	75·2	7·2	19	3	1·9
June	35·11	41·07	28·60	78·9	4·9	13	5	2·2
July	37·24	45·03	30·13	72·4	6·5	8	5	1·3
August ...	40·01	48·81	31·60	72·0	6·2	9	3	1·4
September ...	39·40	48·95	31·42	75·1	4·9	14	6	2·9
October ...	46·49	54·80	35·74	67·8	6·2	14	0	1·8
November ...	46·18	53·87	37·02	64·5	6·9	15	2	3·1
Year	43·63	52·73	34·50	73·8	6·7	170	31	26·3

* Chavanne, 'Die Temperatur und Regenverhältnisse Argentiniens. Veröff. der Deutschen Akademischen Vereinigung.' Buenos Aires: 1903.

† Schimper, *l.c.*, p. 191.

USHUAIA. OBSERVATIONS DURING TEN YEARS. AFTER CHAVANN.

Season.	Mean temperature. Fahr.	Rain and snow. Inches.
	°	
Spring	43·70	4·02
Summer	50·18	8·50
Autumn	42·80	7·56
Winter	34·70	4·72
Year	42·84	24·80

The tables show distinctly the difference between this climate and that referred to above. But they do not give an exact idea of the snow conditions in this part: one would think that, in the rainy region, we should also get more snow. It would have been a great advantage to have had exact figures of the quantity of snow falling, not only the days with snow. Very likely the quantity is greater in Ushuaia than in Orange bay.

And there is an important difference bearing on the constitution of forests: according to our experience of the winter round Ushuaia (September 16 to November 5, 1902), big masses of snow lie in the forests for weeks. The direction of wind is about the same, but there is a great difference as to strength. The nebulosity and relative humidity of air are less too.

The vegetation completely corresponds to the climate. Here we meet with summer-green forests, in the winter presenting about the same aspect as those in Scandinavia. *Nothofagus antarctica* (Forst.), Blume, prevails, mixed with rare and tiny specimens of *N. betuloides* (Mirb.), Blume, *Maytenus magellanica* (Lam.), Hook. fil., and *Drimys Winteri* (Forst.). Also here *N. betuloides* does not go so high above the sea-level as *N. antarctica* (Forst.), Blume. The bushes in the wood are here, as well as further south, evergreen. The ground in the summer-green forest is destitute of a coherent moss carpet; the open spaces are occupied by meadows; the *hepaticæ* are few in number in comparison with the *musci*.

After passing the ridge of the Cordillera, the wind has parted with most of its humidity, and the climate of eastern Fuegia and Patagonia gets more and more dry. The vegetation gradually becomes rather poor and sterile, only the rivers being surrounded by woods. As an example, I may mention Puerto Gallegos in 51° 39′ S., 69° 13′ W., where meteorological observations have been made during two years.

PATAGONIA, PUERTO GALLEGOS. LAT. 51° 39′ S., LONG. 69° 13′ W. AFTER CHAVANNE.

Season.	Mean temperature of air. Fahr.	Rain and snow. Inches.
	°	
Spring	46·22	1·10
Summer	54·68	1·41
Autumn	45·32	3·42
Winter	35·24	2·28
Year	45·36	8·21

The Falkland Islands.—The south-west winds have to pass a broad space of water on their way to the Falkland islands; and, though we cannot expect the

same quantity of rain as in southern Fuegia, it is not surprising that the rainfall is considerably greater than in the corresponding latitude on the eastern coast of South America. It is true that the quantity of rain is smaller than round Ushuaia, but nevertheless it must be considered as quite sufficient for a summer-green forest; yet on these large islands there does not exist a wild tree—the ground is covered by a boggy grassland.

Schimper* considers the climate of the Falkland islands as warm-temperate—in my opinion without any reason; the tables show that no month reaches an annual medium of 50° Fahr., and therefore the cold-temperate might be a more adequate designation.

As Schimper points out, the climate is especially favourable for the existence of grassland and meadows. But this fact does not account for the complete absence of any arboreous vegetation.

FALKLAND ISLANDS, PORT STANLEY. LAT. 51° 41′ S., LONG. 57° 51′ W. 1875–77.

Zeitschrift d. oesterr. Gesellsch. f. Meteorologie, B. xvi. (Wien, 1881).

Month.	Mean temperature. Fahr.	Means of max. temperature. Fahr.	Means of min. temperature. Fahr.	Mean humidity of air. Per cent.	Days with rain or snow.	Rain and snow. Inches.
	°	°	°			
December	46·76	53·06	40·46	76	21·0	2·0
January	49·64	56·12	43·16	72	21·3	2·7
February	48·56	55·04	42·08	76	19·3	2·2
March	48·56	54·32	42·80	81	18·3	1·7
April	43·88	49·10	37·40	84	22·3	2·1
May	40·28	44·60	35·96	90	19·3	1·7
June	37·94	41·54	34·16	91	20·0	1·5
July	36·50	40·64	32·36	91	20·3	1·8
August	37·58	42·08	33·08	88	22·0	1·2
September	39·92	45·14	34·70	81	15·7	1·1
October	41·00	46·40	35·60	82	21·3	1·3
November	44·78	50·54	39·02	76	15·3	1·1
Year	42·94	48·21	37·57	82	236·1	20·4

Without doubt, the rain is sufficient for a summer-green forest, but it is too uniformly distributed over the twelve months. And, what the table does not tell, the ground is deprived of a cover of snow; we cannot take into account the more or less extensive but always thin patches which sometimes cover the ground, especially the slopes of the mountains, for a week or so.† This want of snow in the winter and spring, combined with an exceedingly strong wind from the south-west, blowing day after day at relative low temperatures, has, I dare say, influenced the characters of the Falkland vegetation. Large areas of the ground consist of peat. Nowhere, especially on the eastern island, is there any shelter from the wind.

If we look at the distribution of rain in the four seasons, we shall find that winter and spring show the smallest quantities. It is of interest that the wind at that time of the year blows more from the west and north-west; summer and autumn, with south-west and south wind, are richer in rain. Calm days are more

* *L.c.*, p. 481.

† The winter—July, August, 1902—we stayed there was considered the strongest for at least fifteen years.

common in the winter, but always rare. The winter temperature is not very low, seldom lower than some degrees below freezing, but always, together with the heavy gales, very dangerous for trees, which are not then able to recover the moisture lost by transpiration.

South Georgia.—We might expect South Georgia to receive a great quantity of rain or snow from the winds of the ocean, and the observations made hitherto confirm this. On the contrary to the case of the Falkland islands, we here meet with a high land covered with ice, which sends glaciers down to the fiords. In spite of that, the general aspect of the island is not quite Antarctic, owing to the large areas of lowland with vegetation.

South Georgia, Royal Bay, Lat. 54° 31′ S., Long. 36° W. German Station, 1882–83.

Month.	Mean temperature. Fahr.	Means of max. temperature. Fahr.	Means of min. temperature. Fahr.	Mean humidity of air. Per cent.	Mean strength of wind. Ft. per sec.	Days with rain or snow.	Days with snow.	Rain and snow. Inches.
	°	°	°					
September ...	30·38	35·60	25·34	—	25·3	10	9	5·0
October ...	34·34	39·20	29·66	—	21·6	26	21	4·6
November ...	37·22	41·90	32·54	76·2	17·1	29	19	2·8
December ...	38·66	43·70	34·34	73·9	23·6	30	19	2·9
January ...	40·28	44·96	35·96	71·9	20·7	28	15	3·2
February ...	41·72	46·58	36·32	70·9	23·0	23	13	3·4
March ...	38·30	42·98	34·34	72·6	22·0	26	16	5·8
April ...	32·90	37·40	29·12	77·3	22·6	25	23	3·2
May	31·64	35·96	26·78	—	21·0	27	25	0·6
June ...	26·78	31·10	22·64	75·9	18·7	25	23	2·1
July	27·86	32·18	22·64	72·6	23·3	25	21	1·4
August ...	34·16	39·38	28·76	72·3	27·6	27	18	3·9
Year ...	34·52	39·25	29·87	—	22·2	301	22·2	38·9

The large mass of rain and snow is not very equably distributed; especially remarkable are the months of March and May. The winter is comparatively dry, but as a rule only snow falls and covers the country with a thick layer.* The spring has the greatest quantity of rain or snow. The hydro-meteorological conditions thus do not put any obstacle in the way of an arboracious, even an evergreen, vegetation; but still there is neither tree nor bush. Certainly there is not much lowland to bear a forest, but there is enough. The other climatological factors explain the condition. We have to do with very low summer temperatures, not seldom below freezing, and with gales of great strength, which suddenly with impetuosity break down from the glaciers over the completely exposed ground.

The paucity in phanerogamic species seems to me inexplicable. The few that exist are, as far as we now know, identical with Fuegian and Falklandian plants, and surely more species of those floras should be able to endure the South Georgian climate. The problem gets more difficult still when we think of the numerous cryptogamic species, amongst which a great percentage is endemic. The story of the geographical development and the former large extension of the inland ice will perhaps give an answer to the question.

As I stated already in the beginning of this paper, geographers regard South

* Skottsberg, 'The Geographical Distribution of Vegetation in South Georgia,' *Geographical Journal*, November, 1902 (London: 1902).

Georgia as a real Antarctic land; I also said that this, from a botanical (phytogeographical) point of view, is not my opinion. The vegetation is nearly related to that of the Falkland islands; the lowland is covered by the Austral steppe, and the tussock grass *Poa cæspitosa* (Forst.), Hook. fil., plays the same part as once in the Falkland islands. An important difference between the two floras is that *Empetrum rubrum*, Vahl., one of the most characteristic Falkland plants, does not grow in South Georgia. When my collections are determined, I hope that we shall be a little better informed on the phytogeographical position of that island. Very likely some of the endemic mosses will prove to be identical with others described from other South Atlantic lands.

The *South Sandwich Islands* have never been visited by scientists, and we know nothing about their phytogeographical position. But I conclude that they are nearly related to South Georgia, though perhaps still poorer; their vegetable life perhaps forms a still more apparent transition to the Antarctic.

The Antarctic Zone.—The Antarctic lands, here referred to, are—Graham Land with its subdivisions* (King Oscar II. Land, Palmer Land, Louis Philippe Land, Danco Land) and surrounding groups of islands (Dirk Gherritz Archipelago, Trinity island, Joinville, and Dundee islands, etc.), and the South Shetland islands, the Elephant islands and the South Orkney islands.

The Antarctic zone may be called a cold-desert zone. The climate does not admit the existence of a close vegetation of forest or even grass, not because of an especially low winter temperature, but because the summer is very cold, the ground being frozen almost all the year; further, the wind is really formidable. On the coasts of the main land we cannot hope to make richer finds, because of the inland ice, that covers the land down to the sea-level, steep rocks being very often the only spots of bare ground. But all the small islets are free from ice, and, in summer, from snow too, and there we have to look for the richest Antarctic flora. I have not seen very much of the South Shetlands, but in one location (Harmony Cove, Nelson Island) I made acquaintance with one of the most dense and fine-looking moss carpets I ever saw down there. The islets at the west coast of Louis Philippe Land and in the Gerlache Strait are also in possession of a relatively rich flora, but here

Snow Hill Island, Lat. 64° 24′ S., Long. 57° 6′ W. 1902-03.

Month.	Mean temperature. Fahr.	Means of max. temperature. Fahr.	Means of min. temperature. Fahr.	Mean strength of wind. Ft. per sec.	Days with snow or rain.
	°	°	°		
March	13·28	18·50	7·88	36·15	29
April	7·16	15·08	−0·22	24·93	25
May	−0·76	7·70	−8·68	28·22	27
June	−3·46	1·22	−16·96	28·22	21
July	−5·62	3·38	−13·90	31·17	27
August	−2·92	8·78	−13·00	28·87	20
September	3·74	12·20	−4·18	25·59	20
October	15·08	23·00	6·80	24·93	23
November	17·42	21·74	12·92	24·61	26
December	28·40	32·90	23·36	13·20	15
January	30·38	34·16	27·14	19·69	22
February	25·70	33·80	20·84	22·97	22
Year	10·70	17·70	3·50	25·76	277

* In "Antarctic" (Stockholm, 1904) Mr. Nordenskjöld has proposed the name "West Antarctic" for these parts of the south polar lands.

of course, as in all Antarctic lands, the phanerogamic plants play no part in the general aspect presented by the vegetation; it is not many places where the only Antarctic phanerogamic, *Deschampsia antarctica*, Hook., is found, and very sparely indeed. And, generally, the mosses and lichens do not form a compact, close carpet, but grow in small tufts in the fissures or between the stones.

The penguins are perhaps one of the most inimical influences of Antarctic plants. On many places where the Antarctic flora might have attained a rich development, we find the ground completely covered by penguin rookeries, not leaving as much as a square inch free from guano. A striking example of the influence of the penguin rookeries is Paulet island. There all the level ground, all the slopes, when not too steep, are quite covered with penguins. The vegetation has been forced to withdraw to the upper plateaus round the top of the island. That leads me to think of a statement, made without any reason, that the vertical limit of Antarctic vegetation is to be drawn at 100 feet above the sea-level.* On the top of Paulet island, at a height of 1200 feet, we still find spots of mosses and lichens encrusting the stones.

As to the relations between Antarctic plants and other plants of the world, we know very little. The musci collected by Mr. Racovitza during the Belgian expedition were twenty-seven, of which fifteen were new species.† The others are more or less identical with species found on the northern hemisphere; some exist in the Magellan territories too. One species is found only in South Georgia and in the Antarctic. The hepaticæ, three kinds, are remarkable because two of them were described from South Georgia before. ‡

For many years there has been a special interest in the question of bipolarity. A superficial glance at my Antarctic collections shows great concordance with northern and arctic plants, but it has to be proved that we have to do with real bipolar or merely with cosmopolitan species.

YEARLY MEAN TEMPERATURE AND RAIN (SNOW, HAIL, ETC.).

	Temperature. Fahr.	Rainfall. Inches.
	°	
Tierra del Fuego, Orange bay ...	41·99	53·50
Isla de los Estados	42·30	59·10
Tierra del Fuego, Ushuaia	43·63	26·38
Patagonia, Puerto Gallegos	45·37	8·23
Falkland Islands	42·98	20·36
South Georgia	34·52	38·89

II. THE VEGETATION OF THE OCEAN.

As to the flora of the South Atlantic ocean, also here we, in my opinion, find the same limit between Austral and Antarctic vegetation.

The *Austral flora* is characterized by the existence of types of algæ with, in one way or another, floating fronds. *Macrocystis pyrifera* (Turn.), Ag., and *Durvillea utilis*, Boy., are the most representative Austral algæ. The *Macrocystis* surrounds

* A. Ohlin, "Om antarktiska färder och Antarktis," *Ymer*. Stockholm: 1898.

† Y. Cardot, 'Mousses' ('Résultats du voyage de S.Y. *Belgia*,' Anvers, 1903).

‡ F. Stephani, 'Hépatiques' ('Résultats du voyage de S.Y. *Belgia*,' Anvers, 1903).

the coasts of Tierra del Fuego, the Falkland islands, and South Georgia.* It would be interesting to know if it also lives round the South Sandwich islands. I do not know if the Scottish South Polar Expedition has found the *Macrocystis* in the South Orkneys, but I should think not.† Other characteristic algæ are the Lessonias.

The *Antarctic vegetation* is characterized by the total absence of a type with floating fronds (except the *Marginaria jaquinoti* (Mont.), floating when torn off from the bottom). Such a type would be quite inconsistent with the ice-conditions. The vegetation of the beach is influenced in its character by the ice-floes always grinding against the stones, and has been forced to retire into the small basins, where the ice-floes cannot come. Giant algæ are not at all wanting, especially the *Desmarestiæ*, but in a greater depth. Here, as in more northern shores, calcareous algæ form an important part of the vegetation.

The extension of the Austral and Antarctic zones into the Indian and Pacific oceans has not been referred to here. As botanically Antarctic lands we perhaps ought to consider Enderby and Kemp Land, the different parts of Wilkes Land, Victoria Land with Balleny islands, and Alexander Land with the Biscoe islands. Austral lands are Bouvet island, Prince Edward and Crozet islands, Kerguelen, MacDonald and Heard islands, New Zealand and Antipode, Chatham, Auckland, Campbell, Macquarie, and Emerald islands.

The northern limit of Austral vegetation seems to me difficult to define. I think that the 40° S., of course with some deviations to the north or south, more or less limits it. To this question, as well as to the circumpolar extension of Austral vegetation, I shall return another time.

GRUEBER AND DORVILLE'S JOURNEY ACROSS TIBET.

To the Berlin *Zeitschrift der Gesellschaft für Erdkunde* for 1904, No. 5, Herr R. Tronnier contributes a monograph on the journey made in 1661 across Tibet by the Jesuits, Johannes Grueber and Albert de Dorville. Subjoined is a summary of the results.

The object of the present study is to vindicate for the German, Johannes Grueber, the place to which he seems entitled in the history of geographical progress, but which has certainly not hitherto been conceded to him. He is certainly not the first European that crossed Tibet, as Odorico de Pordenone's journey shortly before 1330 can scarcely be called in doubt. But he is the first who brought back with him a genuine record of the land and its people. Although a Jesuit, he did not go to Lhasa as a missionary like his precursor and his immediate successors; he went on a real geographical mission, imposed by the necessity of finding a new home route to Europe, a route which at the time was supposed to be still untrodden.

Authentic documents referring to the journey are not very numerous. They comprise five of Grueber's letters, a Latin report of the Jesuit, Athanasius Kircher, and lastly a long Italian "Relazione" by an uncertain author. The chief difficulty in reconstructing the journey lies in the fact that these scanty materials present great discrepancies, to reconcile which, where at all possible, is the purpose of this essay.

Grueber's Letters.—I. The earliest extant, dated from Surat (India), March 7,

* Skottsberg, "Några ord om Macrocystis pyrifera," *Bot. Notiser*, 1903, No. 2.

† Since this was written, I learn that the Scottish Expedition has reported three mosses, six lichens, and some algæ from the South Orkneys, but *not Macrocystis*.