A RECORD OF FRUITS AND SEEDS DISPERSED BY MAMMALS AND BIRDS FROM THE SINGIDA DISTRICT OF TANGANYIKA TERRITORY

By B. D. BURTT.

With a Postscript by E. J. Salisbury.

While the writer was stationed in the neighbourhood of Matelele in the Wembare Steppe region of the Singida District, his attention was drawn to the spoor of game and other mammals in order to ascertain, as far as possible, the mammal population and its influence on the invading Tsetse fly (*Glossina morsitans* Mig.). The abundance of seed occurring in the dung of elephant suggested that by the wanderings of these animals from one feeding ground to another, the dispersal of certain species of plants which produce seeds able to withstand the action of digestive juices was considerable. A study of the seeds in the dung of various common animals and birds was accordingly commenced; and also an examination of the stomach contents of various game that were shot in the neighbourhood during the months of August and September, 1927.

Mammals whose dung was investigated.

Elephant (*Loxodonta africana capensis*).
Black Rhinoceros (*Diceros bicornis bicornis*).
Masai Giraffe (*Giraffa camelopardalis tippelskirchi*).
Eland (*Taurotragus oryx pattersonianus*).
Thomson's Gazelle (*Gazella thomsoni thomsoni*).
Impalla (*Aepyceros melampus suara*).
Civet Cat (*Viverra civetta*).
Natives (Turus).
Cattle.

Birds whose dung or crops were investigated.

Turucu (*Turucas corythaix*).
"White Turucu."
Bulbul.
Turtle Dove.

Elephant. Species of plants whose seeds were found in the dung of elephant:

Acacia spirocarpa Hochst.
Adansonia digitata L.
Balanites aegyptiaca Del.
Balanites tomentosa Mildbr. & Schltr.
Borassus flabellifer L. var. aethiopum Warb
Commiphora ugogensis Engl.
Grewia Holstii Burret
Grewia pachycalyx K. Schm.
Grewia platyclada K. Schm.
Sclerocarya birrea A. Rich var. multifoliolata Engl.
Tamarindus indicus L.
Zizyphus mucronatus Lam.

Elephants feeding along the Ugwandi and Iwumbu Rivers showed great preference for the fruits of *Borassus flabellifer* L. var. *aethiopum* Warb., and their dung frequently contained seeds of this palm. In many instances a single seed was found in the "stool," while one stool revealed nine individual seeds. On three occasions the seeds were found to be germinating, the radicle having taken firm root in the soil.

Many clean seeds were found beneath the palm trees, having evidently had all the fruity fibrous coating removed by mastication and then expectorated. Elephants have a fondness for the pods of *Acacia spirocarpa* Hochst. as their dung usually contains seeds of this tree in considerable quantity. Seeds of *Adansonia digitata* L., *Balanites aegyptiaca* Del., *Balanites tomentosa* Mildbr. and *Tamarindus indicus* L. were found very rarely, a surprising fact, as these species are common in the neighbourhood of the seasonal rivers and are heavily laden with fruit. In several instances the fruits of *Sclerocarya birrea* (A. Rich) var. *multifoliolata* Engl. were found in elephant dung; on one occasion the fruits had passed through the digestive tracts of the animal with little harm to the softer tissues of the fruit. Seed of three species of Grewia (*Grewia Holstii* Burret, *Grewia pachycalyx* K. Schm., *Grewia platyclada* K. Schm.), abounded in the dung of elephant; some showed almost pure stools of "Thicket Grewia" seed, *Grewia Holstii* Burret, while those examined near the rivers contained almost pure seed of the "Riverine Grewia," *Grewia pachycalyx* K. Schm., seed of this plant having been carried approximately ten miles from the nearest locality for this species: leaves of *Tamarindus indicus* L. and *Hippocratea obtusifolia* Roxb., found in the dung with the seeds, confirm this. Other seeds found occasionally in the dung of elephant are those of *Zizyphus mucronatus* Lam. and *Commiphora ugogensis* Engl.

Rhinoceros. Species of plants whose seed were found in the dung of rhinoceros:

Acacia verugera Schweinf. — Grewia pachycalyx K. Schm.

Dung of rhinoceros was found to be chiefly composed of small wood chips: the only seeds found were those of *Acacia verugera* in quantities and a few of *Grewia pachycalyx* K. Schm., the latter species forming thickets in the riverine area that are frequented by rhinoceros.

Giraffe. Species of plants whose seeds were found in the dung of giraffe:

Acacia spirocarpa Hochst. — Randia Taylorii Spencer Moore

Giraffe show great liking for the fruit of *Acacia spirocarpa* Hochst., as seeds of this tree were usually present in the faecal pellets. Individual pellets contained from one to four seeds, while the seeds of *Randia Taylorii* Spencer Moore were commonly found in them.

Eland. Species of plants whose seeds were found in the dung of eland and in the stomach contents:

Acacia pallens Rolf
Acacia spirocarpa Hochst.
Acacia verugera Schweinf.
Adansonia digitata L.
Blepharis acanthodioides Klotzsch
Dichrostachys glomerata Hutch. & Dalz.
Strychnos pungens Sol.

Faecal pellets of eland found in the neighbourhood of rivers usually contained seed of *Acacia spirocarpa* Hochst. and *Acacia verugera* Schweinf., of whose pods these animals appear to be very fond.

The stomach contents of several eland were examined, usually revealing many seeds of *Acacia spirocarpa* Hochst., *Acacia verugera* Schweinf., and possibly *Dichrostachys glomerata* Hutch. & Dalz. On one occasion the seeds of *Adansonia digitata* L. and *Strychnos* (near) *pungens* Sol. were found, in the latter case the seeds had been injured and the value of eland being a factor in the dispersal of this plant is doubtful. In another case the seeds of a small spiny Acanthaceous plant, *Blepharis acanthoides* K., were found in great numbers in the large and small intestine; when dried out these seeds dehisce in the manner normal for the species. Apparently eland accidentally eat the seeds of this plant when feeding on the dry heads.

Thomson's Gazelle. Species of plants whose seeds were found in the stomach contents:

Acacia pallens Rolf
Acacia verugera Schweinf.
Balanites aegyptiaca Del.
Solanum Renschii Vatke

During the examination of the stomach contents of Thomson's gazelle, near the village of Iwumbu, five seeds of *Balanites aegyptiaca* Del. were found in the large stomach. The problem as to how the seeds were expelled was the cause of much debate, as the individual dry and woody seeds are large, measuring approximately 1·2 by 0·7 of an inch. Near the village of Magungila, where these antelopes abound, many faecatoria were examined, but no seeds in the form of faecal pellets were observed. Numerous instances of clean dry seeds were seen, while heaps containing 50 to 100 seeds divested of the fruity middle coating were common. A reasonable solution would be that the gazelle has a liking for the fruity middle coating of the fruit, and swallows the whole with the result that the fruity layer is then removed by the early processes of digestion, the clean seed being regurgitated on to the stercus deposits or else on to separate heaps.

Impalla. Species of plants whose seed were found in the stomach contents.

Acacia spirocarpa Hochst.
Randia Taylorii Spencer Moore
Solanum Renschii Vatke

The stomach contents of several impalla were examined revealing in all cases seeds of *Acacia spirocarpa* Hochst. and *Solanum Renschii* Vatke. One animal shot near Matelele had many seeds of *Randia Taylorii* Spencer Moore in the stomach contents.

Civet Cat. Seeds of plants found in the dung were:

Balanites aegyptiaca Del.
Cassia abbreviata Oliv.
Ficus sycomorus L.
Grewia Holstii Burret
Grewia pachycalyx K. Schm.
Grewia platyclada K. Schm.
Royena macrocalyx Gürke
Strychnos pungens Sol.
Strychnos heterodoxa Gilg.
Vitex iringensis Gürke

Great quantities of seed were found in the dung of the civet cat. Seed of "Thicket Grewia" (*Grewia Holstii* Burret) were found in dung dropped over two hundred yards from the nearest thicket containing this species, the faecal matter containing great quantities of seed. The civet has the peculiar habit of returning day after day to the same place and depositing its dung, with the result that considerable variety of seeds may be found heaped together.

Natives. While at Matelele it was noticeable to what an extent local fruits played a part in the meals of the Turu Natives. During his work of bush cutting the native was usually eating some fruit or other, either expectorating the seeds or swallowing the fruity pulp together with the seeds enclosed. Species noted were:

Adansonia digitata L.
Borassus flabellifer L. var. aethiopum Warb.
Grewia fallax K. Schm.
Grewia Holstii Burret
Grewia pachycalyx K. Schm.
Grewia platyclada K. Schm.
Grewia villosa Willd.
Tamarindus indicus L.
Uveria sp.
Vitex ivingensis Gürke & spp.

The seeds of *Adansonia digitata* L., *Tamarindus indicus* L. and *Vitex ivingensis* Gürke are expectorated after the palatable coating has been eaten; while those of *Borassus* are left lying about after the fruity fibrous layer has been cut off with knives. Various native tribes cultivate *Borassus* palms, planting the seeds and eating the root of the young palm; many young palms observed in native cultivations may have appeared in this way. In the case of *Grewia* the seeds may be swallowed or expectorated, while native faeces in the neighbourhood were largely composed of *Grewia* seed.

Cattle. Seeds found in cattle dung:

Acacia spirocarpa Hochst.
Albizzia hypoleuca Oliv.

Birds.

Seeds found in bird droppings and in crop contents:

Cassia goratensis Fres.
Ficus sycomorus L.
Grewia fallax K. Schm.
Grewia Holstii Burret
Grewia pachycalyx K. Schm.
Zizyphus mucronatus Lam.

Various species of bulbul were commonly observed feeding on the fruits of *Ficus sycomorus* L. and *Cassia goratensis* Fres. where the pods had become sugary. The grey Turuku was observed swallowing the fruits of *Zizyphus mucronatus* Lam. and *Grewia fallax* K. Schm. in the riverine forest, the birds were shot and the seeds recovered from their crops. Seeds of *Grewia pachycalyx* K. Schm. were found in the crop of *Turucus corythaix* shot in the riverine forest.

A striking case is shown where turtle doves and bulbuls came to drink at an open well. A tree near by was used as a resting place before and after drinking. The ground below the tree was covered with seeds of *Grewia Holstii* Burret dropped by the birds in their dung. The area measured approximately

250 square feet, while it was estimated that some 550,000 seeds of *Grewia Holstii* Burret lay below the tree. The nearest *Grewia Holstii* thicket was more than a quarter of a mile distant.

CONCLUSION.

From the above notes it will be seen that there is a large field of research open to the naturalist in Africa as far as the dispersal of seeds is concerned; we have yet to ascertain the germinative power of the many seeds found in dung examined, to obtain an approximate knowledge of the numbers by seed counts in dung, and lastly to ascertain what distances the animals may travel before the dung containing seeds is dropped. In the case of *Borassus flabellifer* L. var. *aethiopum* Warb. the germination of the seed has been observed.

The following list of plants has been compiled whose seeds have been observed to be distributed by certain mammals and birds:

Acacia pallens Rolf
Acacia spirocarpa Hochst.
Acacia verugera Schweinf.
Adansonia digitata L.
Albizzia hypoleuca Oliv.
Blepharis acanthodioides Klotzsch
Balanites aegyptiaca Del.
Balanites tomentosa Mildbr. & Schltr.
Borassus flabellifer L. var. aethiopum Warb.
Cassia abbreviata Oliv.
Cassia goratensis Fres.
Commiphora ugogensis Engl.
Ficus sycomorus L.
Grewia fallax K. Schm.
Grewia Holstii Burret
Grewia pachycalyx K. Schm.
Grewia platyclada K. Schm.
Grewia villosa Willd.
Randia Taylorii Spencer Moore
Royena macrocalyx Gürke
Sclerocarya birrea var. multifoliolata Engl.
Solanum Renschii Vatke
Strychnos heterodoxa Gilg.
Strychnos pungens Sol.
Tamarindus indicus L.
Uvaria sp.
Vitex iringensis Gürke
Zizyphus mucronatus Lam.

POSTSCRIPT.

Appreciating the unique and valuable character of the collections of seeds from animal droppings made by Mr Burtt, the writer of this postcript induced him to present the material to the Botanical Department, University College, London. A selection of the seeds was sent to the Chelsea Physic Garden, where Mr Hales kindly undertook to test their capacity for germination. Up to the time of writing seeds of the following species have germinated:

Balanites aegyptiaca Del.
Cassia abbreviata Oliv.
Royena macrocalyx Gürke

A feature of special interest was the presence of seeds of *Strychnos* in diverse droppings of the civet cat. At the writer's request Dr P. Haas kindly tested these for strychnine with positive results. Moreover, when entire seeds of *S. nux-vomica* were digested in hydrochloric acid in a strength approximately equivalent to that of the stomach contents, strychnine was found to have diffused out through the intact testa. Since strychnine can thus diffuse out of intact seeds it is noteworthy that the civet cat would appear not only frequently to swallow *Strychnos* seeds containing strychnine but apparently without ill effects.

E. J. SALISBURY.