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THE ASIATIC TWO-HORNED RHINOCEROS

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In this paper I wish to describe the habits of the Asiatic two-horned rhinoceros (*Didermocerus sumatranus*) as I have observed them in British Malaya. Elsewhere the animal occurs in Borneo, Sumatra, Burma, Siam and Indo-China, but it is now being exterminated throughout most of its range. Probably its habits are everywhere much the same as I have observed them.

PHYSICAL ATTRIBUTES

Didermocerus sumatranus is not a very large animal. I think the maximum height for a male would be about $4\frac{1}{2}$ feet at the shoulder, this being the measurement of an old male I obtained in Ulu Benus, Pahang. This beast, which was stocky and bulky, measured 96 inches in girth directly behind the shoulder and 102 inches in length from the end of his nose to the rump, as near as I could measure it. These measurements were taken on a steep hillside so cannot be considered as very accurate. But I have measured other rhinoceroses and the mature animal, whether male or female, has invariably been more than four feet high at the shoulder. One very old female whose molars were worn down almost to the gum measured 4 feet, 3 inches at the shoulder. The measurements of the horns of this animal are given under no. 4 in the table below.

The color of *D. sumatranus*, which has been mentioned as differing from the variety called *lasiotis* and supposed by Lydekker to be blacker than the northern variety does not, in my opinion, entitle the subspecies *niger* to recognition. The color of the hide of the Malayan variety is a dark gray, and the underside of the skin, on the belly, under the forelegs, and in the groin, distinctly shades towards pink. The blackest part of the rhinoceros is the horn; even the head is not as dark as the horn. The tail is bare and short, and tufted with sparse hairs. The ears, which have been taken as

differing from those of the more northern variety, have a very short fringe and a few hairs on the inside, but no mature rhinoceros living in the dense jungles of Malaya, behaving in the way it does, could possibly save long hairs on the edges of its ears. The young rhinoceros has hair but this disappears as the animal ages and only very short hairs, almost bristles, are found on most of the exposed parts of the mature animal. A young rhino following its mother once passed very close to some of my men and it was noticed as being hairy.

There are two very long horns in the British Museum that are labelled as having been produced by *sumatranus*. These horns, according to Rowland Ward's Records of Big Game, measure $32\frac{3}{4}$ and $27\frac{1}{8}$ inches in length, but the



FIG. 1. Mounted head of male Sumatran rhinoceros.

next in size recorded, from the Malay Peninsula, reaches only a length of 15 inches. The Datok Raja Kiah of Jelebu in Malaya told me that he had once obtained a *sumatranus* whose front horn measured about 20 inches in length, but I am afraid I cannot attach much importance to the measurement although the horn was probably abnormally long. I think that any anterior horn of a *sumatranus* measuring more than 10 inches, and any posterior horn measuring more than 5 inches should be considered as above the average. The females have smaller and less rugged horns than the males, and seldom show anything but a small development of the posterior horn. In an old male the whole of the top of the nose both around and in front of the horns becomes a mass of horn and at times may develop small lumps that might

almost be called subsidiary horns. I have seen two heads with what were almost third horns, and the illustration of the mounted head of a male *sumatranus* clearly shows a small horny protuberance over the left eye (fig. 1). The horn is merely agglutinated hair and as the rhino is very fond of rubbing his horn against trees one can imagine that rough surfaces may easily become enlarged into embryo horns. The horn appears never to be used as a weapon, the large incisors in the lower jaw being depended on for both defense and offense.

The following are the measurements of the horns on four mounted heads of *Didermocerus sumatranus* obtained in Malaya.

	LENGTH ON OUTSIDE CURVE OF HORN		CIRCUMFERENCE OF HORN	
	Anterior	Posterior	Anterior	Posterior
No. 1.....	10½''	6''	18''	16½''
No. 2.....	9''	Broken	22''	14''
No. 3.....	7½''	4½''	16½''	12½''
No. 4.....	8½''	1½''	15''	10''

Numbers 1, 2, and 3 are those of males, number 4 that of a very old female with teeth worn down to the gums. These measurements can be taken, I think, as typical of the class of horn that was obtainable in Malaya.

The *sumatranus*, for his height, has a fairly large foot. The greatest measurement of the track of a fore foot that I have recorded was 9½ inches across the widest part which would be to the outer edges of the two lateral toe nails. Measurement of the centre toe nail, in this case, was 3½ inches wide. Another track that I measured of what was a slightly smaller beast was 8½ inches across with a centre toe nail measuring 2¾ inches. These were all measurements of fore feet. The hind feet are narrower and the toe nails generally slightly longer. The older the rhinoceros the more he digs his toes in when going up hill, which I believe he must do every day of his life. Anyway, he always did whenever I followed him! The result is that his toe nails get shorter as he gets older. The impression of a short but wide toe nail indicates old age. This is in contrast to the wild elephant, which, as he grows older, tends to carry his weight on his heels, his toe nails then inclining to grow longer.

The most extraordinary portion of the external anatomy of the *sumatranus* is his sheath and penis. The sheath points backward and the result is that when the male urinates he does so behind. This is the only definite clue that one has to the sex of the animal one is following. The illustration (fig. 3) shows the sheath and although not very clear it can be seen that it hangs down like a scrotum. If the male urinates when he is walking or even running he appears to throw his penis backwards and his urine shoots up into the air between his legs. In an article by W. S. Thom in the Journal

of the Bombay Natural History Society (volume 38, no. 1, August 1935) on "Rhinoceros shooting in Burma," he states that this habit of urinating on the bushes is found in the female, but I do not think that this is so. Several

FIG. 2



FIG. 3



FIG. 2. Sumatran rhinoceros at bay.

FIG. 3. Sumatran rhinoceros in action.

peculiarities mentioned by Mr. Thom in his article do not correspond with my experiences, but I do not wish to criticise further the writings of a very experienced shikari, so I will merely record the deductions I have made from my own observations.

HABITS AND TERRAIN

In the Malay Peninsula the two-horned rhinoceros formerly was to be found in many parts of the mountainous country and sometimes in the coast belts. It is now almost entirely a mountain animal, having been exterminated in the lower lands. It is, however, occasionally found some distance from the mountains in foot hills or dense low-lying jungle. It lives in the thickest and roughest jungle it can find, and this alone has saved it from extermination. The animal is solitary, it being most unusual to find two of them together. The Datok Rajah Kiah of Jelebu, an old and experienced rhinoceros hunter, who belonged to a type now passed from Malaya, informed me many years ago that he thought when two rhinoceroses were seen together that they were probably mother and calf except on the rare occasions when two came together as mates. I have on four occasions followed two rhinoceroses. In one case they were mating, but on the other occasions when I came across two they may have been mother and calf; apparently the calf runs with its mother until nearly full grown.

The 'To Raja Kiah caught a baby male rhinoceros which he carefully tended and kept for seven years. I did not see it when it was very young but the 'To Raja told me that it was still hairy when he got it. He shot the mother and found the baby near by. At the end of seven years the rhino had grown to a little over three feet in height. It was just showing its anterior horn, but there was no sign of the posterior horn. It foraged in the jungle during the day as it got older, had its own wallows, and returned to the 'To Raja's house in the evening for a feed of rice. When the rice was ready one of the household would call with a loud and shrill, hoh! hoh! hoh! and the rhino would answer from the jungle and come back at full speed for its evening meal. It slept under the house.

As I have written above, rhinoceroses have a poor development of the herd instinct and are extremely unsociable. I have followed them on foot through dense jungles for days but have seldom come across more than one animal. Although at times I have followed fresh tracks that crossed fresh tracks of another animal I have seldom known them to unite. On one occasion when I was following the tracks of two big beasts another one crossed their trail and followed them. So then there were three. But the urge was obvious because presently we came to a place where two of them had had a tustle and the third had lain down near by, no doubt wondering which was to be her future lord and master. I thought I was going to see a rhino fight and followed up the tracks but I saw no signs of anything of the sort. There were some more traces of struggles and then one animal went away and left the two to continue their honeymoon.

Of all the difficult and exasperating animals to follow through dense jungle the rhinoceros easily takes first place. They invariably go through the thickest undergrowth they can find and will deliberately leave a game path

to go through, or under, or over, some fallen tree. When once they are wise to the fact that they are being followed they excel themselves in ingenuity. Nothing is too difficult for them. I remember once tracking a rhinoceros up a steep rocky hillside in very rough country. We came up to him almost on the top of the hill. He heard us, I suppose, and turned round facing the direction we were coming from, but carefully put a large fallen tree and a dense thicket of rattan between himself and the direction of our approach. We could see nothing but were suddenly brought up all standing by a tremendous snort just in front of us. Then came a short rush away from us, cessation of all sound, and another magnificent snort, more like an engine blowing off steam than anything else. This was followed by a shrill squeal, denoting that he had smelt us, and away he went crashing through everything. We saw nothing at all. He rushed down a dry gully and when we followed painfully in his rear—by that time he was far away—we found that when tearing down this dry water course which was full of granite boulders he had come to a place where the formation broke away and he had a sheer drop of twenty feet. That did not bother him, he just took it in his stride, nor did the flat slab of granite at the bottom check him in any way; he had continued his rush as if nothing out of the ordinary had happened. We followed him up for some miles before he stopped and then he had amused himself by rubbing his horn against a tree, taking off rather more bark than usual, and kicking up a greater amount of earth at the foot of the tree than is customary. That was the only indication that he remembered that granite bed-rock. And so it is always with them. They seem impervious to any physical feeling of discomfort. Their walking powers in bad country are phenomenal. I have often followed rhinos that have laboriously climbed—I should say *we* have laboriously climbed—a high mountain merely to go down the other side. A rhino that has been scared may do this two or three times during a day without stopping except to take a quick wallow if he comes across a mud hole, and at the end of the day the unfortunate people following him will be perhaps so far behind that it will take two or three days to catch up with him.

The hunting of rhinoceroses by tracking is a very difficult business and if that were the only way to get them the species would have been in no danger of extinction. But unfortunately the animals continually follow the same game trails, especially near their wallows or near salt licks; and it is due to this habit that they have been so persecuted. Even to this day one finds their game paths passing along side of some long disused and partially filled-up pit, showing that they have some extraordinary obsession for following almost the exact line that generations of their kind have adopted.

When travelling through the jungle on their ordinary rounds rhinoceroses move slowly and steadily, covering a great deal of ground during the twenty-four hours. But occasionally if one finds some particular patch of jungle

that he likes he may hang about in the vicinity for some days. They particularly favor the heads of narrow valleys, where they generally have well-used wallows, plenty of thick undergrowth and precipitous sides to the valley so that they can have plenty of exercise. An ideal place for a rhinoceros to frequent is jungle so dense that a human can see nothing within five yards except a wall of forest, and so steep that he cannot walk without holding on to something, which something will almost certainly be thorny. Another type of jungle favored by them is one interspersed with the large bamboo known to Malays as "buloh semeliang" (*Dendrocalamus giganteus*). This bamboo grows quickly and to a great height, thus not having much rigidity. Much of it falls towards the ground while still alive and on steep hill sides the bamboos thus fallen will present an almost impenetrable tangle. But the rhinoceros does not bother about this; he goes under the bamboo letting the tangled mass pass over his back. This bamboo fractures easily, leaving an edge as sharp as a razor, which will cut one to the bone. To follow a rhinoceros along a steep hill side where he has passed under buloh semeliang is a very ticklish business and if your party gets through without casualties you will have done well. I have seen an elephant's trunk cut very severely by one of these bamboos when he was rushing down a hill after getting a taint of human scent. But these things do not bother the rhinoceros; in fact nothing, except human scent, seems to worry him.

In a very remote part of the Malayan jungle there was an old rhinoceros of which I tried to make an intensive study. I followed on his fresh tracks for a total period of forty days, spread over five expeditions. I heard him three times, was very close to him several times, but saw him never. His habits were fairly regular until he became alarmed and then he was the cunningest thing in the jungle. The country he frequented was not high but extremely steep and covered with thorns of many sorts. The worst obstruction was a palm called by Malays "chuchor" (*Calamus castaneus*). It grows in dense clumps from the ground to a height of about ten feet, and is very thorny. This palm jungle was interspersed with rattans of several varieties and most of the terrain followed by the rhino when he was alarmed was along steep hill sides heavily wooded and covered with chuchor. Directly he knew he was being followed he tried every trick known to the tribe to give us the slip. He never stopped any time in his wallows—to make up for that he wallowed frequently—and he continually made huge circles coming back on his tracks about once in two days. One day he came close to one of our camps which had been used by us two days previously. When some distance away he became aware of the proximity of the old camp and stopped before he came to the banks of a river on the opposite side of which was our camping place. He then turned back and went in another direction. His habits seemed to indicate that he was very old. He had an exceptionally wide track, $9\frac{1}{2}$ inches across. He also had little control

over his urine because when alarmed he had an almost continual dribble for a mile or two. But I have noticed on other occasions that rhinos when alarmed and panicky would do the same thing, but they did not go on for half an hour as this old fellow did. He never ran far but he never seemed to stop. A fast walk which he could keep up for miles defeated us. Whenever we did get up to him he would slip away without our seeing him, and we knew that it would be two or three days before we would have a chance of getting close to him again. We used to track him all day, camp on his tracks at night, and off again early next morning; still he defeated us.

His food was little else than the twigs of trees. This indicated that his teeth were much worn, because generally the rhinoceroses chew up more of the trees they push down than just the slender twigs. He found and demolished large quantities of jungle fruits which were easy to swallow, stones and all, but his digestion was all right because they never seemed to upset him. A favorite trick of his was to get into a river and follow it for half a mile or more; he would then find a place well concealed on the bank and leave the river by climbing over stones or roots or something in which his trail would not be conspicuous. At another time I followed a rhinoceros that went down to a river and first walked about half a mile upstream and then about a mile downstream, and back again for about a quarter of a mile upstream to the mouth of a small stream which was full of large stones on which he walked until he was well away from the main river. There he climbed the bank and disappeared into the jungle. This maneuver delayed us the best part of a day.

All rhinos are very fond of wallowing, something that is essential for their very existence. Their hides are extremely thick but their epidermis is thin and sensitive and the flies that follow them no doubt irritate them and make the habit of wallowing a very natural one. Normally the rhinoceros wallows once or twice in the twenty-four hours, more often in hot, dry weather. It is also fond of walking and swimming in the rivers. I have never seen any evidence of their lying down in the rivers although they invariably lie down in their wallows. Their wallows are generally situated under a bank, but sometimes in a swamp. Wallows under banks are made in such positions, I believe, because the rhinoceros likes to dig into the bank with his horn. This is done, no doubt, to make the mud in the wallow the right consistency, because after heavy rain the mud in the wallow would be very thin and would probably not stick properly to his hide; so he thickens it up a little by breaking down the bank with his horn or with his forefeet. The banks become hollowed out as the illustration shows. Before the days of intensive rhinoceros destruction in Malaya it was possible to find as many as seven or eight wallows near together under a bank and all in use. At one salt lick in Ulu Pahang, a salt lick well patronized by rhinoceroses in their palmy days, I found no less than five large wallows in a series, almost touching each other. Near



FIG. 4. Disused rhinoceros pit.



FIG. 5. Wallow used by rhinoceros. The bank is dug out by the animal with his horn and his feet.

another lick there were eight. They are no longer used because the rhinos are gone.

I have known a rhinoceros that had been disturbed and then followed to wallow as many as six times during the day, remaining only a few minutes in each wallow, rolling about to get himself thoroughly covered with mud and then on again. In one place he had obviously thrown himself into the wallow, probably hot and bothered, because the mud was splashed everywhere in the vicinity. On another occasion when I was following a rhinoceros in very rough country, too rough even for him to find a wallow, the animal tried to wallow in a little stony gully with about two inches of water at the bottom. I think that the necessity to wallow must be very great, otherwise alarmed animals would not be so anxious to perform the rite. Possibly the sensitiveness of their skin demands a coating of mud, although that is scarcely consistent with their fondness for going through the thickest and thorniest jungle they can find. Flies certainly bother them, especially a large unidentified variety of *Tabanus*, with a blue abdomen. They are also attacked by a special type of tick, the only jungle tick that I have come across which will with ease drive its proboscis through thick shikar cloth. Of course compared with rhino hide this feat must be a mere nothing; but the ticks that attach themselves to the wild cattle of the Malayan jungles cannot do it. The ticks appear to fall off the rhino long before they are gorged; in fact at times I have seen rhino ticks on the trail which had evidently not had a meal at all, and yet I believe that they must have come from the rhino's body.

Most of the salt licks affected by rhinos are sulphur springs which are generally situated among rocks. These rocks are polished quite smoothly by the animals that use these licks. For many years I thought that these polishings were the result of the licking of the rocks for some inherent benefit in the rock itself, but I subsequently found out that the rocks are licked to remove from the lips or mouth of the animal a peculiar type of small leech, akin to the horse leech, that lives in the slime of the sulphur water. I first noticed this fact while watching a tapir in a sulphur lick and subsequently often saw sambhur deer do the same trick. I have a film clearly showing a sambhur stag rubbing his lips on the rocks after taking a long drink at the sulphur water. The rocks are also polished by the animals' bodies as well as by the process of removing leeches from their mouths and lips, and it is not surprising that centuries of such contacts have smoothed over all the rocks in the vicinity of a lick. Rhinoceroses also visit mud-licks that show no exudation of sulphur but probably contain some trace of sulphur or possibly of salt. There is, I think, no doubt but that wild animals visit salt licks for the purpose of cleansing their stomachs and intestines of parasites. Wild cattle droppings will be almost pure mud after a visit to a mud-lick, and I have often come across the dung of elephants slimy and covered with mucus after a visit to a salt lick.

SENSES

The senses of hearing and smelling in this rhinoceros are extraordinarily acute. The enormous nasal cavities no doubt enhance the power of scent, and the habit that the animal has of curling up its pointed upper lip when testing the wind is no doubt an effort to utilize more of the inner surface of the nostrils to try to discover the direct line of scent. A rhinoceros that has once decided that the wind is tainted wastes no time in getting away and, as I have described elsewhere, he voices his fear in no uncertain manner. I have no doubt but that the rhinoceros relies more on his nose than any other organ to give him warning of danger. His hearing is also very acute, despite the fact that he has small ears that do not look as if they would be capable of catching much sound. The Datok Raja told me that when approaching a rhinoceros on no account to break anything along the side of the trail except the smallest twig if it was necessary to mark the route, because a rhinoceros could hear so extraordinarily well that he would be put on guard and would immediately start to test the wind in every direction. This is sound advice but a little difficult to follow when on a steep hillside with a thorny rattan holding one back by the lobe of one's ear! In the dense jungles favored by rhinos there is little movement in the air, except during a storm, and I have no doubt that the rhinoceroses, with their extraordinary powers of smell, would detect human scent from almost any direction if sufficiently close to them, even on the stillest day. Their sight is poor, in fact probably of little use for detection purposes. It can be ignored when one is stalking them.

The rhinoceros has several distinct methods of expressing pleasure, annoyance or alarm and uses both his throat and his nose to give vent to his feelings. It is interesting to know that a rhinoceros when alarmed has a very distinct way of showing his fear, as contrasted with an extremely truculent demonstration when only suspicious. As I have written already, a rhinoceros who is suspicious will face the direction where he thinks there is something out of the normal, and then give vent to a terrific blast from his nostrils. He may then turn round and trot away a few yards and repeat the process. It is merely bluff. When he gets a taint of your wind his attitude immediately changes into one of abject fear. Of all animals I think the rhinoceros must hate the scent of man more than any of the others. Occasionally a rhinoceros when suspicious will turn round and run away without any vocal display, stopping at a short distance, no doubt to listen intently. It is then very difficult to approach him because he will keep absolutely still and one is liable to run almost into him. But when he gets one's wind the procedure is very different. The animal will then immediately go off at full speed in any direction—if facing you he is liable to run straight in your direction—making a noise something between the bark of a dog and the quack of a duck. It is not exactly a squeal, but a noise peculiar to a

thoroughly alarmed rhinoceros. The intensity of the quacking will generally indicate the distance he will go before he slows up. When hunting in the mountains I used to despair when I heard a rhino rush away making a series of long and plaintive quacks, for I knew that it would be days before we would be able to catch up with him. On the other hand if he is alarmed, snorts violently and then rushes off he will almost certainly pull up within a hundred yards or so, probably wondering what he is running away from!

When feeding and quite undisturbed a rhino will continually squeak and talk to himself, making some of the noises through his mouth and some through his nose. These noises can be heard for some distance. I have never heard them after a rhino has been disturbed, although followed all day. Apparently he makes these noises only when he is completely at peace with everything. There is a peculiar noise that a rhinoceros makes when in a wallow. This is a quite distinctive sound and not what one would expect from a rhinoceros. The first time I heard it I was with the old Datok Raja and we could hear a rhino splashing about in a wallow but could see nothing. Presently I heard a noise that I took to be made by a monkey, probably a gibbon, I thought. I whispered to the Datok that there was a monkey evidently close to the wallow who had spotted the rhino and that we must be careful that he did not spot us too. The old man smiled and shook his head. "That is the rhino; they make that noise when enjoying themselves in a wallow." I often heard that noise on other occasions and was hard put to it to believe that it really was the rhino and not a gibbon. The sound was low and rather plaintive, something like the low note of a white-handed gibbon but also with a faint resemblance to a bird note—a noise impossible to describe accurately. Finally a rhinoceros will squeal terribly when dying a violent death, not unlike the screaming of the sambhur deer under similar circumstances, but a much more distressing sound.

In addition to noises that present some sort of endeavor to express its feelings, there is a complete series of snorts and grunts and blowings which the rhinoceros sometimes gives vent to when wallowing, probably while trying to get the mud out of his nose and eyes. But, generally speaking, they do not make much noise when settled down in a wallow for a good rest. When lying on the ground, and probably also in a wallow, they never, I believe, lie on their sides, but fold themselves up with their legs tucked under them.

FOOD

I do not think that the *Didermocerus sumatranus* ever grazes; I have never seen any evidence of its doing anything of the sort. They eat fallen fruit but do not appear to eat grass or roots of any kind. Their principle food consists of the small branches of certain species of trees and bitter or astringent fruits. They eat bark of trees and I have once seen a rhinoceros

eating lichen or possibly the fruit of some fungus off a fallen tree; but their main food supply is from young trees that they break down. Whereas the other species of large wild life in Malaya will often find food in secondary jungle the rhino invariably feeds only in virgin forest or very old regenerated jungle. They do not appear to have any regular hours for feeding, although they frequently sleep during the heat of the day. They may, however, wallow at any time.

Rhinoceroses are particularly fond of trees of the Sapotaceae group, some of which are enumerated below. Other trees and fruits that they eat are included in the following list. The native Malay name is given in parentheses.

TREES AND FRUIT EATEN BY DIDERMOCERUS SUMATRANUS

<i>Anacardiaceae.</i>	<i>Mangifera</i> , spp.	(Machang berlawin) fruit eaten.
<i>Apocynaceae.</i>	<i>Dyera</i> , spp.	(Jelutong)
<i>Euphorbiaceae.</i>	<i>Sapium baccatum</i> .	(Mamaya)
<i>Guttiferae.</i>	<i>Garcinia</i> , spp.	(Kandis)
"	<i>Kayea kunstleri</i> .	(Gaha)
<i>Leguminosae.</i>	<i>Pithecolobium</i> , spp.	(Keredas)
"	<i>Saraca</i> , spp.	(Tengelan) flowers eaten.
<i>Myristicaceae.</i>	<i>Myristica</i> , spp.	(Penarah)
<i>Myrtaceae.</i>	<i>Eugenia</i> , spp.	(Kelat merah, kelat kuning, etc.)
<i>Rubiaceae.</i>	<i>Urophyllum</i> , spp.	(Manai badak, manai pahit, manai rumpah.)
<i>Sapotaceae.</i>	<i>Palaquium & Payena</i> , spp.	(Nyatoh, several var.)
"	<i>Payena costata</i> .	(Mengelut or salut) fruit eaten.
"	<i>Palaquium gutta</i> .	(Taban merah, etc.)

Of the many species of *Eugenia*, which are common in the virgin forests of Malaya, young trees are often broken down and the smaller branches and leaves are eaten. Many trees containing gum or getah are favored by rhinoceroses. Jelutong seedlings they are fond of. The gum from large jelutong trees is the principal ingredient of chewing gum. The several species of the shrub manai (*Urophyllum*) which grow in patches on hillsides are often eaten down by rhinoceroses, which are very fond of the bitter leaves.

The principal jungle fruits that they are fond of belong to the species of *Mangifera*, as well as the fruit of a tree called mengelut or salut which has a thick, sticky, creamy juice, no doubt palatable to the rhinoceros. Once when following a *Rhinoceros sondaicus* on the coast of Tenasserim, Lower Burma, I found where the animal had eaten large quantities of the bark of a tree, *Ceriops candolleana*, which grows in mangrove swamps and in tidal water. It has a bright orange inner bark and it is, I believe, used for tanning. The urine of this rhinoceros was stained bright orange by the juices in the bark.

The rhinoceros breaks down small trees by pushing against them with his forehead or chest until the tree is sufficiently bent over to enable him to

walk it down by pressing the tree under his belly. Sometimes when the tree is fairly large he may put his forefeet on the tree to bring more weight into play. He even at times holds a tree down by standing on it with his forefeet; I have often seen the marks of toe nails on the trees that have been broken down. Having lowered the tree the rhinoceros then proceeds to eat the twigs and small branches. He will move round and round the end of the tree, continually altering his position during the process.

A favorite trick of the rhinoceros when feeding is to get a sapling behind his front horn and twist it round and round until it is thoroughly decorticated and covered with mud from his head. I do not know exactly how this is done never having caught a rhino *in flagrante delicto*; but it is generally supposed that this is only done by a rhinoceros which has sufficiently long horns to enable it to twist the saplings between the two horns. I found that this was not the case. In one instance I was following a rhinoceros which had twisted a number of saplings but discovered later that it had a very poor and stumpy posterior horn. Also, I believed, for the same reason, that a female rhinoceros could not twist saplings and, when following rhino's spoor and finding twisted saplings, I concluded that I was on the track of a male that had a good horn. I disproved this by finding saplings twisted by a cow rhinoceros that was accompanied by a calf. I do not now believe that the length of the horns has anything to do with the thoroughness of the twistings and such indications are no guide either to the sex of the animal or the size of the horns.

Another favorite trick of the rhinoceros is to rub his horn against small trees and wear the bark off. This is frequently accompanied by pawing up of the earth at the foot of the tree and the sprinkling of the surrounding shrubs with urine. In this case there is generally some indication of the type of horn possessed by the rhinoceros: an old rugged horn will knock large chunks of bark off; a young horn will merely polish the bark. Much disturbance in this way to the tree and the ground around it will almost certainly indicate a male rhinoceros. I think that the pawing up of the ground may show that there is some sexual connection between the rubbing of the horn and the disturbed earth which is spread about in all directions, no doubt some of it being directed against the sheath. Female rhinos rub their horns against trees in a similar fashion but I have never noticed that this was accompanied by pawing.

GENERAL OBSERVATIONS

Rhinoceroses frequently defecate into water as well as on land. I have only once seen a place where a rhino had returned to a particular spot to defecate. Their droppings consist of round balls, in the case of a mature beast, rather larger than a cricket ball. It is impossible to tell the female from the male feces. The feces of an old animal will contain coarse and

only partly digested twigs, no doubt because of defective or much worn teeth. Often during the fruit season the feces are full of the stones of jungle fruits, unbroken but clean of all fibre. Thus does the rhinoceros spread trees, useful to himself and other animals, throughout the jungle. I have often seen young *Mangifera* seedlings growing out of an old accumulation of rhinoceros dung. A rhinoceros will never defecate in a wallow or a salt lick; at least I have never seen any signs of one's having done so. An elephant will defecate in a salt lick and foul the whole place for any other animals; and even seladang (*Bibos gaurus*) are occasionally known to offend in this way.

I am afraid I cannot write much about the young rhinoceros. I have sometimes come across their tracks but only once have been very close to a rhinoceros calf. All my men saw it but I did not. We were looking for the tracks of the old rhinoceros mentioned earlier and had been following along a game trail on the top of a narrow ridge. The ridge dipped and then climbed again. I was ahead with one man, and some distance behind were six Malay carriers and behind them six Sakai, the aboriginals of the Malay Peninsula. Presently we crossed a fresh track of what was obviously a large rhino. The lateral toe nails were far apart and I mistook the track for that of the old male. The wide spreading toe nails of this rhinoceros should have indicated to me that they were the tracks of a big female and not those of the old male I was looking for. The tracks were very new and I sent my companion back along the trail to stop the carriers, because natives cannot restrain their chattering, and I did not want them to upset my plans. Soon I heard directly below me the noise made by the rhino. I had not gone five yards before the rhino became alarmed and rushed off. The animal made a low squeaking noise and ran back towards where my men were.

Soon I heard cries of alarm from the Sakai. It all happened quickly. I had not far to go to find them. The rhinoceros, which was a female followed by a calf, had run right between them.

Apparently the rhinoceros, having gotten my scent, rushed back more or less on the level until it came out on the game path just in front of my Malays who were plodding along the narrow ridge. The rhino had nowhere else to go so just carried on. The men who had stopped, hearing something coming toward them through the jungle, scattered to each side of the ridge, no doubt looking for suitable trees to climb, but before they could do anything the rhino had passed. Some of the Sakai, who were a hundred yards in the rear, were already up trees when the rhino passed them. I questioned the Malays and Sakai very closely regarding the position of the calf and those that had observed anything told me that the calf was so close to its mother that its head was almost entirely hidden between her hind legs. I extracted this information when inquiring if they had seen any signs of a horn on the calf. One of the men said that he distinctly noticed that the calf showed a good deal of hair on it and they all said that the cow proceeded

at a slow trot and was blowing hard. They also said, which I confirmed afterwards by examining the tracks, that the calf was not very small.

The route taken by the rhino was a perfectly natural one and was more or less in the direction it was moving when I disturbed it. But had this incident occurred when I was not there it would have been described as a desperate charge and still another instance of the ferocity of the rhinoceros. The track of the rhino following along the ridge showed that she had followed more or less the centre of the path and for all she cared the men might not have been there at all. Her main object was to get away from my scent. I examined the place where the rhinoceros and her calf had been when I disturbed it. There was a wallow there which was very nearly dry, but they had been stamping about in the mud. Here the cow had twisted up a small sapling in approved style. My men had noticed merely a small anterior horn on the cow and no signs of a second horn. The tracks of the calf, which were very faint on the ridge, were easily visible in the drying mud of the wallow, and were those of a young but not very young rhino. It is very difficult to spot the tracks of a calf when with its mother because generally it keeps either just in front and so has its tracks covered by those of the larger animal or following close behind steps in the depressions made by the other one's feet.

The rhinoceros has three toes on each foot. The only similar animal in the Malayan jungle that has three toes on its hind foot is the tapir. But the tapir has four toes on his fore foot, so its tracks should not be confused with those of a rhinoceros although when tracking is difficult and the fourth toe of a tapir is obliterated by the track of the hind feet, mistakes can be made except by experienced trackers. The tracks made by a rhinoceros are not easy to follow because its large spongy feet press down leaves which spring back to their original level and only faint indications may be left by the toe nails. An old track of a day or two may easily be confused with a new track, especially during dry weather. Heavy rain will almost completely obliterate the tracks.

The rhinoceros's habit of wallowing is a great help to the tracker. His hide is always dirty. As I have written above, the tracks of the tapir resemble those of a rhino and an oldish track of a large tapir partially washed out by rain might easily be mistaken for that of a rhinoceros. The tapir never wallows, so a careful examination of the saplings or trees that the animal has rubbed against will soon show traces of mud or a mud smear if the animal is a rhinoceros.

POACHING

If salt licks have been a benefit to the rhinoceroses they have also spelt their doom, because the habit of making periodical visits to salt licks enables poachers to set traps along the many game trails leading to the licks. In

Malaya there is now little of this trapping done for the simple reason that the rhinoceroses are so nearly exterminated. But a few decades ago pitting for rhinos was a regular business and hundreds of the animals must have been destroyed. I have travelled a great deal through what was once rhinoceros country and have found dozens of old disused pits, most of them in the vicinity of salt licks. At one lick I found no less than 18 of these pits and I certainly did not find them all. They were twenty or thirty years old. So many pits indicate a former large population. There are none of the animals there now, although this is in an entirely unopened part of the country. At another well known salt lick I found eleven old pits but on one side of the lick I did not make a careful investigation. That lick is still occasionally visited by rhinoceroses, but every year their visits become fewer. In that lick I found, a few years ago, a shooting platform that had been recently constructed, no doubt with the hope of getting a shot at a rhinoceros. At another lick, in quite a different part of the country, about twenty years ago, I found that fences had been made covering each game trail leading to the lick and a spring bamboo spear placed so as to command a small opening left in each piece of fence. This was the work of the Sakai, an aboriginal tribe that does much damage to wild life in some places.

These pits, of which I give an illustration, were made with much care, every trace of the activity of man being removed. There was no difficulty in finding where to make a pit because there were numerous game trails leading to these salt licks and in the old days these trails were regularly used. A pit would be dug about 7 feet deep, 9 to 10 feet long, and 3 to 4 feet wide. The pit was constructed so that when a rhinoceros fell into it he would be wedged between the slightly sloping sides of the pit and thus be kept from reaching the bottom with his feet. Provided the animal was a big one it would be tightly held by its own weight and would be entirely helpless. The chances of its getting out were very small, unless it fell so that it could get its head into the sides of the pit when it would probably be able to dig itself out. In the north of the Malay Peninsula I understand that the pits used were lined with round jungle rollers of hard timber so that there could be no question of an animal's being able to dig himself out, but I have never seen any signs of lining to any pit in Pahang, where most of the pitting took place. In selecting the locality for a pit hard soil was searched for and generally the pit was made on the side of a hill along which ran a game path. Every particle of earth removed from the pit was carried away for some distance and no trace of it was left near the spot. I think this was done more to remove the scent from the earth in which the poachers had been working than to avoid the chance that the rhinoceros would notice a change in the landscape. A fascine of jungle saplings would then be made and placed over the pit. This was covered up with earth and leaves until it looked exactly like any other part of the game trail.

I do not think that the poachers visited the pits very often, the extreme sensitiveness of the rhino's nose making it imperative that as few visits as possible be made. But the poacher was satisfied if his work was good enough to assure a capture. From what I have gathered the wretched animals often starved to death and under such circumstances only the horn would be taken.

Although the pit was the commonest and the most deadly method of capture other methods were adopted. One was a platform made in a salt lick, but this, I believe, was not very satisfactory, because there were then no electric torches, and a rhinoceros seldom came to a lick during the day. The *belantek*, the spring bamboo or steel spear, was sometimes used, but was not so certain as the pit, although some other animal, a deer or a seladang, might be added to the bag.

The tracking of rhinoceroses was seldom undertaken by poachers, although an experienced hunter like the Datok Raja never used any other method. In fact he told me that when pitting began in the Negri Sembilan where he lived he gave up hunting rhino in disgust. He complained bitterly that pits very soon drove all the rhinos out of the district and he described with scorn the methods of people who were capable of getting a rhinoceros only by digging a pit for it. The tragedy of the whole thing lies in the fact that *Didermocerus sumatranus*, one of the cleverest, most cunning, sturdiest and most harmless of jungle animals should be driven from the face of the earth by superstition and greed. For years, in Malaya, this rare mammal has been protected by laws which, being ineffective, are merely 'marks on pieces of paper,' with the result that nothing practical has been done to try to save it from its fate.

COMMERCIALIZED SUPERSTITIONS

There has been for many decades in Malaya a demand for horns and other parts of the rhinoceros because such articles command high prices from Chinese shopkeepers and others. In fact I have known of Chinese who financed poachers, or who were willing to give them credit for a horn not yet obtained. In Northern Pahang, the largest and the least developed of the Federated Malay States, a tremendous amount of destruction was done to the rhinoceros population at the beginning of this century despite the fact that from 1896 there was a law in Pahang making it a punishable offence for any person not licensed to capture, kill or wound any rhinoceros. But no one was either licensed or punished; the poachers were not hampered in any way by an enforcement of the law; and the inertness of the Government was a contributory cause for the disappearance of one of the most interesting and characteristic of Malayan animals.

That the number of rhinoceroses must have been large is confirmed by the numerous trails made by them. A rhinoceros path is different from that

of an elephant, being narrower, because the rhino's footprints continually overlap. Thus they wear a deep furrow down the middle of the path when the track is in steep country. I have seen leading down to a wallow a trail that was 6 to 7 feet deep and much too narrow for an elephant to use. But the most astonishing trail I ever came across was in limestone country. Here there is a huge limestone massif, 2000 feet high, which was often circled by rhinoceroses when travelling that way. In this case a trail passed between two large limestone boulders, both of which were well polished for a height of about three feet. These boulders rested on bed rock—limestone—and in this bed rock the trail had been worn down a few inches. How many thousands, nay, tens of thousands, of rhino's feet must have passed along that trail! None pass now, because there are none to pass.

Parts of the rhinoceros's body have been used since ancient times for magical rites or as medicine. This has been the main incentive to the hunting and killing of these animals in Asia. In Malaya the rhinoceros's horn is the chief attraction, Chinese being willing to pay as much as £2 (U. S. \$10) or even more per ounce for the horn or any part thereof. The dried blood is also a marketable commodity, fetching 5 shillings (U. S. \$1) a pound. It is collected and dried on paper, brown paper for preference—it weighs more—then dried over a fire, the resulting blood-soaked paper fetching the above price. But almost all parts of the body are considered valuable medicine of one sort or another, even the contents of the small intestines before they have been evacuated have a value to the medicine seller. The skin, roasted like pork crackling, is considered a great delicacy. The horn is purchased by Chinese almost solely as an aphrodisiac; it is considered as an infallible sexual stimulant. Whether the effect of taking powdered rhinoceros horn in one's tea or otherwise is psychological or physiological it is difficult to determine, although it is not impossible that the powdered horn has some irritant effect on the generative organs and so produces a sense of increased virility. On the other hand substitutes have been used as the following incidents show. Some years ago throughout Malaya imitation rhinoceros horns made from buffalo horn were hawked around the country by Chinese vendors who sold them to the Chinese medicine shops that are to be found in every small village. These imitations were good efforts to represent a rhinoceros's horn to anyone who had never seen the real thing, and they went like hot cakes. The Chinese medicine-shopkeepers knew, of course, that they were not rhinoceros horns, but the ignorant Chinese laborer did not.

Among other powers attributed to rhinoceros horn are the following: A deep seated thorn can be extracted by rubbing the sore part with a rhinoceros's horn; a severe stomach ache or any other ache can be relieved immediately by the application of a rhino's horn to the affected part, and so on. These legends persist and so long as they persist and no one makes

any serious attempt to preserve the rhinoceros for posterity, *Didermocerus sumatranus* is doomed.

POSTERITY

What will posterity say of the present generation which is allowing, in many parts of the world, the fatal progress of the extermination of species, while professing an anxiety to save such species for future generations? In the new Wild Life Protection Act of 1936 in Burma, which might be considered as the last word on wild life protection, the killing, taking, importation or exportation of rhinoceroses or any part thereof, is prohibited, although there is a provision to enable the local government to give special licences for scientific purposes. This sounds as if the rhinoceros was very well protected, but unfortunately a proviso has been inserted in the Act which reads as follows:

'Provided that it shall not be an offence for any physician or druggist to possess or sell or for any person to possess for private medical purposes rhinoceros blood or any preparation thereof . . .'

How anyone can become possessed of any part of a rhinoceros when all killing and hunting of that animal is prohibited, when all import of the animal or any part thereof is prohibited, and still keep within the law, seems problematical.

The only hope that remains for rhinoceroses in Malaya, and I think I may add in Burma, to save them from complete extinction, is to constitute inviolable sanctuaries in their own habitat where a suitable environment is known to exist. These sanctuaries must be properly guarded and freed from human activities, and severe penalties should be provided for any breaches of such laws as are enacted to make these places real refuges for the animals in them. There must be no loophole in the Act such as there is in the Burma Act. Whatever the superstitions that may be connected with the rhinoceros, it must be recognized that these beliefs have brought all species of the Asiatic rhinoceroses to the verge of extinction, and unless steps are taken to make it practically impossible to continue to commercialize these beliefs then we must realize that we are impotent to save any of these creatures from extinction.

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