caterpillars, while contradictory if we were inclined to form too hastily a generalization based on the behavior of the *Porthetria* larvæ —a generalization that would explain the going up to light as a reflex which had persisted among all leaf-feeding lepidopterous larvæ because of its advantageous leading of them to the most succulent food—is not at all contradictory of the point of view of the biologist who believes in reflexes. Personally, while still inclined to see more wit in ants than Bethe's extreme confidence in the reflex theory of their behavior would admit, and while recognizing the reasonableness and legitimacy of the query, does the reflex basis of behavior really simplify our conception of the springs of animal behavior?—I am willing, on the evidence of the accumulating observations, to see much of the credit which insects have long enjoyed for the possession of unusual intellectuality and elaborately developed instinct, go by the board. Immediate physico-chemical stimuli undoubtedly produce as direct reflexive reactions many of the activities which we have been long interpreting on a basis of complex instincts and associative memory.

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NOTES ON THE VEGETATION OF THE TRANSVAAL.

Before coming to the Transvaal I was informed by a botanist who had some knowledge of the South African flora that the flora of the Transvaal was entirely xerophytic in character, and that it was largely composed of succulent plants—*Euphorbias, Aloes, Mesembryanthemums, Cotyledons, Crassulas* and the like. In my informant's mind it was apparently a continuation of the flora of the Great Karroo.

Imagine my astonishment, therefore, after crossing the Karroo, with its dreary plains so like those of the Great Basin of North America, even in the general aspect and color of its vegetation, to find myself, on waking up one morning, crossing a vast, grassy plateau, the high veldt, practically destitute of trees or shrubs, but producing masses of tall, thick grass, recalling the prairies of the far west. Later I found that this was a fair sample of the vast stretch of country extending from the confines of the Kalahari desert in the west to the summits of the Drakensberg in the east.

Grasses form the most conspicuous features of the Transvaal flora. This is true, at least, of the high veldt. They are only little less abundant in those parts of the bush veldt which I have seen.

Succulents are rare, being practically confined to rocky kopjes, *i. e.,* buttes, and the randjes, *i. e.,* ridges, which cross the country from east to west. Mesembryanthemums are extremely scarce. Bulb and corm-producing plants abound among the grass. A few bushes and small trees, evergreen *Proteas,* caulescent *Aloes* and *Cereus*-like *Euphorbias,* deciduous *Combretums,* etc., also occur on the kopjes and randjes. Patches of diminutive woodland, composed of Doorn-boom (*Acacia horrida*) five to fifteen feet high, are occasionally seen at long intervals in crossing the high veldt, usually in the vicinity of water.

As a rule, however, trees and shrubs are entirely absent. I have driven all day, a distance of sixty miles, without seeing more than one colony of bushes, that composed of about twenty-five individuals in all, and they not more than eighteen inches in height. In the moist vleis, on the other hand, some of the grasses—species of *Andropogon*—would be eight and even ten feet in height. In the absence of woody plants Kaffir and Boer alike fall back on 'mist,' *i. e.,* dried ox-dung, for fuel.

Grasses being, as I have said, the most conspicuous feature of the high veldt flora, one is naturally desirous of knowing what grasses occur, and in particular, which are the most abundant.

Although but little work has been done on the flora of the Transvaal, as compared with that done on the flora of California, for instance, a few good collections have been made, particularly by Wilms Rehmann, Nelson, Galpin and Rand, and sufficient grass material has been gathered by the three first named collectors to give a general idea of the occurrence of the genera. Much still remains

to be done, as my winter's collection of grasses shows, in working out the distribution of genera and species and the relative abundance and economic value of species and individuals. It is almost inevitable that a large number of additional species and some genera will be found, for whole districts of great size and varied climatic and edaphic conditions remain wholly untouched by the botanist.

A reference to Dr. Stapf's masterly enumeration of the Gramineæ, in Vol. VII. of the 'Flora Capensis,' shows that there are some 130 species of grasses recorded as occurring in the Transvaal. These represent 50 genera, or less than half of the 103 genera recorded for the whole South African flora, which includes the desert region of the Karroo and the subtropical coast region of Natal. Of these 50 genera, 44 are represented by species apparently indigenous, four—*Arundo, Poa, Bromus* and *Lolium*—by species certainly alien, while two, *Eleusine* and *Dactyloctenium*, may perhaps be considered doubtfully indigenous.

The limited number of alien species (only about seven) is remarkable as compared with the number found in such new countries as Cape Colony and California. This is due not only to the isolation of the Transvaal, with no coast-line and separated from the Cape by the Karroo, from the Atlantic coast by the Kalahari, and from the Natal coast by the Drakensberg, but also perhaps largely to the fact that so little intercourse has been held between its inhabitants and those of adjacent regions.

Fortunately for the horticulturist, all kinds of alien weeds are at present scarce.

This state of things can not be expected to last much longer, however, and we shall look for several more alien genera of grasses, with many additional species, to become naturalized within a short period. Judging by analogy, and with the instance of the plateau stock-ranges of the Pacific states of North America fresh in mind, it can scarcely be otherwise. With the introduction of thousands of head of cattle from Cape Colony, Madagascar, Europe and Texas, and of thousands of bags of seed-grain from Texas, Argentina, Algeria, Europe and Cape Colony, it would be remarkable if aliens were not largely introduced. Already at least two species of grasses, *Poa annua* and *Sorghum halepense*, have become naturalized in the Transvaal, apparently in the short time since the most recent of the material embodied in Dr. Stapf's paper was collected.

The following species, already established in South Africa, are to be expected as additions to the alien flora of the Transvaal, before very long: *Lolium multiflorum, Hordeum murinum, Bromus maximus, Bromus commutatus, Bromus arvensis, Bromus patulus, Vulpia myuros, Vulpia bromoides, Briza minor, Briza maxima, Dactylis glomerata, Aira caryophyllea, Holcus lanatus, Cynosurus echinatus, Lamarckia aurea, Phalaris minor, Tragus racemosus, Panicum crus-galli, Avena fatua* and *Avena sterilis*.

Far more remarkable and interesting than the scarcity of alien grasses is the distribution of the fifty genera among the eighteen tribes of Dr. Stapf's classification. One of the most interesting points is the fact that nineteen of the genera belong to the two closely related tribes Andropogoneæ and Paniceæ; of the eleven South African genera of Andropogoneæ and eleven genera of Paniceæ, ten and nine respectively are represented by species indigenous to the Transvaal. Of the tribe Chlorideæ, nine of the twelve South African genera are represented, while all of the four genera of Eragrosteæ and the three of Arundinelleæ occur.

On the other hand, we find that the tribe Aveneæ, with thirteen genera in South Africa, is represented in the Transvaal collections by a *single species* only. The Hordeæ with five genera, the Agrosteæ with four, the Phalarideæ and Bambuseæ with two, the Phareæ with one, are not represented by a single indigenous species, while the large tribe Festuceæ, with twenty genera (eighteen indigenous and two alien), has only four native genera and five native species, with two alien genera and two alien species. The Stipeæ, with three genera, is represented by only one,

Aristida, but of this there are ten species recorded from the region.

To gain a general idea of the grass flora of the Transvaal, it is well to note the genera containing the largest number of species. We find the following figures:

Eragrostis	has	23	species.
Andropogon	"	16	"
Panicum	"	12	"
Aristida	"	10	"
Setaria	"	6	"
Trichopteryx	"	4	"
Pennisetum	"	4	"
Sporobolus	"	4	"
Digitaria	"	3	"
Microchloa	"	3	"

Seven genera have only two species each.

Thirty-four genera are only represented by a single species. These include the well-known North American genera *Paspalum, Bromus* and *Poa,* all three represented by alien species. It is probable that native species of *Paspalum* will be found in some parts of the Transvaal.

In these notes I have used the word species in a broad sense, for convenience, enumerating as species some of Dr. Stapf's varieties.

Of the four largest genera, three—*Andropogon, Panicum* and *Aristida*—are well known to North American botanists, being prominently represented in the North American grass flora. With the exception of this apparent connection, which may not be as real as apparent, there is little or no relationship between the two floras.

Certain well-known North American genera, such as *Rottbaellia, Stenotaphrum, Kœleria, Trisetum, Avena, Danthonia, Agrostis, Calamagrostis, Stipa, Oryzopsis, Tragus, Spartina, Phalaris, Melica, Panicularia Puccinellia, Festuca, Poa, Bromus, Lepturus, Agropyron* and *Hordeum,* all of which occur in South Africa, are not represented by a single species indigenous to the Transvaal, and only two of these, *Poa* and *Bromus,* by alien species.

Three of the largest genera of South African grasses, *Danthonia* with twenty-five species, *Ehrharta* with twenty-five and *Pentaschistis* with thirty-eight, have not, so far, been found in the Transvaal collections.

With regard to the relative proportion of individuals, a very rapid reconnoissance of the high veldt made during early winter before the grasses had lost their inflorescences, showed that *Andropogons,* and perhaps in places *Anthistirias,* are the most characteristic grasses throughout the high veldt. Other genera are represented by scattered individuals or by relatively small colonies restricted by peculiar edaphic conditions.

From what little I have so far seen of the bush veldt and the low country, it would appear that grasses are almost as abundant there as on the high veldt, but there they cease to form so characteristic a feature of the vegetation because of the abundance and prominence of the bushes and trees.

Bermuda grass (*Capriola dactylon*) is widely distributed along roadsides, in lawns, in cattle kraals and on town lands where the oxen are outspanned, but it does not have the aspect of an indigenous grass. On the open veldt it is usually found at outspanning places, and covering old and deserted ant-heaps, but the patches are rarely connected. It is highly valued as a pasture grass and is closely eaten down by mules. The Boers state that it is readily introduced into the veldt by grazing closely with sheep.

The reed (*Phragmites vulgaris*) is common along almost every stream that I have crossed, from the sources of the Limpopo on the high veldt to the Mooi, Malmanie and Marico in the west, not far from Mafeking, and to the falls of the Koomatie at Koomatiepoort on the frontier of Portuguese East Africa. It has been called a distinct species by some writers, but Dr. Stapf does not consider it worthy of even varietal rank.

The adaptation of the vegetation to peculiar climatic conditions—a literally rainless winter season of four to five months (May to September inclusive) and a fair rainfall (twenty-five to thirty inches) during the rest of the year—is interestingly demonstrated by the development of the bulb-, corm- and tuber-producing habit. This is not confined to the families Amaryllidaceæ and Iridaceæ (which are well

represented), but extends to a remarkable extent to the Asclepiadaceæ and also to the Leguminosæ; probably other families are also affected. It seems likely that in the Transvaal this development enables the plant the better to survive adverse temporarily xerophytic conditions. It is particularly noticeable here that these plants are among the first to flower in the spring, and that many—I am not yet able to say with certainty, most—of them flower without a drop of rain having fallen for four or five months, and on dry hillsides where they are not affected by any subirrigation. It is true that there has been some heavy dew, but in some of these instances not enough to make the grasses and annuals start growth. As I write there are Liliaceæ, Iridaceæ and Asclepiadaceæ in bloom on some of the driest ridges of the high veldt, where scarcely a new blade of grass is to be found. It must not be inferred from this, however, that there is no green grass at this season. On areas of burned veldt the new growth of grass is in many cases quite perceptible even without any rain, perhaps owing to the effect of heavy dews.

JOSEPH BURTT DAVY.

BRAIN-WEIGHTS OF BROTHERS.

IN a former number of SCIENCE (XVII., No. 430, p. 516) the writer cited several brain-weights of brothers and sisters, mostly children. After the recent execution by electricity of the three Van Wormer brothers, the following data were obtained at the post-mortem examination:

	Willis.	Burton.	Fred.
Age	27	23	21
Stature (centimeters)	172.8	178.0	175.2
Head length	18.2	19 1	19.1
Head breadth	15.1	15 1	16.0
Cephalic index	82.9	79.0	83.7
Head circumference	53.3	54.1	56.1
Body-weight (estimated)	140 lbs.	145	150
Fresh brain-weight	1,340 gms.	1.358	1,600

The high weight of Frederick's brain occasioning some comment, it was again weighed after about five minutes' drainage, the second figure being 1,590 gms. The left hemicerebrum weighed 3 gms. more than the right in Willis's and 10 gms. less in Burton's, while in Frederick's case the two halves weighed exactly the same.

The physiognomy of the cerebral gyral conformation of the three brains is quite similar in some respects.

A full report will be published later. There was a well-marked postorbital limbus on the left side in Frederick's brain.

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RECENT ZOOPALEONTOLOGY.

SCHLOSSER'S LITERATURBERICHT.

DR. MAX SCHLOSSER, of Munich, continues his invaluable 'Literaturbericht' up to the close of the year 1900, and sends it to us as an abstract from the *Archiv für Anthropologie,* Bd. XXVIII. Like all the previous numbers of this review, which began in 1883, this is most welcome not only because our attention through it is directed to the entire literature, but because of the original critical notes which the author adds to the various abstracts which he presents.

AMERICAN OLIGOCENE MICROFAUNA.

IN the White River formation near Pipestone Springs, western Montana, Mr. Earl Douglass discovered a very interesting microfauna. The American Museum of Natural History in 1902 visited the same locality and secured a rich collection of small mammals, especially important because the *Titanotherium* beds of South Dakota have yielded only the large mammals of the period. The collection is described by Dr. W. D. Matthew* as including one marsupial allied to *Didelphys,* three Insectivora, including two new genera of an extremely primitive type, two species of Creodonta, two of Carnivora related to the dogs and mustelines respectively and six species of rodents. Among the horses is the primitive *Mesohippus westoni,* older in type than *Mesohippus bairdi.* The Artiodactyla are also represented by a variety of small forms. In this connection may also be

* 'The Fauna of the *Titanotherium* Beds of Pipestone Springs, Montana,' *Bull. Amer. Mus. Nat. Hist.,* Vol. XIX., 1903, art. VI., pp. 197–226.