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NOTE.—There are many subjects in Africa, such as Racial Characteristics, Political and Industrial Conditions, Labour, Disease, Currency, Banking, Education, and so on, about which information is imperfect and opinion divided. On none of these complicated and difficult questions has Science said the last word. Under these circumstances it has been considered best to allow those competent to form an opinion to express freely in this Journal the conclusions at which they themselves have arrived. *It must be clearly understood that the object of the Journal is to gather information, and that each writer must be held responsible for his own views.*

BIG GAME IN SOUTH AFRICA AND ITS RELATION TO THE TSE-TSE FLY

ONE of the earliest entries in the diary of Van Riebeek, the first Dutch governor of the Cape, reads as follows:—"This night the lions roared as if they would take the fort by storm." This note was made in the middle of the seventeenth century, and I think it more than probable that if on the night in question some six thousand listeners had been placed at intervals of a mile apart, throughout the whole length of Africa, from Cape Agulhas to the very shores of the Mediterranean Sea, every one of them might have recorded the fact that he also had heard lions roaring. For at that time almost the whole of Africa must have teemed with wild animals, and wherever in Africa wild animals are to be found in any number, there lions will be heard roaring at night.

In the present paper I shall make no attempt to deal with the question as to the relationship between big game, and one or other or all of the various species of tse-tse flies found throughout Africa, but shall confine my remarks entirely to the question as to whether *Glossina morsitans*, the only species of tse-tse fly as yet known to occur in Africa to the south of the Zambesi river, is or is not dependent for its continued existence on the blood of big game generally, or of certain species particularly. I may first, however, say a few words as to the past and present distribution of big game in South Africa.

Plentiful as big game must always have been, and in certain districts still is to-day in British and German East Africa, or in the countries between the Nile and the Niger, yet in no part of the great African continent, does there ever seem to have been a greater profusion of wild animals, both as regards numbers of individuals and variety of species, than once existed to the south of the Zambesi river. The dry karoos of the Cape Colony and the grassy plains of the countries north of the Orange and the Vaal rivers were once roamed over by countless herds of gnus, blesboks, springboks, quaggas, and Burchell's zebras, not to mention elands, hartebeests, gemsboks, and other species of animals, which, although plentiful, were never to be seen in such prodigious herds as those first enumerated.

Wherever the country was clothed with forest or bush, as along the coast line, or in the valleys of the great rivers, elephants and buffaloes almost rivalled the lesser game in numbers, whilst in many districts rhinoceroses of both the square-mouthed and the prehensile-lipped species, as well as giraffes and such beautiful creatures as koodoos and sable antelopes, were encountered by the earliest European travellers in almost incredible numbers. In all the rivers, too, hippopotamuses were once plentiful.

Up to the early part of the nineteenth century, the vast herds of South African game had been but little depleted by the European settlers at the Cape. One species of antelope it is true, the blaauwbok (*Hippotragus leucophæus*), whose range never extended beyond the Cape Peninsula, ceased to

exist in the first decade of the nineteenth century, but otherwise the few scattered colonists who were only armed with smooth-bore flint-lock guns made but little impression either upon the wildebeests, quaggas, and blesboks of the plains to the south of the Orange river, or the elephants and buffaloes that abounded in all the forest-clad districts of the Cape Colony. With the gradual advance of Europeans northwards, however, accompanied as it was by a constant improvement in firearms, the wild animals were driven back or killed off at a terrible and ever-increasing rate of speed. About 1850 the hides of antelopes and quaggas commenced to figure as one of the chief articles of export from South Africa, and from that time onwards wildebeests, quaggas, blesboks, and springboks were shot down in hundreds of thousands yearly throughout the plains of the Cape Colony, the Orange Free State, and the Transvaal, merely for the sake of their hides, and by degrees practically exterminated, just as a few years later the same greed of gain caused the almost complete destruction of the bison on the plains of North America. On first visiting South Africa in 1871, I travelled by ox-waggon from Port Elizabeth, in the Cape Colony, to the then but lately discovered diamond mines, a journey which occupied two months. On the way, we passed hundreds of waggons loaded up with the skins of antelopes, all on their way to England to be made into leather. At that time enormous herds of gnus, blesboks, and springboks were still to be seen in parts of the Orange Free State and the western Transvaal, and a few quaggas were, I believe, yet in existence. I saw considerable herds of gnus and blesboks, both in 1875 and 1876, but subsequently to that time never anything but a few stragglers, and by 1880 all the open plains of South Africa, from the Cape to the Limpopo, which only thirty years before had supported vast herds of many different species of wild animals, had become a dead world, an almost absolutely lifeless waste. The quagga had disappeared from the face of the earth, and had it not been for the forethought and public spirit of a few Dutch farmers, who preserved here and there on their farms a few isolated herds of white-tailed gnus, blesboks, and bonteboks, all these

three species of African animals would long ere this have shared the same fate as the quagga and the blaauwbok. As it is, the blesbok is now a rapidly increasing species, and many herds exist on different farms in the Orange and Transvaal Colonies, and also in British Bechwanaland. There are not many white-tailed gnus, but they are increasing in numbers, and the species will in all probability be preserved. Of bonteboks some two or three hundred are being carefully preserved on two enclosed farms in their original habitat near Cape Agulhas, and I understand that they are not decreasing in numbers. The magnificently horned koodoo, by many looked upon as the finest antelope in the world, has too of late years become very plentiful in certain districts of the Cape Colony, owing to the protection afforded it by the more enlightened farmers. Although between the years 1860 and 1870 an enormous destruction had taken place amongst the great herds of game inhabiting the open plains of South Africa, all the greater game, such as elephants, rhinoceroses, buffaloes, giraffes, as well as many of the handsomest species of African antelopes, were still plentiful up to the latter date, in the low bushveld of the eastern Transvaal, in the coast belt of Zululand and Amatongaland, and throughout all the forest-clad country extending from the Limpopo to the Zambesi. In the early seventies of the last century, however, natives commenced to flock from every corner of South Africa to the lately discovered Diamond Fields, and I doubt if any one of them returned to his kraal without a gun or rifle and a supply of ammunition, for at that time in order, I think, to attract labour, natives were allowed to buy arms and ammunition in any quantity they liked on the Diamond Fields, in spite of the repeated protests of the Governments of the Transvaal and the Orange Free State. This general arming of the natives of South Africa in the early seventies of the last century, was not only largely responsible for the native rebellion in the Cape Colony in 1878, and the war with the Basutos two years later, but in my opinion was also the principal cause of the destruction of big game throughout all the native territories beyond the Limpopo. Once the natives became possessed of guns, they always

managed to obtain ammunition either from English or Portuguese traders. Take the case of Amatongaland. The late Mr. William Charles Baldwin has recorded how in 1854, when hunting near the junction of the Pongolo and Usutu rivers, he found elephants, rhinoceroses of both the black and the white species, buffaloes, and many other varieties of game excessively plentiful throughout that district. Since Baldwin's time very few white men have ever visited this part of the country, as the climate is very unhealthy for Europeans, yet in 1896 when I went to the very spot where Baldwin had met with game of all kinds in very large numbers 42 years earlier, I found wild animals almost non-existent, with the exception of inyala antelopes, which were still numerous in the dense jungles between the Pongolo and Usutu rivers. The native Amatonga, armed with guns and rifles bought on the Diamond Fields or at Delagoa Bay, are almost entirely responsible for the destruction of all the game in this part of South Africa.

Although with the exception of the blaauwbok and the true quagga, no other species of wild game that was ever known to exist in Africa the south of the Zambesi, is yet absolutely extinct, I fear that the white rhinoceroses which still survive in Zululand and Mashunaland are so few in number, that the days of this most interesting animal—the largest terrestrial mammal after the elephant—are almost numbered as an existing species in South Africa. The black rhinoceros, too, once so plentifully distributed over an enormous area of country to the south of the Zambesi, is on the very verge of extinction in this part of Africa, though there may still be a few of these animals scattered here and there throughout the uninhabited country which lies between the high veld of north and north-eastern Mashunaland and the Zambesi river. Of buffaloes, but few survived the terrible epidemic of rinderpest which swept through South Africa in 1896–97. There are a certain number of these animals in the Addo bush, and the Knysna forest in the Cape Colony, which are protected by the Cape Government, and there is a small but increasing herd in the lately established game reserve in the eastern Transvaal. There are also a few buffaloes left—survivors of

the rinderpest—in the coast country between the Sabi and the Zambesi and along the Zambesi valley to the north of Mashunaland; but west of the Gwai river all along the central Zambesi and throughout the country drained by the Chobi, the Okavango, the Mababi, and the Tamalakan, I believe there is not one single buffalo left alive. And yet throughout all this great extent of country buffaloes literally swarmed less than forty years ago. With my own eyes I saw thousands upon thousands of these splendid animals in this part of South Africa during 1873, 1874, 1877, and 1879.

Contrary to the general opinion, I am glad to be able to tell you that neither elephants nor giraffes are by any means yet extinct in Africa to the south of the Zambesi. At the time of the native rebellion in Matabeleland in 1896, giraffes were quite plentiful in all the country to the west of Matabeleland, from the Limpopo to the Zambesi, and still ranged in considerable numbers throughout the greater part of that semi-desert and almost uninhabited territory known as the Bechwanaland Protectorate, and from thence through the wastes of the northern Kalahari to southern Angola. Throughout all this vast extent of country, giraffes have practically been unmolested by white men during the last 12 years, and if they have diminished in numbers during that time, Khama's people and the Batauwana natives of Lake N'gami, who are well armed with breechloading rifles, and many of whom possess horses, are alone responsible for this result. I have, however, lately received a letter from Mr. Hodson, the very competent young officer residing with Khama's son, Sekhomi, in the eastern portion of the Bechwanaland Protectorate, in which he gives me the welcome news that giraffes still exist to-day in fair numbers in their old haunts. Mr. Hodson writes as follows—in answer to enquiries from myself—"I know the Mababi country very well. The country from here to that district is quite uninhabited except by Bushmen, and in certain parts of it there are a lot of giraffe and eland, especially around Thamasetsi. At the latter place, too, sable and roan antelopes are plentiful. Even at Sibenani—that is where Sekhomi's people are living—there are a few giraffe." Now since nine-tenths of the whole of the vast country which

stretches from western Matabeleland to the Botletli and Mababi river, and from thence to southern Angola, is uninhabited and uninhabitable by human beings other than Bushmen, though the whole of it is well suited to giraffes (which animals thrive best in semi-desert countries, where, however, in spite of the scarcity of water, there is an abundance of food for their subsistence), I see no reason why these highly specialised and most interesting animals should not continue to exist in the interior of South Africa for an indefinite period of time. Nor can I see that there is any fear of the extinction of any of the races of the giraffe, which are still to-day as plentiful as they ever were in all the more arid portions of British East Africa, the Soudan, and Nigeria, which are not only unfit for settlement by Europeans, but also by natives in any large number.

As for elephants in the country to the south of the Zambesi, I believe that in the aggregate there is a far greater number of these animals alive to-day in that portion of the African continent than is generally believed. It is true that during the last twenty-five years the export of ivory from South African ports has been practically nil, but that does not mean that by the early eighties of the last century elephants had practically ceased to exist, but that by that date the herds which survived had become so wild and cunning, and ranged over such vast areas of country, that it no longer paid either white or black hunters to go after them. I am therefore of opinion that during the last quarter of a century, elephants have been on the increase in South Africa, taking that country as a whole. In 1885 I met with a very large herd of at least 200 elephants—there were quite possibly 300 of these animals together on that occasion, as the whole country in front of me seemed full of them—near Hartley Hills in Mashunaland. From that date until the present year very few of these animals had been killed either by white or native hunters; but last June, owing to the depredations committed by elephants in the Lomagunda district, the Administrator of Southern Rhodesia issued free licences to anyone who cared to hunt them for the sake of the ivory. There was a hearty response to this invitation, and in a short time about 100

elephants appear to have been killed and some 2,000 lbs. of ivory obtained. Judging by the average weight of the tusks, the majority of these elephants must have been young females. No doubt the number of elephants in the Lomagunda district has now been considerably reduced, but I do not believe that these animals have by any means been exterminated in that part of the country, and when it is remembered that throughout the low, unhealthy country lying between Lomagunda's and the river Gwai, and from thence to the Mababi and Chobi rivers, elephants are almost everywhere found at some period of the year in herds of varying size, I cannot think that these noble animals are any more likely to become extinct in this portion of South Africa than is the giraffe. But besides these elephants existing in the more northerly districts of South Africa, there are also, to my own knowledge, isolated herds in the Limpopo valley in the neighbourhood of the Umzingwani river, in the country south of Delagoa Bay, near the Maputa river, and in the eastern part of Mangwendi's country in Eastern Mashunaland; whilst in Portuguese South-East Africa elephants are still numerous to the south of the lower Zambesi. There are, too, some 100 elephants in the Addo bush, near Port Elizabeth, in the Cape Colony, as well as a few in the Knysna forest, near Mossel Bay. Altogether I cannot believe that there can be less than 2,000 elephants alive to-day to the south of the Zambesi river, and there may be a great many more. At any rate, in my opinion, the elephant is not yet on the verge of extinction in the southern portion of the African continent, and even if in the near future it should be entirely expelled from the Lomagunda district of Southern Rhodesia, and from any other parts of the country where it now exists which can be occupied by European settlers, vast areas, in which no human beings other than Bushmen can ever live permanently, will still remain in this section of the Continent over which it will be able to wander for all time. Space will not allow me to say anything concerning lions and other carnivorous animals, except that wherever game still exists in sufficient numbers to supply them with food, they are still to be met with throughout the interior of South Africa. In 1891, the year after the

opening up of Mashunaland by Mr. Rhodes's pioneers, I was sent by the Administrator of that territory to try and find a route free from tse-tse fly between Manicaland and the East Coast. On that journey I walked into a district in the neighbourhood of the Pungwe river, in which no white hunter had ever previously set foot. The country simply teemed with game, especially buffaloes and zebras, the favourite food of lions, and these great carnivora were so numerous, that never a night passed, as long as I was in the game country, on which I did not hear lions roaring near my camp, and on several occasions I heard three and four different parties of lions roaring at one time, apparently answering one another from different points of the compass.

I will now pass on to the subject of the tse-tse fly of the species *Glossina morsitans*, and state my conclusions, for what they are worth, regarding the relation of this insect to wild game in those parts of South Africa in which I travelled and hunted from 1872 to 1896. However, I must first say that the facts from which my conclusions have been deduced do not appear to hold good in other parts of Africa to the north of the Zambesi, where other investigators have come to conclusions quite different from my own, which they have based on an entirely different set of experiences. The whole subject is most perplexing, as is best understood by those who are conversant with the very divergent opinions of the most experienced observers. For instance, Sir Alfred Sharpe, who has so ably administered Nyasaland for so many years, has stated in the course of an article published in the *Field* newspaper for November 2nd, 1907, "So far as Africa north of the Zambesi is concerned (*i.e.*, British Central Africa, North-Eastern Rhodesia, Portuguese East Africa, the south-west portion of German East Africa, and the south-east corner of the Congo State) I am able to speak with some experience, having spent 20 years in those regions. The results of the last few years' careful observation have led me to a decided opinion that the existence of tse-tse fly is not dependent on wild game of any description. Tse-tse (mostly *Glossina morsitans* in British Central Africa), when it has the opportunity, sucks the blood of all such animals as it can get

at in tracts of country in which it exists, but I think that blood is an exceptional diet (as in the case of the mosquito)." On the other hand, Mr. George Grey, after an experience of eight years in North-West Rhodesia, in a very interesting paper which he lately contributed to Vol. IV. of the *Journal* of the Society for the Protection of the Wild Fauna of the Empire, has expressed himself as follows:—"Much is still to be learned about the tse-tse fly. My own experience of eight years in tse-tse fly countries has convinced me that where there is no game there can be no *Glossina morsitans*, that the destruction of game affects the disappearance of the tse-tse; and that where tse-tse originally existed, the re-appearance of game means the re-appearance of the tse-tse fly. This is instanced by the destruction of game by the rinderpest in Northern Rhodesia, and the subsequent diminution of and disappearance in large areas of the tse-tse fly. Later the game has increased, and with it the tse-tse fly and the disease have come back." Then, again, other observers thoroughly worthy of credence have stated that they have found the tse-tse fly in large numbers in certain districts of British Central Africa where there was a considerable native population but absolutely no game, and where therefore the only mammalian blood they were able to obtain was that of human beings. It is only possible to reconcile all these divergent views, on the theory that in different parts of Africa, and under varying conditions, tse-tse flies of the species *Glossina morsitans*, have developed somewhat different habits, though I cannot believe that these insects can maintain themselves for any length of time without a diet of blood of some kind.

In Africa south of the Zambesi the tse-tse fly has always been confined to a strip of country along the south-east coast, and the hot, well-wooded valleys of the Zambesi and Limpopo rivers and their tributaries. Apparently only able to resist a certain degree of cold, it was never able to spread further south than the 28th parallel of south latitude, nor was it ever found at a high altitude above the sea. North of the Zambesi, and therefore nearer the equator, I have myself seen tse-tse flies at an altitude of over 4,000 feet above sea level, but

south of the river I think I am correct in saying that they never reach an altitude of more than 3,500 feet.

Now I think that it is an undeniable fact that 70 years ago, wherever tse-tse flies were first encountered by the earliest pioneers, in Southern Africa, buffaloes were also found in great numbers in the same districts. Buffaloes had no doubt spread down the east coast, and from the head waters of the Limpopo, through Bechwanaland to the Orange river, far beyond the limits of the fly-infested districts, but within those limits buffaloes were certainly everywhere very numerous.

When some 65 years ago Europeans first penetrated to the Central Limpopo, they found tse-tse flies numerous in many places on the banks of that river and all its tributaries, as well as in certain isolated fly belts between the courses of the rivers. At that date, the whole of the northern Transvaal, between the Zoutpansberg and Waterberg ranges and the Limpopo, was more or less "fly"-infested, as well as a large area of country to the north of the river. At the same time, large game of every kind was very plentiful throughout all that country, especially buffaloes, which, living in great herds for the greater part of the year along the courses of the rivers, were accustomed to graze over the whole country during the rainy season. It was the unanimous opinion of Boer hunters that in these regions wherever buffaloes were most plentiful, there was the tse-tse fly found in the greatest numbers. Both buffaloes and tse-tse flies held their ground in the valley of the central Limpopo till the early seventies. In 1871 the well-known traveller, Mr. Thomas Baines, as he has recorded in his book, "The Gold Regions of South East Africa," still found the tse-tse fly and the buffalo numerous on the Mahaliquain river, as well as at many other points throughout the valley of the Limpopo. In the following year, 1872, I first travelled through the country to the north of the Limpopo and know that much of this country was still infested by tse-tse fly. At that time, however, the natives were obtaining guns and rifles in large numbers from the Diamond Fields, and the buffaloes—always the first animals after rhinoceroses to be killed off by natives armed with guns—were soon exterminated in the whole of

the northern Transvaal and throughout the country to the north of the Central Limpopo. Immediately after the complete disappearance of the buffaloes, the "fly" began to dwindle in numbers, and after a time completely disappeared, and this notwithstanding the fact that other game remained in all this country in very considerable numbers years after both the last buffalo and the last tse-tse fly had ceased to exist. In 1886, I travelled all down the Limpopo river nearly to its junction with the Macloutsie, and met with game in very considerable numbers, koodoos, waterbucks, impalas, bushbucks, and reedbucks near the rivers, as well as zebras, roan antelopes, and blue wildebeests, whose grazing grounds were not far distant. On this trip I also came across a very large herd of elands. Now at this time, 1886, Khama and his people had established cattle-posts at many points along the Limpopo and its northern tributaries in a country which only 15 years earlier had been full of tse-tse fly. If it was not the destruction of the buffaloes which brought about the disappearance of the tse-tse fly from the northern part of the Transvaal, and the whole valley of the Central Limpopo and all its tributaries—a very large area of country altogether—I know of no other theory which can account for the fact of their disappearance. Again, when I first visited the Zambesi in 1874, two "fly" belts had to be crossed in the night, the first some 12 miles broad, lying to the south of Daka, the second, of lesser extent, to the north of Pandamatenka. We met with large numbers of buffaloes in the first of these two "fly" belts. These animals, however, were unable to live in this "fly" belt all the year round, for, as soon as the pools of rainwater had dried up, they were forced to retire to the better watered country further eastward. The "fly" therefore lived in this part of the country for several months every year without buffaloes and without water. Other game, such as giraffes and elands, wandered through the country, though in no great numbers, throughout the year. By 1880 the buffaloes, owing to persecution, had entirely ceased to visit the "fly" belts crossed by the old waggon road to the Zambesi, and soon after, if not by that date, the "fly" also completely disappeared. I passed through that country for the last time in

1888. There were then elands, giraffes, and other animals inhabiting this country, though in no great numbers, but the buffaloes had long left it, as well as the tse-tse flies. In 1874, I first visited the falls of the Zambesi, and from there walked westwards along the bank of the Zambesi to its junction with the Chobi, and then for many days' journey along the latter river. From the falls themselves, as far as I went along the Chobi, the neighbourhood of the river was infested with buffaloes. There were thousands upon thousands of them, living in herds of from 60 to 200 or 300; and the tse-tse flies, how can I give you any idea of their numbers? I can only say that they swarmed all along the river. Now, as everyone knows, when buffaloes have not been molested, they never go far from water, and along the Chobi in 1874 they were seldom encountered at a distance of more than half a mile away from the river. At that time, other game, giraffes, elands, sable and roan antelopes, koodoos, impalas, waterbucks, wild pigs, pookoos, &c., were also very plentiful, and most of them as a rule went farther away from the river to feed than the buffaloes. Now it was my experience that the great mass of tse-tse flies never went far away from the river, but lived on the same ground as the buffaloes, so that half a mile away from the river they had ceased to be numerous, and scarcely one was to be seen more than a mile away, in spite of the fact that elands, zebras, sable and roan antelopes were constantly met with just beyond their range. Well, after 1877 the buffaloes were driven by native hunters from the neighbourhood of the Victoria Falls, and ever further westwards along the Zambesi and Chobi rivers, and soon after the disappearance of the buffaloes the tse-tse flies also ceased to exist. In 1888, there were no tse-tse flies throughout all the country immediately south, east and west of the Victoria Falls, where I had met with these insects in swarms in 1874; but except that all the buffaloes had been driven out of it, no other change had taken place. There were still impala antelopes, waterbucks, bushbucks, and koodoos remaining in the country, and very large numbers of baboons. I might multiply such cases in the history of South Africa. There were two "fly" belts, which had to be crossed at night on the road to Lake N'gami,

along the western bank of the Botletli, up to the year 1878, and till that year there were a good many buffaloes on the Botletli in the neighbourhood of the "fly" belts. But in 1878 a large number of Boers, emigrating from the Transvaal to Portuguese West Africa, halted for several months on the banks of the Botletli to rest and recruit after their disastrous journey across the northern Kalahari. After 1878 no buffalo was ever seen again along the Botletli river, and soon after that date the tse-tse fly also ceased to exist in that locality.

In the early fifties of the last century, too, when C. J. Andersson, Fred Green, and other travellers and hunters first visited Lake N'gami, they found both buffaloes and the tse-tse fly very numerous on the banks of the Okavango immediately north of the Lake. As soon, however, as the Batauwana began to obtain firearms they rapidly drove the buffaloes northwards, and the fly went with them. To-day the Batauwana live a long way up the once fly-invested Okavango, and are in possession of great numbers of cattle, sheep, and goats. Similarly, Lobengula, when I last talked with him in 1890, told me that since my early hunting days the buffaloes had all been driven far to the north along the Gwai and Shangani rivers, and that he had lately established a large cattle-post at the junction of those two rivers, where, in 1873, I had hunted elephants, and where at the same date I had found both buffaloes and tse-tse flies very numerous.

Now it seems to me that in the country between the Limpopo and the Zambesi, at any rate, whatever may be the case in other parts of Africa, it is a proved fact that wherever the buffalo has absolutely ceased to exist, where these animals are no longer found at any time of the year, tse-tse flies, however plentiful they once may have been, sooner or later become extinct, whether or no other kinds of game remain in the country, after the buffalo have left it. Therefore I say that in this part of Africa the relation between the tse-tse fly and the buffalo has been very intimate; indeed my opinion is —and it was the opinion of all the old-time hunters, both Boer and British—that in the countries in which my experience on this subject was gained, the tse-tse fly did not long survive without access to the blood of buffaloes. This I know

is quite contrary to the experiences of Sir Alfred Sharpe and others in different parts of Africa, but I submit that the facts I have brought forward in this paper (and they are facts) will need a lot of explaining away.

Now as I have said earlier in this paper, it is easy to believe that, owing to varying circumstances in different areas of its habitat, *Glossina morsitans* may have developed somewhat different habits and requirements. For instance, the close connection which has undoubtedly always existed between the tse-tse fly of this species and the buffalo in all the country between the Limpopo and the Zambesi rivers, may be due to the fact that, before the introduction of firearms amongst the natives, buffaloes had become far more numerous than any other animals in all the low-lying areas where the climatic conditions were suitable to the tse-tse fly; and the fact that buffaloes were slow in their movements, and wont to congregate in large herds, may have led the tse-tse flies to depend almost entirely upon these animals for the supply of blood necessary to their existence. In this way the tse-tse fly may have become so specialised in this part of Africa that it was unable to maintain its vitality on the blood of any of the animals which remained in its haunts after the buffaloes had ceased to exist there, and so gradually died out. In other parts of Africa, however, which have been infested with the *Glossina morsitans* from time immemorial, buffaloes may never have been very plentiful or they may have been entirely absent, and in such countries these insects may have become accustomed to live upon the blood of various mammals other than buffaloes. This, of course, is only a theory which I put forward as a possible explanation of the extraordinarily divergent views held by observers in different parts of Africa regarding the habits and necessities of the tse-tse fly of the species *Glossina morsitans*.

When the rinderpest swept through South Africa in 1896–97, it seems to have killed off all but a very small percentage of the buffaloes and koodoos in the areas through which it passed, and also to have seriously affected the numbers of the elands, bushbucks, inyalas, and warthogs; but I have always understood (for I have not revisited South Africa since the

time of the rinderpest epidemic) that zebras, sable and roan antelopes, as well as waterbucks, hartebeests, tsessebis, and wildebeests suffered but little if at all from its effects. Now it is a very curious thing, but there seems ample evidence to establish the fact, that wherever the rinderpest passed, the tse-tse fly was reduced to the verge of extinction, and in some cases absolutely disappeared from certain districts in the course of a few months. Such a thing had never previously occurred in the history of South Africa, and the decimation of the buffaloes by the rinderpest cannot altogether account for it, for many other species of large game remained alive in the infected areas, and on the blood of these, according to all precedents, the tse-tse flies, though gradually dwindling in numbers, ought to have been able to linger on for some years after the disappearance of the buffaloes. Major J. Stevenson Hamilton, the Warden of the Sabi Game Reserve, in the Eastern Transvaal, has reported that the tse-tse fly, which was still very numerous in that district up to the time of the outbreak of the rinderpest, in 1896, completely disappeared from it in the course of a few months, although a few buffaloes survived the epidemic. Along the Chobi too, my friend Mr. Percy Reid did not see a single tse-tse fly, shortly after the rinderpest had passed through that part of the country, in places where he had met with these insects in perfect swarms not long before the outbreak of the disease. In other parts of South Africa the tse-tse flies, though very much reduced in numbers, did not completely die out during the period of the rinderpest, and they are now again increasing in numbers, as I believe are buffaloes in the same districts. Mr. George Grey has reported that, in North-Western Rhodesia, the big game has been on the increase since the time of the epidemic of rinderpest—he does not mention buffaloes particularly—and that with this increase of the game, the tse-tse fly has also become more numerous, and the same thing has occurred in certain districts of Southern Rhodesia.

Now I cannot but think that the universal sudden diminution, and, in some cases, the absolute extinction of the tse-tse fly, which occurred in the areas through which the rinderpest passed in South and South Central Africa in 1896 and 1897,

can only be accounted for on the supposition that these insects became diseased and died through taking into their systems the blood of the diseased animals. I have always thought that this must have been the case, ever since Mr. Percy Reid told me of the extraordinarily sudden disappearance of the "tse-tse" fly on the Chobi river, after the rinderpest had passed through that part of the country, and Major Stevenson Hamilton has, I think, come to the same conclusion—at least he expressed this opinion long ago in an article to the *Field* newspaper—from his own observations in the Sabi Game Reserve.

There is one other point upon which I should like to say a word. Sir Alfred Sharpe and other experienced observers maintain that in certain parts of Africa the tse-tse fly of the species *Glossina morsitans* is found where there is absolutely no game; but if this is the case, surely the "fly" in such districts must be harmless to domestic animals, for the tse-tse is not in itself poisonous in any way, but only acts as the carrier of the blood parasite which causes the "nagana" disease. The trypanosome which sets up this disease in domestic animals is, however, only found in the blood of certain mammals living in most parts of Africa within the same areas as the tse-tse flies themselves. But if in certain districts the tse-tse fly lives without having access to mammalian blood, I fail to see how, within the limits of such areas, it could possibly obtain the blood parasites which cause the disease so fatal to all domestic animals.

It is pertinent to this view, I think, to point out that *Glossina palpalis* has always existed on the shores of the Victoria Lake, but although it fed freely on the blood of the natives of that district, it was perfectly harmless until a few years ago, when natives came to Uganda from the Congo, with the trypanosomes of sleeping sickness in their blood. The blood parasite which sets up this terrible disease, was then spread with great rapidity by the tse-tse fly of the species *Glossina palpalis*, over large districts of the Uganda province, and this little insect has already caused the death of hundreds of thousands of human beings in that country.

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